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Застосування різних методів обробки осаду в біогазових технологіях
Применение различных методов обработки осадка в биогазовых технологиях
Application of different methods of sludge treatment in biogas technologies

Presented by project development manager Aleksejus Timofejevas

Waste Water Management 2018, 24-25-th of April 2018

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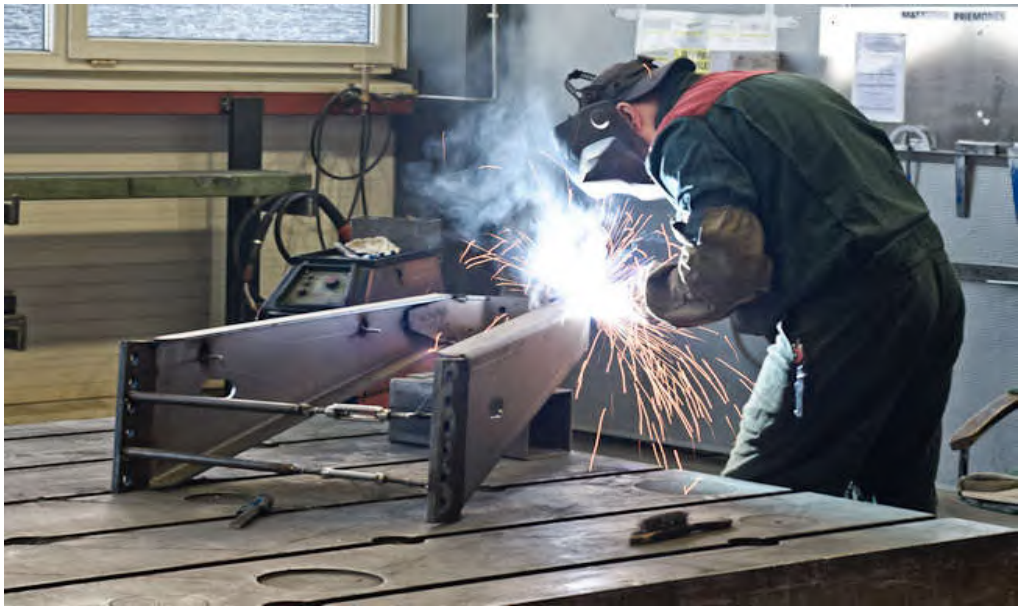


Brief History of Arginta in water management field

1991 – UAB Arginta is established

1995 – Arginta participates in Vilnius WWTP reconstruction

2001 – Small WWTP installation team is assembled

2002 – Arginta started performing consulting in water management field

2004 – Arginta is employed as contractor for equipment installation on municipal WWTP

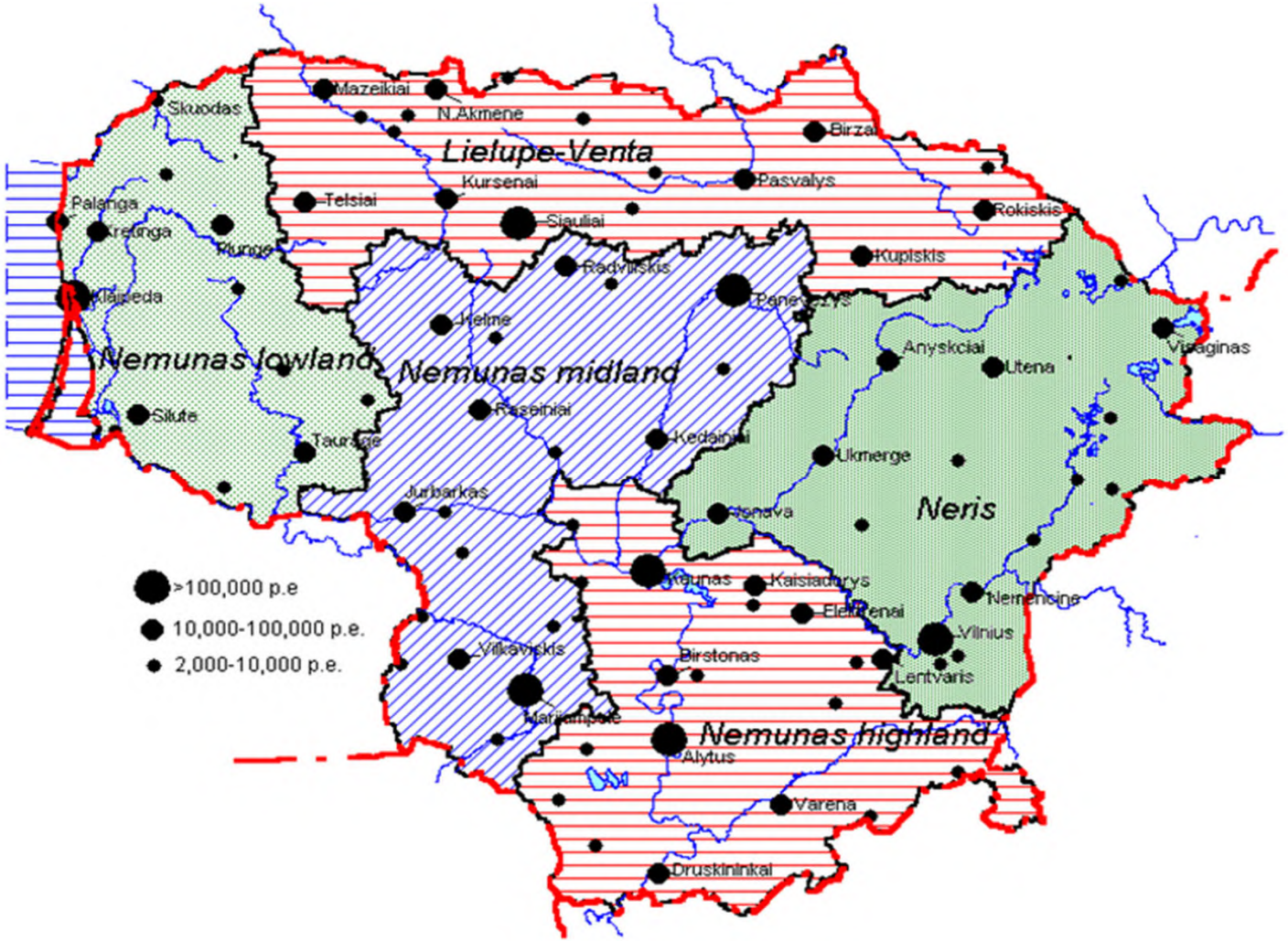
2005 – Arginta starter performing WWTP equipment maintenance serveries.

2010 – First sludge treatment project are being developed.

2012 – Arginta opens foreign offices and started performance of Constriction and Consulting projects in CIS countries.

Feasibility studies

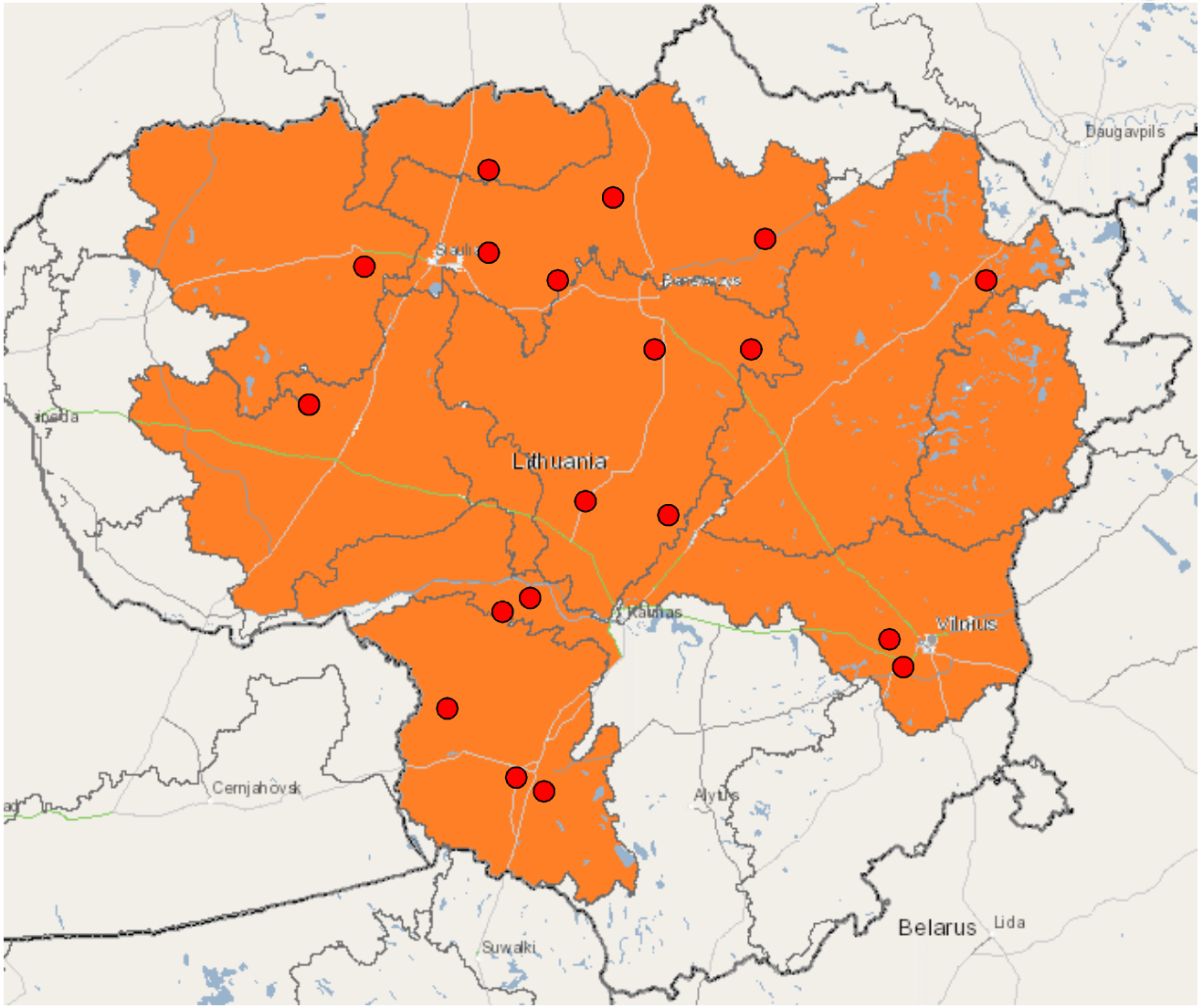
•We completed more than 40% of Feasibility studies for river basins in Lithuania



Design documentation expertise and Technical evaluation

We completed more than 60% of Tender and Design documentation expertise in Lithuania

During 2012- 2014 we have completed design documentation expertise and technical evaluation Of 36 cities in Kazakhstan



Construction of water management objects

- Construction of WWTP
- Sludge treatment plant construction
- Water treatment plant construction
- Construction of pumping stations

By 2012 Arginta successful reconstruction or constructed more than 30 object in Lithuania

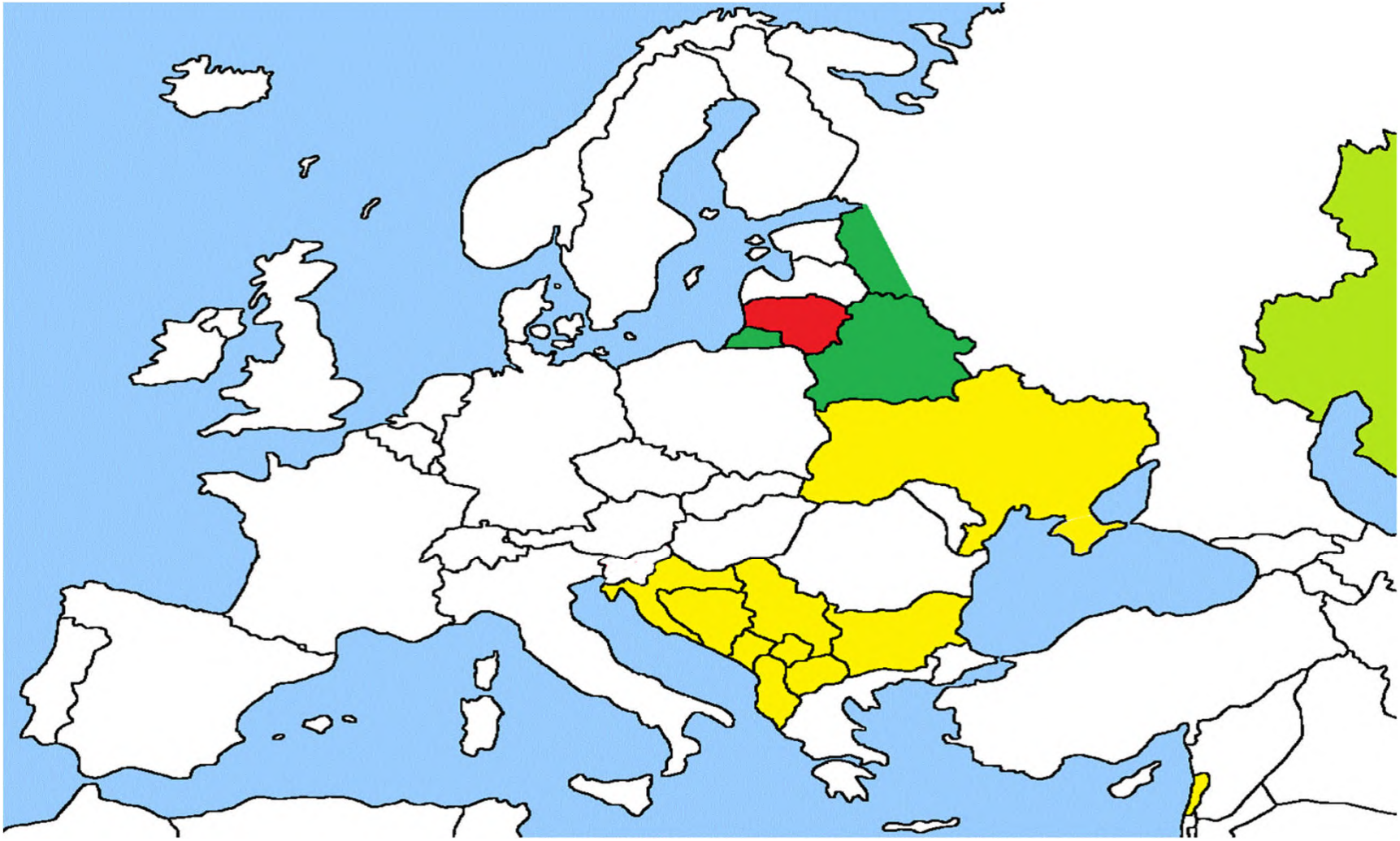
Construction of water management objects

By 2017 we have completed 7 project abroad

Currently 3 large projects are ongoing

Overall 41 mEUR of investment in the region

Activities on international markets



- Project management
- Technological design
- Plant maintenance and operation
- Pre-contract, consulting services
- Equipment and automation manufacturing

- Water treatment
- Waste water treatment
- Sludge treatment

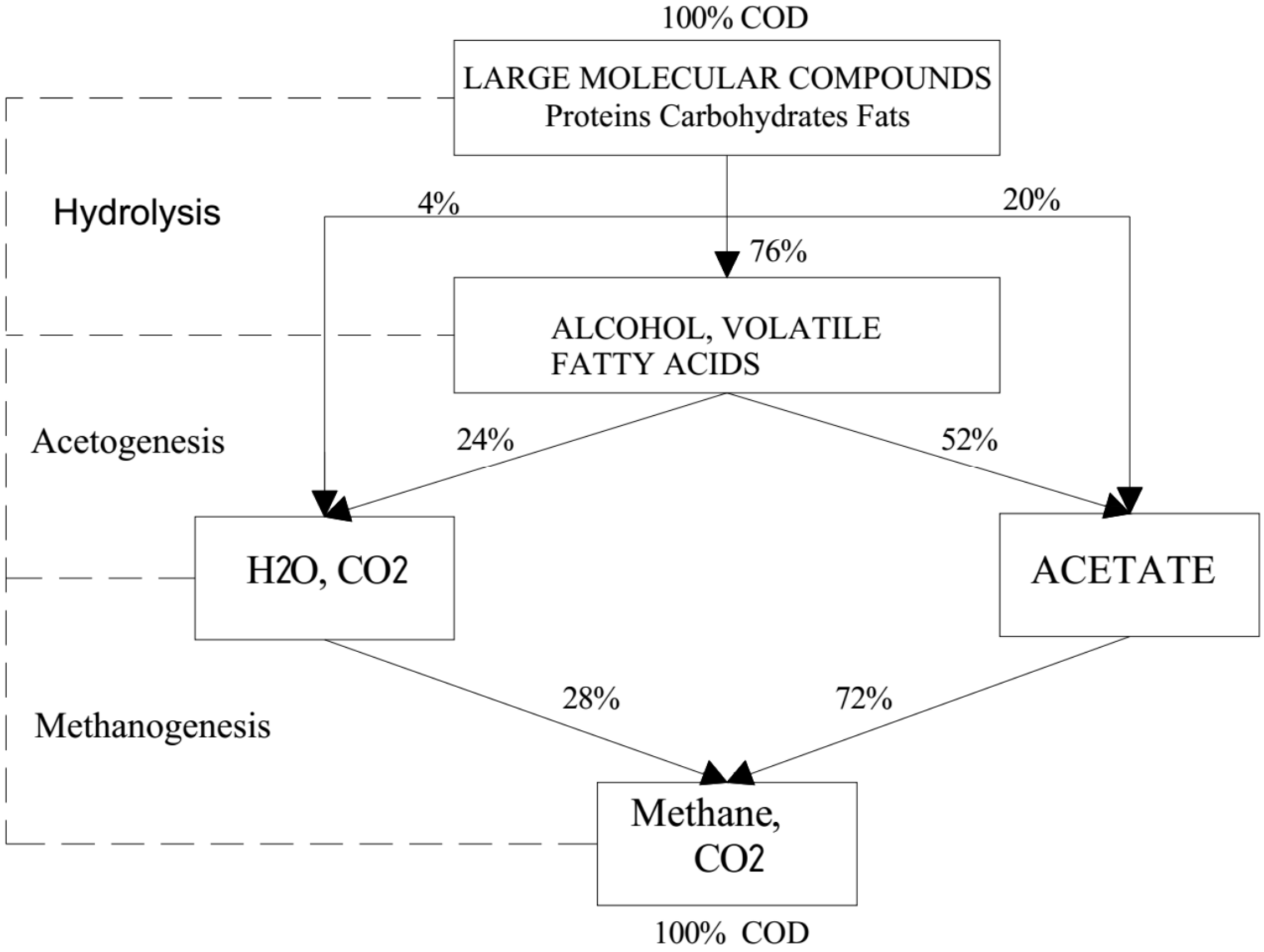
Sludge treatment and utilization

As the side product, sludge is produced during biological wastewater treatment process, and it requires further treatment and disposal. When storing untreated sludge on sites or filtration fields, groundwater gets repeated contamination and an unpleasant odor arise. One of the most environmentally friendly ways of treating the sludge is its anaerobic digestion.

Sludge digestion is carried out for decomposition of organic sludge compounds before further processing. For this purpose, digesters should be used. Usually mesophilic or thermophilic conditions are maintained inside the digesters: the temperature of the sludge mixture is maintained between 36-38 ° C and 50-56 ° C.

Digestion biochemical processes

In these conditions anaerobic bacteria transform part of organics into a biogas (methane and carbon dioxide mixture) and water.

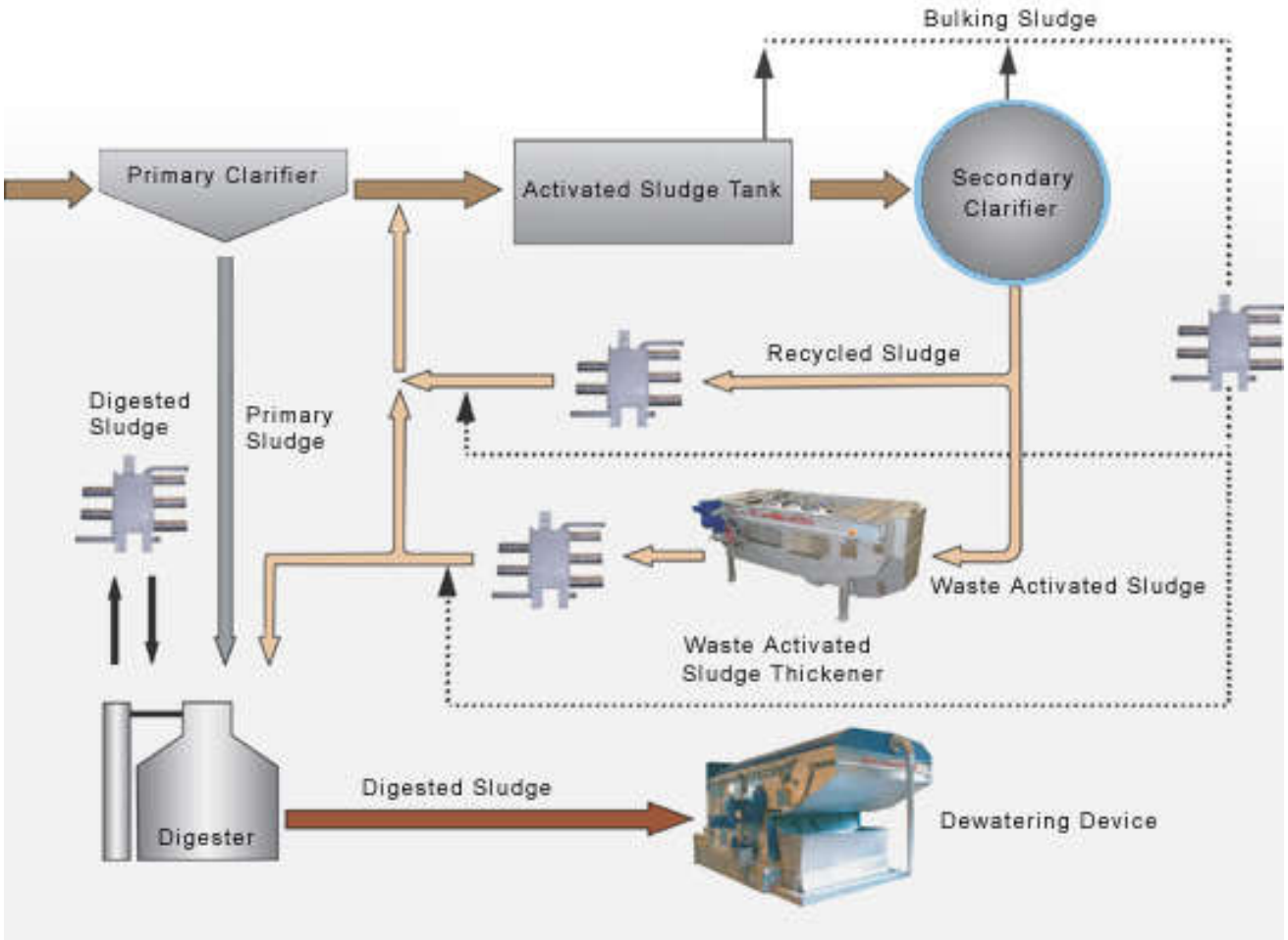


New biogas producing and sludge treatment plant on Baranovichi WWTP

Sludge disintegration technologies applied by us

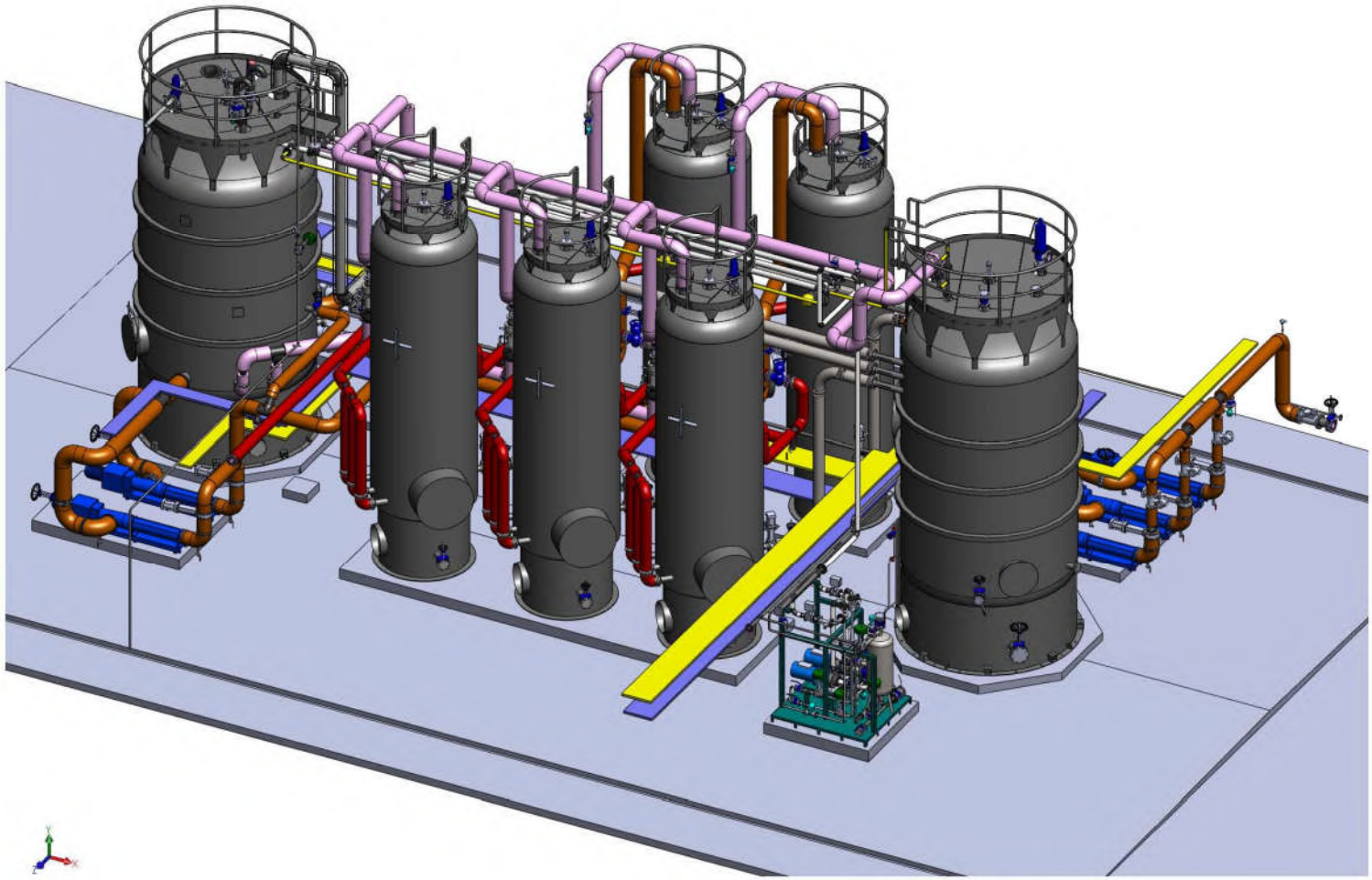
Excess active sludge digestion is more difficult than the primary, since the organic matter is inside the cells of microorganisms. For the disintegration of organic matter, the cell membrane must be destroyed first. Destruction speed of the cell membrane is the main factor limiting the efficiency of digestion.

To increase digestion efficiency sludge disintegration equipment is widely used. Due to it biogas yield rises and sludge amount decrease.



Sludge thermal hydrolysis

Most advanced, most effective and most expensive disintegration equipment is sludge thermal hydrolysis. But in big enough plants, overall price will be reduced due to decreased required digester size.

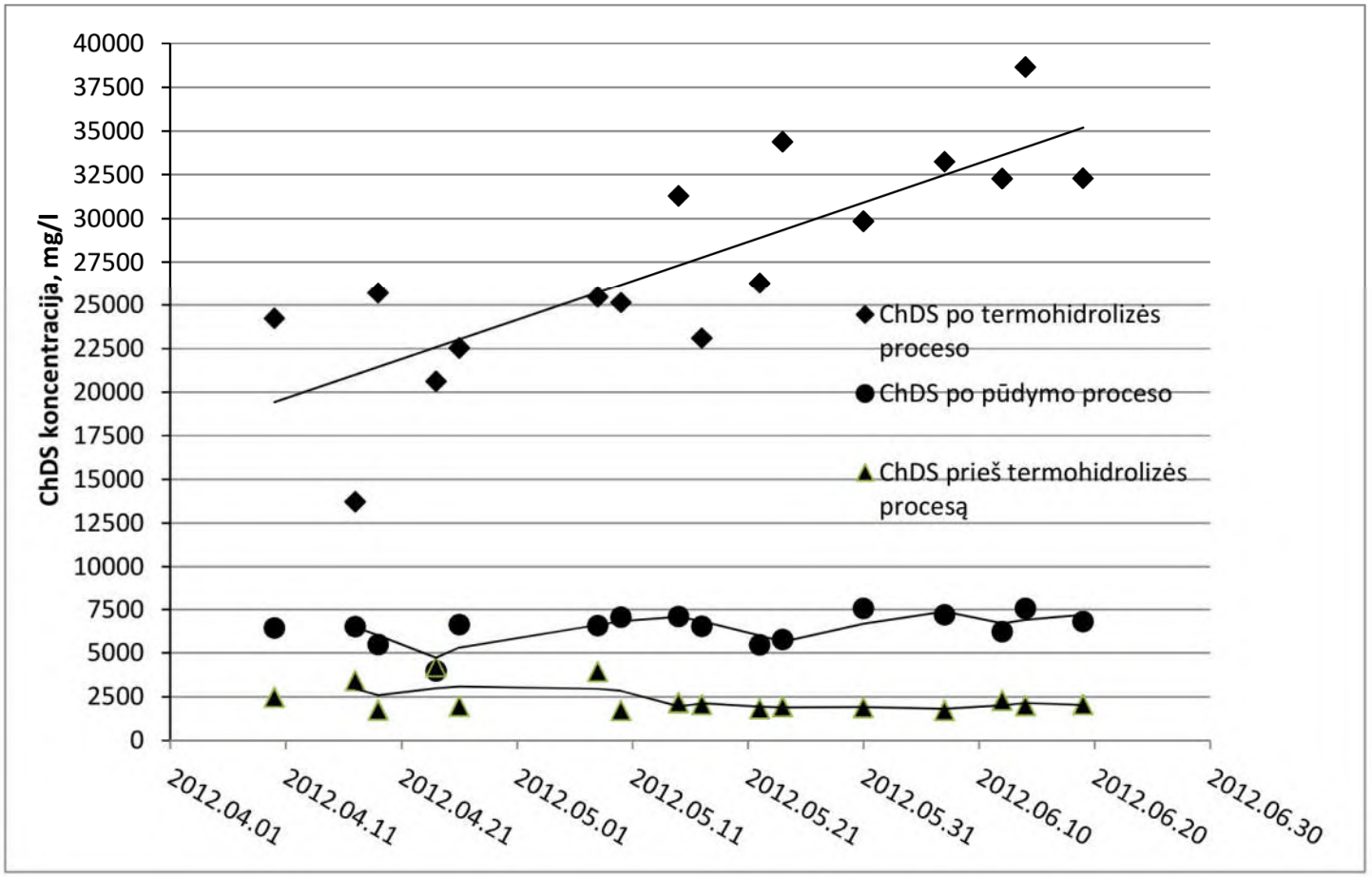


Vilnius sludge treatment plant

Research results

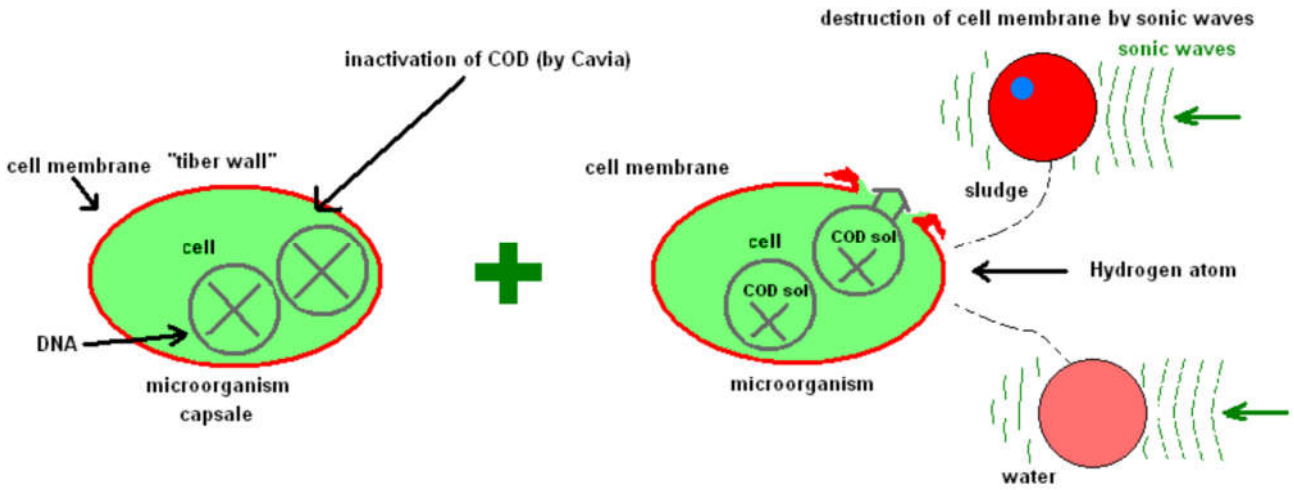
Thermal hydrolysis equipment technically is impossible to shut down, that is why disintegration efficiency can be measured by indirect parameters, like:
COD concentration before, after thermal hydrolysis and after digesting: 2350 mg/l, 27500 mg/l and 6430 mg/l,

- DS=56100 kg DS/d, VSS(volatile suspended solids)=42180 kgVSS/d
- Average VSS reduction in Vilnius STP= 65 %. Specific gas production - 0,6-0,7 m^3/ kgVSS



Sludge disintegration by ultrasonic cavitation

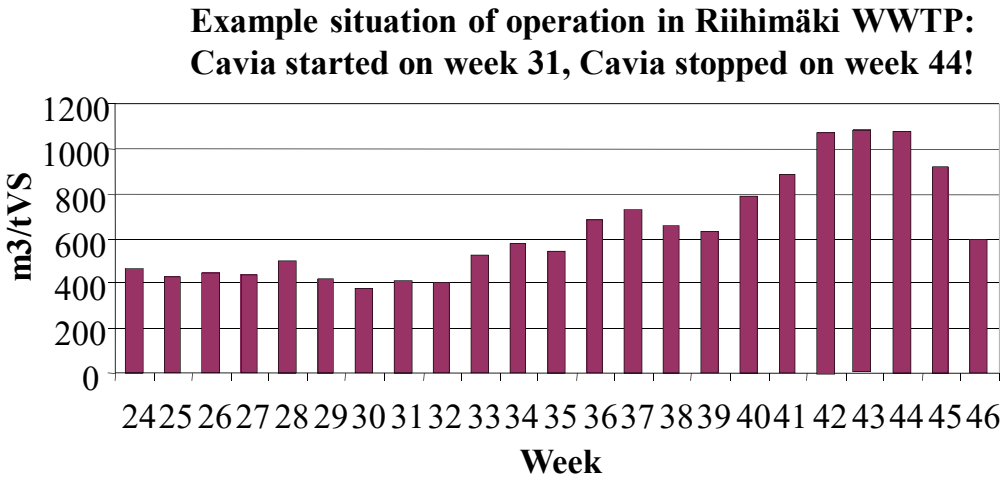
In reactor ultrasound generates cavitation process in the sludge mixture, that destroys cell membrane



Marijampole sludge treatment plant

Dewaco CAVIA system - Riihimäki WWTP

Weekly report from plant:



Average results received in Riihimäki WWTP:

1. Increased biogas production (500 → 700 m^3/t VS) ”app 40%”
2. Increased VS reduction (8 → 14 %)
3. Increased TS of digested sludge (2,8 → 3,2 %)

This slide is from producer presentation. Results are not approved by us

CAVIA™ A Dewaco product

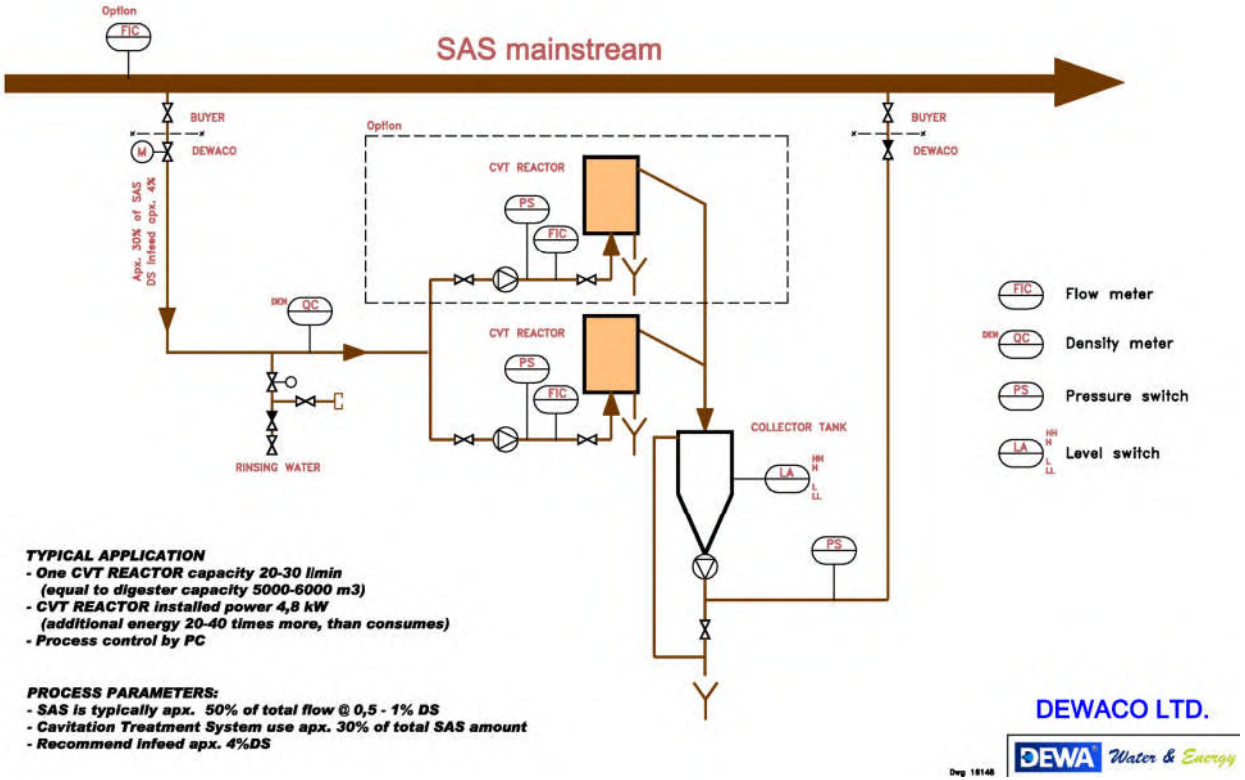
Actual efficiency results of ultrasonic disintegration equipment

Klaipėda sludge treatment plant:

„within this project was installed the Austrian company's *VTA Technologies GmbH* **ultrasonic excess sludge disintegrating facility**, which allows to increase the amount of generated biogas in digesters up to 10-15%."

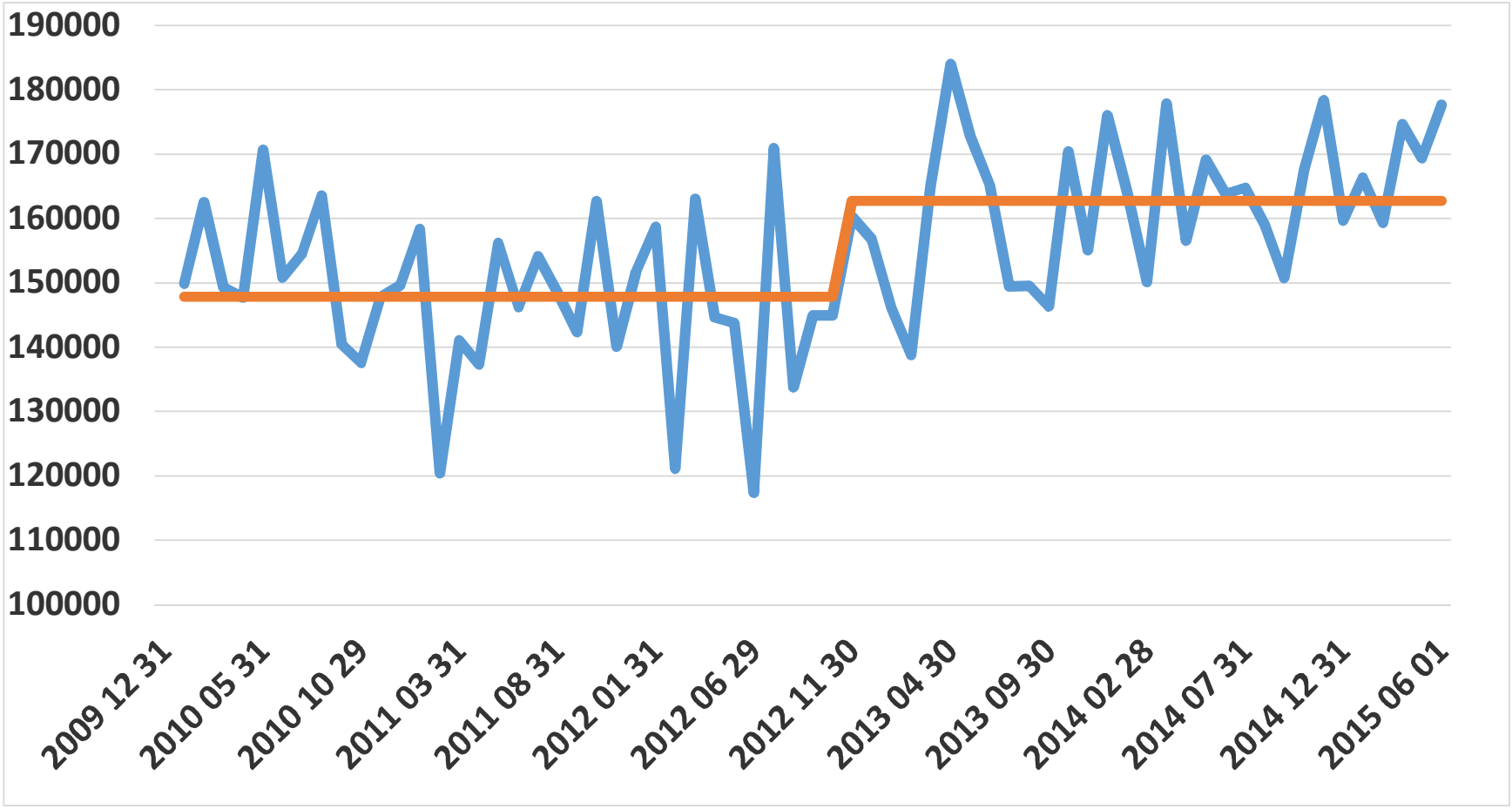
Mariampole sludge treatment plant:

Sludge disintegration is regulated for automatic treatment of 30 % of total excess sludge flow.
Biogas production without disintegration equipment: 2272 m^3/h
Biogas production with disintegration equipment : 2500 m^3/h
Biogas yield rise during tests: around 10 %.



DEWA ultrasonic cavitation sludge treatment unit

Change of biogas production amount after installation of ultrasonic sludge disintegration unit on Klaipėda WWTP



- *VTA Technologies GmbH* **ultrasonic excess sludge disintegrating facility**, which allows to increase the amount of generated biogas in digesters up to 10-15%.

Sludge disintegration by high voltage

Taurage WWTP sludge treatment plant

Taurage WWTP sludge disintegration equipment test report

Data	Biogas production					VSS reduction			
	Start m3	Finish, m3	Measurement period h	Quantity, m3/h	Quantity, m3/d	VSS feed, kgVSS/d	VSS after digestion, kgVSS/d	VSS reduction, kg VSS/d	VSS disintegration, %
Results with disintegration unit(2015 05 11-2015 05 15)									
10.05.2015						2803			
11.05.2015	116125	117975	24	77,1	1850	2940	1359	1444	51,5
12.05.2015	117975	119580	24	66,9	1606	2776	1254	1686	57,3
13.05.2015	119580	120907	24	55,3	1327	2530	1178	1598	57,6
14.05.2015	120907	122317	24	58,8	1411	2186	1174	1356	53,6
15.05.2015	122317	123512	24	62,9	1510		1069	1117	51,1
Average				**64,2**	**1541**	**2647**	**1207**	**1440**	**54,2**
Results without disintegration unit (2015 05 16-2015 05 21)									
15.05.2015						2151			
16.05.2015	123512	124885	24	57,2	1373	2186	1049	1102	51,2
17.05.2015	124885	126175	24	53,8	1291	2186	1069	1117	51,1
18.05.2015	126175	127556	24	57,5	1380	2366	1204	982	44,9
19.05.2015	127556	128737	24	49,2	1181	1787	1251	1115	47,1
20.05.2015	128737	129982	24	51,9	1246		1298	489	27,4
Average				**53,9**	**1294**	**2135**	**1174**	**961**	**44,3**

Brief results

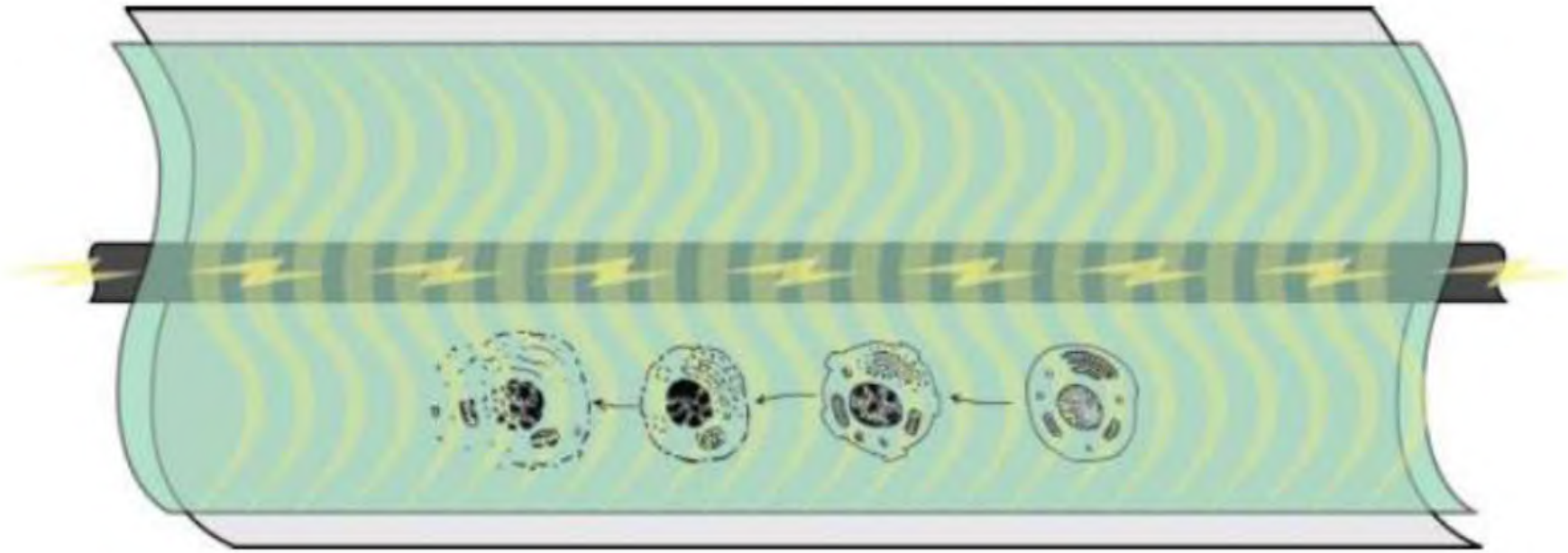
From the above results we may see, that:

- Total biogas production has increased by 19 %, from average 1294 Nm^3/d to average 1541 Nm^3/d;

VSS reduction has increased by 9,9 %, from average 44,3% to average 54,2%.

How the equipment works:

The sludge flows through a pipe system with an internal electrical high voltage field. The electric force creates a pulsing effect on cells causing them to deform and finally rupture. As a result, the raw material inside the cell is exposed to the bacteria. The enhanced exposure produces more methane gas.

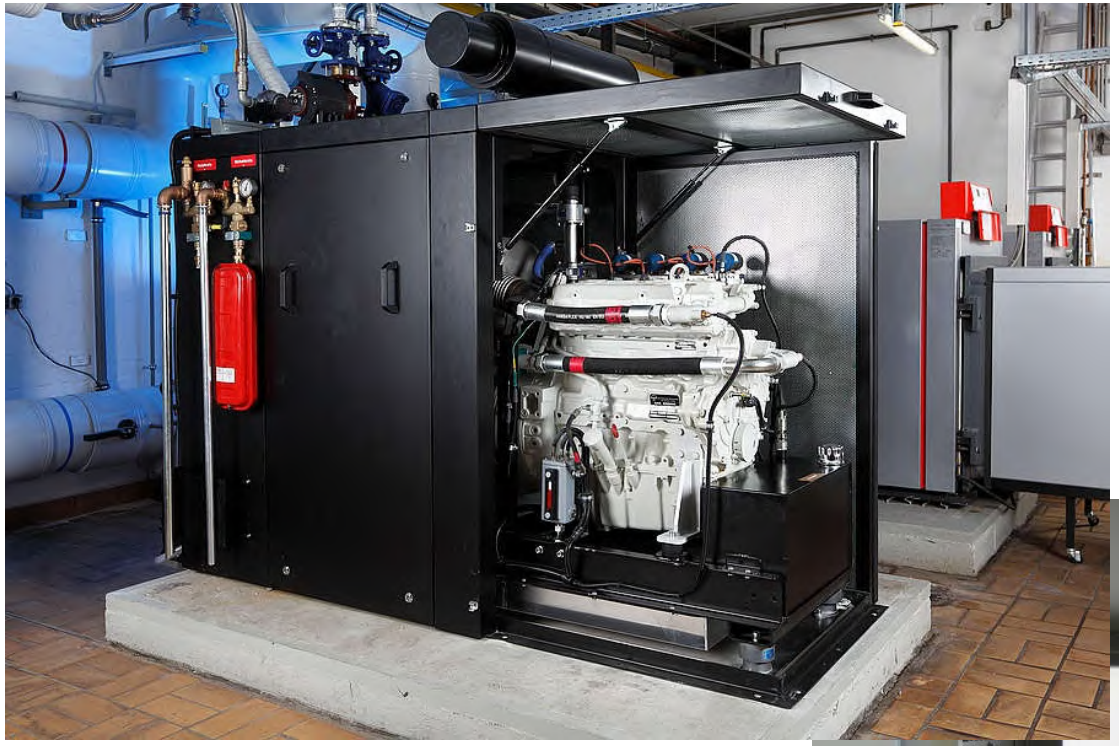


Equipment efficiency comparison

Disintegration method/results	Total VSS reduction %	Total biogas production increase %	Total VSS reduction increase %
Thermal hydrolysis(Vilnius WWTP) *	65 %	No data to compare	25%
High voltage (Taurage WWTP, Baranovichi WWTP)	54%	19%	10%
Ultrasound (Klaipeda WWTP, Marijampole WWTP)	50-52%	10-15%	8%

* It is not fully correct to compare thermal hydrolysis equipment with other type of disintegration, because the result of this treatment type is a dramatic change in the physical properties of sludge, allowing fermentation at 15-16% of DS, sludge pasteurization and significant improvement of dewatering quality, as well as higher VSS reduction

Energy production from biogas comparison



Micro turbine
vs
combustion
engine

Different type of CHP comparison

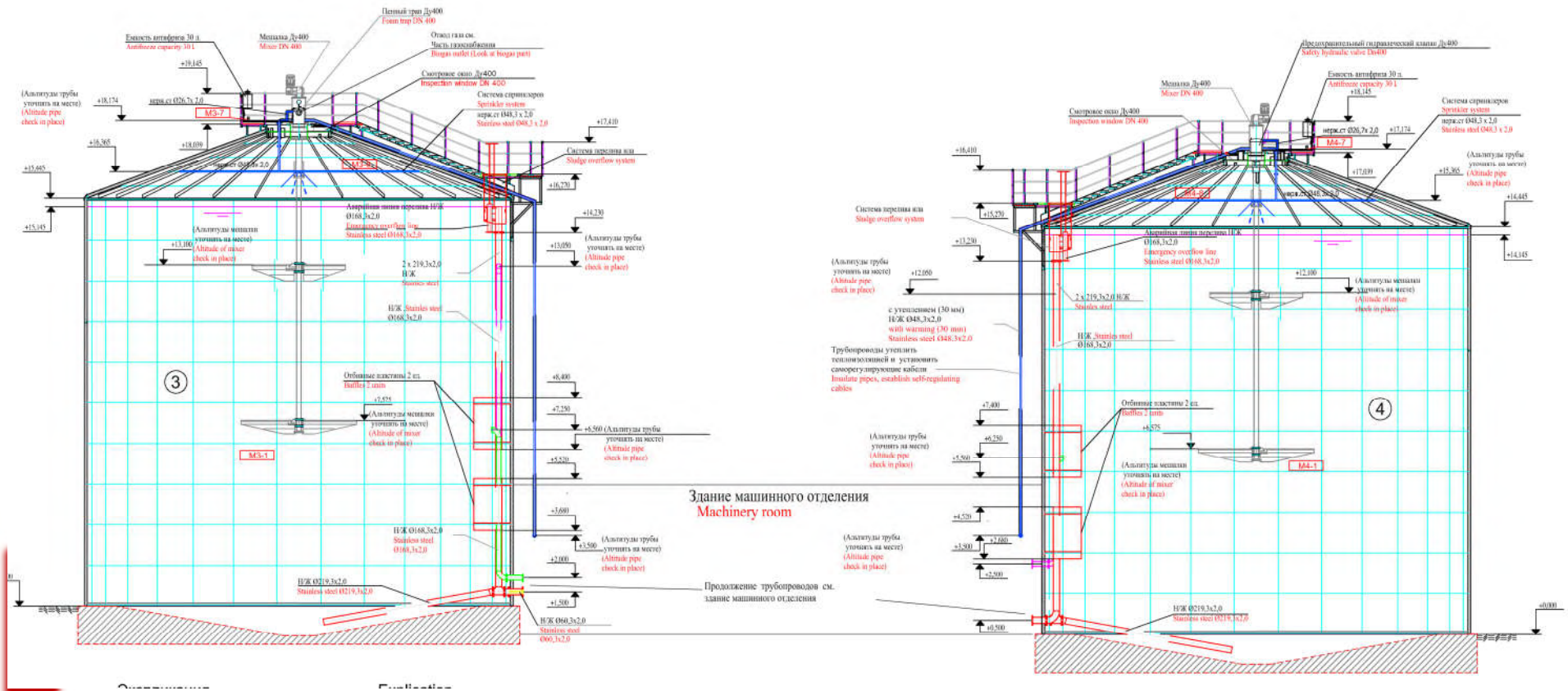
Parameter	Combustion engine	Micro turbine
Total efficiency	~90%	~90%
Electric efficiency	<42%	<33%
Steam production	20%	50%
Heat production	30%	-
Maintenance interval	3000 hours	8000 hours
Operational costs	~0,01 Eur/kWh	~0,003 Eur/kWh
H2S limitation	30 PPM	No limitation
Biogas quality	Min 40% CH4	No limitation

Information is provided based on operational data from Mariampole, Taurage, Baranovichi and other WWTP's biogas CHP

Construction or reconstruction ?

Baranovichi WWTP sludge digesters 5000 m³.

Drawing of enamel sheet digesters, Baranovichi WWTP



Baranovichi WWTP sludge digesters 5000 m³.

Digesting plants reconstruction projects

During soviet period sludge digesters were built on majority of large WWTP, but after accident with gas explosion on one of the plants, were no longer operated. Standard design solution was – 2 digesters 1600 m³ volume each.

Reconstructed digesters on Panevežys WWTP are in operation since 2004

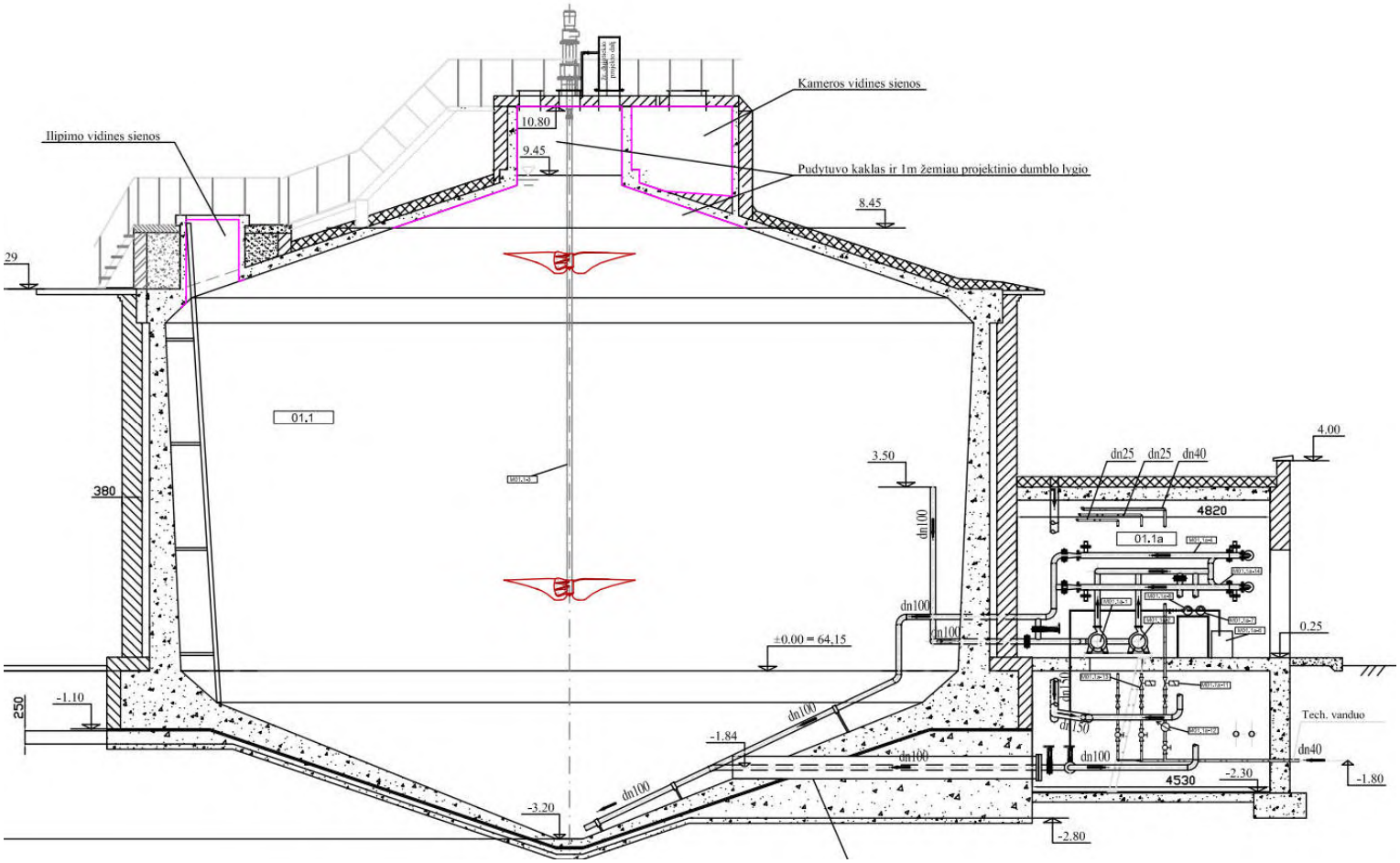
Digesters condition before reconstruction

Digesters have not been used for more than 30 years, brick walls have partially crumbled, lower segments of the digester flooded, roof was covered with grass and trees, all metal structures corroded

Mariampole WWTP digesters before reconstruction

Digester structure details

As can be seen on the drawing, external brick wall is not part of the supporting structure. It serves as an external finish, providing an air layer as a thermal insulation. The same applies to the outer layer of the roof. Existing monolithic reinforced concrete bowls on all the examined digesters were in satisfactory condition and after repair with the special compounds resistant to sulfuric acid were suitable for further operation.



Using modern technologies it is economically valuable to reconstruct existing digesters

Digesting plants reconstruction projects

First digesters has been reconstructed in Utena WWTP. Due to average Since the condition of the structures was satisfactory, after equipment installation digesters were put in operation.

Utena WWTP digesters in operation since the middle of the 90-ties

Biogas plant reconstruction projects

Taking into account modern construction materials and technologies, the life cycle of reconstructed digesters is practically similar to the new construction

Digesters on Mariampole WWTP were reconstructed within sludge treatment and utilization plant construction scope. In operation since 2013

Biogas plant reconstruction projects

New technologic equipment on the top of the digester

Necessary additional equipment for sludge treatment plant

Huber strain press (sludge screens) on Baranovichi sludge treatment plant

We propose:

- Perform the analysis and a detailed calculation or feasibility study for the various sludge treatment plant;
- Perform design and “turn key” sludge treatment plant construction;
- Design and construct the plant with guaranteed OPEX and energy balance;
- Perform technologic calculations and select proper equipment with design parameters performance guarantee;
- Perform a survey of the existing condition, design and perform reconstruction of existing digesters.

Thank you for your attention!

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