ВОДОКАНАЛ
САНКТ-ПЕТЕРБУРГА

SUE “Vodokanal of St.Petersburg” experience in water management and resource-saving efficiency improvement

PLATFORM BSR WATER
Interreg Baltic Sea Region
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
WITH FINANCIAL SUPPORT OF THE RUSSIAN FEDERATION

SUE "Vodokanal of St.Petersburg" is the largest water consumer in the Baltic Sea basin

9 water treatment plants
7,677.5 km of water supply network

21 wastewater treatment plants
3 sludge incineration plants
279.2 km of tunnel collectors
9,407.2 km of sewerage network

- Water intake from the source exceeds 1,500 thou. m3 per day
- Wastewater treatment volume surpasses 2,200 thou. m3 per day

Improving Eco-Efficiency of Water Management

Eco-efficiency of water management to be improved by:

Reducing water volumes taken out of water supply sources for the city needs.

Mitigating the negative impact of sewage discharge on water bodies.

Organizational and technical actions

- ✓ Implementation of sustainable water recycling systems at water treatment plants.
- ✓ Reduction of water losses in water distribution networks.

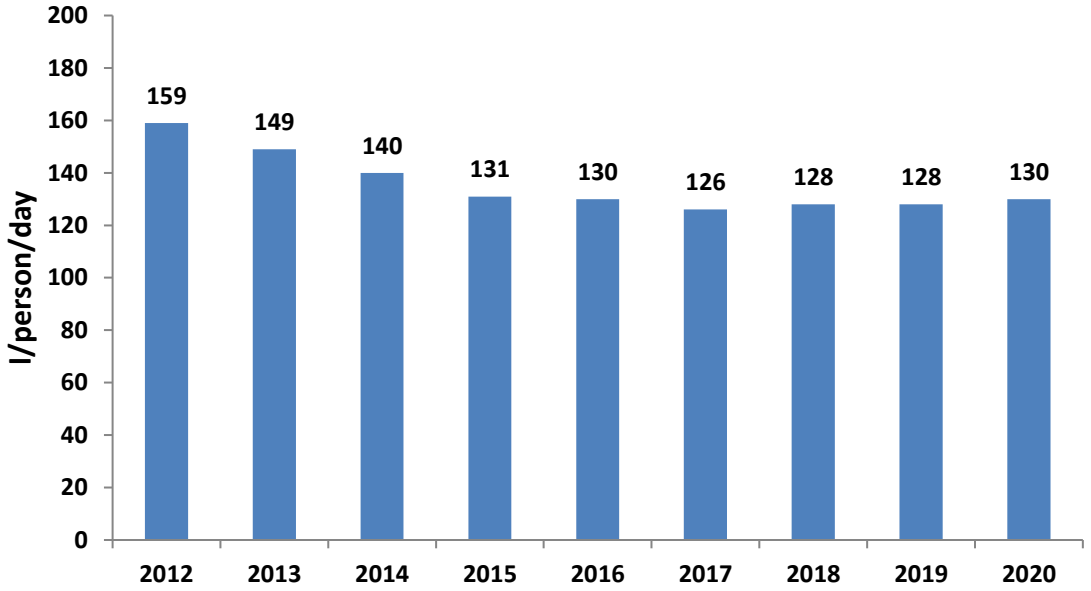
- ✓ Elimination of untreated wastewater discharge into water bodies under the Neva Untreated Wastewater Discharge Closure Programme.
- ✓ Retrofitting and modernization of wastewater treatment plants; implementation of environment protection technologies.

Outreach activities and awareness raising

- ✓ Training of water specialists, sharing practical experience in water technologies, environmental awareness raising.
- ✓ Organization of environmental workshops, learning programmes and events for schoolchildren and college students.
- ✓ The Universe of Water museum complex.

Reduction of water consumption in St. Petersburg

Specific cold water consumption in St. Petersburg in 2012-2020



Actions to reduce water consumption:

- ✓ Installation of individual cold water meters;
- ✓ Installation, modernization and operation of building-level meters; transition to actual water metering;
- ✓ Reconstruction and repairs of in-house water networks;

Water Supply Management System in Southern districts of St. Petersburg

Characteristics of the Southern water supply zone

Population 1,274 thou. pax.

Service coverage 194.7 km^2

Daily average water supply 496,000 m^3/day.

Number of residential buildings 6,498

Project rationale :

- Excessive pressure;
- A lot of damage at the network;
- High level of water losses;
- Low performance of pumping units;
- Manual taking of customers meter readings is inconvenient and does not provide timely and reliable information for settlement with customers.

Southern zone project results

	Prior to reconstruction (2010)	After reconstruction (2020)	Effect
Losses and non-revenue water in water supply network, thous. m3./year	28,544.8	11,872.4	58.4%

Employment of modern water-saving technologies in water treatment

K-6 new water treatment block was commissioned in 2011 at the Southern Water Treatment Plant and it encompasses state-of-the-art two-stage water treatment technology and water saving solutions

K-6 capacity is 350 thou. m3/day

Environmental efficiency improvement solutions were implemented:

- ✓ Recycling water supply system;
- ✓ Backwash water sludge disposal.

Outcome:

- Own needs water consumption reduced from **15%** to **3%**
- Backwash water direct discharge was stopped

Key actions to stop untreated wastewater discharge in St.Petersburg

1978	1st stage of Central WWTP with the capacity 750,000 m3/day is put into operation	27 %
2005	South-West WWTP with the capacity 330,000 m3/day is put into operation	85%
2011	Seven outdated and worn-out WWTPs are closed with 3,000 m3/day of wastewater diverted to Northern WWTP	94%
2013	Northern Tunnel Collector is put into operation, 76 direct discharges equivalent to 330,000 m3/day are diverted	98,5 %
2019	Modern WWTP with the capacity 2,500 m3/day is put into operation in Molodezhnoye settlement	98,6 %
2019	15 direct discharges equivalent to over 2,000 m^3/day are diverted of the Karpovka River	99,0%
2020	Okhta Collector completion (1 stage), 59 direct discharges equivalent to 27,000 m^3/day are diverted	99,5 %

Helsinki Convention

1974 – **The Baltic Sea Marine Environment Protection Convention (Helsinki Convention)** was signed by all countries of the Baltic Sea Region.

1992 – the **updated Helsinki Convention** was signed by the Baltic-states, as well as by the European Community and entered into force following to ratification on January 17, 2000.

1998 – Convention on the Protection of the Marine Environment of the Baltic Sea was approved **by the Russian Federation Government Decree № 1202 dated October 15, 1998.**

Principal objective of the Convention – protection of the natural marine environment of the Baltic Sea from all pollution sources, reclamation and preservation of the Baltic Sea environmental balance, provision of sustainable use of its natural resources.

HELCOM Recommendation 28E/5 "Wastewater Treatment"

Treated effluent parameters	1999	2006	2008-2021
Total nitrogen, mg/l	<10,0	<10,0	<10,0
Total phosphorus, mg/l	<1,5	<1,0	<0,5

Tasks within the environmental and sectoral legislation reforming in the Russian Federation

Federal Law № 225-FZ "On Amendments Being Made to the Federal Law "On Environmental Protection" and Certain Legislative Acts of the Russian Federation" dated 29.07.2017 came into effect on 01.01.2019

The new law divides responsibility for the negative impact on water bodies between Vodokanals and their customers

SUE "Vodokanal of St.Petersburg" initiated implementation of measures for the transition to process-oriented regulation in 2020:

- preparation of documentation for obtaining an integrated environmental permit (IEP) for the 1st category facilities;
- preparation of Environmental Performance Improvement Programs for the 1st category facilities.

Customers are obliged to:

- develop and approve discharges reduction plans with the Rosprirodnadzor authorities;
- Implement planned activities (incl. local WWTPs construction).

The SUE "Vodokanal of St.Petersburg" operates 8 facilities of the 1st category of negative environmental impact, 6 of which are wastewater treatment plants

No	I NEI category facilities	IEP obtaining term	Actions implementation term
1	CWWTP	up to 2022	up to 2029
2	NWWTP		
3	SWWTP		
4	Pushkin WWTP	up to 2025	up to 2032
5	Petrodvorets WWTP		
6	Kolpino WWTP		

Comparison of designed process indicators and "fishery" requirements

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Process indicators of the best available technologies for discharge into the Baltic Sea catchment area

Ranges/capacity of treatment facilities, incl.	Concentration values of pollutants in municipal wastewater, max, mg/l						
	SS	COD	BOD5	Ammonium nitrogen	Nitrates nitrogen	Nitrites nitrogen	Phosphorus phosphates
Big to large-scale (more than 600 thou. m3/day)	10	80*	6	1	9	0.1	0.7

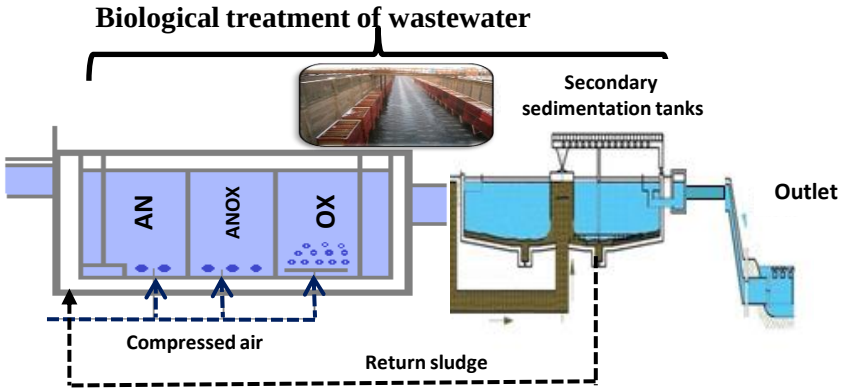
Requirements for the discharge quality based on the "fishery" MPC (regardless of the water body category)

Regardless of WWTP capacity	**0.25 + background**	**30**	**2**	**0.4**	9.0	**0.02**	**0.2**

Improvement of Biological Treatment Process

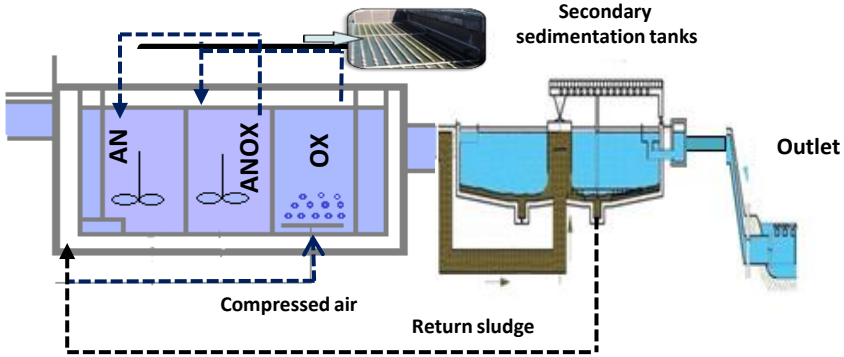
Process flow chart of wastewater treatment using Kreal biological treatment technology

Disadvantages:
- bubbling with coarse bubble aeration
- no controlled recycles



Process flow chart of wastewater treatment using up-to-date UCT and JHB biological treatment technologies

Advantages:
- membrane aerators, mixers
- internal recycling
- online water quality control devices



Clean Baltic Project, 2005 – 2011

Elimination of eutrophication, green-blue algae pollution of the Sea, is one of the principal environmental tasks of the Baltic region countries.

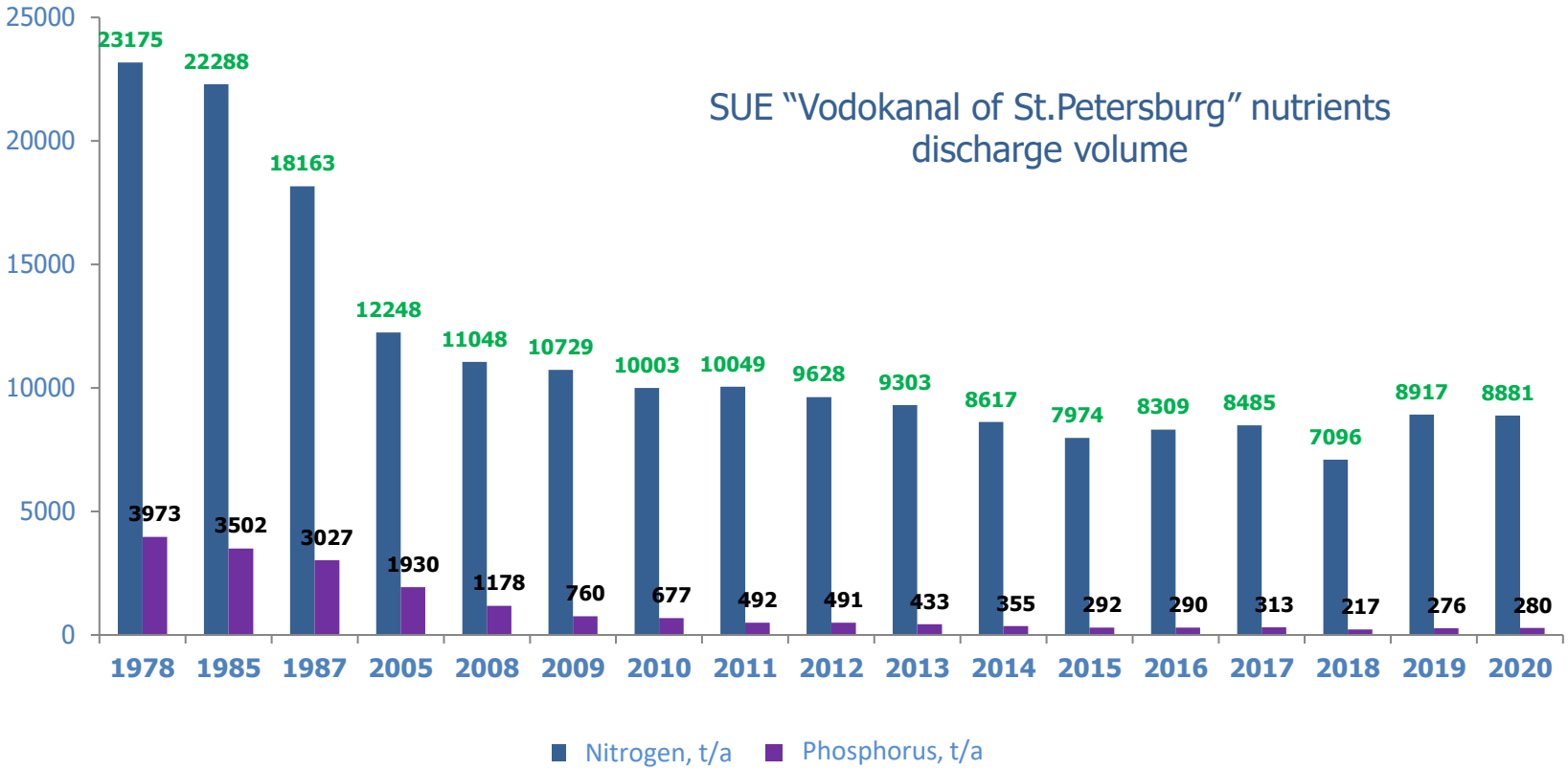
Clean Baltic is a joint project of Vodokanal of St.Petersburg, Finnish Ministry of Environment, Swedish international cooperation agency SIDA, and John Nurminen Foundation.

Project objective is wastewater treatment in compliance with HELCOM recommendations

Outcome:

- ✓ Enhanced phosphorus precipitation technologies are implemented at all St.Petersburg WWTPs since 2011.
- ✓ Ca. 10 tons of phosphorus are precipitated daily
- ✓ Average phosphorus content in overall discharge is less than 0.5 mg/l

Nutrients load reduction



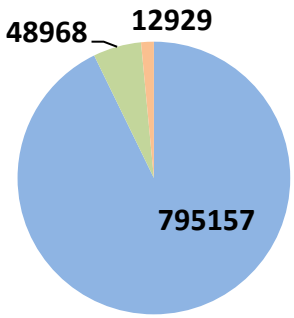
Annual phosphorus removal level at Vodokanal's WWTPs exceeds **3,000** tons

Surface runoff

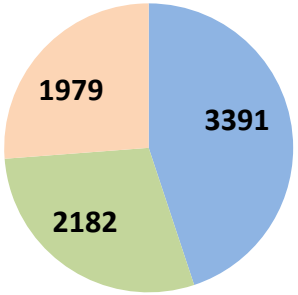
Percentage of surface runoff in the total volume of wastewater collected by the centralized wastewater system

30%

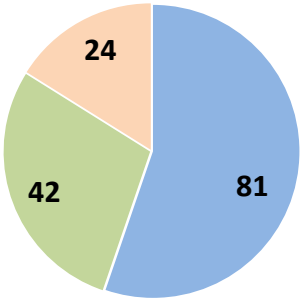
Wastewater discharge, thou. m3/year

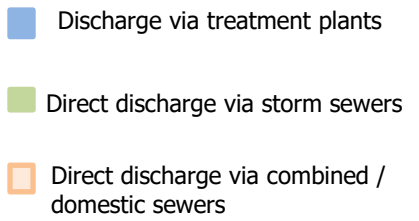


Discharge of suspended solids, t/year



Discharge of oil, t/year





Surface runoff collection and treatment actions

Atmospheric precipitation metering system is implemented

34 precipitation gauges

Surface runoff treatment plants

Search for new process solutions to treat surface runoff

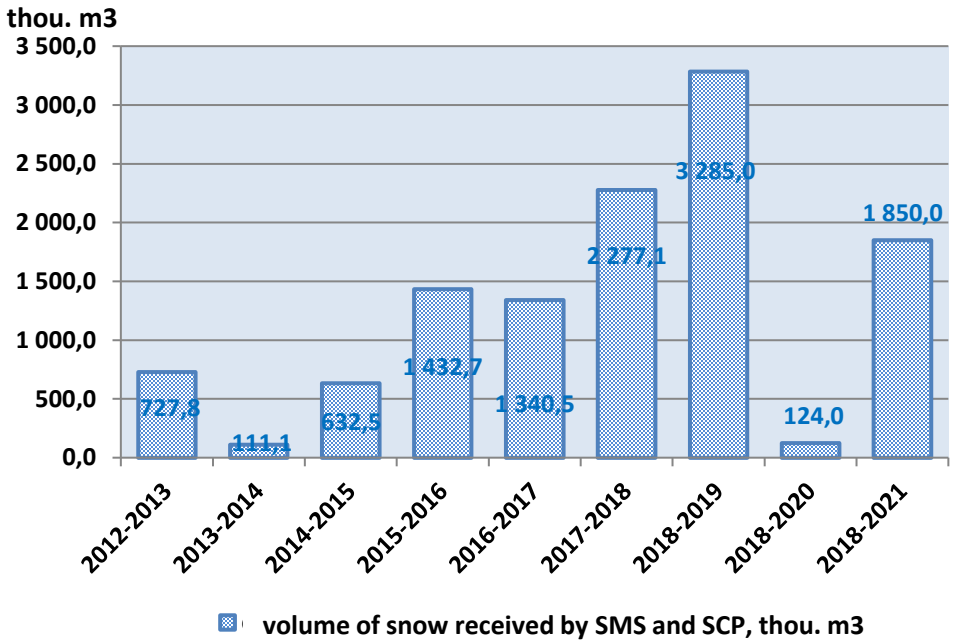
Cartridge filters in stormwater sumps

Discharge of polluted snow into the city water bodies is stopped

In St. Petersburg, there are:

- ✓ 11 permanent snow-melting stations
- ✓ 7 permanent technically-equipped snow collection points

Volumes of snow received by permanent snow melting / collection facilities in winter periods 2012-2019



Environmental benefit

In one season of snow-melting stations operation the city water bodies evade

> 100 thou. tons of sand

> 150 tons of litter

Sludge incineration plants

CWWTP SIP since 1997.

SWWTP SIP since 2007

NWWTP SIP since 2007

St.Petersburg is the first city to solve the wastewater sludge utilization challenge.

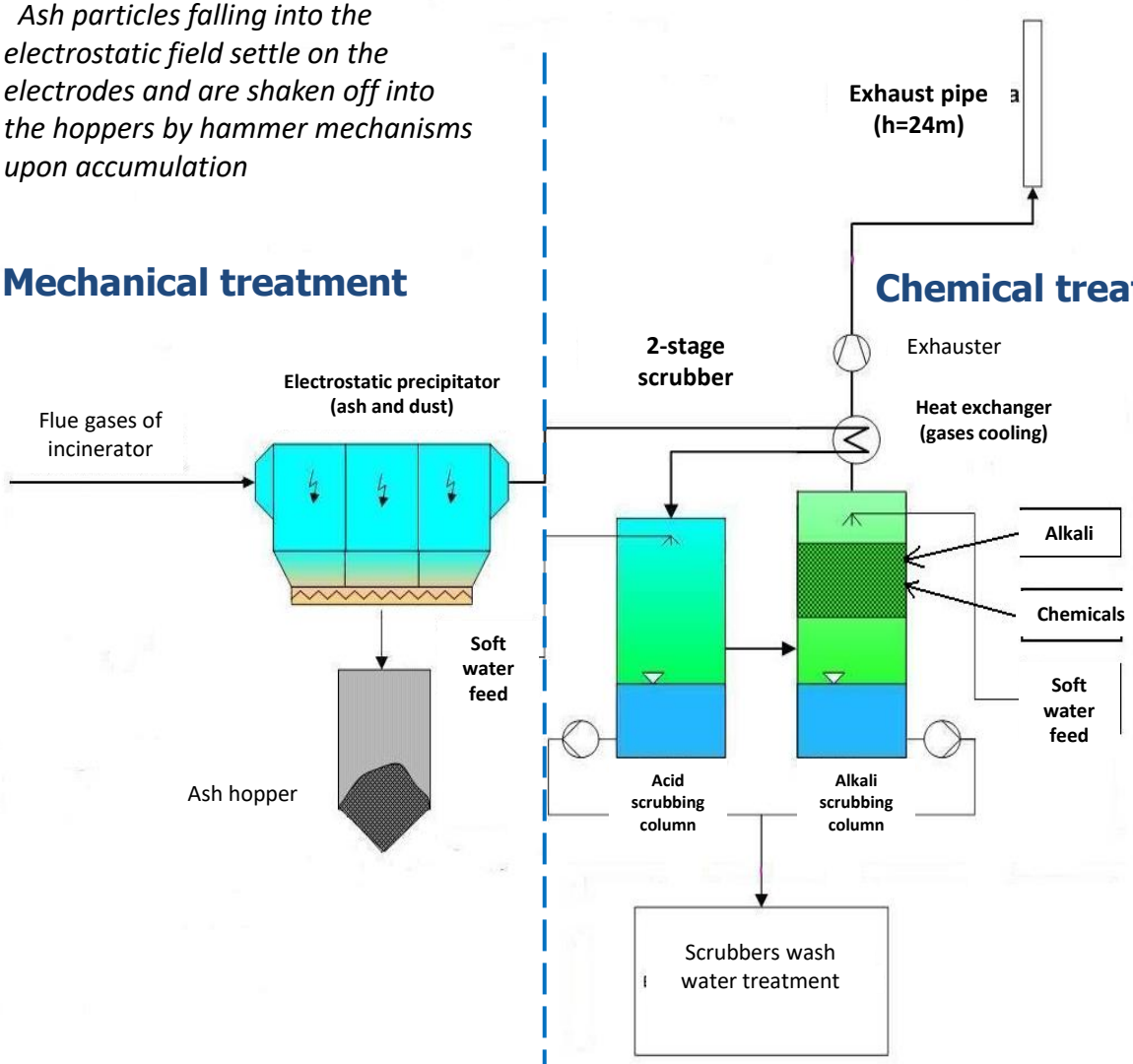
Vodokanal has 3 sludge incineration plants.

- 100% utilization of dewatered sludge;
- Sludge incineration with ash formation, 10 times reduction of sludge volume;
- Commercial use of ash is possible;
- No pathogens or unpleasant odor in the ash;
- Concentrations of hazardous substances in the cleaned flue gases produced by sludge incineration fully comply with the standards of the Russian Federation and EU
- Flue gas heat recovery for hot water supply and space heating;
- Steam utilization. Electricity production is possible.

Flue gases treatment at sludge incineration plants

Electrostatic precipitator - ash removal from flue gases.

Ash particles falling into the electrostatic field settle on the electrodes and are shaken off into the hoppers by hammer mechanisms upon accumulation



In the acid scrubbing column, gases are sprayed with water**.**
Due to the scrubbing liquid and flue gases interaction, acid-forming contaminants are removed.

In the acid scrubbing column -

- Alkali dosing. *Sulphur compounds and other pollutants removal*
- Chemical dosing for metals binding.

Gas treatment system performance

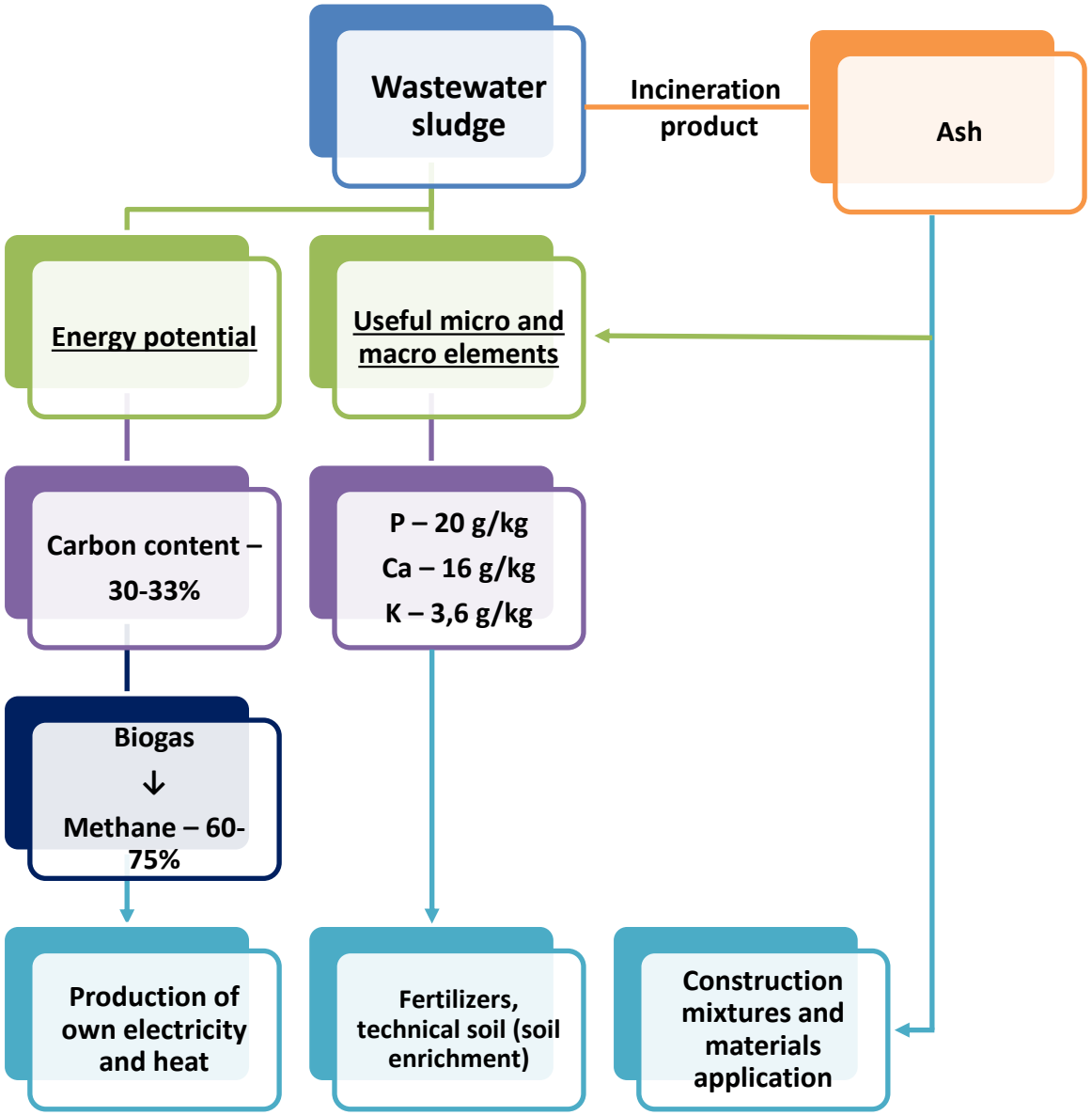
Snails control composition of flue gases at the SWWTP SIP.

Flue gas treatment systems at the SWWTP and NWWTP SIPs are identical.

Chemicals applied for gases treatment	
Limestone	Sulphur oxides sedimentation
Hydrochloric acid	Feed water pH adjustment
Sodium chloride	Feed water softening
Ammoniate PK-2, KO-3	Feed water quality adjustment
TMT-15	Heavy metals sedimentation
Ammoniate PK-2, KO-3	Quality adjustment
Ferrous chloride	Coagulation of sediment solids in discharge water
Sodium hydroxide	Neutral environment development for Sulphur oxides retaining

Sludge incineration plant (SIP)	Pollutants emissions, mg/m3					
	Inorganic dust: 70-20% SiO_2		Sulphur dioxide		Mercury compositions	
	Standard	Actual	Standard	Actual	Standard	Actual
CWTP SIP	10	5	50	34	<0.05	<0.0003
NWTP SIP		10		34		<0.00017
SWWTP SIP		4.4		45		0.00088

Wastewater Sludge Application Options



HELCOM Recommendations

The Helsinki Commission (HELCOM) initiated the implementation of the Baltic Sea Region Environmental Policy by developing:

- common environmental goals;
- actions to reach the goals

HELCOM		
2007 Recommendation 28E/5 "Municipal Wastewater Treatment"	**2015 Draft Recommendation for sewerage sludge treatment**	**2018 Draft Recommendation for nutrients recycling**
Objectives: 1. Reduction of nutrients load on the Baltic Sea Parameters of effluent discharged to the Baltic Sea catchment area: Total nitrogen, mg/l – 10 Total phosphorus, mg/l – 0.5	Objectives: 1. Reduction of the negative impact on the environment by reducing landfilling of sewage sludge. 2. Recommendation of possible options for the sewage sludge beneficial application, taking into account: • Sludge energy potential; • Useful elements content, incl. phosporus.	Objectives: 1. Implementation of process solutions for the beneficial application of sewage sludge. 2. Implementation of a circular economy for wastewater treatment processes. 3. Development of regional sewage sludge management strategies, which differentially account methods of its disposal and possibility of secondary products extraction, depending on the sludge qualitative composition and the settlement size.

GOST "Technical principles for sewage sludge treatment. General requirements" (draft)

In 2021, GOST, which includes a differentiated approach to the sewage sludge treatment methods selection, is being developed in Russia

ФЕДЕРАЛЬНОЕ АГЕНТСТВО
ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

НАЦИОНАЛЬНЫЙ СТАНДАРТ РОССИЙСКОЙ ФЕДЕРАЦИИ

ГОСТ Р

(вторая редакция)

Технические принципы обработки осадков сточных вод. Общие требования

Настоящий проект стандарта не подлежит применению до его утверждения

Москва
Стандартинформ
20

Table B.1 – Sewage sludge treatment options and requirement therewith

Sludge treatment process/ application	Optional preliminary treatment of sludge	Physical properties of raw sludge	Sludge treatment resulting product, its application/disposal options
Sludge incineration for large and extra-large WWTPs	Preliminary dewatering, drying or combination of both	Cake humidity – less than 78% Ash content up to 60%	Ash is applied for: - production of fertilizers subject to the heavy metals extraction; - vitrification with obtaining of an inert construction material; - as part of construction mixtures. Heat and power generation
Aerobic digestion in specific conditions – high energy costs	Thickening	Dry matter content 93–96%	Stabilized and decontaminated sludge is used as local organic fertilizer, etc. Possibility of realization in a liquid state and in a dehydrated state (moisture content - 82–83%). Excess heat recovery.
Geotubing/ flexible, but season dependent – temperature over 0 °C.	Homogenization	Humidity - 95%	Technical soil - for the enrichment of soil cover - for small and medium WWTPs; - for formation of a vegetation layer in improvement of roadsides and slopes, for recovery of disturbed lands, quarries, solid waste landfills and industrial waste landfills (outside populated areas) - for large and extra-large WWTPs
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Thank you!

Dmitry Troshenko

SUE "Vodokanal of St.Petersburg"