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Market survey Russia - Waste and Waste Water

This Market survey is carried out by Royal Haskoning,
by order of EVD and in cooperation with the Dutch embassy in Moscow.

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Summary

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The objective of this research is to provide relevant and reliable information on waste and waste water sector in the Russian Federation.
The following key subjects were in the scope of the research:

- Waste and waste water regulation/ new trends
- Elements of waste and waste water management
- Waste and waste water generation information
- Treatment methods in the Russian Federation
- Main suppliers and consumers
- Investment projects and programs/ best opportunities Regions
- Special events (congresses, conferences, etc.)
- General recommendations on the approach for the Dutch companies

The results of the Market Survey will allow the Dutch Companies to derive business opportunities and prospects for Dutch trade and industry and to take an informed business decision on waste and wastewater treatment market in Russia;

The current Russian waste management regulation system is mainly aimed at the provision of environmental safety in waste handling, i.e. regulation of handling waste deemed as environmental pollutants. Basically, no regulation of handling waste deemed as secondary material resources actually exists.

However, the positive headway started to pick up in the last years. Therefore, Regional programmes and strategies in waste management were adopted in some of the Regions in the Russian Federation, like e.g. Moscow, St-Petersburg, Vladivostok, Murmansk, Perm krai. The common main targets of these initiatives are:

- Minimization of waste generation;
- Maximization of re-use
- Minimization of landfilling and reclamation of landfills
- Provision of safe storage, treatment and utilization of waste

Regarding the waste generation volume there are about 4 billion tons of wastes being generated annually in the Russian Federation. Most of this amount are industrial wastes (3 billion tons). A large amount of accumulated waste is normally placed on factory sites occupying vast territories. As of late 2007, the factory sites had 26.7 billion tons of waste.
The huge amount of industrial waste generation and huge accumulation of this waste at the industrial sites present a significant environmental issue and requires relevant solutions.

Segregation and segregation at source are rather outstanding element of the entire waste management system. Separate collection of glass, plastics and paper has been introduced in a very limited scale in the cities of the Russian Federation. This is because of shortcutting of legislative regulation, absence of solid requirements to segregate wasters, lack of public awareness as well as absence or lack of bring stations and local disposal outlets.
Due to the absence of segregation at source solid municipal waste requires full initial segregation at the segregation facilities.
In Moscow 7 more segregation facilities are planned to be constructed till the year 2011.
Therefore any initiatives from the investors and contractors seem to be reasonable in this area.
As for promotion of segregation at source any initiatives seem to be premature for the time being.

Transportation of wastes is characterised by the following key features: long average distance from waste generator to the disposal outlets, low compression ratio in garbage tracks (therefore low efficiency), absence or lack of transfer station. Transfer stations are presented in a very limited number in Moscow and S.-Petersburg.

Regarding waste treatment incineration prevails under other methods. However, the lack of incineration capacity is identified in the Russian Federation.
In Moscow by the year 2025 total incineration capacity is going to be increased to 2850 thousand tons (today - 580) by construction new incineration facilities. Estimated investments will amount 60 billion rubles. In some of the Regions such projects are also going to pick up as well.
In this regard initiatives in providing technology, design solutions, know-how, equipments etc are welcome from contractors.

Recycling is presented in a very limited scale in the Russian Federation. According to the different information sources the rate from total waste generation going to recycling amounts to 3-5 %.
In demand are only high liquid wastes like metal scrap, cullet, polymeric and wooden wastes, class wastes, wastes generating in electro energy production, steel making, chemicals and construction wastes.
Market of metal scrap processing is developed most of all. Recycling of other categories seems to be not profitable at the moment due to that the cost of recycling includes also collection, segregation and transportation of wastes to be recycled.

Landfilling is still the most common way of waste disposal in the Russian Federation. According to the different appraisals there are 90 – 96 % of total wastes generated in the Russian Federation being dumped into landfills. Most of the landfills are overfilled and still being operated, some of the landfills represent environmental and epidemiologic hazard and require significant upgrade.
In this regard, capacity extension, upgrade, closure and further reclamation are the main activities might require know-how from potential contractors.
The existing potential projects can be mentioned here: Capacity extension of landfills “Iksha,” “Khmetievo”, “Timokhovo” to 4000-4500 thousand tons per year in Moscow Region.

Biogas (landfill gas) production is still in a very initial stage of market development in the Russian Federation. At the moment, some single pilot projects exist.
There are certain difficulties associated with the distribution of energy produced from landfill gas. First of all, it is connected with non-existent legislation as to the transformation of “alternative” electric energy, as well as laws binding consumers to buy alternative energy. This detains the vast spread of the technology in Russia. In present conditions, the use of landfill gas for landfill purposes or for local consumers is more realistic.
The Russian Federation still does not have a national program stimulating the installation of biogas facilities, let alone major biogas plants.

Wastewater treatment facilities - More than 80 % of facilities in small towns and settlements of the RF do not operate properly and do not provide proper treatment quality. This is because of unserviceability during long period of operation, decline and stop of biological treatment in cold season, quick death of active sludge while shut-down of energy supply in emergencies. All the above belongs to biological treatment techniques.

About 50 km^3 of waste waters are being discharged annually into surface water bodies; about 30 % of this volume is contaminated with different pollutants.

Note, that any planned production facility in case of non-conformance of discharge with the established standards must envisage a waste water treatment facility. Otherwise, the project won't be possible whatsoever. So, design and construction of local treatment facilities is much required in this regard.

The market of local waste water treatment facilities is quite mature and mostly presented by domestic design and construction companies.

The review of the waste and waste water market demonstrated high requirement in waste treatment facilities and increase of capacity of waste water treatment facilities.
The reasons here are the increase of waste and waste water generation, lack of existing facilities, exhaustion of available landfills,
worn-out state of waste water treatment facilities.

Today both domestic and foreign investors (private equity companies and banks) reflect the interest to the waste and waste water market. The demand to equipments on waste treatment is increasing by 20 % every year.

The major Russian investors in waste treatment are group of companies "Eco-sistema" (investments into Tomsk segregation complex and incineration facility and landfill in Astrakhan Region), LLC "Partner-Invest" (Waste treatment facility in Voronezh Region), JSC "Direction of Environmental Programs" (Waste treatment facility in Stavropol krai).

Foreign investors: Advanced Recycling Technology (waste treatment facility in Nizhniy Novgorod), Remodis (waste collection and segregation facility in Nizhniy Novgorod), DSD (waste management concept for Nizhniy Novgorod Region), Key Industry Engineering Group (Waste treatment facility in Koltsovo, Novosibirsk Region), EBRD (Surgut municipal services project), NEFCO (Petrozavodsk water supply and sewage system reconstruction)

About 80% of market of equipment for waste processing facilities is covered by foreign companies. Most of them are Asian companies – China and South Korea. However, European suppliers prevail in number in certain waste treatment segments like waste segregation and thermal treatment techniques.

The biggest companies operating in different waste segment and importing equipments are as follows:
<u>Segregation:</u>
JSC "Tiskond", Coparm (Italy), Sacria Industries (France), Imabe Iberica (Spain), Persona (Sweden)

<u>Thermal treatment techniques:</u>
Keppel Seghers, Austrian Energy and Environment, CNIM, Steinmuller Engineering, AMIG.

<u>Waste treatment facilities construction and design:</u>
HGMA Wulf GmbH (Germany), Key Industry Engineering Group (Czech), ILF-Engineering (Austria), ASA International GmBH (Austria), Advanced Recycling Technology (UK), Dual System Deutschland (Germany), MCI (UK), GFA Envest (Germany), FFK (Germany) and Remondis (Germany).

<u>Plastic waste processing:</u>
Shuagma (China), Lisheng (China), Sky Star Hi-polymer technologies, South China Service group LTD (China).

<u>Scrap metal processing:</u>
Delta (South Korea), TIANFU MACHINERY (China).

<u>Fuel briquettes making - Luniwei (China)</u>
<u>Presses for wastes</u> - XLHJ Construction Group (China)

The volume of investments depends on complicity of waste treatment techniques and type of equipment which is going to be installed at a plant.
For example construction of a modern landfill (capacity – 30-40 thousand ton) may cost 6-10 million. Euro; construction of waste treatment plant as well as incineration plant may require 20-90 million. Euro.

Design and construction of local waste water treatment facilities of capacity of 10,000 m3/day will cost 3 million Euro, 5000 m3/day – about 1.5 million Euro.
A as whole, any waste treatment initiative is considered as high capital investment. Profitability and payback period indicators of projects are particular in each case and depend on many factors, like:

- Utilization rates
- Mandatory deductions
- Equipments specific
- Regional market conditions

At present existing treatment facilities operate with a profit of 20 % and higher. The produced secondary resources became more attractive from the side of consumers.

In respect to the input of Dutch companies into Russian waste and waste water sector it is reasonable to turn attention to the planned investment projects.
Regarding the investments into Russian waste and waste water sector, gaining profit is more likely in case of creation of large high-tonnage production. The mandatory condition here is presence of own procuring system.
Alternative option is processing of a certain kind of waste. The single-purpose production has an advantage in a way that for such companies it is easier to search partners and clients and react in changing market conditions.
Low profitability of waste water treatment facilities which utilize traditional techniques (payback period more than 20 years) is the main constrain for private investments into this sphere.
According to expert judgment only introduction of new techniques will enable to reduce capital and operation costs and will attract private investments. This trend started to pick up in the last years in the Russian Federation.

List of acronyms

APEC - Asia-Pacific Economic Cooperation
ABS - Acrylonitrie butadiene styrene
BOOT - buy, operate, own, transfer
CIS - The Commonwealth of Independent States
EBRD – European Bank for Reconstruction and Development
GOST - Russian National Standard
HDPE - High-density polyethylene
HPP - High-pressure polyethylene
IPCC – Intergovernmental Panel on Climate Change
JSC – Joint Stock Company
LLC – Limited Liability Company
MMK - Magnitogorsk Metallurgy Works
MPC - Maximum Permissible Concentrations (MPC)
MPD - Maximum Permissible Discharge
NEC – National Environmental Company
NEFCO - Nordic Environment Finance Corporation
NLMK - Novolipetsk Metallurgy Company
OMK - Oskol Metallurgy Companys
PA - Polyamide
PBT - Polybutylene terephthalate
PC - Polycarbonate
PET - Polyetheleneterephthalate
PP - Polypropelene
PS - Polysterene
PVC - Polyvinilchloride
PW - Polyethylene wax
RF – Russian Federation
SIB - Securities and Investment Board
SR – Solid Residue
TGK - Territorial Generating Company
TMW - Taganrog Metallurgy Works
TPP – Thermal Power Plant
TS - Thing Section
UNFCCC - United Nations Framework Convention on Climate Change
USSR - Union Of Soviet Socialist Republics
VTZ - Volzhsky Pipe Plant
WGDP - Waste Generation and Disposal Project

1 Introduction

1.1 Background

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1.2 References

The report is based on the information which Royal Haskoning considers as reliable. The information presented in this report is derived from mass media sources, branch statistics, Web-sites of market players, rating agencies, date submitted by marketing agencies.

1.3 User Reliance

Royal Haskoning has prepared this report for the sole and confidential use of *EVD*. The report can be passed to third parties only on the written Client's request.

This report may be distributed and relied upon by *EVD*, its successors and assigns. Reliance on the information and conclusions in this report by any other person or entity is not authorized without the written consent of *OOO Haskoning Consultants, Architects and Engineers*.

1.4 Report Structure

This report consists of 13 Chapters and 2 Attachments. This introductory chapter 1 is followed by Chapter 2 *Waste and Waste water regulation* which includes new regulation trends and targets. Chapter 3 provides information on *Waste and waste water generation volumes* in the Russian Federation.
Chapters 4 to 8 cover the main elements of waste management system: *storage and collection, transportation, waste treatment, recycling and landfilling.* Each element considers general information, the RF regulatory and common practice, constrains and actual data with a reference to the information source.
Chapter 9 includes existing methods of waste water treatment in the Russian Federation.

Chapter 10 gives information on waste water treatment facilities and presents example of the biggest waste water treatment facilities in the RF cities.
Chapter 11 summarizes big investment projects and programs as well as potential projects in the RF territory and therefore provide information on best opportunities Regions for Dutch companies.
Chapter 12 refers to some of the special events on waste and waste water management being conducted regularly in the RF like exhibitions and conferences.

Chapter 13 concludes the present report with summary and recommendations.

2 Russian Federation waste and waste water legislation

2.1 Fundamental laws – general principles

The basic laws regulating waste management and waste waters treatment are as follows:

1. The Federal Law "On Environmental Protection" (2002);

The main statement of this law regarding wastes is that any waste disposal and waste water discharge are negative environmental impacts and is to standardized, monitored and paid.
Federal Law requires accountability for industrial and domestic waste disposal and the application of resource-saving, low- and non-waste technologies in the design and operation of buildings, constructions, utilities and other facilities (Articles 36, Paragraph 1, Article 39, Paragraph 39). It prohibits the development of buildings, constructions, utilities and other facilities, without technical means and the equipment needed for safe disposal/treatment of industrial and domestic waste (Article 38, Paragraph 2). The Law details specific requirements on design documentation and construction operations in respect of safe disposal of wastes generated by thermal power plants (Article 40, Paragraph 2). The Law requires provisions for adequate measures on: waste treatment/waste neutralisation, the collection of associated gas and mineralised water in the development of the design process, construction/upgrading, commissioning and operation of oil/gas production facilities, oil refining facilities, gas processing facilities; transportation, storage and selling of oil, gas, and petroleum products (Article 46; Paragraph 2). According to the Law, adequate measures on industrial/domestic waste treatment and disposal must be taken during planning and building up of urban/rural residential areas (Article 44, Paragraph 2).
The Federal Law determines general requirements for the collection, use, disposal, transportation, storage and permanent disposal of industrial and domestic waste (Article 51, Paragraph 2). It prohibits the disposal of waste into water bodies, storage and permanent disposal of hazardous waste and its importation into the Russian Federation (Article 51, Paragraph 2).

2. The Federal Law "On industrial and domestic wastes" (1998);

The Federal Law determines legal regulation and fundamental principles of the state policy in the field of waste management (Article 4).
The Law determines the procedure for rating, registration and reporting in the field of waste management (Articles 18, 19) and describes the concept of the state Waste Register (Article 20). It establishes basic principles for economic regulation in the field of waste management, waste disposal fees and financial incentives for waste management activities. It outlines procedures for development of federal and Regional target programs on waste management (Articles 21-24), determine objectives and controls in the field of waste management. It designates responsibilities for state, corporate and public control over waste management (Articles 25-27). It establishes the responsibility for assessing violations of Russian Federation Law in the field of waste management and examine procedures for limitation, suspension, or termination of activities by individuals who violate waste management laws (Articles 28, 29).

3. Water Code of the Russian Federation (2006)

This is a major law in the area of water management of the Russian Federation. It covers general principles in relation of water use and water protection.

4. The Federal Law "On the sanitary and epidemiological welfare of the population" (1999)

The Federal Law is aimed to ensure the sanitary and epidemiological safety of population. The Federal Law prescribes that industrial and domestic waste collection, use, treatment, transportation, storage and permanent disposal be in compliance with sanitary rules and by means that are safe for public health (Article 22, Paragraph 1). It establishes that the procedure and conditions of collection, use, treatment, transportation, storage and permanent disposal of industrial and domestic waste be determined by local authorities in the presence of a sanitary-epidemiological statement (Article 22, Paragraph 2). It obliges radiation monitoring in locations of centralised use, treatment, storage and permanent disposal of industrial and domestic waste (Article 22, Paragraph 3) and establishes administrative responsibility for dealing with the violation of sanitary laws (Article 55, Paragraph 3).

Pursuant to current Russian law, the maximum permissible chemical, biological and micro-organic pollution/discharge standards are stipulated and approved by government agencies in charge of sanitary supervision in order to assure the protection of water bodies and prevent them from pollution and clogging.

Other regulations include:

- Decisions and Provisions of the Government of the Russian Federation (RF);
- Department Provisions and Methodical Instructions;
- National Standards (GOST);
- Sanitary Rules and Norms (SanPiN);
- Construction Norms and Rules (SniP).

2.2 Waste management regulation

The RF environmental legislation in the area of waste management regulates the order of: *collection* (collection at sources of generation from waste generators - enterprises with the purpose of further use or land filling), *storage* (temporary placement of wastes), *transportation* (transferring of waste from the places of generation, collection and storage to the outlets of treatment and disposal); *treatment* (extraction of harmful admixtures), *utilization* (a kind of disposal which involves extraction of useful products can be used in further production cycle); *land filling* (isolating of waste not appropriated for further utilization in special storage places with purpose of protecting its penetration into environment).

Waste categorization

The significant element in the RF waste management regulatory system is the determination of hazardous waste classes. A number of governing regulatory documents on the determination of hazardous waste classes have been developed ("Criteria of Hazardous Waste Categorisation", adopted by the order of the Ministry of Natural Resources of Russia № 511 of May 15, 2001)

There are 5 classes of wastes ranged according to hazardous characteristics.
Class 1 – extremely hazardous wastes
Class 2 – highly hazardous wastes
Class 3 – moderately hazardous wastes
Class 4 – low hazardous wastes
Class 5 – practically non-hazardous

This classification system is based on a set of parameters which take into account both the impact of wastes to environment and the toxic or related hazardous parameters which are very significant for assessment of potential harmful impacts to human health (both acute and chronic risks).

2.2.1 Collection

Waste collection is a subject to licensing according to the Federal Law on licensing of certain activities. Hence, collection of wastes from generators with purpose of its further use is to be conducted by licensed companies.
Waste generators should accumulate wastes separately according to the hazardous class and physical characteristics. Special requirements on accumulation, packaging and labeling are applied toward certain waste categories like mercury lamps, medical wastes, used oils, oily wastes, spent accumulators and some others.
It is important to mention, that waste management on the territory of the certain municipal district (city, town and Region) is stipulated by the local authorities according to the RF legislation (providing, the Regional legislation does not contradict the Federal law).

That means that local authorities can establish their own requirements, for example the requirement for separate collection of all types of waste for industrial and municipal enterprises within the district.

2.2.2 Storage (temporary storage)

Depending on toxic and physic-chemical characteristics temporary storage of waste is allowed both in open air and in a closed space (specially designated site or within the production area).

The way of temporary storage depends on hazardous class of waste. General requirements for storage of waste of different hazardous classes are as follows:
Class 1 – in sealed containers;
Class 2 – in closed containers (boxes, barrels, plastic bags, metal containers);
Class 3 – in paper, plastic or textile bags;
All other wastes – in bulk (within the designated place) or in metal container.

The site for temporary waste storage should be equipped with special protecting coating with raised edge to prevent contamination of soil and storm waters canalization. Protection from precipitation must be also provided at the site. The site must be easily accessed by vehicles for collection.
The maximum amount of waste allowed to store at the temporary storage site is limited by the established norms and stipulated in the Waste Generation and Disposal Project (WGDP). (Explanation see in paragraph "General requirements towards enterprises")

2.2.3 Transportation

Transportation of hazardous waste is to be undertaken with a hazardous waste passport by means of specially equipped vehicles carrying appropriate identifying symbols and with observance of hazardous waste transportation safety requirements. It also requires documentation describing the conveyance and transportation of the hazardous wastes, specifying the nature of the waste and its destination.
Collection schedule is to be set according to the terms of the contract and sanitary rules and providing that the quantity of waste in the temporary storage is not exceeded (this condition is mentioned in the WGDP – Explanation see in subparagraph 2.2.7 "General requirements towards enterprises"
The transport company should have a license for certain types of wastes which it is dealing with.
Detailed information see in the chapter 5 "Waste Transportation"

2.2.4 Treatment

There is a number of treatment methods and technologies, among them are incineration, pyrolyze, composting, demercurization and many others.
All the waste of class 1-3 must be treated prior to their further utilization by means of established ways of treatment.
As well as collection waste treatment is subject to licensing according to the Federal Law on licensing of certain activities.

2.2.5 Utilization

Waste utilization is a subject to licensing according to the Federal Law on licensing of certain activities.

2.2.6 Landfilling

General condition for accepting waste to landfills is subject to sanitary rules on air, soil, ground and surface waters protection.
Wastes of hazardous class 1 and 2 are prohibited to dispose of at landfills for household wastes.
Wastes class 3 and 4 can be disposed of to a limited extent (not more than 30% from the total mass of wastes) together with municipal household waste.

According to the definition of landfilling, the only waste which is not appropriate for further utilization is allowed for landfilling. So, in order to dispose of the certain waste to a landfill a waste generator has to prove that there is no other available technology and outlets for this waste except for landfilling.
The common practice is that hazardous waste class 4 and 5 are accepted by landfill operators regardless whether this waste can be recycled and utilized or not.
A landfill operator should have a license and operate the landfill in compliance with fire safety, environmental and technical requirements of operation.
All the waste streams coming to the landfill are subject to strict control (radiation and visual control) and recording (volumes, supporting documentations – passports etc).

2.2.7 General requirements towards enterprises

Waste generators (enterprises) should prove the hazardous class of waste by means of laboratory test to be conducted in the special licensed laboratory or by gaining it from the reference information (Federal wastes classifier). For wastes of class 1-4 should be developed the passport containing characteristics of the generated waste.
A waste generator should develop the Waste Generation and Disposal Project (WGDP). This document sets specific waste rates (per unit of production) and maximum waste volume (mass), which the enterprise or facility may dispose of during the defined period (usually a calendar year). Based on this WGDP the enterprise obtains the limit for waste generation and storage from authorities. This limit is valid for 5 years but should be validated annually by authorities.
A waste generator keeps recording of all wastes generating in the enterprise and reports annually to authorities the amounts of generated wastes (This reporting form is called 2 TP-report).
According to the Federal Law on Environmental Protection waste generation is a subject to payment as all the negative impacts to the environment. Therefore, an enterprise has to pay for waste accumulation and temporary storage at the established rate for 1 ton of the generated waste. The rate is fixed for each hazardous class (class 1 – the highest rate, and for other classes - in descending order).

Payment is not collected for those parts of waste, which are going to be recycled in the licensed facilities. Thus, this is an economic tool to encourage an enterprise to maximize the rate of waste for recycling and to minimize the volume of waste to be landfilled or burned.

2.3 Waste waters regulation

The RF environmental legislation in the area waste waters considers the following issues: waste water discharge, contaminants concentration in waste waters, standardizing, monitoring and industrial control, treatments methods, waste water sediments utilization, etc.

The outlet for these waste waters can be water body/relief or artificial collector: for industrial waters – a system of industrial canalization, for household waste waters – a system of household canalization, for storm waters – storm waters collector.
Any discharge of waste waters into municipal canalization is to be conducted in accordance with Agreement with municipal canalization, and discharge into water body or relief - in accordance with Permit to Discharge (or Temporary Agreed Discharge). Agreement/Permit implies conditions for discharge including volume of discharged waters and concentrations for pollutants (Maximum Permissible Discharge - MPD) which can be determined on basis of calculation method and must be approved by regulating authorities. For water bodies these MPDs are calculated with consideration of background concentrations or Maximum Permissible Concentrations (MPC) of pollutants. MPC is a reference information and established for water bodies depending on its water use category.
MPD must be strictly observed by any facility/water user. Fees are obligatory for any discharge and paid both 1) discharge within the established limits (volume and concentration) and 2) discharge beyond the established limits (exceeding of volume and concentration).

Community water supply and water discharge is governed by the Rules of Using Water Supply and Sewage Systems in Russia (dated December 12th, 1999).

2.4 New legislation and its trends

Waste and waste waters legislation is being updated from time to time throughout the entire hierarch structure, starting from the federal laws and ending by specific norms. These updates are initiated by the new needs and requirements on the “waste” and “waste waters” markets as well as by dynamics in the environmental legislation.
Thus, the last update of such fundamental laws like the Water Code of the Russian Federation took place in 23 July 2008, the Federal Law on “On industrial and domestic wastes” – 30 December 2008, the Federal Law on Environmental Protection – 14 March 2009.

The new Water Code was accepted in 2006 instead of the old one dated from 1995.
One of the primary changes in the water regulation system were the procedure and grounds for dedication of water bodies.

The new Russian Water Code does not contain any provisions governing water use. The independent grounds for water body use are Water Use Agreements or Decisions regarding the dedication of water bodies. However, dedication of a specific water body under such Agreements or Decisions is based on particular purposes for using such water bodies (Clause 11, Russian Water Code).

The current Russian waste management regulation system is mainly aimed at the provision of environmental safety in waste handling, i.e. regulation of handling waste deemed as environmental pollutants. Basically, no regulation of handling waste deemed as secondary material resources actually exists. For example, Federal Law “Industrial and Domestic Waste” does not contain definitions of such basic notions as “secondary material resources” and “secondary raw materials”. No principles of law regulating handling waste as secondary material resources have been set. Responsibility for waste collection and waste treatment is borne by municipalities. Given the current legal and economic conditions in Russia, however, they have insufficient resources for treating waste as secondary material resources (exceptions form this are negligible). All the above detain the growth of cost-effective waste management.

Such situation is a good precondition for changing waste management regulations, and waste treatment and secondary resource use, in particular.

Thus a Concept Federal Law “Secondary Material Resources” No DM-P12-6420 has been developed in pursuance of Russian Government Assignment dated December 26th, 2005. The ideas of developing Federal Law “Secondary Material Resources” is based on a conjunction of solutions to two interrelated problems, namely, the prevention of adverse environmental effects by various wastes and the procurement of secondary raw materials in industries (resource-effectiveness).

In order to assure good economic conditions for waste treatment, Federal Law “Packages and Packaging Waste” is being developed under the auspices of Russian Council of Federation. The provisions of this Law stipulate the introduction of fees for using packages and establishment of a special Package Waste Collection and Treatment Center.

2.5 Strategy and targets in waste and waste waters regulation

The main targets of waste management policy in the RF are waste minimization, re-use and recycling maximization.
As an official normative-technical document the Concept of solid municipal waste management was adopted in 1999 for the Russian Federation.

The Concept is to be used by local utility administrators in Russia and Russian Gosstroy officers in charge of long-term solid municipal waste management planning.

In Moscow Region the Program on waste management for 2006-2015 is in force. In Saint Petersburg there was accepted a concept of waste management for 2005-2014.

The main targets of these documents are:

- Minimization of waste generation;
- Maximization of re-use in economy
- Creation of additional working places
- Provision of safe storage, treatment and utilization of waste
- Reclamation of landfill territories
- Elimination of the accumulated industrial wastes which represent hazard to human and environment

For solid municipal waste certain targets are established.
As one of the main targets in solid municipal waste management is the implementation of separate collection of those waste, which can be recycled.

The main tools to achieve these targets are:

- Provide containers in residential areas for separate collection of paper, glass, plastics and metals.
- Development of a network of bring stations for secondary recourses; organization of movable bring stations for these recourses.

Other targets to be mentioned here are creation of recycling facilities, two-stage transportation, environmentally friendly treatment of those part of domestic waste, which can not be recycled, enforcement of collecting and storage control, economic encouragement of recycling etc.

In April 2008, the Government of Moscow adopted Resolution “Building the Technical Basis for Municipal Waste Treatment in the City of Moscow” pursuant to which an improvement plan has been developed with regards to municipal waste treatment.

Moscow officials promise to completely discontinue the direct disposal of municipal waste at local landfills, which will only contain what remains after treatment, by 2012.
As the target of this decree by 2015 is planned to reduce solid municipal wastes to be landfilled from 82 till 27-37 %.
The list of the waste management facilities to be constructed in order to achieve established targets is presented in the Attachment 1 of the present report.

3 Waste and waste water generation

This chapter provides information on wastes classification, generation sources and key figures on generation and accumulation in the Russian Federation.

3.1 Waste classification and composition

Wastes are classified according its genesis:

- Industrial wastes
- Consumption wastes (municipal solid wastes)

According to its aggregative state:

- Solid
- Liquid
- Gas

According to its hazardous class (as it was mentioned in 2.2):

- Class 1 – extremely hazardous wastes
- Class 2 – highly hazardous wastes
- Class 3 – moderately hazardous wastes
- Class 4 – low hazardous wastes
- Class 5 – practically non-hazardous

There is a federal waste classifier in the RF where all kinds of wastes are identified with its own ID depending on the source of generation.

The Federal Waste Classification Catalog is a list of waste generated in the Russian Federation and grouped according to priority attributes, such as the aggregate state, physical state, hazard rate, environmental impacts.

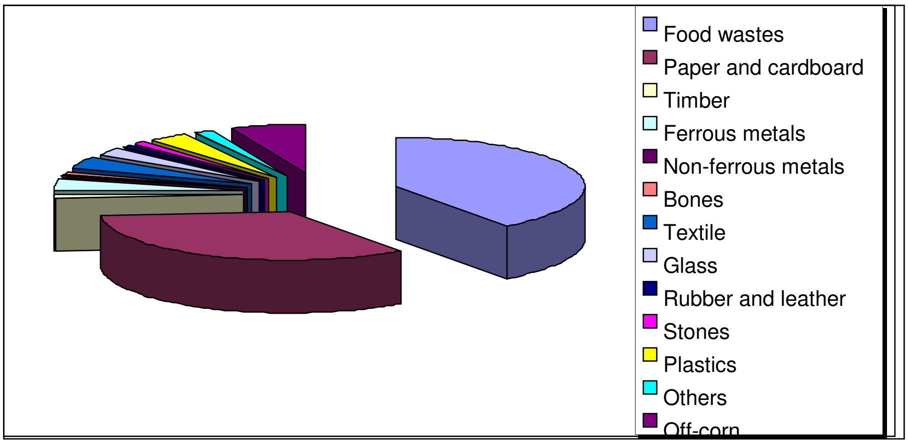
2) A thirteen-digit code defines the type of waste characterizing its general classification features. The first eight digits are used to encode the origination. The ninth and the tenth digits are used for encoding the aggregate state and the physical form of waste (0 – data undefined: 1 – solid; 2 – liquid; 3 – slurred; 4 – mud; 5 – gel, colloid; 6 – emulsion; 7 – suspension; 8 – dry; 9 – granulated; 10 – powdery; 11 – dust-lie; 12 – fiber; 13 – finished product with lost consumer properties; 99 - other). The eleventh and the twelfth digits are used for encoding the hazard rate and combinations thereof (0 – data undefined; 1 – toxic (t); 2 – explosive (v); 3 – combustible (p); 4 – highly reactive (r); 5 – contains agents of infection (i), 6 - t+v, 7 - t+p, 8 - t+r, 9 - v+p, 10 - v+r, 11 - v+i, 12 - p+r, 13 - p+i, 14 - r+i, 15 - t+v+p, 16 - t+v+r, 17 - t+p+r, 18 - v+p+r, 19 - v+p+i, 20 - p+r+i, 21 - t+v+p+r, 22 - v+p+r+i, 99 – zero hazard rate). The thirteenth digit is used for encoding the environmental impact rate (0 – hazard rate undefined, 1 – hazard rate 1, 2 – hazard rate 2, 3 – hazard rate 3, 4 – hazard rate 4, 5 – hazard rate 5).
Examples: 95000000 00 00 0 – liquid wastes of waste water treatment facilities,
97100000 00 00 0 – medical wastes.

Solid municipal waste
The composition of solid municipal waste differs from country to country, and from town to town. Its composition depends on many factors, including the wealth of the population, climate and public services and amenities. It may change in different seasons and weather. Waste composition is greatly affected by municipal glassware collection systems, waste paper collection systems, etc.

In the Russian Federation the solid municipal waste typically comprises the following components: paper, cardboard, food wastes, wood, metal, clothes, bones, glass, leather, rubber, stones, polymeric materials and other (non classified components).

The average content of domestic waste generated in the cities of the Russian Federation for middle climatic zone can be described as follows (% from mass): Food wastes – 35…45 %, Paper and cardboard 32…35 %, Timber – 1…2 %, Ferrous metals -3…4 %, Non-ferrous metals – 0,5…1,5 %, Bones – 0,5…1 %, Textile – 3…5 %, Glass – 2…3 %, Rubber and leather - 0,5…1 %,Stones – 0,5…1,5 % Plastics – 3…4 %, Others – 1…2 %, Off-corn – 5…7 %.[1]

Figure 3.1: Average content of solid municipal waste



3.2 Waste generation figures

Totally in 2007 there were 3.9 billion tons of consumption and industrial wastes generated in the territory of the Russian Federation.[2] (Official data on waste generation in 2008 are not available as far as the state report for 2008 have not been published yet by the time of writing this report). The dynamics of generation for the last years is presented in the table below:

Table 3.1: Wastes generation volumes in the Russian Federation (2002 - 2007)

Years	Wastes generated in the reporting year (million tons)
2002	2034,9
2004	2634,9
2006	3519,4
2007	**3899,3**

The rate of non-hazardous wastes (class 5) from the total waste generation amounts to 90 -96 % (in 2007 – 92.6 %), the rest is class 4 (7 %) and class 1-3 – less than 1% (in 2007 – 0.3%).
Regarding genesis of wastes generation annually in the Russian Federation is generated[3]:

- Industrial wastes – more than 3 billion tons;
- Solid municipal wastes – more than 40 million tons;
- Waste water sediments from industrial facilities and utilities – 80-100 million tons;
- Construction wastes (including wastes from buildings demolishing and oil contaminated soils) – dozens of tons.
- Agricultural wastes (organic waste) - 250 million tons.

More than 90 % of industrial wastes are generated in the process of minerals extraction and dressing.

All in all, the yearly accumulation of industrial waste per person is 18-20 times higher than the municipal waste accumulation standards. If the overall number of industrial waste is 100, ferrous metallurgy waste, chemistry waste and other toxic industry waste will constitute 10 to 20.

[1] MDS Treating Solid Municipal Waste in the Russian Federation: Concept
2 State Report “On environmental state and protection in the Russian Federation”, 2007
[3] ФГУ НИЦПУРО (FGU NICPURO research)

Russia is witnessing a steady waste accumulation with no major changes of the situation being forecasted for the nearest future. It is obviously linked to an increased industrial output and consumptive use level. The consumption waste is growing faster than the industrial waste due to a faster growth of the consumptive use products, mainly, computers and radio-electronics, domestic appliances, clothes, cars, etc.

Moscow
In 2007, Moscow generated 25.4 million tons of consumption and industrial waste, including toxic soils – 7.8 million tons; non-polluted soils – 4.5 million tons; construction and demolition waste – 4.0 million tons; solid waste form public sector – 2.8 million tons; municipal drainage treatment facility sediment – 1.9 million tons; industrial waste – 1.6 million tons. [4]

Leningrad Region
As of early 2007, the factories accounted for 1.19 thousand tons of industrial and domestic waste, whilst 1.64 thousand tons of waste was generated throughout a year. [5]

Other Regions of the Russian Federation:
Urals Federal District
Chelyabinsk Region – in 2007 were generated 70.52 million tons
Sverdlovsk Region – 185 million tons

Southern Federal District
Krasnodar Krai – 9.06 million tons

Siberian Federal District
Republic Buryatia – 20.13
Krasnodar krai – 233.3 million tons
Irkutsk Region – 97.6 million tons
Kemerovo Region – 1735,3 million tons
Chita Region – 82.6 million tons
Tyumen Region – 0.83 million tons

Central Federal District
Tula Region – 3.5 million tons
Bryansk Region – 3.44 million tons

Volga Federal District
Perm Region – 44.2 million tons
Nizhniy Novgorod Region – 2.91 million tons
Orenburg Region - 273.4 million tons
Samara Region – 4.68 million tons

Far Eastern Federal District
Kamchatka krai – 0.58 million tons
Primorski krai – 1099 million tons
Khabarovsk krai – 34 million tons
Sakhalin Region - 34.59 million tons

4 State Report “On environmental state and protection in the Russian Federation”, 2007
5 State Report “On environmental state and protection in the Russian Federation”, 2007

3.3 Classification and Composition Waste Waters

By origin, waste waters may be classified thus.

- Industrial waste waters (generating in production process any production facility or in any minerals extraction process)
- Household waste waters (generating in household use in residential buildings or in welfare spaces in production facilities)
- Storm waters (rain waters and snow-melt waters)

Two primary polluting groups are segregated in waste water, namely, the conservative pollutants, i.e. those that barely react chemically and are basically non-degradable (such as salts of heavy metals, phenols, pesticides); and non-conservative pollutants, i.e. those that may participate in self-purification of water.

Waste water is composed of both inorganic matter (particles of soil, ore and mining waste, slag, inorganic salts, acids, alkali) and organic matter (oil, organic acids), including the biological specimen (fungi, bacteria, yeast, including pathogenic ones).
Table 3.2 below shows the tentative composition of waste waters from selected factories

Table 3.2: Physicochemical Parameters of Waste Waters from Selected Factories

Parameter	**Metal works**	**Wool processing plant**	**Hydrolysis plant**	**Starch factory and distillery**	**Paint factory**
Content of, mg/l					
dissolved solids	600	33500	8600	1400	1200
suspended solids	500	28000	950	470	170
ammonia-nitrogen	—	210	150	45	12
phosphates	—	—	40	15	1
mineral oil	40	—	—	—	—
fats	—	7800	—	—	—
polyaromatic substances	—	—	—	—	100
furaldehyde	—	—	50	—	—
Color strength on dissolution, mg/l	—	—	—	—	1:150
BOD5	—	6300	2400	360	200
BODcompl	—	17800	3300	580	250
COD	50	44000	4900	830	600
pH	8	9.5	5.5	7.2	9

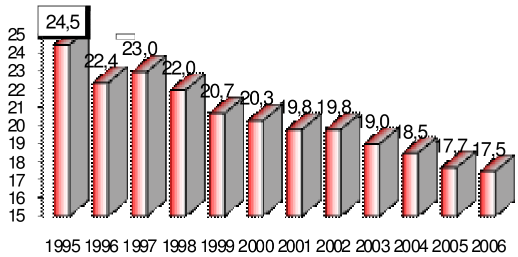
3.4 Generation of Waste Waters and Sources of Pollution

In 2007, 51.42 km^3 of waste water were discharged in the country's water bodies (51.39 km^3 in 2006), of which 33.4% is the segment of polluted waste waters, 62.6% is the standard-clear waste water, and 4.0% is the standard-purified waste waters.

In 2007, the aggregate discharge of polluted waste waters into surface water bodies was 17.2 km^3 (98.3% as compared to 2006), of which 3.4 km^3 of waste waters were discharged without any treatment whatsoever (3.5 km^3 in 2006).

Changes in the discharge of polluted waste waters into Russian surface water bodies are shown in Figure 3.2.

Fig. 3.2 Changes in Discharge of Polluted Wasre Waters into Russian Water Bodies, km3



About a quarter of the mentioned waste water category was discharged in surface water bodies in the Central Federal District, in the Volga Federal District and the North-Western Federal District was discharged 18% of polluted waste water each (Fig. 3.3).

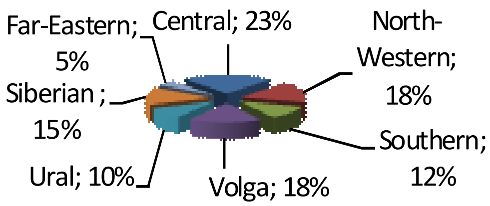


Fig. 3.3 Polluted Discharge into Surface Water Bodies in 2007: Distribution by Federal Districts.

For the vast majority of constituents of the Russian Federation, one of the main sources of pollution are plants associated with water accumulation, treatment and distribution; plants associated with waste water and/or waste removal and similar plants (housing and utilities).

In selected cities, the fraction of such businesses in the discharge of polluted waste water in surface water bodies is: more than 90% in Moscow and Omsk; up to 80% in Ulyanovsk and St. Petersburg; up to 70% in Volgograd; and about 50% in Nizhny Novgorod, Saratov and Voronezh. [6]

Moscow

Along the entire Moscow River within the city boundaries, water is classified as “moderately polluted” except the Yauza fall spot, where water is classified as “polluted”. Note that in some areas quality of water has improved in comparison with the year 2006.

Basically all metropolitan businesses and organizations are consumers of metropolitan utility services, including waste water discharge; therefore the discharge from Moscow State Unitary Enterprise *Mosvodokanal* and State Unitary Enterprise *Mosvodostok* impact water bodies in Moscow the most.

In addition, about 150 businesses discharge their waste water in water bodies or on drain areas. The list of major special consumers that adversely affect water bodies in Moscow includes Moscow State Unitary Enterprise *Promotkhody*, *Mosenergo* JSC, *Northern Rover Port* JSC, *Moscow Kristall Plant* JSC, *Vnukovo Airport* JSC.

The total annual waste water in Moscow (less surface runoff from the residential area) in 2007 was about 2506 billion m3, which is 5% less than in the previous year.

One of the key pollutants within the city boundaries is the storm water (stormwater, meltwater, road washings) that penetrates in water bodies through drainage, over the landscape and through groundwater.

[6] State Report “On environmental state and protection in the Russian Federation”, 2007

The most waste water is generated by *Mosvodokanal* (more than 70%). Metropolitan waste water that drains into the sewers in Moscow is primarily generated by domestic waste water. The share of industrial waste water in the entire volume has not been more than 10% in recent years.

St. Petersburg

In terms of surface water reserve, St. Petersburg is among the largest global cities as water table occupies approximately 10% of the metropolitan area. Water bodies are intensely used as sources of potable water and industrial water. They are also used for draining waste waters, producing heat and energy, navigation, fishing and recreation.

The volume of water in the recycle and reuse systems is 683.57 million m3, and fresh water saving is 55%, which is less than average for the country.
In 2007, 1317.28 million m3 of waste waters were discharged in water bodies, of which 1187.05 million m3 (90%) was polluted, and 432.44 million m3 of waste water was non-purified.

Despite the commissioning of Southern Treatment Facilities, the discharge of waste water in water bodies has increased again (by 13.4 million m3). However, the discharge of non-purified waste water decreased by 36.4 million m3.

With regards to the organization of water disposal (combined sewer), most waste water is discharged through the lines of State Unitary Enterprise *St. Petersburg Vodokanal*. Besides, some enterprises continue discharging polluted waste water in water bodies. Among them are TPP-2, TPP-5, TPP-14, TPP-15 *TGK-1* JSC, *Plastpolymer* JSC, *GOZ Obukhovsky Zavod* JSC, *Severnaya Verf Shipyard* JSC. The intensive use of water bodies for navigation and active sightseeing along the river and channels negatively impact the water bodies.
The water supply system in St. Petersburg is mainly based on surface waters of the Neva. The use of fresh underground water is restricted and does not constitute more than 5% of overall water consumption.

4 Waste Storage and Collection (accumulation)

Waste disposal system comprises of the following essential elements: collection, transportation, processing (sorting, burning, composting, recycling) – landfilling.
First element of this system is presented in detail in this chapter of the report.

4.1 Industrial waste

As it was mentioned in 3.2 the vast majority of wastes generating in the Russian Federation comprises industrial wastes (about 80%). More than 90 % of this volume is generated in the process of minerals extraction and dressing.
Generally speaking, management of waste from the manufacturing industry which is not similar to solid municipal waste (manufacturing waste or production waste) does not fall under the responsibility of the municipalities. It is the manufacturing industry itself who is responsible for management of their waste. The waste may be managed on-site or externally, by treatment (including recycling/ recovery) or disposal.
Prior to disposal industrial wastes are to be accumulated and stored on specially designated areas in the territory of industrial facilities. Hazardous wastes (class 1-3) are to be stored separately from other wastes. Some specific requirements are laid towards special kinds of wastes, like uses oils, liquid chemicals, mercury lamps etc.

Mercury lamps
Collection and storage must be conducted in separated room apart from production buildings (not less than 100 away). Non-broken lamps are to be collected in cardboard boxes (paper and plastic bags are allowed as well) in quantity not more than 30 pieces and stored on shelves. Broken lamps are to be collected in sealed metal containers with handles and label "For broken mercury lamps".
Disposal method appropriated in the RF – only treatment - demercurization at special plants (No landfilling!).

Spent batteries
Spent batteries are to be collected and stored in specially designated ventilated room apart from administrative and public service buildings in closed containers. Containers are to be equipped with protective trays (depth – not less than 5 cm) to prevent spills of electrolyte. The floor of the room where spent batteries are collected must be made of acid-proof material. Disposal methods in the RF – processing in special plants.

Used oils
Collection of used oils must be conducted excluding any spills and firing as well as any possibility of environment pollution. Used oils are to be collected in sealed containers and stored in specially designated areas under shed or indoor with fire protection equipment. Pouring should be done in the area with concrete pavement.
In case of absence of the concrete pavement containers should be provided with protective trays. For clean-up of potential oil spills special equipment should be in place (sand, shovel). Disposal methods in the RF - incineration, regeneration (for transformer oils), processing.

Oily rugs
Oily rugs are to be collected in metal labeled containers with cover separately from other wastes. Storage is allowed outdoor. In this case the area where containers are situated should but under shed and concrete pavement. Disposal methods in the RF – land filling (partly), incineration.

Collection of Medical Waste
Medical waste from state and private hospitals, clinics and medical stations within the project area should be collected separately from other waste.
This type of waste has its own internal classification (А,Б,В,Г,Д – subclasses, depends on origin and hazardous characteristics of waste). For each subclass certain collection and storage requirements are established. Genera rule – separated collection and storage with observance of sanitary rules. All the responsibility on management of medical wastes takes the medical institution.

Accumulated volumes
A high proportion of class 1 and class 2 hazard rate products is processed by the users in situ. Non-processed waste is primarily stored within the factory in special locations, including collectors.
Due to grown waste generation and insufficient recycling and sterilization, a large amount of accumulated waste is normally placed on factory sites occupying vast territories. As of late 2007, the factory sites had 26.7 billion tons of waste.

Almost half of the 2007 waste, 1735.35 million tons or 44.5% is the waste from coal mining in Kemerovo Region (class V, non-hazardous).

Among other constituents of the Russian Federation with the said parameter close to or more 100 million tons are:

Orenburg Region	– 273.4 million tons (7.0% of amount nation-wide),
Republic of Sakha (Yakutia)	– 246.6 million tons (6.3%),
Krasnoyarsk Region	– 233.3 million tons (6.0%),
Murmansk Region	– 202.8 million tons (5.2%),
Sverdlovsk Region	– 195.7 million tons (5.0%),
Belgorod Region	– 127.0 million tons (3.3%),
Republic of Karelia	– 106.38 million tons (2.7%),
Irkutsk Region	– 97.64 million tons (2.5%),
Chita Region	– 83.71 million tons (2.1%).

So, the main issue here is that large volumes of waste are not disposed of in a timely manner but accumulated in the territories of industrial facilities resulting into environmental impact. This problem is caused by the lack of waste disposal outlets in the remote areas of minerals extraction, lack of logistics in waste disposal market of these Regions.

4.2 Solid Municipal Waste

Due to the increase of urban population, the waste disposal problem is growing higher for towns and other municipalities. The average solid municipal waste disposal distance for Russia is 20 km, and in towns with the population of 500 thousand inhabitants and more it can be 45-60 km. According to the statistics, the waste disposal distance grows 1.5 km every year, whilst the transportation cost increases by 15-20% respectively. This urges the authorities to turn to a double-stage waste disposal system with the use of transfer stations and sorting stations, and large dump trucks.

In Russia, the organization of collection processes and gradual recycling of secondary raw materials (depending on the specific treatment facilities) is sporadic, often experimental, and concerns just a few municipalities. This is due to practical non-existence of federal laws and regulations governing the implementation of selective waste collection plans and the formation of a secondary raw materials market. Certain efforts can be seen in Moscow, St. Petersburg, Vladimir, Kirovo-Tchepetsk, Kursk, Orel and some other towns.

Given the current legislation, the labor-intensive process of domestic waste segregation is unprofitable. However, it has no alternative whatsoever. Foreign experience demonstrates that waste segregation followed by recycling is the most effective way in waste management.

4.2.1 Segregation of solid municipal waste

Waste segregation presupposes the isolation of valuable fractions from the entire bulk of waste. Such fractions should be suitable for recycling with consequent 5-10 time compression and packaging in standard blocks.
Such an approach will decrease truck mileage, facilitate waste storage, reduce the number of landfills and dumps, and finally return valuable secondary resource in merchandize turnover.
This will drastically ease the environmental burden on the Region and improve the sanitary state thereof, i.e. this will provide an integral long-term solution to the solid waste problem, establish a coherent industrial recycling infrastructure.
Sorting of solid municipal waste enables its use as a source of raw materials at the lowest environmental losses and comparatively low cost.
It is proven, that segregation at source can result in saving of 80 % secondary materials.

4.2.2 Segregation at source

Selective waste collection (waste paper, textile, plastic, glassware, metals, etc.) is used in many countries, which prevents some valuable recyclable or reusable components from being disposed of as solid waste. Besides, selective segregation of hazardous waste is being practiced, i.e. the segregation of potentially hazardous used batteries or luminescent lamps that are dumped in landfills and incineration plants as part of solid waste.
Some towns in Russia have made several attempts to establish waste segregation. For example, in South Urals there are waste segregation stations sponsored by local entrepreneurs.
In Moscow in residential areas usual garbage containers were replaced with selective containers to promote residents to garbage segregation at source (Fig. 4.1)
In St. Petersburg, waste segregation was planned for establishment as early as in 2006. Government finance was used for purchasing more than four thousand special containers. Only 440 of those were placed in the yards.
However, none of the attempts of segregation promotion resulted in any positive outcome.
Massive organization of segregation at source in the Russian Federation is problematic due to shortcomings of legislative regulation, lack of population awareness, absence of logistics solution to ensure segregate collection.

Fig. 4.1: Container for separated garbage collection

4.3 Waste segregation facilities

The modern segregation facility typically comprises the following components (as it is illustrated in the figure below).

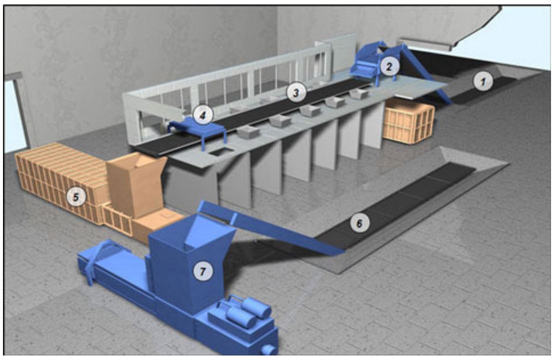


Fig. 4.2: Segregation facility

1. Infeed container (solid waste from dump trucks is fed to the infeed container where bulk waste is segregated)
2. Dynamic separator (segregates small fractions not used for sales)
3. Sorting conveyor (sorting and selection of secondary raw materials: cardboard, paper, plastic…)
4. Magnetic separator (segregates ferrous and non-ferrous metals)
5. Press-container (compacting waste remnants after sorting)
6. Infeed press conveyor (feeds sorted secondary materials to the press)
7. Briquetting press (for briquetting secondary materials)

Up to a half of sorted solid waste is used as secondary materials. The other waste is briquetted and dumped in landfills.

The non-residential sector accounts for 30-40% of the entire solid waste generated in towns. However, the sorting efficiency for such waste is way higher than with the residential waste.

Improved Traditional Sorting Complexes

Their most specific features are a longer sorting conveyor (up to 30-40 m), a larger number of posts enabling an increased output of secondary materials and higher sorting level with better organization. Compared to rattlers and shake tables, the dynamic separator is more efficient at segregation of smaller fractions. The magnetic separator segregates ferrous metals more efficiently, too.

The capacity of a single line is up to 1000 thousand tons of waste per year. Double or triple lines may be used, which enhances cost-effectiveness of the entire complex. Thus, the doubled performance produces only a 40% increase in the price of the complex.

Fig. 4.3: Sorting container

The so-called “tails” (sorted leftovers of solid waste) have to be pressed to decrease landfill areas and with the aim of multiple reduction of poisonous waste water (pressed garbage does not infiltrate atmospheric precipitation), multiple reduction of highly toxic gas emission (landfills of pressed packets are non-combustible and produce no smoke), and multiple reduction of dumping costs. The land can be used immediately after closing the landfill, which is of utmost importance.

Fig 4.4: Secondary materials and “tail” pressing line

Pressing on such lines is distinct for its use of horizontal briquetting presses which decrease the size of packs compared to other line standards. From practical experience, it is known that large packs can be damaged and destroyed during loading, transportation and unloading. In the landfills, such packs are often rolled flat with bulldozers, thus pressing turns to be senseless. The packs from lines have higher quality, with the price for press basically halved.

Wet Sorting Lines

All polymers except PVC float in water, which enables 95% segregation of polymeric waste. Re-sorting of washed “tails” almost doubles the secondary material output.
After dry sorting, the “tails” are washed in a screen cylinder to be further sent for re-sorting. Water is rapidly purified to precipitate the organic and mineral components separately.
Purified water is reused.
The organic sediment may be used for production of fertilizers and biogas.
Mineral sediment may be used for production of construction materials.
Cost-effective sorting facilities would sort waste, which is sufficiently enriched with valuable components. According to estimates, returns from sales of secondary raw materials are more than 12% (of original) higher than the net production sorting cost. If the net production output is approximately 30% (of original) and the capacity of the facility is at least 35 thousand tons/year, the payback time is 2 years[7].

Fig. 4.5: Wet sorting lines

[7] http://www.energyresearch.ru

The benefits of waste sorting complexes are obvious:

- tripled or quadrupled life of the landfill and 5-6-time reduction of its area (landfills become unnecessary if complete solid waste recycling technologies come into use)
- reduced biological and chemical activity of briquetted waste
- 6-8 time reduction of solid waste transportation and disposal costs

At the moment there are 16 waste segregation facilities in Moscow Region (total capacity – 1.5 million tons of wastes annually). However, this amount is not sufficient to process all the solid municipal wastes (3.5 million tons) in the Region.
For improvement of waste management situation in the Region and for deduction of landfilling rate by 35-40 % Moscow authorities are planning to construct 7 more facilities with capacity of 500 thousand tons each.
Segregation and segregation at source are rather outstanding element of the entire waste management system and presented in a very limited scale in the cities of the Russian Federation. This is because of shortcutting of regulation, absence of solid requirements to segregate wastes, lack of public awareness as well as absence or lack of bring stations and local disposal outlets.
Segregation facilities are mostly presented within the waste treatment facilities or separately in the territories of landfills and make profit of procuring and sale of commercial waste like – metal scrap, plastic, glass.

Examples of segregation facilities in other RF Regions:
Kazan – waste segregation facility (Capacity – 600 thousand tons per day);
Tambov Region – waste segregation facility (Capacity – 150 thousand tons annually);
Perm Region – waste segregation facility (Capacity – 30 thousand tons annually);
Sochi – waste segregation facility. (Capacity – 200 thousand tons annually);
Lipetsk, Ryazan, Belgorod – waste segregation facilities;
In Murmansk a new waste segregation facility is going to be to constructed (see in details in Chapter 11)

The market of waste segregation equipment is presented by majority of domestic and foreign companies like: JSC “Stankoagregat”, Company Nodricalliance, Company MSK “Stanko”, NPP LLC “Rekstrom-M”, Company “Dormarsh”, JSC “Tiskond”, Coparm (Italy), Sacria Industries (France), Imabe Iberica (Spain).

Note, there are no extra requirements towards any imported equipments for any waste treatment process but for provision of certificate for these equipments and customs proceedings.

5 Waste Transportation

Waste transportation must be licensed. Waste carrier companies (regardless of whether they handle industrial or municipal waste) must all have licenses.

5.1 Industrial Waste

Waste from factories is handled by carrier-companies under the agreements between such factories and carriers stipulating this sort of services. Such agreements must stipulate the periodicity of waste transportation, as well as other conditions, such as the use of tare for waste collection.
In actual fact, the factory generating various wastes has a single waste transportation contractor that handles such waste to various disposal outlets, which may be regular landfills or recycling enterprises based on the type of waste.

According to the legislation the factory - waste generator should control the transportation of waste from the moment the carrier removes it from the factory and up to the moment it arrives at a disposal outlet. The factory also keeps records of all wastes removed from its territory.

Industrial waste is handled to a landfill with industrial vehicles according to "Transportation of Hazardous Freights by Automotive Vehicles: Guidelines" approved by USSR Ministry of Home Affairs Directive No 371 dated November 20th, 1980.

Loading, transportation, unloading and burial of the waste in a landfill must be performed according to the guidelines developed by factories pursuant to the requirements of these Sanitary Regulations and approved by the factory's Chief Engineer upon preliminary approval by local authorities and local sanitary agencies.

All and any works as to waste loading, transportation, unloading and burial shall be mechanized and hermetically sealed. Waste shall be carried in special vehicles that prohibit any losses en route and pollution of the environment. Such vehicles shall be convenient for reloading:

- semiliquid (slurry) waste transportation vehicles shall have flexible tubing for discharging such waste;
- solid or dust-like waste shall be handled in special tare with take-in devices for unloading by crane trucks at landfills or have special devices;
- dust-like waste shall by moisturized on all stages, at loading, transportation, unloading and leveling.

No third persons may be present during industrial waste transportation except the driver and the accompanying members of the factory staff.

5.2 Solid Municipal Waste

Solid municipal waste is handled by both municipal carriers and private entrepreneurs.

In Russia, a fairly wide range of vehicles used for waste transportation is manufactured. Such vehicles differ by:

- the mode of use (vehicles for waste transportation from residential and public organizations, vehicles for bulk waste transportation);
- the capacity of the vehicle body (mini-dumptrucks with the capacity of 7-10 m^3; medium vehicles carrying 16-45 m^3 and large dumptrucks with the capacity of more than 45 m^3);
- waste load mechanisms;
- waste compression character (permanent, cyclical);

- the dumping system (tilting or forced dumping with the use of a puller plate).

The average waste transportation distance for Russia is 20 km, and in larger cities with the population of more than 500 thousand inhabitants it rises to 45 km and more. Statistics for 100 Russian towns (less Moscow and St. Petersburg) shows that 45% of all solid waste is transported to 10-15 km, 40% - to 15-20 km, and 15% of all waste is carried away to more than 20 km. According to the statistics, the waste disposal distance grows 1.5 km every year, whilst the transportation cost increases by 15-20% respectively.[8]

5.3 Waste Transfer Stations

One of the most realistic ways to reduce transportation costs would be a transition to a double-stage solid waste disposal system with the use of waste transfer stations and large dump trucks. Analysis suggests that double-stage disposal may result in 30% reduction of transportation costs. Simultaneously, atmospheric emissions from dumptrucks would come down. This type of technology is very enthusiastically introduced in larger cities where waste landfills are located far from town (e.g. in Moscow).

Double-stage solid waste disposal with the use of large capacity dumptrucks and removable press-containers is being further developed as well.

The double-stage technology includes the following processes:

- collection of solid waste in accumulation spots;
- waste disposal by collecting dumptrucks to waste transfer stations;
- reloading into large vehicles;
- handling solid waste to the burial or recovery area;
- unloading solid waste.

Upon the construction of such station, the dumptrucks unloads the collected waste in a transfer station consisting of a stationary press and automatically replaced large capacity containers instead of a landfill. The trucks dump solid waste in a receiving bin, under the funnel of which there is an infeed window of the stationary press. The pressing force of the said facility decreases the volume of waste 5-7 times. Upon filling of the container, it automatically “unfastens” from the press to be replaced with an empty one. The containers have special rollers, which enables automatic replacement of full containers with empty ones. Full containers are handled to the landfill for emptying. To increase cost-effectiveness, sometimes a single truck would carry 2 containers (one on a trailer), so only one truck is required instead of 15.

Benefits:

- reduced consumer-landfill waste transportation losses (time and fuel) (up to 15 times)
- use of dumptrucks for its immediate purpose
- increased lifetime of landfills due to compacted waste
- fewer traffic jams and less gas pollution

As of today, 6 waste transfer stations work in Moscow with the total capacity of approximately 1 million tons.

The first station was commissioned in the 4th quarter 1994 within the Experimental Plant GTT *Ecotechprom* site. Stations in Eastern Administrative District and South-Eastern Administrative District are under way. In the opinion of the concept-makers, a more prospective solution, namely pressing waste in high density briquettes, which prolongs lifetimes of landfills, is employed in constructing a transfer station in North-Eastern Administrative District. As was approved by the Prefecture of the Southern Administrative District, domestic transfer station “Chertanovo” was built in 1995 and commissioned in late 1995. Waste pressing at this station is performed in large dumptrucks. In the opinion of the concept-makers, transition to the double-stage system will result in more efficient

[8] MDS Treating Solid Municipal Waste in the Russian Federation: Concept

employment of low-tonnage dump trucks and in 20% reduction of the overall number of such dump trucks.

<u>Main waste transfer stations in Moscow</u>
Waste transfer station *Vagonoremontnaya*
Location: Vagonoremontnaya St., Northern Administrative District. Commissioned: 1995. Waste transfer method: *Partek* (Sweden). Designed capacity: 70 thousand tons/year.

Waste transfer station *Chertanovo*
Location: Dorozhny Lane, Southern Administrative District. Commissioned: 2nd quarter 1996. Waste transfer method: domestic. Designed capacity: 150 thousand tons/year.

Waste transfer station *Signalny*
Location: Signalny Lane, North-Eastern Administrative District. Commissioned: 1996. Waste transfer method: *Imabe-Iberica* (Spain).). Designed capacity: 300 thousand tons/year.

Other RF Regions where waste transfer stations are operating: Kazan, Vladimir.

The project of waste transfer station is going to be implemented in Khabarovsk.
In Samara 6 waste transfer stations are planning to be constructed (see in details in Chapter 11)

6 Waste treatment

<u>The following waste treatment methods are distinguished:</u>
a) biological treatment
b) thermal treatment
c) special treatment

6.1 Biological Treatment

The biological treatment methods include biodegradation, composting, and recycling to produce biogas.

<u>Biodegradation</u> (enzymic oxidation) is the degradation of any agent as a result of vital functions of microorganisms. This process ultimately results in producing stable simple compounds (such as water and carbon dioxide).
This method is used for processing food waste, organic agricultural waste and oily waste, such as used lubricants and soils polluted with oil products.

<u>Composting</u> is a biological process of degrading organic waste with the help of enzymes in an oxygenous medium aimed at the production of compost or biofuel. First of all, the organic waste - agricultural waste, crop production and animal husbandry waste, food waste and the organic component of the solid waste is normally composted.
Composting of solid waste has developed worldwide as an alternative to incineration (the first European waste composting plant was built in the Netherlands in 1932). However, it has never been never spread wide.
Up to 2% of solid waste is composted in Europe, whilst in the US and Japan this figure is up to 2%. In Russia, the composting fraction is very small.

In the CIS, 8 plants (in St. Petersburg, Nizhny Novgorod, Tashkent, Alma-Ata, Baku, Tbilisi, Minsk, Mogilev) were built in 1971-1987 based on *Giprokommunstroy* designs; and in late 1994 the 9th plant was built in St. Petersburg. All those plants employed basically the same method of direct solid waste composting.[9]

As it was mentioned in the section 3.2 about 250 million tons of agricultural wastes is generated in the Russian Federation annually. These figures demonstrate a huge potential for development of this sector of organic waste processing and compost production.

<u>Biogas Production</u> Biogas is the gas produced by methane fermentation of the biomass. The biomass is degraded by three types of bacteria. Within the food chain, the subsequent bacteria feed on the waste products of the previous ones. The first type is the hydrolytic bacteria, the second type are the acidic bacteria, and the third type are the methanogenic bacteria. Biogas is produced not only by the methanogenic bacteria, but by all the three types.

The composition and quality of biogas is: 50 - 87 % methane, 13 - 50 % CO_2, negligible impurities of H_2 and H_2S.
Purification of gas from CO_2 produces biomethane. Biomethane is fully similar to the natural gas, the only difference is its origin.
Since only methane produces energy from biogas, gas quality, gas output and gas quantity are reasonable to account for in terms of methane production with its standardized characteristics. The volume of gases depends on temperature and pressure. High temperatures result in gas expansion

[9] http://www.rospress.ru/makulatur8.html

and the reduction of its caloric value as the volume reduces. In addition, with more moisture, the caloric value of gas decreases as well. To make the comparison of gas outputs possible, they must be correlated to the normal condition (temperature 0℃, atmospheric pressure 1.01325 bars, relative humidity of gas 0%). Generally, gas data is rendered in liters (l) or m3 of methane per kilo of dry organic substance, which is much more precise than calculations in m3 of biogas or m3 of fresh substrate.

The list of organic waste suitable for biogas production is: manure, poultry manure, grain and molasses draff, brewer's grains, beet presser, feces sediment, fish-processing and butchering waste (blood, fat, bowels, still), grass, domestic waste, dairy waste (salty and sweet lactoserum); production waste: biodiesel glycerin from biodiesel fuel production of rape; juice waste: fruit presser, berry presser, vegetable presser, grape husks, sea weeds; starch and treacle waste: fiber and syrup, potato treatment waste; and potato chips production waste: peelings, skin, rotten tubers, coffee pulp.

Biogas output depends on the contents of dry substance and the type of raw material used. A ton of cattle manure produces 50 - 65 m^3 of biogas containing 60% methane; 150 - 500 m^3 biogas of various plants with up to 70 % methane. The maximum amount of biogas, namely 1300 m^3 with up to 87% methane, may be produce of fat.

There is a difference between the theory (physical possibility) and the feasible gas output. In the 1950-70-s, the technically possible gas output constituted only 20-30 % of the theoretic output. Today, the use of enzymes, artificial raw material degradation boosters (such as ultrasonic or liquid cavitators) has increased biogas output from 60% to 95% for the simplest facility.
Biogas calculations employ the notion of the dry substance (TS) or solid residue (SR). Water in the biomass does not produce any gas.
In actual practice, 1 kg of dry substance produces 300-500 liters of biogas.

To calculate exact biogas output from a specific raw material, lab tests are required. Alternately, one may look up reference data to define the contents of fats, proteins and carbohydrates. The calculation of the latter should also define the percentage of quick-rotting residue (fructose, sugar, sucrose, starch) and recalcitrant residue (for example, cellulose, hemicellulose, xylogen). Upon defining the contents of substances, one can calculate gas output per each substance separately and then add those.

Landfill gas is a biogas resulting from anaerobic degradation of organic municipal waste.

Waste decomposes due to bacteria from two large families, acidogenes and methanogenes. The acidogenes primarily degrade waste into volatile fatty acids. Methanogenes process the volatile fatty acids into methane CH_4 and carbon dioxide CO_2. As a result, landfill gas consists approximately of 50 % methane CH_4, 50 % of CO_2, plus insignificant impurities of H_2S and organic matter.

Straight wells are used for producing landfill gas in solid waste landfills. They are evenly distributed around the landfill at 50-100 m intervals between the wells. Their diameter is about 200 - 600 mm, whereas their depth is dependent on the landfill depth and may be several dozen meters. The wells are drilled with the use of regular drilling machines as well as specialized equipment producing large diameter wells. The choice of equipment is normally determined by economic reasons.
In expert's opinion, well drilling in Russian landfills should rather use auger drilling. It is comparatively cheap and easily available, since it is widely spread in soil surveying. With this type of drilling, the maximum diameter of wells is 0.5 m. However, the construction of such wells in Russia faces certain impediments associated with the inclusion of a lot of foreign matter (metal and concrete structures, machine residues, mechanical residues, etc.) in landfills, which makes drilling more difficult and leads to frequent failures of drilling tools. Practical experience suggests that drilling of 200-300 mm wells (diameter) is relatively easily, whereas they are quite sufficient for landfill gas production.

Well engineering consists of several phases. The first is placing a steel or plastic perforated pipe plugged from the bottom and equipped with a flange joint near the wellhead. Then the tube space is filled with porous materials (e.g., gravel) to be compacted layer-by-layer up to the 3-4 m depth from the wellhead. The last stage is building a clay lock with the capacity of 3-4 m to prevent penetration of air into the well.
Upon the completion of construction, the well head is to be installed. The well head is a metallic cylinder with shutoff valves used for controlling well production and landfill gas composition, and a connection to link the well to the gas line.

On the final stage, a metallic or plastic box is placed on the well head to prevent trespassing.
The following ways of landfill gas disposal are used worldwide:

- flaring that helps remove odors and reduce fire risks on the landfill. The energetic potential of landfill gas is not used economically;
- direct incineration of landfill gas to produce heat;
- using landfill gas as fuel for gas drives to produce electric energy and heat;
- using landfill gas as fuel for gas turbines to produce electric energy and heat;
- raising methane contents (enriching) to 94-95% in order to further use landfill gas in regular gas networks.

Russia accumulated up to 300 million tons of organic waste per year on the dried basis: 250 million tons in agriculture, 50 million tons as domestic waste. This waste could well be a source of biogas. The potential yearly volume of biogas produce may reach 90 billion m^3.
Agriculture could potentially produce about 58 million m3/year of biogas, which may achieve 0.015 % of overall gas consumption nation-wide.[10]

Two landfill gas projects were included in 35 Russian projects publicized on the UNFCCC web-site, including landfill gas disposal at *Khmetievo* and *Dmitrovsky* landfills in Moscow.[11] Based on IPCC standards, the rated volume of wastes for Russia is 0.93 kg/person/day, which makes 338.45 kg/person/year, which corresponds to 130 million cubic meters/year or 30 million tons/year.

Pilot landfill gas disposal projects include biogas production projects at *Dashkovka* landfill in Serpukhov District, Moscow Region, and at *Kargashino* landfill in Mytishchi District, Moscow Region. At present, both facilities (Serpukhov, Mytishchi) work in test mode with the output of 80 kW/h of electric energy each. The operation experience showed that 1 m3 of biogas may produce 1.3-1.5 kW of electric energy in Russia.
That means that the full use of biogas from landfills may produce 260 - 300 kW of electric energy per hour, which corresponds to the production of 2500 MW of electric energy per year.

In Russia, dumps and landfills occupy the area of about 2,000 square kilometers, and more than 80 billion tons of waste has been accumulated recently.

According to IPCC estimates, Russian dumps emit 1.1 million tons of pollutants which is about 2.5% of the planetary amount.
This leads to a conclusion that landfill gas production potential in Russia is equally high.
However, there are certain difficulties associated with the distribution of energy produced from landfill gas. First of all, it is connected with non-existent legislation as to the transformation of “alternative” electric energy, as well as laws binding consumers to buy alternative energy. This detains the vast spread of the technology in Russia. In present conditions, the use of landfill gas for landfill purposes or for local consumers is more realistic.
However, the country still does not have a national program stimulating the installation of biogas facilities, let alone major biogas plants.

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[10] Global Tendencies in Biofuel Production and Consumption, N.A. Gorbunova, A.N. Ivankin (www.solidwaste.ru)

[11] Environmental Systems, May 2005

In 2009-2010, biogas production and disposal followed by the production of heat, energy and motor fuel is planned to be organized at Moscow Regions landfills of *Iksha*, *Khmetievo*, *Timokhovo*.[12]

6.2 Thermal Treatment

Common knowledge is that for cities with more than 0.5 million residents thermal solid waste sterilization methods are more reasonable. There are three ways of thermal waste treatment and recovery: *layer-by-layer burning of original (unprepared) waste in incineration boilers*; *layer-by-layer or chamber burning of specially prepared waste* (freed from ballast fractions) in energy boilers together with natural fuel or in cement furnaces; *pyrolysis of previously prepared or previously unprepared waste.* Despite the heterogeneous composition of solid waste, it may be seen as low grade fuel (a ton of burned waste produces 10001200 Gcal). Not only does thermal treatment sterilize waste, but it also produces heat and energy, as well as segregated ferrous scrap. The entire burning process can be automated, thus the number of staff can be noticeably reduced with its functions boiled down to purely managerial. This is specifically important with regards to the fact that the staff has to deal with such an insanitary material as solid waste.
Layer-by-layer burning of waste in incineration boilers. This sterilization technique involves burning of all incoming waste with no preliminary treatment or preparation. The layer-by-layer burning method is the most widespread and best known. However, burning emits a lot of pollutants, therefore all modern incineration plants have highly efficient solid and gaseous pollutant catches, the price of which reaches 30% of all capital investments into the construction of an incineration plant.
Only 2% of solid municipal waste is burned throughout Russia, and 10% of waste is burned in Moscow.[13]

6.2.1 Incineration Plants

Waste incineration is the most complex and “hi-tech” alternative of waste handling. Incineration needs preliminary treatment of solid waste (resulting in production of the so-called fuel produced of waste). Segregation removes larger objects, metals (magnetic and non-magnetic) from solid waste and crushes it more and more. To decrease polluting emissions, waste is freed from batteries, plastic, leaves. Incineration of non-separated waste is considered highly hazardous. Thus, waste incineration may be just one of the components of an integral recovery program.

Incineration reduces the waste weight approximately 3 times and removes some features, such as odor, toxic exudates, bacteria, attractiveness for birds and rodents. It also results in additional energy potentially used for producing energy or heat.

Even in the early 1990-s, up to 7 incineration plants worked in Russia. They were located in Vladivostok, Sochi, Pyatigorsk, Murmansk and Moscow. The primary purpose of incineration was to decrease the volume of waste prior to filling. Ash and slag transportation was up to 30% of the entire amount of burned waste. At present, the incineration plants in Moscow and Murmansk still work.
The major part of plants was equipped with foreign equipment. Only the plant in Vladimir had three boilers manufactured domestically. An important process defect in all plants was non-existent gas and ash treatment, while emitted gas and ash contained heavy metals and dioxines that are impossible to catch by electric filters.

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[12] Estate Market Indicators, March 12th, 2008

In Russia, there is no batch production of incineration plants. Among the social, environmental and economic aspects of waste incineration is the fact that the construction and operation of such plants is exactly what municipal budgets cannot afford, therefore it should be loaned or performed by private companies. In many cases, a company that owns an incineration plant uses its best efforts to sign an agreement with the town. Such an agreement would normally stipulate obligatory shipment of a specific daily amount of solid waste with set quality. Such conditions make recycling or composting programs virtually impossible. Other major changes in the methods of recovery become impossible, too. Thus, construction of an incineration plant must be thoroughly coordinated with other aspects of waste management programs, and this alternative should be turned to only after all other programs have been planned.

At present, about a dozen of incineration plants operate in Russia. In Moscow, three such plants are operable.

As of early 2008, the aggregate capacity of Moscow thermal treatment (incineration) plants was 740 thousand tons/year. This is more than a quarter of domestic solid waste in Moscow. [14]

Incineration Plants in Moscow:

Plant No2.
Solid waste thermal treatment plant in North-Eastern Administrative District.
Location: Altufievo Highway, North-Eastern Administrative District
Primary equipment manufacturer: *CNIM* (France)
Receiving capacity: 130 thousand tons/year
Upon fractioning and metal separation, the slag resulting from incineration (19.6 thousand tons/year) will be reused as filler in manufacturing construction and fire-resistant products. Upon neutralization, caught ash (8.7 thousand tons/year) will be used as artificial construction material.
Energy released upon the incineration will be used in steam boilers producing up to 15 tons of steam/hour at the pressure of 1.3 MPa and temperature of 240℃. The produced steam will be used in an energy complex under construction which will provide the plant's requirements in heat (54.3 thousand Gcal/year) and electricity (15.3 x106 kW.hour/year). Electricity is produced by three turbogenerators manufactured in Kaluga with the capacity of 1.2 MW each. Steam is used for the in-house needs.
Upon commissioning and reaching the rated capacity, the problem of waste disposal in North-Eastern District will be completely resolved; the dumptruck fleet requirements will go down; fuel consumption will reduce, which will improve the environmental conditions, respectively.

6.2.1.1 Plant No3

Solid waste thermal treatment plant in Southern Administrative District.
Location: 22a, Podolskikh Kursantov St., Southern Administrative District
License No 003754/002
Commissioned in 1983
Equipment manufacturer: *Volund* (denmark)
Receiving capacity: 200 thousand tons/tear
Area: 3.5 ha
A new technology of fluid bed incineration with combustion temperatures of 1300 - 1500℃ is planned for future use. Such temperatures enable slag melting, which is extremely important for further ash and slag disposal. As of now, such low capacity facilities have been successfully tested with waste that was preliminarily cleared from large ballast fractions.

[14] www.irn.ru March 12th, 2008

6.2.1.2 Incineration Plant Rudnevo

Solid waste thermal treatment plant in Eastern Administrative District
Location: industrial zone Rudnevo, Eastern Administrative District
Primary equipment manufacturere: *Helter* (Germany)
Receiving capacity: 250 thousand tons/year
Upon commissioning and reaching the rated capacity, the problem of waste recovery in Eastern District will be completely resolved; the dumptruck fleet requirements will go down; fuel consumption will reduce, which will improve the environmental conditions in town, respectively. In addition, the load on the few existing landfills around Moscow will decrease by 250 thousand tons/year, which will also impact positively the environmental situation in the adjacent locations.

6 new incineration plants have been planned to build and two old incineration plants (in Altufievo and Rudnevo) were planned to be remodelled by 2012(15). (An Edict regarding the construction of six new incineration plants by 2015 was signed by Mayor of Moscow Yuri Luzhkov in April, 2008). According to the official plans, incineration plants that would be built by 2012 in Moscow would burn 3.5 million tons of waste per year instead of 740 thousand tons burned by the three existing plants. The existing capacities are not enough. Municipal waste in Moscow exceeds 5 million tons/year, and industrial waste exceeds another 17 million tons.

According to the plans, there will be 10 incineration plants in Moscow located in all industrial zones except the central zone:

1. 25, Vagonoremontnaya St., *Korovino* industrial zone (Northern Administrative District)
2. 33a, Altufievo Highway, *Altufievo Highway* industrial zone (North-Eastern Administrative District)
3. 22a, Podolskikh Kursantov St., *Biryulevo* industrial zone (Southern Administrative District)
4. 579 Designed Lane, *Rudnevo* industrial zone (Eastern Administrative District)
5. 6/6a Ostapovsky Lane, *Yuzhny Port* industrial zone (South-Eastern Administrative District)
6. Stroitelny Lane, *Trikotazhnaya* industrial zone, 43 (North-Western Administrative District)
7. 28/45 Ryabinivaya St., *Ochakovo* industrial zone (Western Administrative District)
8. *Tyoply Stan* industrial zone (South-Western Administrative District)
9. Zelenograd, *Vostochnaya-Kommunalnaya* industrial zone (Zelenograd Administrative District)
10. Zelenograd, *Malino* industrial district (Zelenograd Administrative District)15

Capital investments for the construction of these 7 facilities will constitute RUR 60 billion. However, as of August 12th, 2009, the Government of Moscow declined the construction of new incineration plants due to crisis. This project seems to be postponed until not earlier than 2025 [16]
So, the problem of waste disposal in Moscow is still not resolved.

In St. Petersburg, there are no large incineration plants for solid municipal wastes. Therea are only 3 waste water sediment incineration plants are operable: waste water sediment incineration plants located at the waste water treatment stations (see Chapter 10).
St. Petersburg development plans include erection of two incineration plants in Leningrad Region, in Yanino (located approximately 3 km from Petersburg border) and in Mga (located approximately 39 kilometers from town). There will be two more plants on St. Petersburg territory: one at Volkhonskoye Highway (close to Strelnya, approximately 23 kilometers from the city center), and another one on *Novoselovo* landfill (19 kilometers from the city center).
Despite prevailing of incineration under other waste treatment techniques, the incineration capacity is not sufficient to treat all the appropriate wastes in the Russian Federation.

[15] http://www.stringer.ru, 28 February 2008
[16] www.lenta.ru, August 12th, 2009, Rossiyskaya gazeta

6.2.2 Waste Pyrolysis

Solid Waste Pyrolysis

There are projects regarding domestic waste disposal with the use of pyrolysis. Difficulties with the pyrolysis of tires, plastic and other organic waste do not root in pyrolysis per se, since this method is not different from thermal treatment of other solid materials. The problem is that the majority of waste contains phosphorus, chlorine and sulfur. Oxidized sulfur and phosphorus are volatile and hazardous for the environment. Chlorine actively reacts with pyrolitic organic products to produce stable poisonous compounds (e.g., dioxines). Separation of such compounds from smoke is not at all a cheap process and it is difficult as well. The problem with treatment of used automobile tires and used industrial rubber goods is a significant environmental and economic issue in developed countries world-wide. Non-renewability of oil dictates the need for using secondary resources with maximum efficiency, i.e. instead of piles of waste we could have a new Regional industry, that of commercial waste treatment.

Tires and polymers are valuable raw materials. Their treatment with the help of low temperature pyrolysis (less than 500℃) produces liquid hydrocarbon fractions (synthetic oil), carbon residue (carbon black), steel wire cord and combustible gas. At the same time, burning of 1 ton of tires will release 270 kg of soot and 450 kg of toxic gases into air.

Industrial Waste Pyrolysis

Oxidizing Pyrolysis

Oxidizing Pyrolysis is thermal degradation of industrial waste via partial burning or immediate contact with fuel combustion products. This method is good for sterilization of many types of waste including those “bad” for burning or gasification: viscous, slurry waste, wet sediments, plastic, highly ashed slag, soil polluted with heavy oil, soil polluted with lubricants, generally polluted soil, and heavily dusty waste. Besides that, oxidizing pyrolysis is good for waste containing metals and their salts that melt and ignite at regular burning temperatures, as well as for used tires, crushed cables, car scrap, etc. The oxidizing pyrolysis method is a prospective way of solid industrial waste disposal and waste water disposal.

Dry Pyrolysis

This thermal treatment technique permits highly efficient sterilization of waste and its subsequent use as fuel or raw materials for chemistry, which propels the development of low-waste and waste-free technologies and the rational use of natural resources.

Dry pyrolysis is the process of thermal decomposition with no penetration of oxygen. The output is the pyrolysis gas with a high combustion temperature, a liquid product and a solid carbon residue.

Depending on the pyrolitic temperature, there are [4]:

1. Low-temperature pyrolisis or semicoking (450 - 550° C). This type of pyrolysis is characterized with the maximum liquid and solid (semicoke) residue output and the minimum pyrolysis gas output with the maximum combustion temperature. This method is good for producing the primary resin, a valuable liquid fuel, and for processing scrap rubber in monomers that are raw materials for reproducing rubber. Semicoke can be used as energy and domestic fuel.
2. Middle-temperature pyrolysis or middle-temperature coking (up to 800° C) gives way to more gas with a lower combustion temperature and a lower liquid residue and coke.
3. High-temperature pyrolysis or coking (900 - 1050° C). It is characterized with the minimum output of liquid and solid products and the maximum output of gas with the minimum combustion temperature, a high-quality fuel good for far trips. As a result, the amount of resin is decreased, and so are the contents of valuable light fractions therein.

It is one of the most promising methods of solid organic waste disposal and segregation of valuable components on the today’s stage of scientific and technology development.

The benefit of pyrolysis as compared to immediate waste incineration is, primarily, its non-polluting effectiveness. Pyrolysis can treat the components that are difficult to recover, such as tires, plastic, used lubricants, sediments. Pyrolysis does not leave any biologically active substances, thus underground storage of pyrolysis waste does not harm the environment. The resulting ash has high density, which dramatically reduces the amount of waste to be stored underground. Pyrolysis does not restore eliquate heavy metals. Another benefit of pyrolysis is that the resulting products are easy to

store and handle. Also, the equipment may be of low capacity. On the whole, the process requires fewer capital investments.
Pyrolysis facilities function in Denmark, the Netherlands, Japan, Germany, the US and other countries

In Russia, the first test non-composting pyrolysis facility with the capacity of 30 thousand tons/year was designed by *Giprokommunstroy* Institute and *LenNIIGiprokhim* based on the procedures developed by *VNIINeftekhim*. The facility was part of Leningrad Mechanical Waste Treatment Plant. The facility comprised three major parts: the preparation section, the receiving section, and the crushing section.
In Russia, the fraction of waste to be treated via pyrolysis is very low due to the unavailability of facilities and unpopularity of this treatment method.

<u>Main market players</u>
The main companies operating on the market of thermal treatment techniques:
Domestic companies: EMAlliance, GUP "MosvodokanalNIIghjekt", GUP "Mosecostroy"
Foreign companies: Keppel Seghers, Austrian Energy and Environment, CNIM, Steinmuller Engineering, AMIG.

6.3 Special Waste Treatment Techniques

Special Waste Treatment Methods are the methods of treating some kinds of waste at specialized plants. Some of those methods see in the next chapter.
In practice, integrated waste treatment techniques are utilized in waste treatment facilities. Such facilities are spread in the RF but in much less extent than in the European countries.

However, the positive trend has started to pick up: e.g. in some of the Regions of waste treatment facilities construction projects are included in the municipal development programs, some of the projects are still in a very initial stage of implementation: with no clear budget, financing, contractors etc (Krasnoyarsk, Nizhniy Novgorod, Omsk), other protects have been recently already implemented e.g. in Novokuznetsk (2009), Sochi (2008), Novosibirsk (2004),

Note, that so far in the RF the number of projects on waste treatments which are being claimed is significantly higher than those which are actually being implemented.

Projects on construction of waste treatment facilities are going to be implemented in Moscow, Saint Petersburg, Astrakhan, Arkhangelsk, Sochi, Novosibirsk Region, Stavropol krai (See in details in Chapter 11).

Mostly foreign and to less extent domestic companies are operating on the market of waste treatment facilities construction and design e.g. Construction company "MVK-Story" (RF), HGMA Wulf GmbH (Germany), Key Industry Engineering Group (Czech), ILF-Engineering (Austria), ASA International GmBH (Austria), Advanced Recycling Technology (UK), Dual System Deutschland (Germany), MCI (UK), GFA Envest (Germany), FFK (Germany) and Remondis (Germany).

7 Recycling

7.1 General information

Treatment (in other terms, (waste) recycling) is the reuse or recycling of production waste or garbage. The most usable technologies are secondary, advanced etc. waste processing of such materials as glass, paper, aluminum, asphalt, iron, fabric and different types of plastic.
In the USSR, waste management was a big issue. Uniform milk bottles, beer bottles, soft drink bottles were in use, and glassware collection centers were scattered all over the country. School students and young pioneers were engaged in waste paper collection and scrap metal collection. The industrial use of precious metals was rigorously accounted for, particularly, in electronics.
Today, legal regulation of waste management in the form of secondary material resource management is non-existent. Federal Law “Industrial and Domestic Waste” does not define such basic notions as “secondary material resources” and “secondary raw materials”. Also, legal regulations governing waste management in the form of secondary material resource management are non-existent.
Among current standards, an important document is the Sanitary Guidelines for Collection, Storage and Primary Treatment of Secondary Materials (dated January 22nd, 1982).

As of today, the share of recycling in the Russian Federation is less than 3%[17]
Table 7.1 below shows the actual recycling norm as % of the respective type of waste[18]

Table 7.1: Structure of Recycling in Russia and Western Europe

No	Component and type of package recovered	Actual recycling norm as % of the respective type of waste	
		Western Europe	Moscow
1	Paper (bundles, bags, pack paper)[19]	10-15%	10-20%
2	Cardboard (boxes, panty liners, disposable cardboard tableware)	40% (Ireland) 80% (Netherlands)	50-60%
3	Glass (jars, bottles, flasks, vials)	48% (Finland) 93% (Austria)	60-70%
4	Aluminum (foil, soft drink cans, spray bottles)	15% (Denmark) 90% (Sweden)	95%
5	Tin (cans, cans from paint, wrapping tape)	5% (Ireland) 80% (Netherlands)	3%
6	Plastic (soft drink vials, technical fluid vials, film and bags, disposable tableware, disposable tare, PVC packing forms, packing cord and packing tape)	15% (Denmark) 36% (Germany)	5%
7	Timber (disposable plywood and wooden cases and pallets)	Out of use	15-20%
8	Cotton fabric (disposable bags, packs)	Out of use	5-7%

17 Petersburg News, March 2nd, 2006
18 [Waste Recycling No1 February 2006, Waste Recycling Industry: Problems and Prospects].
19 Newspapers and magazines are out of this list since they are not package materials

In the view of experts, up to 10% of domestic waste and up to 50% of industrial waste may be well recycled into secondary raw materials using the existing technologies. However, this process is developing very slowly in the historic perspective.
Many practitioners believe that the primary problem of waste management is the defects in federal and Regional legislation. However, numerous positive changes in this domain have occurred.
An important event in waste business has been the formation of Regional associations and unions. Their acts aimed at the organization of Regional production systems and protection of entrepreneurial rights promote prompt addressing of environmental protection issues by the local authorities, which also includes the interests of the general public. For Russian waste management entrepreneurs, landfilling and intermediary services are the most appealing today.

Profit is primarily generated from waste treatment paid for by the industry (for example, mercury lamp disposal), or recycling for reuse (for examples, aluminum cans, PET-bottles). Many types of recycling are unprofitable due to cancellation of tax benefits and absence of clear business criteria in this industry. Another reason is that waste does not produce the secondary raw materials; it only produces raw materials for secondary raw material production. And these raw materials are low-quality materials where the production costs are way above the cost of producing fresh high-quality raw materials. Only several fractions segregated from the waste inflow have primary market niches (aluminum, PET). Of special note is the fact that it is not waste treatment that is unprofitable, it is waste collection and delivery to treatment plants that is so. Unlike Europe, Russian package cost does not include the loan rate. Therefore, foreign investors willing to build treating factories in Russia (and they are numerous) face the problem of financing the material collection and delivery.

Another specificity of waste treatment industry is that it has been traditionally budgeted on all levels, thus being unprofitable as-designed. Profitability may be achieved by including secondary material production capacities and trading companies in Regional sanitary cleaning systems. In addition, there is no information system in the field of environmental entrepreneurship. It frequently happens that a Regional plant processes the accumulated waste within just 2-3 years and stands still, whilst businesses in other localities have difficulties getting rid of their waste. This is especially acute for complex waste, such as the waste from chemistry, pharmaceutics and plating industry.

The main problem in secondary materials processing is separation of secondary materials from the remaining garbage (and segregation of different secondary material components). Many techniques can separate waste and secondary materials. The most expensive and complex of those is the extraction of secondary materials from the overall inflow of waste on specialized plants. Simpler extraction techniques can and should be used, for example, enriching solid waste to increase its energetic value and elimination of undesirable elements prior to incineration. More progressive extraction technologies involve the participation of public: organizing material collection centers or purchasing such materials from the general public; measures enabling segregated waste collection outdoors with the use of special containers or organizing a separate waste collection system on the domestic level.

The secondary material yield at waste treatment plants in Moscow is about 300 tons/year, which is the highest figure nation-wide.[20]

Russia possesses considerable resources of secondary resources. However, its average practical use is only one third. In demand are only high liquid wastes like metal scrap, cullet, polymeric and wooden wastes, class wastes, wastes generating in electro energy production, steel making, chemicals and construction wastes.

[20] MOSCOW, March 11th, 2008 - RIA Novosti

7.2 Scrap Metal

Recycling of scrap metal is extremely important both economically and environmentally. A look at today's global industrial development and the mass of metal involved in industrial use shows that it is gigantic; therefore the permanent yield of scrap metal is also huge. With this in view, many countries have had the organized metal recycling industries for more than 100 years now. The primary stimuli and benefits of recycling all kinds of scrap metal are:

- Decreased load on metal deposits (greatly exhausted by now).
- Improved environmental situation.
- Reduced fuel consumption for producing key metals.
- Reduced dispersal and diffusion of metals world-wide.

Metal scrap is graded mostly basing on the highest percentage of such and such metal in its composition, or by the predominant economic appeal for recycling.
Non-ferrous scrap and waste are grouped based on the names of metals; by physical characteristics – into classes; by chemistry – into groups and alloy grades; by quality parameters – into sorts.
Secondary ferrous metals are classed in two classes by the contents of carbon, in two categories by the presence of alloying elements; into 28 types by quality parameters; and in 67 groups by the contents of alloying elements. In business, production and trade, letter designations of metal scrap kinds and groups are used. Such letter designations were adopted by USSR GOST (National Standard).

- Ferrous scrap (ferrous metal scrap):
    - Waste iron: chips, scale, foundry waste, overage products.
    - Cast iron scrap: chips, foundry waste, etc.
    - Stainless steel waste: machining waste, used products.
- Pursuant to **GOST 2787-75**, secondary ferrous metals (ferrous scrap) are grouped:
  а) by contents of carbon – in 2 classes:
- steel scrap and waste;
- cast iron scrap and waste;
- б) by presence of alloying elements – in 2 categories:
- - A (carbon waste) and
- - B (alloyed).

- Non-ferrous scrap (non-ferrous metal scrap):
    - Waste copper: machining waste and other waste.
    - Copper alloy scrap: copper alloy waste (brass, bronze, tombac)
    - Aluminum scrap: all types of aluminum waste and aluminum alloy waste.
    - Magnesium scrap: airplane metal scrap.
    - Titanium scrap: airplane and boat scrap of titanium alloys.
    - Lead scrap: battery and cable scrap.
    - Rare-earth metal scrap: complex alloy scrap and hi-tech waste.
    - Semiconductor scrap: electronic industry waste.
- Precious scrap (precious metal scrap):
    - Gold scrap: overage jewelry of gold alloys, chemistry equipment, catalysts.
    - Silver scrap: overage jewelry, silver and zinc batteries, catalysts, etc.
    - Platinum scrap: overage jewelry, chemistry equipment, crucibles, catalysts, electric heaters, etc.

The scrap metal collection and processing market is very well developed in Russia, though it is prone to regular fluctuations due to various government acts.
Globally, the metal scrap recovery problem is resolved integrally: the plants handle both ferrous and non-ferrous scrap. Historically, ferrous and non-ferrous metals have been recovered separately in Russia.
The generation sources of scrap in Russia are shown in the table below.

Table: 7.2: Scrap Resource Structure: Generation Sources, Russia, %.[21]

Scrap generation sources	1990	1995	2000-2005
Production waste	44	37	26-34
Metalworking	19	17	14-18
Depreciation scrap	34	42	46-52
Other	3	4	4-5

In 2007, metal scrap consumption was 270 thousand tons in Russia. Compared to the same period of 2006, the index grew up by 20%. Automotive recycling increased considerably. These trends propel the increased demand for metal scrap processing equipment.
As of August 2009, the price for stainless steel scrap was USD 1750/ton in Moscow. [22]
Prices for non-ferrous scrap are shown in the table below.

Table 7.3: Prices for Ferrous Scrap (2009)[23]

Type of scrap	Price	Region
Purchase		
Quick-speed scrap R6M5, R18	USD 1900 (ton)	Moscow
Used rolled metal	RUR 6000-10000 (ton)	Samara Region
Quick-speed scrap	USD 1500 (ton)	Saratov Region

<u>Processing Companies</u>
In Russia, the main metal scrap processing companies are:

- *Profit* JSC (Urals), as part of mining company *MMK* JSC, *Vtorchermet* JSC (entire North-West of Russia) - since 2007.
- *Vtorchermet* JSC, as part of Russian mining company *Severstal* JSC),
- *Vtormetproekt*, *Vtortsvetmet* JSC (Moscow and Moscow Region);
- *Maxi-Scrap Siberia* LLC, *Obyedinenie Vtorchermet* JSC (Novosibirsk Region);

Domestic manufacture of metal scrap processing equipment is barely developed, foreign companies occupy about 90% of the market, and such trend are most likely to survive in the future. The range of domestic manufacturers does not fully meet the market requirements. Crocodile shears and shearing presses are not manufactured in Russia.

Foreign equipment surmounts similar domestic equipment in all respects (except Chinese equipment), but its cost is considerably higher. Due to that, many domestic plants prefer to buy restored foreign machines which are comparable with domestic equipment in terms of price, but are much more efficient in terms of performance.

Experts have observed a recent tendency for the improvement of quality of Russian equipment and reduction of its price, which positively affects the demand. The following segments are defined in scrap metal processing equipment:

- Scrap presses;
- Scrap shears (crocodile shears);
- Shearing presses;
- Shredding machines.

Depending on the material machined, the presses may be baling presses or briquetting presses.

[21] Resource and Environmental Problems of Depreciation Scrap Accumulation as Part of National Metal Fund
[22] www.solidwaste.ru
[23] www.solidwaste.ru

Consumers
The primary consumers of metal scrap are metals companies, the biggest of which are Severstal, Novolipetsk Metallurgy Works (NLMK), Magnitogorsk Metallurgy Works (MMK), Oskol Electric Metallurgy Works (OMK), Volzhsky Pipe Plant (VTZ), Taganrog Metallurgy Works (TMK), *Kransy Oktyabr* Metallurgy Works (Volgograd) and some others.

Russia is a major metal scrap exporter. The major market outlets are Turkey (one third of the entire export), then Spain, Greece, Italy – together 25 %, and then China and Korea – 16 %.

7.3 Plastic

According to Russian Ministry of Industry and Energy, about 700 thousand tons of polymeric waste suitable for recycling and use as secondary materials are generated in Russia annually(reported in 2007) This number is well understated, since the production (and disposal of, respectively) of PET-bottles alone exceeds 450 thousand tons/year.
Of all plastic manufactured, 41% is used for packaging, of which amount 47% is used for packing food. Convenience and safety, low price and an appealing appearance are the prerequisites of the accelerating use of plastic in package manufacturing. Packaging of synthetic polymers, which makes 40% of overall domestic garbage, is basically “immortal”: it does not degrade. Thus, the manufacture of plastic package is linked to waste generation in the order of 40…50 kg/year per person.

Classification of plastic waste
Reworked plastic is:
- PET — Polyethyleneterephthalate
- PVC — Polyvinylchloride
- PP — Polypropylene
- HDPE — High-density polyethylene
- HPP — High-pressure polyethylene
- PW — Polyethylene wax
- PA — Polyamide
- ABS — Acrylonitrile butadiene styrene
- PS — Polystyrene
- PC — Polycarbonate
- PBT — Polybutylene terephthalate

It is assumed that by 2010 the polymeric waste in Russia will make more than a million tons, whilst the percentage of reusing such waste is still negligible. With regards to the specific features of polymers (they are non-degradable and non-corrosive), the polymer recovery problem is mainly an environmental issue. The overall volume of buried solid waste in Moscow Region alone is about 3.5 million tons per year. Just 5…7% of the entire weight of waste are recycled. According to the average content of solid municipal waste the rate of plastic wastes amounts to 4 %, which is equal to 140 thousand tons per year However, the polymeric waste recycling issue is becoming topical not only from the environmentalist standpoint. Given the shortage of polymeric raw materials, plastic waste becomes a powerful resource of raw materials and an energy resource.

At that, the resolution of environment problems needs significant investment. The cost of plastic waste treatment and disposal is 8 time higher than the cost of most industrial waste treatment, and almost 3 times higher than the cost of domestic waste disposal. This is due to the specific characteristics of plastic which greatly enfeeble or deny the known disposal techniques.
The use of polymeric waste will considerably reduce the utilization of fresh materials (primarily, oil) and electric energy.
The problems associated with polymeric waste recovery are fairly numerous. They are specific but not insoluble. However, no solution is possible without the organization of collection, sorting and primary

treatment of depreciated materials and products; without pricing the secondary materials that would encourage businesses to recycle them; without the efficient recycling techniques for the secondary polymeric materials and quality-improvement methods; without establishing a product mix to be manufactured of secondary polymers.[24]

Russian economy has a relatively low level of polymeric material production and consumption compared to the developed economies. With regards to using plastic as structural material per GDP unit, Russia is 5 times slower than the US (20 times per aggregate yield), and in terms of using plastic as packaging materials per person it is approximately 7-10 times behind.

However, polymeric waste generation in Russia totals to a significant value of about 900 thousand tons/year, which initiates numerous environmental problems, since the average level of polymeric waste collection and recycling is no more than 13%.

According to the estimates by National Research Center for Resource and Waste Management (NICPURO), in the overall polymeric waste structure

- polyethylene waste is 34%,
- PET - 20.4%,
- laminated paper - 17%,
- PVC – 13.6 %,
- Polystyrene – 7.6 %
- Polypropylene – 7.4 %

The polyethylene waste is best collected and recycled (20%); 10% of PVC waste is recycled. Recycling of the polystyrene waste constitutes 12%, polypropylene – 17%, PET – 12%. The laminated paper waste is practically non-collectible and non-recyclable.

The following polymeric wastes are recycled: synthesis and thermoplastic processing waste, and consumption waste in the form of polymeric film, polymeric film bags and other polymeric film packages, plastic cases, non-polluted fuel cans and barrels, pipes, tableware, a vast range of plastic products and parts of overage complex domestic and industrial appliances, including cars, radio-electronic devices.

The main products manufactured of polymeric waste (or with the use of polymeric waste) are: pipes (mostly, drain pipes), cases, buckets and other vessels, film, wheelarch liners and other parts for cars, different products of non-food use – of polyethylene waste; floor coatings (including linoleum) – of PVC waste; furniture accessories, different industrial and domestic products, facing tiles – of polystyrene and co-polymers; exported granulated material, mylar fiber for textile industry, packaging film – of PET waste.

Science-intensive methods of recycling polymeric waste, such as pyrolisis of polymeric waste producing valuable components, cannot make their way into the industry.

Polymeric waste is treated, primarily, with the same equipment (domestic and foreign) as fresh materials. Domestic equipment is in more demand since it is 5-10 times cheaper than foreign equipment, though its specifications are often less efficient. Some equipment (not manufactured domestically) is exported from abroad, mostly from Asia. This includes automatic molding machines and polymeric tare extruders.

The economic conditions for recycling polymeric waste in Russia are characterized by fundamental differences rooting in the demand for products made of waste, the existing collection practices and recycling practices employed for various wastes, which practices primarily depend on economic requirements. To generalize, all wastes can by divided into three groups:

[24]www. Polimech.com

- high quality materials of non-polluted and non-mixed waste, which are in high demand, since their recycling is reasonably profitable: clean waste of homogenous polyethylene, PVC, polystyrene, polyamide, PET, high-grade waste paper, dry clean timber in the form of sawdust, chips, pieces;
- secondary middle quality materials, which are essentially the waste of the same materials including a reasonable amount of garbage and impurities, or large pieces needing crushing (ingates), or sorting, or disaggregation, etc. As of today, this type of secondary materials may include worn tires with textile cords. Recycling of such waste is unrewarding or almost non-profitable. The distribution of products manufactured of such waste needs additional distribution measures, for example, at the expense of tax benefits or municipal assignment;
- barely recyclable multicompound waste and heavily polluted waste: package of complex compounds, worn tires with metal cords. This waste can be recycled only upon additional financing, or based on financing the part of recycling costs by the supplier. For example, recycling of worn metal cord tires becomes profitable if the supplier covers the part of costs in the order of RUR 50-75 per ton.

The primary trends in polymeric waste recycling in Russia are:

- manufacturing market products of secondary waste, including market products for export (ground flakes, agglomerate, granulated material) of polyethylene, PVC, PS, PP, PET, mylor fiber;
- manufacturing traditional industrial and domestic products (completely of waste or in part) via casting, pressing, extrusion;
- manufacturing material-intensive products non-manufacturable of fresh materials only, including the use of mixed waste or compounded waste (compounds of polymers with waste paper, timber, textile): wood and plastic slabs, planks, paling, supports.

All crucial problems that detain the collection and recycling of the polymeric waste in Russia can be formulated thus.

1. Non-existence of technical standards stipulating the acceptable quality of secondary materials produced of polymeric waste. For instance, the selective waste collection system is also non-existent. There is no labeling system for polymers. Secondary materials certification centers have not been organized.

Thus, the marketed secondary materials do not have the respective certificates of quality and may contain garbage and metallic impurities, as well as other polymeric fragments.
To resolve the issue, some large Russian towns try to organize selective waste collection in residential areas, introduce solid waste sorting prior to burial (depositing) in order to extract useful reusable components (Moscow, Moscow Region, St. Petersburg). In order to provide help to Regional authorities, the development of typical waste collection procedures in towns and other communities was organized on the federal level in 2002.

2. Low competitiveness of products manufactured using waste. The quality of products using secondary materials is invariably lower compared to the quality of products made of fresh materials, with price reduction being insignificant. This demonstrates the incompliance of such products with the basic market criterion of “cost-effectiveness”.
This situation chiefly results from two factors: the objectively lower characteristics of recycled waste compared to fresh materials and incremental costs of preliminary preparation of waste for use as secondary materials, particularly, for collection, handling, sorting, washing, crushing. For polluted and mixed waste, such preparation costs may exceed the cost of fresh materials. The increase in collection and recycling cost is also propelled by the vast use of hand labor in collecting and sorting waste; use of mostly foreign (i.e. more expensive) equipment; the permanent growth of energy costs; high taxes and numerous “fees” levied on the entrepreneurs.

Due to these factors, only clean and non-mixed waste is being collected and recycled, which helps save on preparing waste for the use of the secondary material, on the one hand, and helps provide the acceptable quality of finished products, on the other hand.

Pursuant to current Russian law, the organization of waste collection and recycling is a responsibility of local authorities. However, the measures to boost the process do not provide the collection and recycling of the dominant portion of waste.

3. No economic environment for collecting and recycling the dominant portion of polymeric waste. According to NICPURO estimates, more than two thirds of Russian polymeric wastes do not have good commercial opportunities for recycling, since the cost of collection, preparation, handling and subsequent recycling in free market conditions cannot have sufficient returns from the sales of secondary materials produced of such waste, or products manufactured using such waste. As a rule, local authorities that are in charge of collecting and recycling waste pursuant to the Industrial and Domestic Waste Law have no finance to subsidize such acts. What is objectively necessary are additional financial tools and federal support.
The experience of developed economies proves that the implementation of the "polluter pays" principle needs the introduction of additional environmental taxes, such as payment for the use of package, loan rates, payments to recompense the costs of collection and recycling of barely recyclable waste. Therefore, the key problems associated with the collection and recycling of polymeric waste in Russia have commercial rather than technical nature. Russian market offers an immense variety of equipment (both domestic and foreign) for collection, recycling and preparation of basically all polymeric wastes, the more so that the majority of such machines are used primarily for processing fresh polymers.

The key issues are mostly associated with non-existence of good commercial opportunities for collecting and recycling of polymeric wastes which makes the entrepreneurs:

- use domestic equipment, as it is cheaper, though it is normally worse in technical terms;
- use fresh materials as raw materials, since the profit from the reduced cost of secondary materials is comparable with losses from the reduced quality of finished products and the performance of secondary material recycling equipment;

- refuse from the use of the secondary material due to the non-existent demand for the products manufactured using waste, since they have lower quality and do not comply with the "cost-effectiveness" criterion.

Primary plastic waste recycling plants:

- *TcheslavpolymerDon* LLC (Rostov Region) built in 2008
- *Christie International Ltd* JSC (St. Petersburg)
- Plastic recycling plant (Sverdlovsk Region): test startup was performed in early 2009
- LLC Polymer (Kaluga)
- AngarskPoly-M (Irkutsk Region)
- LLC "Vtorplast" (Vladimir Region)
- LLC "NPL Plastic" (Tver Region)
- LLC "PET Technology" (Moscow)

Plastic Waste Consumers
The primary demand for polymeric waste is generated by fresh material processers, i.e. manufacturers of plastic products, e.g. packages, bags, bottles, tare, plastic pipes, construction materials. Such companies recycle in-house waste and purchase industrial and domestic waste from third parties. Sometimes, they sell in-house waste. However, the yield is not high (rarely more than 50 tons/month). The table below shows prices for plastic waste in different Regions.

Table 7.4: Prices for Plastic Waste as of August 2009

Purchase			Sales		
Waste	Price	Region	Waste	Price	Region
HPP Agglomerate	RUR 16/kg	Ivanovo Region	HPP baled stretch	RUR 9/kg	Voronezh Region
HPP Industrial film waste and package.	RUR 20/kg	Kaluga Region	PP bags, big-bags, battery cases, film.	RUR 5/kg	Kursk Region
Landfilled pressed or crushed PET-bottle, reject (preforms, bottles)	RUR 11/kg	Kirov Region	Soft PVC (slugged)	RUR 7/kg	Lipetsk Region
HDPE (natural, white, crushed)	RUR 20/ kg	Moscow	General purpose modified polystyrene	RUR 28/kg;	Moscow
HIPS-M, natural or white, crushed	RUR 27/ kg	Moscow	Modified polystyrene (colored, black)- up to 40 tons/ month	RUR 29-34 /kg	Moscow
HIPS-M, HIPS, modified polystyrene, polystyrene sulfonic acid waste	RUR 12-27/kg	Moscow	HIPS-M (black)- up to 40 tons/ month	RUR 36.5-39/kg	Moscow
PVC waste	RUR 25/kg	Moscow	HDPE (colored, white)- up to 30 tons/ month	RUR 30-34 /kg	Moscow
HPP film, baled stretch	RUR 8/kg	Moscow Region	PP (white, blue)- 1300 kg	RUR 30/kg	Moscow
PVC: unmarketable, storage balance, waste	RUR 12/kg	Nizhny Novgorod Region	ABS (black, cast)- 2500 kg	RUR 32/kg	Moscow
PET reject performs and PVC profile waste	RUR 15/kg	Novosibirsk Region	ABS (white, cast)- 1500 kg	RUR 34/kg	Moscow
HDPE cases, plastic, any color	RUR 10/kg	Pskov Region	HPP, agglomerate, stretch-film	RUR 16-18 /kg	Moscow

7.4 Rubber

According to the latest statistics, Western Europe produces approximately 2 million tons of worn tires, while Russia produces approximately 1 million tons of tires. The same amount of old rubber is produced by the general mechanic rubber products. Tire and rubber product manufacturers generate lots of waste, a large portion of which is never reused, for example, used butyl membranes on tire works, ethylene-propylene waste, etc.
Due to a large amount of old rubber, incineration still dominates amongst the recovery techniques, whereas the share of material recovery is still insignificant despite the fact that this technique is good for improving the environmental situation and preserving resources. Material recovery has not become popular due to high energy consumption and a high cost of fine rubber powders and reclaimed rubber.

Without economic regulation by the government, tire recovery remains unprofitable. There is no collection, depositing and recycling system for tire and rubber products in Russia. Legal and economic regulation methods have not been developed yet. To a large extent, worn tires accumulate in car fleets or are disposed of in forests or pits. At present, large amounts of annual worn tires are a considerable environmental concern for all Regions of the country.
As practical experience suggests, this task is barely soluble on the local level. A Federal Tire and Rubber Recovery Program has to be developed and approved. The Program should contain legal and economic mechanisms enabling the following scheme for worn tire movement.

Two principles that may become the economic mechanism of tire utilization system are discussed:
1. tire recovery is paid for by the owner – “polluter pays”;
2. tire recovery is paid for by the manufacturer or importer – “manufacturer pays”.

The “pollutant pays” principle is partly implemented in Tatarstan, Moscow, St. Petersburg, etc. Given the realistic level of environmental and economic nihilism on the part of Russian compatriots, efficiency of the “pollutant pays” principle may be considered null.
The country would definitely benefit from the “manufacturer pays” principle. It works well in Scandinavia. In Finland alone its use allows the recovery of 90% of tires.

Crushing Worn Casings and Inner Tubes
The initial stage of producing reclaimed rubber of worn rubber products (casings, inner tubes, etc.) using existing industrial techniques is crushing.
Crushing of tire rubbers partly destroys the rubber network, the value of which (as estimated by the changes in equilibrium swelling), ceteris paribus, is the more, the less the size of resulting rubber crumbs is. However, the rubber chloroform extracts changes only irrelevantly. At the same time, carbon structures are destroyed, too. Crushing of rubbers containing active carbon is accompanied by certain destruction of chain structures across the carbon-carbon bonds. If it is low-activity (thermal) carbon, the number of contacts between carbon particles goes up. All in all, the changes of rubber network and carbon structures of rubbers upon crushing must depend (as is the case of any mechano-chemical process) on the type of polymer, the nature and amount of the filler in the rubber, the nature of cross bonds and network density, and the fineness ration and the type of equipment used. The size of rubber crumbs is determined by the rubber digestion method, the type of rubber crushed and the requirements to end product (reclaimed rubber) quality.
The smaller the crumbs, the faster and more evenly the material destroys. The amount of digested rubber particles is insufficient for the digester, which results in producing reclaimed rubber of more homogenous quality, reducing the amount of refining waste, and increasing the performance of refining equipment. However, as the size of the rubber crumbs decreases, the production costs increase.

Due to that and given the existent methods of rubber crumb production, the use of rubber crumbs with the size of 0.5 mm and less for producing reclaimed rubber is, as a rule, non-recoverable. Since the worn tires contain other materials (apart from rubber), namely, fabric and metal, tire crushing is accompanied by cleaning rubber from such materials. If metal among rubber crumbs is inacceptable,

the presence of fabric residues depends on the subsequent rubber digestion technique and the type of fabric.
Worn rubber products are most frequently crushed with crackers (in Russia, Poland, the UK, and the US) and disk mills (in Germany, Hungary, the Czech Republic). Also, impact crushers (hammer crushers), rotary choppers, such as *Novorotor* facilities, are used. Rubber is also crushed through extrusion based on the destruction of rubber due to uniform compression and fracture.
A machine that passes the crushed material between the rotor and the case wall has been introduced. The crushing effect is enhanced due to the change of the size and form of the opening between the rotor and the case wall with rotor rotating. A comparison of several crushing techniques demonstrated that in terms of equipment performance, energy efficiency, and labor efficiency the highest indices have the cracker scheme, rather than disk mills or rotor machines.
The worn tire crushing technique used in domestic rubber reclamation plants can produce rubber crumbs of tire with fabric cords.

Processor companies
About 50 processors work on the tire recycling market.
Some of those are:
- *Volzhsky Regeneratorno-Shinoremontny Zavod* JSC (Volgograd Region)
- *Tushino Mashinostroitelny Zavod* JSC (Moscow Region)
- *Chekhov Regeneratorny Zavod* JSC (Moscow Region)
- *Tamplier Centr* JSC (Far East)
- *Slansevsky Zavod Polymer* JSC (St. Petersburg)

Equipment
Germany is the most prominent supplier of plastic and rubber recycling machines in Russia – almost 40%. It is followed by Italy – 15.5%, Austria – 8.8% and France – 5.9%. China is on the fifth place – 5.4%.

Consumers
The main consumer of secondary materials made of rubber wastes are producers of car tires, coatings, sound-proofing materials, roofing materials and composition materials.
The special material of rubber processing – a fine fraction of rubber crumb can be used as a sorbent in oil spill response.

Table 7.5: Prices for Rubber Waste as of August 2009

Type of waste	Price	Region
Purchase		
rubber flashes, butyl membranes, rubber reject, rubber waste.	from RUR 2000/ton.	Moscow
Sale		
Rubber crumbs of various fractions	From RUR 10000/ton	Novosibirsk Region

7.5 Glass

7.5.1 Glassware

A stable growth of food glass can be observed in Russia. In 2001–2006, glassware production doubled and achieved 10.2 billion production units. Further production growth is expected to reach 12 billion units by 2009.

Fig 7.1 shows changes in glassware production after 2000. The growth trend is quite obvious.

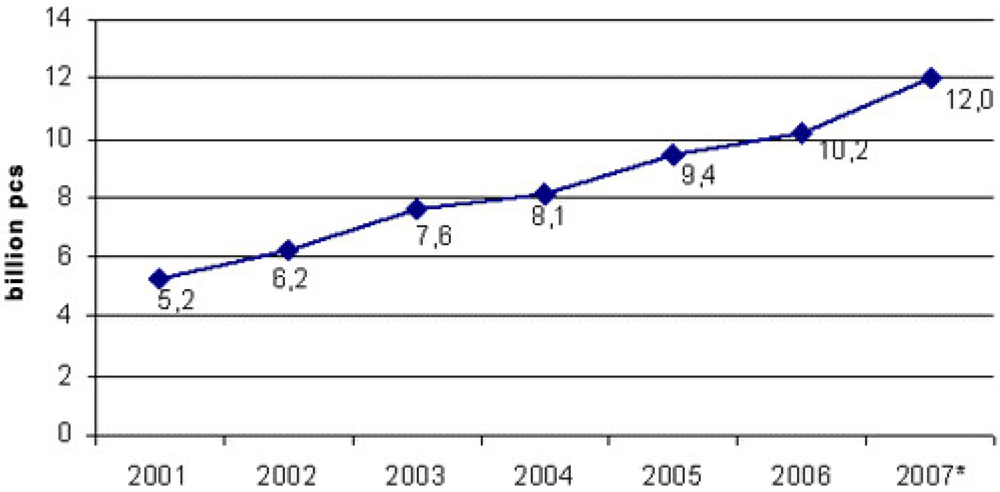

Fig. 7.1: Changes in Glassware Production in Russia

Production growth can be explained by relatively low prices for glass bottles and jars. They are environment-friendly, hermetically sealed. Also, the consumers are quite conservative.
Besides, a stable and intense growth is apparent in manufacturing bottled products, primarily, alcohol. Bottles are widely used for bottling, storage and handling of alcohol (brandy, wine, vodka) as well as low-alcohol and alcohol-free drinks, food, perfumes and drugs.

Glassware recycling means reusing glass for any purpose after its primary content has been eaten or drunk up.
The reuse may be close to the primary function (for instance, storage of whole sour in three-liter jars), or may be very different (decorating fences with empty bottles).

Part of the food industry demand is supplied by secondary glassware. Recyclable tare truly is a national problem since the old Soviet-era system of loan tare return does not exist anymore. The new system based on separate garbage disposal and economic encouragement of garbage collectors works just in a few cities and mostly on paper only. The glassware manufacturers are on the one hand interested and glass collection, yet on the other hand, they are unwilling to pay for that. The Soviet-era bottle disposal system worked only because the price for the bottle was essentially a loan rate: the bottle did not cost one tenth of what was paid for it when the consumer purchased, say, lemonade or milk. Besides, waste (including glassware) collection practices are barely defined in current Russia legislation.
In the USSR, the recyclable glassware constituted 85% of the entire consumption rate. A beer bottle could be reused 12-14 times, and in the context of the increased demand in summer it was reused 20-30 times (with 3-4 time reuse being optimum). Secondary glassware was in active use in late 1990s – early 2000-s, when tare was lacking greatly. In recent years, the share of recyclable bottles dropped to 40%.

Another trend in the domestic glassware market is the diversification of production by breweries and liquor businesses which organize in-house glassware production. This is explained by the desire to insure themselves from delayed deliveries of tare and fluctuations of tare market prices.
Also, exclusive glassware production has accelerated. In addition to a distinguishing label, an individually shaped bottle has become part of the brand name. The bottle has a corporate design showing higher quality of the content.
As in most domestic industries, glassware production equipment is really worn out, and information about the manufacturers' operations is not at all transparent, which makes industry analysis quite difficult.
The bring points to accept glassware are presented in some of the towns of the Russian Federation to certain extent.

Coca-cola Company is considering commissioning of lines for bottles washing and to restart accepting used glass bottles of its factories including factories located in Moscow, Orel, Nizhniy Novgorod (reported 02/2009).
In Moscow, there is a large plant involved in glassware recycling. It is called *MELZ* (Moscow Electric Lamp Plant) and has a subsidiary *MELZ-ECO steklo* involved in cullet collection.

7.5.2 Cullet

The cullet recycling issue has become one of the most urgent recently, and that for a series of good reasons:

- firstly, glassware production requires enormous energy consumption;
- secondly, cullet is one of the most difficult-to-recover wastes (like steel, it can degrade for decades). It is very detrimental environmentally.

According to the statistics from Moscow State Unitary Enterprise *Promotkhody*, up to 160,000 tons of cullet per year is accumulated in Moscow alone.[25]
Of all solid (domestic) waste components, the cullet is one of the traditional easily-processed types of waste. Besides, a considerable amount of glass waste is generated in industries.

As for glass manufacturers, professionally organized glass production is waste-free. Reject and cullet resulting from glass production are reused and remelted.

Pursuant to **GOST 52233-20004** "Glass Tare. Cullet. General Specifications", cullet is sorted in two sorts based on the size of pieces. Sort 1 pieces must be 10-50 mm. Sort 2 pieces are not standardized, but the weight of pieces may not be more than 2 kg. In addition, a five-grade division has been accepted.

Table 7.6: Cullet Classification

Cullet grade	**Cullet color**
BS	Blank
PST	Semi white tare glass
PSL	Semi white plate glass
ZS	Green
KS	Brown

Cullet recycling involves color-based sorting, removal of mechanical impurities and garbage, washing and crushing into the 50 mm fractions.
In cullet recovery, more preferable are the techniques that do not have adverse environmental impacts and do not require large energy consumption. Therefore, such methods as the use of the newest coolant circulation recycling systems, glass melting and filtration via the state-of-the-art “gas” technology, etc. have received recognition. Fluid glass produced after the respective treatment can be used for manufacturing construction materials, structures and goods, such as glass stones, glass units, regular glass panes, insulation materials, etc. The use of cullet reduces energy consumption by 30-40%.

Cullet is an important raw material used for manufacturing certain products (tare, construction materials, etc).

The priority trend in the use of cullet (due to the contents of silica, alkaline oxides, Al2O3 and CaO) is autoclave cementation and non-autoclave cementation. The most promising tendency in the field is the production of foam glass, a highly porous inorganic heat insulation material produced by sintering of fine glass and a blowing agent. The raw material can be cullet or fluid glass made of glass sand, limestone, soda and sodium sulfate. Since cullet is very cheap on Russian market, the use of it results in a considerable reduction of production costs. Since foam glass is almost 100% glass, it has a wide

[25] www.cleandex.ru/ Glass Waste Recycling/ November 07th, 2008

thermal range if employment. It is noncombustible, noncorrosive and shrinkage-free. Therefore the scope of its use is equally wide: from industrial and civil engineering to nuclear power. The global leader in foam glass production is *Pittsburg Corning* (USA). Foam glass is manufactured also in China (*Lanzhou Pengfei Heat Preservation Co.*, Ltd.), Belorussia (*Gomelsteklo* JSC), and since recently, in Russia (*Penosital* JSC, *Express-Stroyindustriya* LLC, *Penostek*).

Processing Companies:
LLC "Energotorgservis" (Nizhniy Novgorod Region)
LLC "Promitey" (Izhevsk)
LLC "PromStec" (Volgograd Region)
JSC "Daimon" (Moscow)
LLC "Greycompany" (Moscow)

Consumers
The primary demand for cullet comes from glass manufacturers. About 120 large and medium glass and glass product manufacturers are active in Russia. Some of them are: *Russain Glass Company*, *Tchagodoshchensky Zavod and Co* LLC, *Velikodvorsky Stekolny Zavod* JSC, *Orekhovo-Zuevo Glass Company* JSC, etc.

The table below shows prices for cullet:

Table 7.7: Prices for Cullet as of August 2009

Type of waste	Price	Region
Purchase		
Cullet BT, grade 1 acc. to GOST	RUR 3150	Moscow
Sale		
electric insulator cullet. From 140 tons/month.	1200	Kursk Region

7.6 Construction Waste

Problems associated with construction waste recycling and recovery are relevant for any growing metropolis. According to independent estimates, well-organized recycling provides considerable reduction of construction cost price, up to 25%.
It has been proven that the use of industrial waste would cover up to 40% demand of Russian construction industry in raw material resources, decrease the production cost of construction materials by 10-30%, and significantly reduce anthropogenic impacts on the environment. It is also noteworthy that waste output and accumulation in Russia grows against the shortage of quality natural resources.[26]

Regulation
In Moscow and Moscow Region, a regulatory system as to construction waste treatment has been approved, and it works well. An example of regulation in the domain of handling construction waste could be a Decree No 1210-RP of the Government of Moscow dated June 17th, 2004. It is entitled

[26] V.P. Knyazeva, V.G. Mikulsky. Assessing Construction Materials Made of Industrial Waste: Environmental Approach (/www.sovstroymat.ru)

"Coordinating Acts of Construction and Demolition Waste Recyclers in Moscow". It sets an authorization system governing the movement of such waste. Permits for moving construction and demolition waste to landfills and authorized dumps can be granted only upon proving the impossibility of recycling (no technology, equipment, production capacities, hazardous waste, etc.) The permit identifies the name of the organization, the transportation organization, the site address, the waste location site, the consignee, the overall amount of construction waste and the hazard rate. In addition, the permit identifies the organization that grants and cancels the permit, and the amount of actual delivery and acceptance of construction waste.

Types of Construction Waste

Demolition of buildings produces the most construction waste. That may be concrete debris mixed with bituminized roofing felt, phenol-based linoleum, three-layered slabs with mineral cotton, chipboard and asbestos-cement slabs, and other materials used for mass construction.

Construction waste is not only what remains upon the completion of works, but also the soil that was dug during excavation or pioneering.

Usage

Secondary materials produced from construction waste can be used for various purposes in construction: road maintenance, small pond filling. Besides, crushed concrete resulting from concrete treatment may be used for heavy concrete production. Wood chips, reinforced steel, used asphalt (after heating): all such materials are greatly required and are used for various jobs.

Among recyclable materials, concrete is the most popular. Disassembly of buildings and facilities made of concrete as well as concrete recycling are developing dynamically. The output of concrete recycling is sand (that is half composed by waste dust) and secondary crushed concrete. Concrete became a widespread material a short time ago, after the possibility of its reuse in construction after recycling had been confirmed.

Before using the fine (recycled concrete) for concrete production, Portland cement was used for such purposes. In turned out that the way of using both materials (reinforcing the finished product) is not really different. The only dissimilarity is a higher price for Portland cement.

Construction Waste Processing Plants

In Moscow the main construction waste treatment market is formed by 11 companies. The most well-known of those companies are *SATORI* and State Unitary Enterprise *Ecotechprom*.

A new construction waste treatment complex will be built in the Eastern Administrative District of Moscow. It will comprise plants processing construction waste, bitumen roofing, and the plants that do sorting and primary processing of bulk waste.[27]

In St. Petersburg, waste recycling companies are *House Demolition Association, Olveks*, *Terminator*, *Crushing and Sorting Complex No1* and *Crashmash*. The aggregate output of these companies is about 380 thousand secondary crushed concrete per year. Given all the fields of use, the annual need of St. Petersburg construction companies in secondary crushed concrete is about 2300 thousand tons.[28] In addition, approximately 30 plants offer disassembly services in St. Petersburg. They work with residential buildings, industrial buildings, including chimneys, and other specific tall structures.

The *House Demolition Association* Holding is planning to build an incineration plant in Leningrad Region in the next year. The plant will comprise 2 sorting and 4 crushing complexes with the overall capacity of 500 thousand cubic meters/year. [29]

The company also owns 4 similar mobile enterprises which recycle bricks and reinforced concrete into secondary crushed concrete. The *House Demolition Association* was incorporated in 1997. Since

[27] Estate Market Indicators, December 10th, 2007

[28] Industrial and Construction Review, issue 99, March 2007. "Tomorrow's Cares of the Metropolis", Tatiana Reter

[29] Construction News, October 23rd, 2007

2003, the company has offered services as to integrated recycling of construction waste in materials that may be reusable in residential construction and road and railroad construction.

Consumers
The main consumers of secondary products made of construction waste are construction companies, especially road construction companies.

7.7 Paper and Cardboard

7.7.1 Waste Paper

Waste paper is the overage products of paper and cardboard.
Waste papers are used as a secondary material in producing paper (correspondence paper, printing paper and toilet paper), packing board and roofing, insulating and other construction materials. The use of waste paper considerably reduces the use of timber (a ton of waste paper can replace 4 cubic meters of wood) and, consequently, deforestation.

Waste Paper Classification
In Russia and the CIS, waste paper and waste cardboard is procured and purchased pursuant to GOST 10700-97. It classifies the following groups and grades of waste paper (briefly):

- **GROUP "A"** – high quality waste paper.
  - grade MS-1A – white paper production waste (except newspaper).
  - grade MS-2A – production waste for all types of white paper in the form of trimmings with ruling and a black-and-white or colored stripe.
  - grade MS-3A – sulfate brown pulp paper production waste.
  - grade MS-4A – used non-moisture-proof paper bags.
- **GROUP "B"** – medium quality waste paper.
  - grade MS-5B – corrugated board and its components production and consumption waste.
  - grade MS-6B – printed board production and consumption waste.
  - grade MS-7B – used books, magazines, brochures, catalogs, note pads and other printing and paper products made of white paper with no binders, covers or backs.
- **GROUP "V"** – low quality waste paper.
  - grade MS-8V – newspaper production and consumption waste.
  - grade MS-9V – paper cartridges, paper spools, paper inserts.
  - grade MS-10V – cast paper products.
  - grade MS-11V – coated and saturated paper and cardboard production and consumption waste.
  - grade MS-12V – black and brown paper and cardboard production and consumption waste, waste of carbon paper, etc.
  - grade MS-13V – cardboard, white and colored (except black and brown) paper production and consumption waste.

Usage
The use of waste paper in pulp and paper industry is extremely profitable since it saves significant material and energy resources (Table 7.7) and recovers the majority of waste at the same time. [30]

[30] Recycling Waste Paper, Solid Waste No 6, 2007

Table 7.7: Characteristics of material and energy resources savings

Indices	Paper production		Resources saving, %
	of fresh materials	of deinked materials	
Use of resources			
Fresh material consumption, tons	1100	0	100
Industrial water consumption, m^3	178600	152000	15
Energy consumption, kJ	25122	9540	60
Pollutant emissions into air, tons	49	20	60

In the two recent decades, the use of waste paper has been growing fast to reach its possible limits in some countries. The leader in waste paper recovery is Japan, where more than 50 % of paper waste is produced, and for some types of paper waste, its recovery reaches the theoretical level. In 1986 alone, this country recycled 92.6% of used newspapers and 76.1% of corrugated board. These yields have not really changed ever since. Despite the obvious benefits, the use of waste paper is restricted by quality requirements to end products. As table 2 clearly shows, the higher the requirements to newly produced paper, the less waste paper may be used in pulp.

Table 7.8: Waste paper re-uses data

Type of paper	Possible waste paper content, %
Unbleached kraft-paper	10-25
Bleached kraft-paper	5-15
Composite board	90-100
Paper:	
newspaper	100
High quality correspondence paper	10-80
Pack paper, printing paper	10-80

This results from the deterioration of quality of finished goods as the content of secondary materials increases. This is due to: aging of secondary resources because of multiple recuperations; increased content of special impurities that are added to produce special sorts of paper; difficulties associated with deinking of new inks used for up-to-date printing (for example, xeroxing, electrostatic copying, etc).

In the USSR, the accumulation and recovery of waste paper was especially high in the 1970-s – 1980-s. The yields even surmounted the average global yields. As of the mid-80-s, the extent of waste paper reuse in this country was 28 %, with 31% in the EC, and 26% in the US and Canada.

Waste paper is used for production of more than 70 sorts of cardboard and paper (pasteboard, binder board, grey packing board, linerboard, corrugated board, wall paper, newspaper, offset paper, carbon paper, toilet paper, packing paper, etc).

<u>Waste Paper Recycling Stages:</u>

Water paper recycling for generating pulp reproducible into paper and cardboard comprises the following operations:

- disaggregation of waste paper into separate pieces and fiber bundles;
- cleaning or removal of impurities;
- defibration of pieces and bundles;
- sorting and caking of pulp to required concentrations;
- deinking of pulp.

In industrial waste, the share of waste paper is 0.9%; whilst in solid waste, the share of waste paper is normally about 30%. More than 2 million hectares of land has been allocated for waste storage. The majority of official waste storage areas have exhausted their capacities, and the remaining ones are close to being full. Quite clearly, these data are far from being all-encompassing, since they are official, whereas the number of self-emerged illegal dumps is totally unknown.

Waste Paper Processing Plants
About 80 waste paper collection plants work in Russia. See the list of those at http://www.rospress.ru/sbormak.html (in Russian).

The major Russian waste paper processors are *St-Petersubrg KPK* JSC (part of *Ilim Pulp Enterprise* forestry holding, up to 18% of the market), *Naberezhnye Chelny KBK* JSC (10.5 %), Aleksin KF (12.1 %), *Stupino KPK* LLC (10 %), *Kartontara* JSC (Maikop, 9 %). Each of them processes more than 100 thousand tons of waste paper yearly. Balakhna Cardboard Mill, Perm Paper Mill, Svetogorsk Paper Mill, Ryazan Cardboard and Felt Plant, *Karavaevo* JSC can process 20-50 thousand tons/year. The capacities of other processors are 20 thousand tons/year and less.
Large paper mills also have waste paper processing plants or shops. For instance, a waste paper processing plant with the capacity of 80 tons of air-dry weight per day works at Kamennogorsk Offset Paper Plant (Leningrad Region, Russia, SZLK Group).
In Lipetsk is going to be constructed a new waste paper processing plant (see in details in Chapter 11)

Consumers
The main waste paper consumers are paper mills (more than 50% of recycled products), package plants, construction materials plants, etc.
The primary waste paper suppliers dealing with paper and cardboard arere printing works, package manufacturers), trade enterprises, especially larger networks, and, to a lesser extent, waste paper collection (including domestic collection) companies.
The table below shows waste paper prices as of August 2009.

Table 7.9: Waste Paper Prices (Different Grades) as of August 2009[31]:

Type of paper	Price	Region
Purchase		
different grade waste paper	RUR 2000 / ton	Belgorod Region
MS-5B, MS-6B	RUR 3000 / ton	Republic of Mari El
MS-5B/3	RUR 2200 / ton	Moscow Region
MS-5b	RUR 2500 / ton.	Nizhny Novgorod Region
MS-5B	RUR 3000 / ton	Perm Region

On the whole, it may be boldly asserted that Russian secondary waste cardboard market has an enormous potential.

7.7.2 Package

A separates segment of waste paper/cardboard processing is package processing.
Many types of package, especially food package, cannot be defined as “waste paper” as it is coated with foil or polyethylene film, whereas, pursuant to GOST 10700-97, waste paper may not “contain paper or cardboard that are unsuitable for recycling, i.e. paper and cardboard coated with polyethylene or other polymeric films…”

[31] www.solidwaste.ru

Several major companies are manufacture package in Russia. Among those are *Tetra Pack* JSC and *Recycle Pack* LLC, etc.
Tetra Pack JSC and *Recycle Pack* LLC have launched a project as to cardboard package waste recycling for packing liquid food, a historic first in Russia**.**
The market of package processing with regard to technology and equipments is less developed in comparison with other commercial wastes.

7.8 Timber

Wood industry is the main waste generator. The major part of timber wastes generated through wood processing remains unrecycled. The choice of the most efficient way of using such waste depends on the type of production, production yield, range of products and the amount of waste generated, as well as on the mode of product handling and distribution.
The accumulation of considerable amounts of waste in processing plants then becomes one of the fundamentals for profitable waste recycling as secondary materials.

<u>Classification of Timber Waste</u>
Timber waste is generated on all stages of logging and woodworking. Such waste includes branches, boughs, collars, butts, tomb stones, sawdust, stumps, roots, bark and chatwood.
According to the information from the Forestry Confederation of Russian North-West, logging waste constitutes 20%, lumbering waste constitutes 33–35% of production yield; plywood production waste constitutes 60%, timber waste in pulp milling make 20% of the supplied materials; wooden product and furniture production waste make 50% of the entire production yield.
Woodworking waste is classified into three groups based on type:

- solid (or lumpy),
- soft (sawdust, shreds)
- bark.

The waste is also classified by the generation sequence: logging waste, round wood waste, primary and secondary processing waste.

<u>Usage</u>
Construction materials and products are mostly manufactured with the use of sawdust, shreds and lumpy waste. The latter can be used either for manufacturing glued lamination products, or for processing it into chips and then into shreds, shredding, slush, etc.

Sawdust is one of the most widespread wastes from logging and woodworking. Sawdust is often used in hydrolysis distilleries or yeast plants; as a combustible additive in brick production; or as filler in gypsum-and-sawdust slabs; yet a considerable portion is burned or dumped. Size distribution in sawdust depends on the mode of generation and constitutes 10 – 0.2 mm. Particles smaller than 0.2 mm are wood powder.

Not long ago sawdust and machining chips were basically out of reuse in Russia: they were mostly dumped. In recent years, due to the growth of wood industry, many logging and woodworking businesses have searched for modes of reusing the soft waste. It has been widely used as cheap wooden briquetted fuel with no adhesives. Apart from being used as fuel, small amounts of soft waste have been used in hydrolysis for cement wood production. However, the most promising mode of soft waste recycling is the production of composite materials to further replace solid wood.
The first ideas on shreds and sawdust recycling for composite product manufacturing arose as early as at the end of the 19th century. The transference to the expansive use of soft timber waste began differently in different countries and went on with variable rates. The countries short of woods with exhausted sawdust and shreds generation resources (such as Germany and Sweden) import such materials from the neighboring countries.

Timber Waste Processing Plants

Timber waste processing is mostly done in the plants that manufacture wooden products. Major pulp mills, construction material plants, furniture business, etc. use part of timber waste in production. Lumber businesses have become the closest to complete recycling of timber. Production waste is used in in-house boilers to produce heat required for production processes, heating of production and administrative facilities.

Apart from heat production, some lumber companies export products made of waste. For example, *Swedwood-Tikhvin* LLC produces and exports fuel briquettes, technical chips, slabwood. *Svir-Timber* LLC exports chips. *Volosovksy LPK* LLC supplies secondary materials to *Vyborg Cellulose* JSC and *Syas CBK* JSC.

There are also specialized enterprises the only raw material at which is timber waste. As a rule, they are part of logging or woodworking businesses.

One of the biggest enterprises engaged in fuel granule production, *Vologdbioexport*, works in Vologda Region. Its capacity is 500 thousand tons/year. All in all, about 50 biofuel (fuel granule) production businesses are scattered all over Russia.

Consumers:

The main consumers for fuel granules are thermal power plants and boilers, for wooden products – variable manufactures dealing with wooded goods making.

8 Waste landfilling

8.1 General information

Waste landfilling is the disposal of waste that is unsuitable for reuse in special storages, in order to prevent penetration of pollutants in the environment.
In today's Russia, waste landfilling is the most widespread mode of waste sterilization. Waste landfilling is also widespread globally owing to its simplicity, cost-effectiveness and relative safety.
According to various estimates, 90% to 96% of solid waste is landfilled in Russia. By comparison, this figure is 55-57% in the US, and about 70% in Western Europe.
The landfills in Russia occupy more than 40 thousand ha, and the area increases 2.5-4% on the yearly basis.
Pursuant to current Russian law, only non-recyclable 5th hazard rate waste must be landfilled, wastes class 3 and 4 can be disposed of to a limited extent (not more than 30% from the total mass of wastes) together with the municipal household waste.

8.2 Landfills

The landfill is a specially constructed facility. They are built on barren lands with a small natural incline. If the slope is absent, it is built artificially.
Normally, landfills are built on clay and clay loam bases. If that is impossible, an impervious bed is built, which results in high additional costs. The area is normally chosen to enable its use for 15...20 years, and it may occupy 40…200 ha depending on the amount of waste to be disposed. The storage height is normally 12...60 m.
Landfills can be:
- low-rate – 2-6 tons/m^2
- high-rate – 10-20 tons/m^2

The annual waste input may be 10 - 3000 thousand m^3. Waste is usually disposed of via the mapping method, due to which the environmental actions can be taken in a step-by-step manner without waiting for the expiration of the landfill's lifetime. Solid waste storage technique involves groundwater protection with the help of impermeable shields, and air/soil/land protection via daily external insulation. All storage, compaction and insulation jobs are mechanized.
Global standards suggest that a ready landfill may contain only a single type of solid waste. This enables successful recycling or recovery of domestic waste with reference to its type. Storage of such waste is accompanied by further modification (if possible) thereof by crushing and pressing, which prolongs useful lives of landfills. Upon placement of a layer of domestic waste, it is covered with an additional bedding layer, on which domestic waste is further dumped. Upon exhaustion of the landfill, it is sanded, clayed and soiled to be further reclaimed.
Reclamation of closed landfills is a scope of works aimed at the restoration of fertility and economic value of reclaimed lands, as well as at environmental improvements. It involves:

- building of a final insulation layer;
- operation and maintenance of collection systems, filter waste water/biogas/surface water removal systems;
- control of slope erosion and channel silting;
- landfill protection;
- environmental monitoring.

Landfills are environmental constructions, therefore their organization and operation has to minimize risks of adverse effects on the environmental components. Thus, waste storage may pollute land with surface waste water and filter waste water resulting from reactions between atmospheric precipitation and waste.

Moreover, air is usually also polluted around the landfill due to the generation of volatile components. Therefore, in order to minimize losses associated with reclamation of used quarries via the organization of a solid/construction waste landfill, the quarry must be surveyed from geoecological standpoints, whilst the condition of waste (i.e. reclamation material) must be surveyed from the sanitary and physicochemical standpoints. The used quarry as a potential landfill must comply with all requirements of Russian environmental law.

More than 1300 solid waste landfills are used in Russia. Of those, 20 (very large landfills) contain the more than 2.5 million tons of waste; on 90 (large) landfills waste weight is 1.2-2.5 million tons; whilst 400 (medium) landfills have 0.5-1 million tons of waste. The other (small) landfills contain less than 0.5 million tons of waste . About 10% of solid waste is dumped in non-organized places, a small portion of waste (about 6%) remains in towns and factories. The area occupied with operative landfills and dumps constitutes more than 40 thousand ha. About 1 thousand ha is allocated for waste disposal annually. Closed landfills and dumps occupy about 50 thousand ha.[32]
The majority of landfills are owned by state enterprises; yet private waste disposal business also exists.

Moscow and Moscow Region
At present, solid waste is disposed of on garbage dumps commissioned in the late 1970-s. They are essentially a pit that is gradually filled with non-sorted garbage.
In Moscow Region, landfills and dumps occupy more than 860 ha. Unauthorized dumps occupy more than 1.4 thousand ha.
Out of 55 functioning landfills in Moscow Region, 27 landfills have practically exhausted their capacities (filling ratio is 100%), 19 landfills are close to expiration of lifetime (filling ratio is 90%), and the residual capacity of the remaining landfills fluctuates between 30% and 50%. According to expert estimates, the capacity of existing landfills is no more than 30 million tons.
The list of landfills in Moscow Region is shown in Appendix 1.

Resources of landfills are rapidly approaching their limit. According to Rostechnadzor, no more than 40 million tons of solid waste is possible to dump in Moscow Region landfills, i.e. their lifetimes are restricted by 3-4 years. 10 landfills have been completely filled in two last years, and the largest Moscow Region landfills (*Timokhovo, Khmetievo, Iksha*) have acceptance restrictions. However, no state-of-the-art waste sterilization projects have been implemented within the last 15 years.
Pursuant to the Edict of the Government of Moscow "Building the Technical Basis for Municipal Waste Treatment in the City of Moscow", mechanobiological recycling plants will be built on *Timokhovo, Khmetievo, Iksha* landfills. For example, these plants will collect and recover biogas to produce heat, energy and motor fuel. In 2010-2012, three sites (in Moscow Region and adjacent Regions) will be planned for the construction of Regional waste recycling and disposal plants in the southern, western and eastern directions from the capital.[33]

St. Petersburg and Leningrad Region
13 landfills (3 of those are located in St. Petersburg) and approximately 500 permanent waste dumps are situated in Leningrad Region.
The main licensed landfills in Leningrad Region that store waste from St. Petersburg are listed below. According to the information from open sources all this landfills violate technical procedures and licensing conditions.are:

- *Zavod Kompleksnoy Pererabotki Otkhodov* JSC located in Lomonosov District, Volkhonskoye Highway stores more than 1.5 million m3 of waste on the site of ex-PTO-1 (Southern Landfill). The technically possible limit is exceeded by 30-50 %.

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[33] www.irn.ru March 12th, 2008

- *TBO Polygon* LLC located near the village of Lepsari, Vsevolozhsk District, stores up to 600 thousand cubic meters of waste, which almost doubles the technical capacity.
- *Vuoly-Eco* landfill was organized in 2004 in Kuivozi Volost, Vsevolozhsk District, to regulate the old waste and localize the new waste to reclaim those within 5 years.
- *Novy Svet-Eco* LLC, located in Gatchina District, accepted more than 900 thousand m3 of waste in 2004, of which 90% were waste from St. Petersburg. Thus, the annual capacity of the landfill was exceeded more than 4.5 times, which may result in shortened lifetime.
- *Krasny Bor* landfill is used for accepting, sterilizing and burying toxic industrial waste. The landfill is located in Tosna District, 30 km from St. Petersburg.

The main companies operating on the market of landfills construction are the following: NBA Technologies, LLC “Anicom”, groupo of companies “Petro-Domus”, Company “Center of Geotechnologies”, Company “Sibshakhstroy”, LLC “BMF Mostremstroy”, "A.S.A"(Austria)

<u>The Regions where the projects on landfills construction have been recently implemented are:</u>
Tver Region (2005), Kirovsk Region (2007), Bryansk Region (2008), Primorskiy krai (2007), Perm krai (2008).
<u>Projects which are going to be implemented:</u>
Construction of landfills in Nizhniy Novgorod Region, Krasnoyarsk Region, Sakhalin Region, Vladivostok, Chelyabinsk Region.

As is clear from the above, the key problems of landfilling in Russia are:

- lack of landfill capacities due to a high portion of buried waste. As a result, the overage landfills keep being operated;
- most landfills are not operated in due manner (environmental and sanitary standards are often violated);
- the number of non-authorized dumps and non-licensed landfills progresses on the yearly basis;
- many landfills close without reclamation.

9 Waste Waters Treatment Techniques

9.1 General information

Treatment of waste waters is essentially the destruction or removal of certain substances, decontamination and removal of pathogenic organisms.

Treatment techniques are very versatile, yet they may be divided into primary groups based on the fundamental principles:

- Mechanical methods. They are based on screening, filtration, thickening, and inertial separation. They permit the separation of insoluble impurities. In terms of prices, the mechanical methods of treatment are among the cheapest.
- Chemical methods. They are used for segregating soluble inorganic compounds from waste water. When waste water is treated with chemical agents, they are neutralized, discolored, and decontaminated. Chemical treatment may result in relatively rich sediment.
- Physicochemical methods. They are based on coagulation, oxidization, sorption, extraction, electrolysis, ion-exchange purification, hyperfiltration. This is a highly efficient treatment method, and an expensive one. It cleans waste water of fine and coarse particles as well as of dissolved compounds.
- Biological techniques. These are based on the use of microorganisms that consume pollutants. Biofilters with a thin bacterial film are used, biological ponds with specially reared microorganisms, aerotanks with activated sludge of bacteria and microorganisms.

The combined techniques that use different treatment methods on various stages are also frequent. The use of each technique is dependent on the concentration of impurities and their hazard rate. Depending on whether or not the polluting components are removed from waste water, all treatment techniques may be classified as regenerative and destructive.

9.2 Mechanical Treatment

Mechanically, waste water can be cleaned in two modes.

The first is essentially screening water through grills and sieves resulting in segregation of solids. The second mode is essentially desilting in special basins resulting in sedimentation of mineral particles.

From the sewer, waste water is first fed to the grills of sieves to screen through them, whilst bulky components (such as cloth, kitchen waste, paper, etc.) are retained. The bulky components detained by grills and sieves are then carried away for decontamination.

Screened discharge water is then fed to grit basins where mineral impurities (sand, slag, carbon, ash, etc.) are retained.
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Screened discharge water is then fed to grit basins where mineral impurities (sand, slag, carbon, ash, etc.) are retained.

Grit basins protect desilters from pollution with mineral impurities. Their design may be different to depend on the amount of waste water. After the grit basins, water is supplied to the primary desilters where the sedimentation of insoluble suspended particles, both organic and inorganic, is performed. Grit basins are horizontal basins, vertical basins and slot basins.

The horizontal and vertical basins are used in treatment facilities, whilst slot basins are used on the canals. The horizontal and vertical grot basins are required if the amount of fecal waters is more than 300 m3/day. The grit basins have a two-section design, so that at least one section remains operable during maintenance and de-sanding even if it is temporarily overloaded.
In the horizontal grit basin, the sedimentation of sand and other mineral particles occurs during the horizontal movement of liquid at 0.1 m/sec. In the vertical grit basins, the sedimentation occurs when liquid rises at 0.05 m/sec. The choice of type depends on the entire height of the facility.

Desilters are the main type of treatment facilities. They are the most widespread. Insoluble suspended particles, both organic and mineral, sedimentate in such desilters. The movement of water in the dseilters may be horizontal (horizontal desilters) or vertical (vertical desilters).
In addition, radial desilters are used, where water moves in radial direction. The desilters for fecal waters are normally calculated for the most infeed of waste water.

The desilters can be primary and secondary desilters. The primary desilters are used before the biological treatment facilities, whilst the secondary desilters are mounted for secondary clarification of water after the biological treatment facilities. After the biofilters, the secondary desilters are also contact tanks. If the local situation allows the discharge of waste water in water bodies after the primary desilters, the mechanical treatment scheme must include decontamination (chlorination) in the contact tank.
The sediment produced in the primary desilter rots, and then it is dried on special platforms and used as fertilizer. The vertical desilters can be rectangular or round in plan view.
The most frequent are round desilters, which are essentially tanks with a cut tapered bottom. A pipe is mounted in the center of the desilter. Waste water flows along it to the bottom. Peripheral collection chutes are mounted on the desilter. The suspension sedimentates when the waste water is backwashed from the hood and the central pipe and travels upwards at 0.7 mm/sec. The resulting sediment is removed through the sludge pipe under the influence of the water column.

The horizontal desilters are essentially the tanks with the longitude that is 4-5 times more than the width. They are mostly built of reinforced concrete, brick stone or other impervious materials. The tanks incline towards a pit which is built at the front end of the desilter (behind the water flow). Such design provides intensive sedimentation of suspension.

To evenly distribute the waste water across the width of the desilter, the chutes are mounted at the front and rear ends of the desilter. To distribute liquid down to the entire depth, a kick board is mounted on a certain depth at the front end. To prevent superficial penetration of floating substances, a floating board is mounted at the rear end of the desilter.
In large desilters, the sediment is removed by mechanical scrapers with which it is supplied to the pit to be further removed through the sludge pipe. Radial desilters are a type of horizontal desilters. In plan view, they are circular tanks of reinforced concrete. Liquid travels horizontally in radial direction from the center edgewise.

Water is supplied to the central distribution pipe and is collected with a peripheral chute. This type of desilters also successfully combines the alternation of net section with sedimentation dynamics. The cross section of the desilter gradually increases from the central pipe towards the peripheral chute.

The usual waste water clarification effect in the primary desilters is never more than 60%, whereas the suspended particle segregation is more than 100-150 mg/l which is adverse for further biological treatment. To increase the clarification efficiency, tared filters are used (similar to the clarification of fresh water). In the clarifiers with tared filters, the suspended particles inter-coagulate or flocculate.

Since polluted waste water is a dispersion system where fine and coarse particles accelerate coagulation, the task is to establish the optimum coagulation conditions. To do so, waste water is preliminarily aerated in aerators or biocoagulators.

Aerators and biocoagulators are the facilities that house nonchemical coagulation and flocculation of impurities with excessive sludge with water being blown with compressed air.

The aerator is essentially a rectangular tank with partitions to elongate the waste water travel. Aerators are used for better clarification of waste water in desilters, for removal of liquid fat, and for preparation for biological treatment.
Aeration is essentially blowing of waste water with air during 10-30 min with the use of activated sludge from secondary desilters. The air is supplied from below through the orifices in pipes or through filters.

The biocoagulator is essentially a vertical or horizontal desilter with a circular desilting zone and a central biocoagulation chamber where excessive activated sludge contacts and mixes with the waste water. The reduce air consumption, the central biocoagulation chamber has triangular cases, and horizontal cases with filtering plates are mounted on the depth of 2.5-3.0 m.

The mixture of water and excessive activated sludge is supplied to the central pipe through the leading chute. The waste water is supplied in the biocoagulator below the filtering plates to avoid their clogging with coarse impurities. The concentration of activated sludge is approximately 7 g/l, and its amount must be equal to approximately 1% of waste water consumption.
Compressed air is supplied to the filtering plates. Compressed air helps mix the activated sludge with the waste water and keep the sludge suspended. Aeration intensity is kept at 1.8-2.0 m2/hour.

The liquid bubbled by air starts circulating over the four circulation cases in the corners of the biocoagulation chamber. The cases are shorter than the walls that enclose the chamber. In the circular desilting zone, between the central chamber and the external walls, a suspended layer of activated sludge is produced, the level of which depends on waste water consumption.
The suspended layer fosters the coagulation of impurities. It helps equalize the water rise rate in the desilting zone and eliminate the vertical flow of liquid, which is characteristic for vertical desilters. Water filtered through the suspended layer flows over the peripheral spillway into the collection chute. A board that prevents the penetration of floating particles is mounted in front of the chute. Compressed sludge is removed through the sludge pipe under hydrostatic pressure upon opening of the valve.

9.3 Chemical Treatment Techniques

Chemical treatment is essentially the segregation of impurities via chemical reactions between the impurities and the chemicals. Such reactions are the oxidization and regeneration, which result in the formation of new compounds that can sedimentate or emit as gases. The most frequent methods are neutralization combined with coagulation.
The coagulation process is essentially adding a chemical that foster fast segregation of fine suspended solids in the waste water, which cannot sedimentate in simple desilting. The chemical (coagulant) must be added before the desilters.
The coagulant can be polyacrylamide, ferric sulfate, sulfuric alumina. The coagulant is added in the form of a 6-10% solution. The waste water mixed with the coagulant solution in the blender is supplied to the desilter where the suspended particles sedimentate.
The neutralization of waste water occurs upon its chemical interaction with substances that neutralize water.

9.4 Physicochemical Treatment Techniques

The physicochemical treatment techniques allow drastic intensification of mechanical waste water treatment. With reference to the required extent of cleanness, physicochemical treatment can be performed as the final or intermediate step before biological treatment.

The physicochemical treatment techniques include *extraction, sorption, evaporation, floatation, crystallization, ion exchange, electrolysis, electrodialysis, the use of the hydroelectric effect.*

In *extraction*, the waste water is mixed with a solvent in which the certain type of pollutant dissolves the most (for example, to remove phenol from the waste water, benzene is added). The solvent is supplied from below. Since its specific weight is less than the specific weight of the waste water, the solvent rises upwards.
The polluted water supplied from above contacts the solvent and transfers the polluted substance to it. The cleaned water is drained from below, and the polluted solvent (extractant) is drained from above.

In *sorption*, the pollutants are either absorbed by soled particles (absorption), or sedimentate on its actively developed surface (adsorption). In the third case (chemical sorption) the pollutant reacts with the solid body.

Evaporation is essentially stripping of volatile pollutants by water vapors. Evaporation is performed in an intermittently active machine or in continuously active distillation columns.

The *floatation* process is based on floating of dispersion particles with bubbles of air. Floating occurs due to the creation of foam that envelops the impurities and is removed from water together with the impurities. To produce foam, water is saturated with the bubbles of finely dispersed air. Solid particles interact with the bubbles or air on the boundary of three phases: particle-air, particle-water, water-air.

In *crystallization*, the waste water is treated by separating the pollutants in the form of crystals.
In *ion exchange*, cations and anions are extracted from water with the help of ion exchangers.

In *electrolysis* and electrodialysis, molecules break down, transform, and ions concentrate by the electrodes.

The hydroelectric effect that occurs upon high-voltage current discharge may be used to destroy molecules of complex pollutants, for example, dyes.

9.5 Biological Treatment Techniques

Biological treatment is based on the vital functions of microorganisms that promote oxidization or regeneration of organic matter in the form of fine suspensions, colloids that are solved in water and are the nutrient sources of such organisms, which results in treating of waste water of pollution.
Biological treatment facilities can be of two main types:

- facilities where the treatment conditions are close to natural conditions;
- facilities where treatment conditions are artificial.

The former type includes the facilities that filter the waste water through the soil (sewage farms and absorption fields), and the facilities that are essentially water reservoirs (sewage lagoons) with running water. Microorganisms living in such facilities use oxygen for breathing directly from air. In the facilities of the second type, microorganisms use oxygen via its diffusion through the water surface (re-aeration) or via mechanical aeration.
In artificial conditions, biological treatment is used in aerotanks, biofilters and aerofilters. In such conditions, the treatment process is more intense since the conditions for microrganic activity are more beneficial.

9.6 Choosing a Treatment Scheme

The choice of an optimum water treatment scheme is a fairly complex task because of a versatility of impurities and high requirements to water quality. The choice of a treatment scheme does not only rely on the composition of impurities in the waste water, but it also considers the requirements that treated water must meet: the maximum permissible discharge and maximum permissible concentrations – if water is discharged in water bodies; and the requirements of a specific process – if water is to be reused in production.

The preparation of process water or the provision of good treated waste water discharge into water bodies also needs good assessment of water treatment techniques. As a rule, closed-loop systems are more economically beneficial. However, the introduction of waste-free production, which also includes a fully closed-loop water system, is a long process. Thus part of treated waste water is discharged in water bodies. In such cases, the compliance with the standards regulating relative concentrations of pollutant is mandatory.

Treatment techniques have to provide the maximum use of treated water in primary processes and the minimum discharge in open water reservoirs. Wide usage of circulation systems offers additional reserves as to the reduced consumption of fresh water and decrease discharge in open water reservoirs (process improvement, higher treatment efficiency). The waste water is clean if their discharge in water bodies does not violate water quality requirements at the monitoring site or water use point.

The extent of cleanness should be determined based on the local conditions with reference to the possible usage of treated waste water and surface runoff in industry and agriculture.

For waste water discharged in the water bodies, the level of treatment must comply with the requirements of “Protection of Surface Water from Waste water Pollution: Guidelines” (1974), “Sanitary Protection of Coast Waters and Seas: Guidelines” (1988) as well as the stipulations of SanPiN 2.1.5.980-00 “Water Disposal in Towns, Sanitary Protection of Water Bodies. Hygienic Requirements to Surface Water Protection” (2000).

For waste water, discharged in the sewers, the level of treatment must comply with the requirements a “Using Public Water Supply Systems and Sewers in the Russian Federation: Guidelines” (1998).

10 Waste water Treatment Facilities

10.1 General information

According to the statistics from Russian Ministry for Regional Development, the average physical wear of water supply pumping stations has reached 65%. The physical wear is 57% with sewers pumping station, 54% with water supply treatment systems, and 56% with sewers treatment systems. In some municipalities, the wear of utilities is 70-80% to increase 2-3% annually. About 30% of key housing assets are far past their lifetimes. The wear of key assets continues to grow, thus potentially leading to anthropogenic or environmental collapses. Until now, the base of economy is budgetary support of the enterprises. Housing production management is highly centralized, with competition almost non-developed. The consumers cannot influence the amount and quality of rendered services.

According to the statistics, Russian utility enterprise discharge more than 50% of metropolitan waste water annually, of which 88% are below treatment standards.
Treatment facilities of the water and drainage system also accept industrial waste water, which constitutes 32% of the overall yield, of which 82% are below treatment standards.[34]

More than 80 % of facilities in small towns and settlements of the RF do not operate properly and do not provide proper treatment quality. This is because of unserviceability during long period of operation, decline and stop of biological treatment in cold season, quick death of active sludge while shut-down of energy supply in emergencies. All above belongs to biological treatment techniques.

Suppliers
The market of local waste water treatment facilities is quite mature.
As more especially that any planned production facility in case of non-conformance of discharge with established standards must envisage a waste water treatment facility. Otherwise, the project won't be possible whatsoever. So, design and construction of local treatment facilities is much required in this regard.
The market of rendered services in this area is mostly presented by domestic design and construction companies.
The long list of design companies and equipment suppliers in the RF can be started with the following names: JSC "Siyuzvodokanal", GUP "Mosvodokanal", LLC "Rosecostroy", Biotal, Albatros, company "Ecos", LLC "Ochistnye sooruzheniya" LLC "StroyProjectCity".

10.2 Largest Treatment Facilities in Russian Towns

Water supply and wastewater discharge are provided by the State Unitary Enterprise Vodokanal in some of the cities and towns of the Russian Federation. This enterprise controls also municipal waste water treatment facilities.
The largest treatment facilities in the largest cities of the RF are presented below.

Moscow
100% of metropolitan waste water is fully treated on Kuriyanovo, Lyubertsy, Southern Butovo and Zelenograd treatment facilities, which totally eliminates the discharge of polluted waste water in water

[34] Environmental Investment Project in Housing and Utilities

bodies. All these plants are controlled by State Unitary Enterprise *Mosvodokanal*. A high level of treatment enables a steady reduction of pollutants that are discharged in water bodies. The treatment facilities use state-of-the-art sediment processing techniques, such as thickening on belt thickeners, fermentation in metatanks, compression and dehydration on press-filters.

Kuryanovo Treatment Facilities
Capacity: 3.125 million m3/day, the largest in Europe, They provide overall biological treatment according to the classical scheme: metal grills, grit basins, primary desilters, aerotanks, and secondary desilters.
The most characteristic is the use of tertiary treatment systems with the capacity of 1.1 million m3/day. Such systems use flat sieves and high-rate filters. After tertiary treatment and decontamination, up to 50 thousand m3/day of water is supplied to the industrial water supply system. The process scheme of sediment processing includes sludge compressors and belt thickeners for excessive activated sludge; meta-tanks; fermented sediment compressors and belt thickeners; chamber membrane press-filters for dehydration of sediment with the use of flocculants; sludge platforms and deposit landfills.
With the capacity of 3 million m3/day, the process scheme is similar to Kuryanovo treatment Facilities.

Lyubertsy Treatment Facilities
The most characteristic is the use of deep removal of nitrogen and phosphorus technology. 3 biological treatment lines with the total capacity of 300 thousand m3/day have been remodeled to remove the compounds of nitrogen and phosphorus. In 2006, a new biological treatment unit was commissioned. On that unit, biogenic elements (nitrogen and phosphorus) are removed, and its capacity is 500 thousand m3/day. All facilities are fully automated.

On August 25th, 2007, a new UV decontamination unit with the capacity of 1 million m3/day was commissioned. The unit is the largest such facility in the world (based on designed hourly performance equal to 56 250 m3/hour). The equipment was designed and mounted by a Moscow enterprise, NPO *LIT*.
Throughout the entire operation period, the UV system has steadily provided the designed quality parameters.

Southern Butovo Treatment facilities
Capacity: 80 thousand m3/day. They were built based on the BOOT (buy, operate, own, transfer) concession model.
The facilities remove biogenic elements, provide tertiary treatment of water, UV decontamination of water. The sediment processing complex dehydrates the stabilized excessive activated sludge with the use of mineral chemicals. The process is fully automated.

Zelenograd Treatment Facilities
Capacity: 140 thousand m3/day. They were built based on the BOOT concession model.
The process scheme is similar to Soutern Butvo. Sediment is not processed. Sediment is discharged in the municipal sewers.

St. Petersburg
As of today, special facilities in St. Petersburg treat 85% of waste water; the other 15% is discharged in water reservoirs without treatment. The primary treatment facilities are: the Central Aeration Station, Northern Aeration Station, South-Western Treatment Facilities. All the above plants are owned by State Unitary Enterprise *St. Petersburg Vodokanal*.

Central Aeration Station
The treatment facilities are located on the artificial island Bely. The development area is 57 ha.
The station was commissioned in 1978. The total capacity is 1.5 million m3 of treated water per day.

The waste water is first fed to the retaining grills and then to grit basins where it is cleaned of sand and other mineral impurities. The next stage is desilting in primary desilters accompanied with retaining of suspended and floating matter. Then the waste water is treated biologically in aerotanks, to which activated sludge and air is also supplied. Upon the separation of the activated sludge and treated water, the latter is discharged into the Gulf of Finland.
Sediment sterilization if performed on a sludge residue incineration plant commissioned in 1997.

The Central Aeration Station was remodeled in 2005-2007 as part of the Russian-Finnish environmental project called *The Clean Sea*. As a result, the technology of deep biogene (nitrogen and phosphorus) removal was introduced that meets the requirements of Helsinki Commission. Also, the overall efficiency and reliability of the station was improved at lower energy costs and maintenance costs.

Northern Aeration Station
It is located to the west of the village of Olgino, It occupies the area of 65 ha.
In 2007, major remodeling of treatment facilities was performed.
In 2007, a sediment incineration plant (the second one after the Central Station plant) was commissioned. Its designed capacity is 112.4 ton of sediment in terms of solids.
The construction cost constituted 90 million euro, with 81 million 600 thousand euro to have been raised through loans from international financial institutions (EBRD and SIB) on the security of St. Petersburg Government. The prime contractor was *OTV* (France).

In 2009, the biogene removal project is planned for completion. This includes the construction of a sewer pipe from Pesochny to Novoselki with a branch leading to the Northern Station. This will totally eliminate the discharge of polluted waste water to improve the condition of the Gulf of Finland and the Sestroretsky Razliv Island. Remodeling of the station will promote intensive housing and industrial development of the Northern Coastal part of the city, as well as of *Parnas* Industrial Zone, the villages of Pesochnoye and Levashovo.

South-Western Treatment Facilities
Treatment of waste water at South-Western Treatment Facilities is based on the deep biogene removal technology. The capacity of the facilities is 330 thousand m3/day. Sediment processing is essentially its compaction and incineration.
The sediment is burned on a special plant located on site and built in 2007.
The construction cost constituted approximately Euro 28 million. The moneys were granted by the EC as part of the TACIS program. The capacity of the plant will be about 70 tons/day of sediment.

Note, that any planned production facility in case of non-conformance of discharge with established standards must envisage a waste water treatment facility. Otherwise, the project won't be possible whatsoever. So, design and construction of local treatment facilities is much required in this regard.

The market of local waste water treatment facilities is quite mature and mostly presented by domestic design and construction companies.

Yekaterinburg
Southern aeration station – 85% of waste water.
The process includes 2 stages: 1-st stage – only mechanical treatment, was commissioned in 1975, capacity – 350 thousand m^3 per day;
2-nd stage – mechanical+biological treatment was commissioned in 1987.

Northern aeration station – 15 % of waste waters.
The station was constructed in 1975, capacity – 80 thousand m^3 per day. The station provides mechanical and biological treatment.
The investment feasibility study to upgrade the station is prepared for the moment. The upgrade is planning to conduct in the next 4-5 years and will enable to increase the capacity to 140 m^3 per day.

11 Investment Programs and Projects in the Domain of wast water Treatment and Waste Management

As a whole, the investment volume into the Russian business has reduced in 2009 in comparison with 2008. So, in 2008 it amounted to $ 70.3 million, in 2009 is $ 50 million estimated. (Review of Russian economy and investment market, 1-st quarter 2009, prepared by “On Point”). In the early 2009 the rate of foreign investors in the RF economy was 3.5 % (in 2008 – 75%).

On the Russian market of investments the situation is similar with foreign investments. The trend in 2009 is relocation of investment interest from the Regional markets to the central one. Developers and investors prefer operating during the crisis on the more mature and less risky markets of Moscow and Saint Petersburg.

The major Russian investors in waste treatment are group of companies “Eco-sistema” (investments into Tomsk segregation complex and incineration facility and landfill in Astrakhan Region), LLC “Partner-Invest” (Waste treatment facility in Voronezh Region), JSC “Direction of Environmental Programs” (Waste treatment facility in Stavropol krai).

Foreign investors: Advanced Recycling Technology (waste treatment facility in Nizhniy Novgorod), Remodis (waste collection and segregation facility in Nizhniy Novgorod), DSD (waste management concept for Nizhniy Novgorod Region), Key Industry Engineering Group (Waste treatment facility in Koltsovo, Novosibirsk Region), EBRD, NEFCO.

The best opportunities Regions with regard to investments and know-how attracting are considered as those Regions where projects on waste water and waste management are expected to be implemented. The selected projects are presented below.

Central Federal District

Construction Waste Processing Complex in Moscow

It will be built in Eastern Administrative District. The Complex will comprise a construction waste processing plant, a bitumen and roofing processing plant, and a bulk waste sorting and primary processing plant.

Environment and Natural Resources Regional Target Program in 2006-2010, Voronezh Region

Pursuant to the said Program, new landfills are planned to build in 19 communities. The existing dumps in five communities will be improved. New solid waste and industrial waste sorting and disposal stations will be built, as well as the medical and biological waste collection and disposal centers.

Waste Paper Processing Plant in Lipetsk

The would-be enterprise will manufacture flat package cardboard (test-liner) and Fluting (corrugation paper). According to the Feasibility Study accomplished by an engineering company from Austria, the equipment will be supplied by the world leader in paper and cardboard production, *Voith Paper* (Germany). The tentative value of the project is RUR 6.5 billion.

Construction of Transfer Station in Samara

The collection and sorting are anticipated on the area of 15 thousand square meters located in the sanitary zone of municipal sewer treatment facilities in Kuybyshev District of Samara.

Construction of waste segregation facility in Tula Region
"National Environmental Company" (NEC) will construct a waste segregation facility, of capacity of 100 thousand ton of wastes and 2 landfills for solid municipal wastes. The NEC's project has won an open tender. The project will be implemented out of the founds attracted by NEC.
The Company has planned and approved construction of the modern waste segregation facilities in Tambov, Tula, Saratov Regions, Stavropol krai and republic Khacassiya.

Construction of waste treatment facility in Nizhniy Novgorod
In 2008 the company Remondis signed the framework agreement on cooperation with Nizhniy Novgorod Administration. It is planned to construct a waste treatment facility dealing with solid municipal waste in the city. Investment in this project amounts to Euro 12 million.

Volga Federal District

Volzhski Water Project
The EBRD is considering a senior loan to Volzhski Vodokanal, a municipal water services company under a financial guarantee of Volzhski City for the purposes of co-financing a priority investment programme on rehabilitation and upgrade of water supply and wastewater treatment facilities.
Municipal Enterprise Volzhski Vodokanal fully owned by the municipality of Volzhski City that would be providing full financial guarantee for the project.
Total project cost - RUB 450 million, including RUB 90 million co-financing from local sources

Waste transfer stations in Samara
6 waste transfer stations will be constructed in Samara. One of them is in the process of construction; other 5 stations are at the stage of feasibility study. The capacity of each station will amount to 200 thousand tons of waste annually. The main benefits from this project are provision of secondary material collection and reduction of transportation distance.

Construction of waste treatment facility and new landfill in Astrakhan Region
Pursuant the Agreement between the Government of Astrakhan Region and JSC UC "Eco-Sistema" there will be a waste treatment facility and a new landfill constructed in the Region. The overall cost of this project is RUR 674.2 million. New objects will cover all the needs of the Region in waste treatment and land filling. The project is supposed to be implemented in 2010. The Agreement was made within the frameworks of 8-th International Investment Forum which took place in Sochi 17-20 September 2009.

North-Western Federal District

Programs "Stop Discharging Non-treated Waste water in St. Petersburg reservoirs" (2009)
The primary acts of the program are the completion of the Main Sewer Pipe (in particular, loaned assets will be used for equipping the Waste water Control Unit, which is an integral part of the pipe) and upgrading of the Northern Aeration Station (which will treat the waste water directed to the sewer pipe).
St. Petersburg Vodokanal has received 17.5 million euro as loans from SIB and EBRD.

Construction of Second Stage of A Waste Treatment Plant in Yanino (Central Factory of St. Petersburg State Unitary Enterprise *Zavod MPBO-2*, Vsevolozhsk District, Leningrad Region)
According to the Feasibility Study, the construction costs constitute 120 million euro.

Construction of waste incineration plant in Saint Petersburg
The estimated capacity of the plant will amount to 3.1 million tons of wastes annually, capital investments – Euro 150 million, estimate commissioning date – December 2012.

Integral Reconstruction of Water Supply and Sewer Treatment Facilities in Petrozavodsk
The reconstruction of water supply and sewer treatment facilities is a major investment project for Petrozavodsk housing and utilities management. Upon commissioning of the entire complex, water in the local water supply system will meet the set standards.

As of August 19th, 2009, the overall cost of facilities is estimated at almost RUR 2 billion. The implementation of the project involves financial allocations from the municipal budget, *Clean Water* Federal Program, Petrozavodsk Housing and Utilities Services. Possible fund-raising from international grants and loans is also considered.
Environmental financial corporation NEFCO asserted it was ready to co-invest the project, as well as the *Severnoe Izmerenie* Partnership. Finnish Ministry of Environment has approved the allocation of a grant.

Construction of Waste Treatment Plant in Arkhangelsk
The design capacity will be at least 150 thousand tons/year. Processing depth – 85%. The construction cost is RUR 1.9 billion. It will be covered by raised investments and long-term loans. No allocations from the municipal budget will be required. About 200 of new workplaces will be created on the plant.

Vologda Municipal Water Services Project
The City of Vologda has received a loan from the European Bank for Reconstruction and Development ("the Bank") and intends using the proceeds of the loan as well as donors funds to finance an Investment Program for the Municipal Water Services Development Project (the "Project"). The Project includes rehabilitation of water and wastewater infrastructure, and modernization of water and wastewater treatment facilities.

Reconstruction of Murmansk Waste Water Treatment Facilities
Project initiator – Murmanskvodokonal.
The entire cost of the project, including design and construction is estimated as RUR 543 million. Financing is to be found.

Construction of segregation facility in Murmank
Project initiator – LLC "Orko-Invest". Financing is to be found. The entire investments including feasibility study, design and construction amount to RUR 300.8 millon. Financing to be found.

Southern Federal District
"Clean House" Investment project, Rostov-on-Don
The project aims at the construction and reconstruction of certain water discharge system elements In Rostov-on-Don, which will add new consumers to the centralized waster discharge system, as well as at the improvement of waste water treatment quality on treatment facilities and sediment incineration. The overall cost of the Regional investment project (VAT inclusive, in respective prices) is RUR 4 466.72 million.
The project was launched in 2008. It was initiated by *ABVK-Eco* LLC. The sources of finance are *ABVK-Eco* LLC, Russian Investment Fund, budget of Rostov Region, municipal budget of the town of Rostov-on-Don.

Construction of Waste Treatment Facility in Sochi
The Sochi plant will treat 240 thousand tons of waste/year, sort waste for more efficient and environmental-friendly treatment. The project value constitutes 30 million euro. The construction is planned to complete in 2010.

Construction of waste treatment facility in Stavropol krai
The facility will be located close to Lermontov town in Stavropol krai. The total investment will amount to 1 RUR billion, capacity – 300 thousand tons of wastes. The project initiator – JSC "Direction of environmental programs".

Far Eastern Federal District

Reconstruction and Development of Water Supply and Sewer Systems in Vladivostok

The upgrade of the water supply and sewer system in Vladivostok (which also includes the construction of treatment facilities) has become part of the "Developing Vladivostok as the International Cooperation Center in APR" subprogram, the chief document governing the preparation of the city for the 2012 APEC summit. The project is financed from the Regional budget.
The problem associated with waste water treatment is topical for Vladivostok, since only 6% of all waste water (350 thousand m3/day) is being treated, as of today.

Construction of *BlagEco* Treatment Complex, Blagoveshchensk

The complex is part of the *Economic and Social Development of the Far East and Transbaikalia until 2015*. Pursuant to the set program RUR 45 million has been allocated for these purposes. The construction period is anticipated to take two years. The Construction costs constitute 9.5 million euro.

Construction of incineration plant in Vladivostok

Incineration plant is as part of objects of APEC summit in Vladivostok. Potential contractor may represented by Chinese company.
Construction of waste transfer station in Khabarovsk
The waste transfer station "Severnaya" is going to be constructed in Khabarovsk. The cost of the project is Euro 15.5 million (including equipments and vehicles). The capacity will amount to 600 thousand m^3 of wastes. In august 2009 the Project was submitted to the State Expertise

Construction of landfill in Vladivostok

The design cost of this project amounts to 66 RUR million. The tender for design has won the federal company "Gostekhstroy", The capacity of the landfill is estimated as 1 million of solid wastes annually,. The project envisages as well mechanical treatment facility, storm waters treatment plants and biological treatment facilities.

Urals Federal District

Construction of Waste Paper Treatment Plants in Chelyabinsk Region

Lafarge Group (France) plans to build a waste treatment plant in the Urals to produce fuel for cement plants. The first plant will be located in Chelyabinsk Region next to the plant of *Uralcement* owned by *Lafarge*. The overall investments in the construction of a single site is estimated in the order of USD 3.5 million.

Siberian Federal District

Construction of Waste Treatment Plant in Kemerovo Region (Ulus village)

A waste treatment plant with the capacity of 200 thousand tons/year will be built in Kemerovo Region, as the local administration informs.
According to the information, 80 ha have been allocated for development near the stone quarry beyond the village of Ulus, not far from Kemerovo.

Waste Treatment Plant in Koltsovo, Novosibirsk Region

The plant is planned to build in 2010. In 2008, the Municipality of Koltsovo signed an Agreement of Intent with *Key Industry Engineering Group*, a Czech Company. The plant will do deep processing of organic compounds with the capacity of 20 tons/day. The project values in USD 6 million.

Surgut municipal services development project

Surgut Municipal Unitary Enterprise "Gorvodokanal" has applied for a loan from the European Bank for Reconstruction and Development to implement an investment project to improve wastewater services in the City of Surgut.

The proposed project, which has the total estimated costs equivalent to EUR 50,000,000 will require procurement of the following goods, works and services:

- Construction of gravity collector
- Construction of pressure wastewater main
- Construction of wastewater pumping station
- Project implementation support

Open tenders for the above works are expected to commence in the fourth quarter of 2009.

Construction of waste segregation complex in Tomsk Region

The investment agreement on construction of a new waste segregation complex was made between the government of Tomsk Region and the group of companies "Eco-sistema" in 2008. The capacity of the complex will be 200 thousand of wastes. The total cost of this project is RUR 350 million. Financing will be gained both out of own funds of investor and attracted funds.

12 Exhibitions and Conferences

This chapter lists important events in the domain of waste and waste water treatment that take place regularly in the Russian Federation. The nearest event in 2009 will be Wasma-2009 (see first table in this Chapter). The official date for events for 2010 has not been published yet.

"Wasma-2009 Waste Collection, Treatment and Recovery Equipment and Technologies "
Date and Place of conducting: **October 13th 16th, Moscow, Crocus Expo** Initiator: International Exhibition Company MVK. Patronage: Government of Moscow. With support from: Federal Agency for Environmental, Technical and Nuclear Supervision, Department for Environmental Management and Protection of the City of Moscow, the International Assembly of Capitals and Major Cities. The range of issues raised at the forum-exposition WASMA is closely linked to the environmental, economic, technical and social issues that basically all developed countries face. These are industrial and consumption waste collection, handling, recycling and reuse. The target of the forum-exposition was to allow the industry to show new equipment, the newest concepts and state-of-the-art technologies which may promote the resolution of one of the global current tasks, that is of health and environment protection from negative impacts by industrial and domestic waste.

"INTEGRAL USE OF SECONDARY RESOURCES AND WASTE, 2nd Academic and Research Conference"
Date and Place of conducting: **September 24th-25th, St. Petersburg** Initiator: Federal Agency for Science and Innovations (Rosnauka). With support of and featuring: Russian Ministry of Science and Education, Government of St. Petersburg, St. Petersburg Recycling Association.

Siblespolzovanie. Woodworking – 2009
Date and Place of conducting: **September 15th-18th, 2009r. 253A Baikalskata St., Irkutsk, Russia** The 15th International Exposition of timber, woodworking technologies, new tools, tooling and wood industry equipment Primary topics: - Logging and woodworking: state-of-the-art techniques, machine tools, machines, mechanisms, equipment, tooling, tools - Deep processing of timber: equipment and technologies - Forestry management, forestry, forest protection, resource and forest use monitoring - Scientific concepts, investment projects, leasing of equipment, consulting, credits - Wood industry products: timber, cellulose, paper, plywood, wood wool slabs, finishing materials - Timber protection and processing media - Wooden housing: architecture, technologies, materials, services - Recycling techniques and equipment - Workwear, personal protective clothes

6th International Exposition for Waste Management and Environmental Technologies WasteTech-2009

Date and Place of conducting: May 26th-29th, 2009,
Location: Moscow, Pavilion No3, Crocus Expo
Topics WasteTech embraces the entire spectrum of environmental equipment and services.

- Waste management and recycling
- Collection and handling, treatment techniques, integrated waste management, minimization of waste, recycling, products of waste
- Special exposition ScrapExpo
- (ferrous and nonferrous scrap metal management)
- Beautification of communities
- Winter and summer street cleaning. Landscaping. Beatification of yards
- Treatment of waste water and sediment management
- Control of air pollution Luft-Tech
- Industrial and sanitary cleaning of dust and gas emissions from industries and transport, aspiration, ventilation, deodorization and aid conditioning in industrial facilities
- Rehabilitation of polluted land and water areas
- Energy
- Recycling waste into energy. Bioenergy (biogas, solid biofuel). Renewable sources of energy (solar and wind energy, smaller hydroenergy, thermal resources, geothermal energy). Kioto protocol: implementation mechanisms. Energy-efficiency and resource-efficiency
- Pollution control
- Industrial washing and cleaning
- Safety and labor protection

Initiators
•Firm SIBIKO International JSC
•EKVATECH JSC

CityPipe-2009

Date and Place of conducting: May 26th-29th, 2009. Moscow, Crocus Expo

4th International Exposition CityPipe-2009 “Pipeline Systems in Housing and Utilities: Construction, Diagnostics, Operation and Maintenance "

The CityPipe exposition is dedicated to the issues associated with construction, operation and maintenance of pipeline systems within the metropolitan infrastructure.

Initiator: Firm SIBIKO International JSC

Environment in a Big City International Environmental Forum
Date and Place of conducting: March 18th-20th, 2009 Location: St. Petersburg, Lenexpo Complex, Pavilion No7 Topics WASTE MANAGEMENT: TECHNOLOGIES AND EQUIPMENT An industrial fair for equipment and technologies associated with industrial and consumption waste collection, treatment, handling, recycling, recovery, sterilization and disposal. WATER TREATMENT An exhibition of equipment and technologies associated with waste water treatment, industrial water treatment, water supply and water discharge. Water are treatment. AIR TREATMENT An exhibition of equipment and means for protecting air from stationary and movable pollution sources. ENVIRONMENTAL SERVICES AND EQUIPMENT An exhibition of environmental and legal support of projects, instruments and laboratory equipment, safety and labor management media.

13 Conclusions and Recommendations

Summarizing the information provided the following key highlights should be mentioned as conclusions.

Waste Management - The current Russian waste management regulation system is mainly aimed at the provision of environmental safety in waste handling, i.e. regulation of handling waste deemed as environmental pollutants. Basically, no regulation of handling waste deemed as secondary material resources actually exists.

However, the positive headway started to pick up in the last years. Therefore, Regional programmes and strategies in waste management were adopted in some of the Regions in the Russian Federation, like e.g. Moscow, St-Petersburg, Vladivostok, Murmansk, Perm krai. The common main targets of these initiatives are:

- Minimization of waste generation;
- Maximization of re-use
- Minimization of landfilling and reclamation of landfills
- Provision of safe storage, treatment and utilization of waste

Regarding the waste generation volume there are about 4 billion tons of wastes being generated annually in the Russian Federation. Most of this amount are industrial wastes (3 billion tons). A large amount of accumulated waste is normally placed on factory sites occupying vast territories. As of late 2007, the factory sites had 26.7 billion tons of waste.
The huge amount of industrial waste generation and huge accumulation of this waste at the industrial sites present a significant environmental issue and requires relevant solutions.

Segregation and segregation at source are rather outstanding element of the entire waste management system. Separate collection of glass, plastics and paper has been introduced in a very limited scale in the cities of the Russian Federation. This is because of shortcutting of legislative regulation, absence of solid requirements to segregate wasters, lack of public awareness as well as absence or lack of bring stations and local disposal outlets.
Due to the absence of segregation at source solid municipal waste requires full initial segregation at the segregation facilities.
In Moscow 7 more segregation facilities are planned to be constructed till the year 2011.
Therefore any initiatives from the investors and contractors seem to be reasonable in this area.
As for promotion of segregation at source any initiatives seem to be premature for the time being.

Transportation of wastes is characterised by the following key features: long average distance from waste generator to the disposal outlets, low compression ratio in garbage tracks (therefore low efficiency), absence or lack of transfer station. Transfer stations are presented in a very limited number in Moscow and S.-Petersburg.

Regarding waste treatment incineration prevails under other methods. However, the lack of incineration capacity is identified in the Russian Federation.
In Moscow by the year 2025 total incineration capacity is going to be increased to 2850 thousand tons (today - 580) by construction new incineration facilities. Estimated investments will amount 60 billion rubles. In some of the Regions such projects are also going to pick up as well.
In this regard initiatives in providing technology, design solutions, know-how, equipments etc are welcome from contractors.

Recycling is presented in a very limited scale in the Russian Federation. According to the different information sources the rate from total waste generation going to recycling amounts to 3-5 %.

In demand are only high liquid wastes like metal scrap, cullet, polymeric and wooden wastes, class wastes, wastes generating in electro energy production, steel making, chemicals and construction wastes.
Market of metal scrap processing is developed most of all. Recycling of other categories seems to be not profitable at the moment due to that the cost of recycling includes also collection, segregation and transportation of wastes to be recycled.

Landfilling is still the most common way of waste disposal in the Russian Federation. According to the different appraisals there are 90 – 96 % of total wastes generated in the Russian Federation being dumped into landfills. Most of the landfills are overfilled and still being operated, some of the landfills represent environmental and epidemiologic hazard and require significant upgrade.
In this regard, capacity extension, upgrade, closure and further reclamation are the main activities might require know-how from potential contractors.
The existing potential projects can be mentioned here: Capacity extension of landfills “Iksha,” “Khmetievo”, “Timokhovo” to 4000-4500 thousand tons per year in Moscow Region.

Biogas (landfill gas) production is still in a very initial stage of market development in the Russian Federation. At the moment, some single pilot projects exist.
There are certain difficulties associated with the distribution of energy produced from landfill gas. First of all, it is connected with non-existent legislation as to the transformation of “alternative” electric energy, as well as laws binding consumers to buy alternative energy. This detains the vast spread of the technology in Russia. In present conditions, the use of landfill gas for landfill purposes or for local consumers is more realistic.
The Russian Federation still does not have a national program stimulating the installation of biogas facilities, let alone major biogas plants.

Wastewater treatment facilities - More than 80 % of facilities in small towns and settlements of the RF do not operate properly and do not provide proper treatment quality. This is because of unserviceability during long period of operation, decline and stop of biological treatment in cold season, quick death of active sludge while shut-down of energy supply in emergencies. All the above belongs to biological treatment techniques.

About 50 km^3 of waste waters are being discharged annually into surface water bodies; about 30 % of this volume is contaminated with different pollutants.

Note, that any planned production facility in case of non-conformance of discharge with the established standards must envisage a waste water treatment facility. Otherwise, the project won't be possible whatsoever. So, design and construction of local treatment facilities is much required in this regard.

The market of local waste water treatment facilities is quite mature and mostly presented by domestic design and construction companies.

The review of the waste and waste water market demonstrated high requirement in waste treatment facilities and increase of capacity of waste water treatment facilities.
The reasons here are the increase of waste and waste water generation, lack of existing facilities, exhaustion of available landfills, worn-out state of waste water treatment facilities.

Today both domestic and foreign investors (private equity companies and banks) reflect the interest to the waste and waste water market. The demand to equipments on waste treatment is increasing by 20 % every year.
The major Russian investors in waste treatment are group of companies “Eco-sistema” (investments into Tomsk segregation complex and incineration facility and landfill in Astrakhan Region), LLC “Partner-Invest” (Waste treatment facility in Voronezh Region), JSC “Direction of Environmental Programs” (Waste treatment facility in Stavropol krai).

Foreign investors: Advanced Recycling Technology (waste treatment facility in Nizhniy Novgorod), Remodis (waste collection and segregation facility in Nizhniy Novgorod), DSD (waste management concept for Nizhniy Novgorod Region), Key Industry Engineering Group (Waste treatment facility in Koltsovo, Novosibirsk Region), EBRD (Surgut municipal services project), NEFCO (Petrozavodsk water supply and sewage system reconstruction)

About 80% of market of equipment for waste processing facilities is covered by foreign companies. Most of them are Asian companies – China and South Korea. However, European suppliers prevail in number in certain waste treatment segments like waste segregation and thermal treatment techniques.

The biggest companies operating in different waste segment and importing equipments are as follows:
Segregation:
JSC "Tiskond", Coparm (Italy), Sacria Industries (France), Imabe Iberica (Spain), Persona (Sweden)

Thermal treatment techniques:
Keppel Seghers, Austrian Energy and Environment, CNIM, Steinmuller Engineering, AMIG.

Waste treatment facilities construction and design:
HGMA Wulf GmbH (Germany), Key Industry Engineering Group (Czech), ILF-Engineering (Austria), ASA International GmBH (Austria), Advanced Recycling Technology (UK), Dual System Deutschland (Germany), MCI (UK), GFA Envest (Germany), FFK (Germany) and Remondis (Germany).

Plastic waste processing:
Shuagma (China), Lisheng (China), Sky Star Hi-polymer technologies, South China Service group LTD (China).

Scrap metal processing:
Delta (South Korea), TIANFU MACHINERY (China).

Fuel briquettes making - Luniwei (China)
Presses for wastes - XLHJ Construction Group (China)

The volume of investments depends on complicity of waste treatment techniques and type of equipment which is going to be installed at a plant.
For example construction of a modern landfill (capacity – 30-40 thousand ton) may cost 6-10 million. Euro; construction of waste treatment plant as well as incineration plant may require 20-90 million. Euro.
Design and construction of local waste water treatment facilities of capacity of 10,000 m3/day will cost 3 million Euro, 5000 m3/day – about 1.5 million Euro.

A as whole, any waste treatment initiative is considered as high capital investment. Profitability and payback period indicators of projects are particular in each case and depend on many factors, like:

- Utilization rates
- Mandatory deductions
- Equipments specific
- Regional market conditions

At present existing treatment facilities operate with a profit of 20 % and higher. The produced secondary resources became more attractive from the side of consumers.

In respect to the input of Dutch companies into Russian waste and waste water sector it is reasonable to turn attention to the planned investment projects listed below:

- Construction Waste Processing Complex in Moscow
- *Environment and Natural Resources* Regional Target Program in 2006-2010, Voronezh Region
- Waste Paper Processing Plant in Lipetsk

- Construction of Transfer Station in Samara
- Construction of waste segregation facility in Tula Region
- Construction of waste treatment facility in Nizhniy Novgorod
- Volzhski Water Project
- Waste transfer stations in Samara
- Construction of waste treatment facility and new landfill in Astrakhan Region
- Programs “Stop Discharging Non-treated Waste water in St. Petersburg reservoirs”
- Construction of Second Stage of A Waste Treatment Plant in Yanino (Central Factory of St. Petersburg State Unitary Enterprise *Zavod MPBO-2,* Vsevolozhsk District, Leningrad Region)
- Construction of waste incineration plant in Saint Petersburg
- Project “Integral Reconstruction of Water Supply and Sewer Treatment Facilities in Petrozavodsk”
- Construction of Waste Treatment Plant in Arkhangelsk
- Vologda Municipal Water Services Project
- Reconstruction of Murmansk Waste Water Treatment Facilities
- Construction of segregation facility in Murmank
- “Clean House” Investment project, Rostov-on-Don
- Construction of Waste Treatment Facility in Sochi
- Construction of waste treatment facility in Stavropol krai
- “Reconstruction and Development of Water Supply and Sewer Systems in Vladivostok” Project (2008)
- Construction of *BlagEco* Treatment Complex, Blagoveshchensk
- Construction of incineration plant in Vladivostok
- Construction of waste transfer station in Khabarovsk
- Construction of landfill in Vladivostok
- Construction of Waste Paper Treatment Plants in Chelyabinsk Region
- Construction of Waste Treatment Plant in Kemerovo Region (Ulus village)
- Waste Treatment Plant in Koltsovo, Novosibirsk Region
- Surgut municipal services development project
- Construction of waste segregation complex in Tomsk Region

Here, would be helpful to present Dutch know-how, equipments, and new technologies in waste water treatment, waste processing as well as recycling. In this regard the possibilities for Dutch Government and business institutions to advise Russian counterparts on BtoB level seem to be high.

Considering the current shortcoming of waste management system in the Russian Federation we foresee some opportunities on GtoG partnership with the Netherlands (e.g. on transferring of experience on waste management institutional framework).

Identified areas of concern where considerable improvements are required are landfills, lack of waste incineration treatment facilities, lack of recycling facilities, worn-out waste water treatment facilities and full absence of these facilities in some of the RF Regions.
All those indentified areas of improvement can potentially be the subject of interest for the Dutch companies.

Regarding the investments into Russian waste and waste water sector, gaining profit is more likely in case of creation of large high-tonnage production. The mandatory condition here is presence of own procuring system.
Alternative option is processing of a certain kind of waste. The single-purpose production has an advantage in a way that for such companies it is easier to search partners and clients and react in changing market conditions.
Low profitability of waste water treatment facilities which utilize traditional techniques (payback period more than 20 years) is the main constrain for private investments into this sphere. According to expert judgment only introduction of new techniques will enable to reduce capital and operation costs and will attract private investments. This trend started to pick up in the last years in the Russian Federation.

Attachment 1: List of waste management facilities planned to be developed in Moscow

List of waste management facilities to be developed to achieve established targets (according to Moscow Resolution "Building the Technical Basis for Municipal Waste Treatment in the City of Moscow dated from 22.04.2008)

#	Facility/location	Existing capacity	Planned capacity	Functional purpose	Completion date
Thermal treatment					
1	Incinerator (in Altufiyevo district)	130	180	Thermal treatment of solid municipal wastes, medical wastes with production of heat and electric energy	2009
2	Incinerator Rudnevo	250	1st stage - 280 2nd stage - 600		2009 2011-2015
3	Incinerator (Northern Administrative District)	-	420		2011 - 2015
4	Incinerator (South-Eastern Administrative District)	-	450		2012 - 2015
5	Incinerator (North-Eastern Administrative District)	-	360		2012 - 2015
6	Incinerator (Western Administrative District	-	360		2012 - 2015
7	Incinerator (South-Western Administrative District)	-	360		2012 - 2015
8	Incinerator in Zelenograd district	-	120		
	Total	380	2850		
	Estimated financing, billion rubles	60.07			
	Waste processing complexes (solid municipal waste and bulk waste)				
9	Waste transfer station in South Butovo	20	150	Accepting and segregation of wastes, extraction of secondary materials, after-segregation of pre-	2011

#	Facility/location	Existing capacity	Planned capacity	Functional purpose	Completion date
				segregated fractions of solid municipal waste, crushing, pallet-making	
10	Waste processing facility in Chertanovo district	100	400	Accepting and segregation of bulk waste, secondary materials extraction, after-segregation of pre-segregated fractions of solid municipal waste, as well as wastes of electrotechnics	2011
11	Waste processing facility in Biryulevo	-	100		2011
12	Waste processing facility in Zelenograd		50		2011
13	Waste processing facility in Avtomotornaya area (Northern Administrative district)	-	100		2011
14	Waste processing facility in Southern Ochakovo district	-	100		2011
15	Waste processing facility in Ochakovo district	-	100		2011
16	Waste processing facility in Chagino industrial area	-	150		2011
17	Waste processing facility in Trikotazhnaya industrial area	-	90		2011
	Upgrade and conversion of existing facilities				
18	Waste transfer station in North-Eastern Administrative District	300	375	Accepting and segregation of solid municipal waste, secondary materials extraction, after-segregation of pre-segregated fractions of solid municipal waste, pressing, transshipment	2012 - 2015
19	Waste transfer station in Eastern Administrative District	100	100		2012 - 2015
20	Waste Processing facility in Southern Administrative District	300	375		2010
21	Waste transfer station in South-Eastern Administrative District	100	120		2012 - 2015
	Total	920	2210		
	Estimated financing, billion	7.202			

#	Facility/location	Existing capacity	Planned capacity	Functional purpose	Completion date
	rubles				
	Thermal treatment of medical wastes (Б, В, Г -fractions) and hazardous fractions of solid municipal wastes				
22	Production area within water treatment facilities in South-Eastern Administrative District	-	30	Thermal treatment of hazardous fractions of solid municipal wastes including medical wastes “Б” and “В”	2010
23	Veterinary and sanitary Facility “Ecolog”	24(1)	24	Thermal treatment of hazardous biological wastes including medical wastes	2011 (According to the last media information this facility is going to be relocated from Lyubertsy town to Voskresensk district of Moscow Region)
	Total	24 (1)	54		
	Estimated financing, billion rubles	4.060			
	Construction of new sites on processing of segregated fractions of solid municipal wastes in the territory of existing facilities				
24	Production area in South-Administrative District	-	20	electrotechnics wastes processing	2010
25	Production area in South-Eastern District		10	Automatic segregation and recycling of pre-selected polymeric and metal-containing wastes	2010
26	Production area in Soutern District, in the territory of water treatment facilities “Kotlyakovo-Kolomenskiye”	-	35	Recycling of packing made of polyethylene terephthalate. Automatic segregation and recycling of pre-selected polymeric and metal-containing wastes and wastes of electrotechnics	2011
	Total		65		
	Estimated financing, billion rubles	0.810			
	Capacity extension of landfills “Iksha,” “Khmetievo”, “Timokhovo” to 4000-4500 thousand tons per year /Construction of production sites to process and to landfill solid municipal wastes and unrecyclable content of waste extracted in the waste processing facilities				
27	Special complex in South-Eastern Administrative District	-	100	Processing of plant wastes and food wastes, pre-treatment of bulk wastes with extraction of plant fraction	2010
28	Production sites for mechanic-	-	800	Mechanic-biological processing of organic fraction of	2010

#	Facility/location	Existing capacity	Planned capacity	Functional purpose	Completion date
	biological processing of wastes at the landfills “Iksha”, “Khmetievo”, “Timokhovo”			municipal wastes, plant wastes, ashes from incinerators, collection and utilization of biogas to produce electric energy or engine fuel	
	Total		900		
	Total estimated financing, billion rubles	2.030			
	Selective collection and accumulation of secondary materials				
29	Bring stations (stationary, semi-stationary, mobile)	-	830 points (1 per 12.5 thousand people)	Accepting of secondary materials from residents and companies on a paid basis	2012 - 2015
	Automatic terminals “Fandomat-M”, “Fandomat-Terminal”	-	6100 items (1 per 1.7 thousand people)		
	Special containers for selective collection of wastes	-	29200 items (1 per 0.4 thousand people)	Selective collection followed by further after-segregation at the waste processing facilities	
	Total estimated financing	1.543			
	Selection of land plots, design and construction of Regional facilities to process and to landfill wastes				
30	Regional facilities southward Moscow		800 - 1000		2012
31	Regional facilities westward Moscow		800 - 1000		2012
32	Regional facilities eastward Moscow		800 - 1000		2012
	Estimated financing	4.205			
	Total estimated financing, billon rubles	79.920			

Attachment 2: List of RF companies dealing with waste and waste water treatment

#	Company name	Contacts
Waste incineration equipments and techniques		
1	EMAlliance	Address (Moscow branch): Dorozhnaya street, 60 B, 117405 Moscow Tel.: +7 (495) 787 3148 Fax: +7 (495) 787 3143 E-mail: info@em-alliance.com Website: www.em-alliance.com
2	GUP "MosvodokanalNIIprojekt"	Address: Pleteshkovskiy pereulok, 22, Moscow, 105005 Tel: +7 (499) 261 5384, +7 (499) 263 0138, Fax: +7 (499) 261 7775 E-mail: post@mvkniipr.ru Website www.mvkniipr.ru
3	GUP "Mosecostroy"	Address: Shumkina str., 16, Moscow,107113 Tel: +7 (495) 544 2162 Fax: +7 (495) 544 2161 E-mail: gup@mosecostroy.ru Website: www.mosecostroy.ru
Waste segregation equipments and techniques		
1	JSC "Stankoagregat"	Address: Porovskoye shosse, 21, Moscow, 109202 Tel.: +7 (499) 170 5601, 174 2492 Fax: +7 (499) 170 5983 E-mail: cc@stanko-agregat.ru Website: www.stanko-agregat.ru
2	Company Nordicalliance	Address: Bolshaya Pochtovaya str, 55/59, bld.1, 105082, Moscow Tel: +7 (495) 921 3652 E-mail: info@em-alliance.com Website: www.baler.ru
3	Company MSK "Stanko"	Address: Gilyarovskogo str, 65, Moscow, 129110, Tel: +7 (495) 681 4416 Fax: +7 (495) 688 5788 E-mail: msk-stanko@mail.ru Website: www.msk-stanko.ru
4	NPP LLC "Rekstrom-M"	Address: Spasonalivkovyi pereulok, 17 building 2, Moscow, 119049 Tel/Fax: +7 (495) 365 4985 E-mail: pochta@rextrom.ru, rextrom-m@rinet.ru Website: www.rextrom.ru
5	Company "Dormarsh"	Address: Kromskoye shosse, 3, Orel, 302042 Tel: +7 (4862) 724 305, 720 158 Email: market@orel-dormash.ru Address: Kalanchevskaya Street, 15A, Moscow, 107078 Tel: +7 (495) 926 1188 Email: Moscow@chel-prom.ru Website: www.orel-dormash.ru
6	JSC "Tiskond"	Address: Argunovskaya str., 2, build. 1, office 1219, Moscow, 129075 Tel: +7 (495) 933 7181 Tel/Fax: +7 (495) 933 7181 E-mail: tiscond@mail.ru Website: www.tiscond.ru

Glass wastes processing and recycling		
1	*MELZ* (Moscow Electric Lamp Plant)	Address: Elektrozavodskaya str., 21 107023, Moscow, Russia Tel: +7 (495) 963 7375 Fax: +7 (495) 963 4336 E-mail: comelz@melz-evp.ru Website: www.melz-evp.ru
2	LLC "Energotorgservis"	Address: Kalinina prospect, 26/1, office 11, Barnaul, Altai krai 656037 Tel/Fax: +7 (3852) 770 168, 773 223 E-mail: info@ets-barnaul.ru Website: www.ets-barnaul.ru
3	LLC "Promitey"	Address: Soyuznyy prospect, 7A, Nizhniy Novgorod, 603040 Tel/Fax: +7 (831) 2730049, 2738366, 2739536, E-mail: prometei-nn@mail.ru Website:www.prometey.nn.ru
Plastic wastes processing and recycling		
1	LLC Polymer	Address: Desnogorsk, p/o box 10/3 Smolensk Region, 216400 Tel: +7 (48153) 32282; Fax: +7 (48153) 32282; +7 (48153) 71695
2	AngarskPoly-M	Address: Chaykovskogo str. 1 A, Angarsk, Irkutsk Region, Tel: +7 (3951) 533 347, 532 048, Fax: +7 (3951) 533 347 Email: hi-end.irk@mail.ru
3	LLC "Vtorplast"	Address: Kuybysheva proezd, 6, Murom, Vladimir Region Tel: (49234) 91216, 91913 E-mail: vtorplast2007@mail.ru Website: www.vtorplast.megasklad.ru
4	LLC "NPL Plastic"	Address: Krasnoarmeyskaya str, 1A, Kimry, Tver Region Tel: +7 (909) 901 9419 , (495) 978 2241 E-mail: npl@hotbox.ru Website: www.nplastic.ru
5	LLC "PET Technology"	Address: Baumanskaya str, 58/25, build. 16, Moscow, 105005 16 Tel: +7 (495) 771 2470 Tel/Fax: +7 (495) 223 7778, 492 9115 Website: www.pettech.ru
Rubber waste recycling		
1	Volzhsky Regeneratorno-Shinoremontny Zavod JSC	Address: Alexandrova str., 69, Volzhskiy, 404103 Tel: +7 (8443) 227059 E-mail: regenerat@vlz.ru
2	Tushino Mashinostroitelny Zavod JSC	Address: Svobody str., 35, Moscow, 125362 Tel: +7 (495) 495 50 53, 4933047, Fax: +7 (495) 497 53 51 Website: www.oao-tmz.ru/index_full.htm
3	Chekhov Regeneratorny Zavod JSC	Address: Chekhova str., 20Б, Chechov, 142300 Moscow Region Tel: +7 (49672) 7-05-00 Website: www.chrz.ru

4	Tamplier Centr JSC	Address: Bolshaya Novodmitrovskaya str., 14, office 21, Moscow, 127015 Tel: +7 (495) 685 6797 E-mail: centr@tamplierc.ru Website: www.tamplier.ru
5	Slansevsky Zavod Polymer JSC	Address: Dorozhnaya str., 3A, Stantsy, Leningrad Region, 188560 Tel: +7 (81374) 35 408, 24 170 Tel/Fax: +7 (81374) 21 700 E-mail: oaopolimer@mail.spbnit.ru, oaopolimer@yandex.ru
Metal scrap processing and recycling		
1	Profit JSC	Address: Gryaznova str., 34, Magnitogorsk, Chelyabinsk Region, 455037, Tel: +7 (3519) 204 359, 204 361, 204 095, Fax: +7 (3519) 203 555, 203 553 Website: www.profit.ru
2	Vtorchermet JSC	Address: Khimicheskiy pereulok, 4, Saint Petersburg,198095 Tel: +7 (812) 320 0440/-41 Fax:+7 (812)252 6544 Website: www.vchm.spb.ru
3	Vtormetproekt	Address: Karacharovskoye shosse, 8, build. 2, Moscow, 111398, Tel/Fax: +7 (495) 978 0537, (499) 786 7178 E-mail: lom199@mail.ru Website: www.vtormetproekt.ru
4	Vtortsvetmet JSC	Tel:+7 (499) 267 7997, +7 (495) 743 0260 E-mail:sokolov@vzm.ru Website: www.vzm.ru
5	Maxi-Scrap Siberia LLC	Address: Stantcsionnaya str., 60, Novosibirsk Tel: +7 (383) 325 1061 Fax: +7 (383) 353 6905 E-mail: mssib@yandex.ru Website: www.uralvtorchermet.ru
6	Obyedinenie Vtorchermet JSC	Address: Chukotskaya str., 2, Novosibirsk, 630024 Tel: +7 (383) 353 3958 Fax: +7 (383) 353 4013 Website does not exist
Paper waste recycling		
1	St-Petersubrg KPK JSC – part of Ilim group	Address (factory): Pavlovskaya str., 9, Kommunar, Leningrad region Tel: +7 (812) 460 2278, (812) 460 1696 Fax: +7 (812) 460 2287, (812) 460 1963 Ilim group: Address: Marata str, 17, 191025 Saint-Petersburg Tel.: +7 (812) 718 6050 Fax: +7 (812) 718 6006 E-mail: office@ilimgroup.ru Website: www.ilimpulp.ru

2	Naberezhnye Chelny KBK JSC	Address: Naberezhnye Chelny, p/o box 50, Tatarstan, 423808, Tel: +7 (8552) 49 1910, 46 8495, 46 6283, 46 1966 Fax: +7 (8552) 49 1992 E-Mail: postmaster@kbk.chelny.ru, sbit@kbk.chelny.ru Website: www.kbk.chelny.ru
3	Stupino KPK LLC	Stupino, Moscow region Tel: +7 (264) 20 540 Fax: +7 (264) 21 267 E-mail: stupex_jsc@mtu-net.ru Website: www.stupex.ru Managing company: Armyanskiy pereulok, 9, Moscow, 101000 Tel.: (7-095) 208 0445, 208 6365 Fax: (7-095) 207 9988 E-mail: novopack@novopack.ru
4	Kartontara JSC	Address: Profsoyuznyi pereulok, 2, 385012 Maikop, Republic Adygeya Tel: +7 (8772) 54 8862, (8772)54 9258, (8772) 54 8455 Fax: +7 (8772) 54 8820 E-mail: maykop@kartontara.ru Website: www.kartontara.ru
Wooden wastes processing and recycling		
1	Swedwood-Tikhvin LLC	Address: Shvedskiy proezd, 15, Leningrad region, 187550 Tel: (812) 331 1020, (921) 966 4913 Fax: (812) 331 1022 Website: www.swedwood.ru
2	Svir-Timber LLC	Address: 187742, Leningradskaya oblast Podporozhskij raion Poselok gorodskogo tipa Vazhiny ulitsa Karyernaya, No. 48 Russia Tel: +7 (812) 380 5166 Fax: +7 (812) 380 5179
3	Volosovksy LPK LLC	Address: 6th Sovetskaya str., 29, Saint Petersburg, Tel: +7 (812) 493 5103, +7 (812) 493 5104, +7 (812) 493-5105 Fax: +7 (812) 274 4542 E-mail: info@inok.spb.ru Website: www.inok.spb.ru
Waste water treatment plants construction and design		
1	GUP “Mosvodokanal	Address: Pleteshkovskiy pereulok, 2, Moscow,105005 Tel: +7 (499) 763 3434 Email: webmaster@mosvodokanal.ru Website: www.mosvodokanal.ru
2	LLC “Rosecostroy”	Address: Nagatinskaya str., 1, build. 26, Moscow, 117105 E-mail: office@rosecostroy.ru Tel/Fax: +7(495) 781 5098 Website: www.rosecostroy.ru

3	Biotal	Address: Nagatinskaya str., 29/4, Moscow, 115533 Tel: +7 (495) 937 6578 Address: Armavirskaya str., 8 A, Tuapse, Krasnodar krai, 352800 Tel: +7 (86 167) 27 835 E-mail: biotal@biotal.ru, kubovel@bk.ru Website: www.biotal.ru
4	Albatross	Address: Malodubenskoye shosse, 30, Orekhovo-Zuevo, Moscow region Tel/Fax: (495) 749 25 30 (496) 423 7740 (496) 423 4001 E-mail: info@biostok.ru Website: www.biostok.ru
5	Company “Ecos”	Address: Oktyabrya prospect, 67, Yaroslavl, 150054 Tel/Fax: (0852) 25 9964, 72 1918 E-mail: ecos@yaroslavl.ru Website: ecos.yaroslavl.ru
6	LLC “Ochistnye sooruzheniya”	Address: Koletvinova str. 6, office 302, Tula, 300007 E-mail: mail@1os.ru Tel/Fax: +7 (4872) 363 253 Website: www.1os.ru
7	LLC “StroyProjectCity	Address: Malaya Semenovskaya str., 9, Moscow, Tel: +7 (495) 580 3014 E-mail: spcity@mail.ru Website: www.spcity.ru

Other authorities and organizations which are based in the Russian Federation and can be useful for Dutch companies:

Organization Name	Functions	Head/Contact person	Contacts
Rostechnadzor (Federal service)	Approvals, licensing, inspections	The head of Rostekhnadzor – Nikolay Kutuyin	Lukiyanova str., 4/8, 105066 Moscow Fax: (495) 411 6022; (495) 261 6043 Taganskaya str., 34 build. 1, 109147 Moscow E-mail: rostehnadzor@gosnadzor.ru Website: www.gosnadzor.ru
Rospotrebnadzor (Federal service)	Sanitary control, inspections	The head of Rospotrebnadzor Gennadiy Onishenko -	Address: Vadkovskiy pereulok, 18, bld. 5 and 7, 127994 Moscow Tel: +7 (499) 973 2690 E-mail: depart@gsen.ru Website: www.rospotrebnadzor.ru
Moskomexpertiza (in Moscow)	Expertise of projects in Moscow	The head of Moskomexpertisa - Anatoliy Voronin	Address: 2-nd Brestskaya str., 8 Tel: +7 (495) 250 1701
Mosvodokanal (in Moscow)	Municipal water supply and sewage	Head of Mosvodokanal – Stanislav Khramenkov	Post address: Pleteshkovskiy pereulok, 2, 105005 Moscow Tel: +8 (499) 763 3434 E-mail: webmaster@mosvodokanal.ru Website: www.mosvodokanal.ru
Mosvodostok (in Moscow)	Surface water discharge	General Director – GUP Mosvodostok – Konstantin Ishkhanyan	Legal address: Novokuznetskaya str., 26/8 bld. 1, 119017 Moscow Actual address: Dmitriya Ulianova str., 7a, 117461 Moscow Tel: +7 (499) 132 7022 E-mail: epifanov@mosvodostok.info Website: www.mosvodostok.com
EBRD	funding	Contact person – Natasha Khanjenkova	Address: Ducat Place III Second floor 6 Gasheka Street Moscow 125047 Russia Tel: +7 (495/501) 787 1111 Fax: +7 (495/501) 787 1122 Email: Moscow@ebrd.com
IFC	funding	Contact person – Elena Bourganskaia Manager	Address: Bolshaya Molchanovka str., 36, bld.1, 121069 Moscow Tel: +7 (495) 411 7555 Fax: +7 (495) 411 7563 Website: www.ifc.org
World Bank	funding	Contact person - Marina Vasilieva - Sr.External Affairs Officer	Address: Bolshaya Molchanovka str., 36, bld.1, 121069 Moscow Tel: +7 (495) 967 3167 Email: moscow@worldbank.org Website: www.worldbank.org.ru