Klaukkala wastewater treatment plant

General information

The wastewater treatment plant of Klaukkala in the region of Nurmijärvi has been commissioned in 2006. This plant is constructed underground in rock caverns and the process consists of three process trains. This plant collects the wastewaters of Klaukkala, Rajamäki and Röykkä districts and several large industries in the area: Altia Oyj, Roal Oy, Teknos Oy, Onni Forsell Oy and Premix Oy. In addition, the septic tank sludge is collected and treated at the plant. The yearly amount of septic tank sludge is about 25 000 m^3.

This plant is designed for 37,600 inhabitants (PE) and 13,200 m_3/d for the ow rate. This treatment plant is composed by three lines of an activated sludge process. The phosphorus removal is ensured by a chemical precipitation and removal in the primary sedimentation.

WWTP of Klaukkala

All the processes of the WWT are shown in the Figure 1. The process contains an equalization basin which is used to store influent hourly flow rates exceeding 550 m3/h. The stored water is pumped

back to the process when influent flow rates decrease (nighttime). The influent is brought to a pre-treatment with a screening, a grit removal and an aerated sand separation tank. This part removes the big debris and solids with the sand from the water. The precipitant, ferrous sulphate, ($FeSO_4$) is added in the grit removal. It serves to precipitate phosphates.

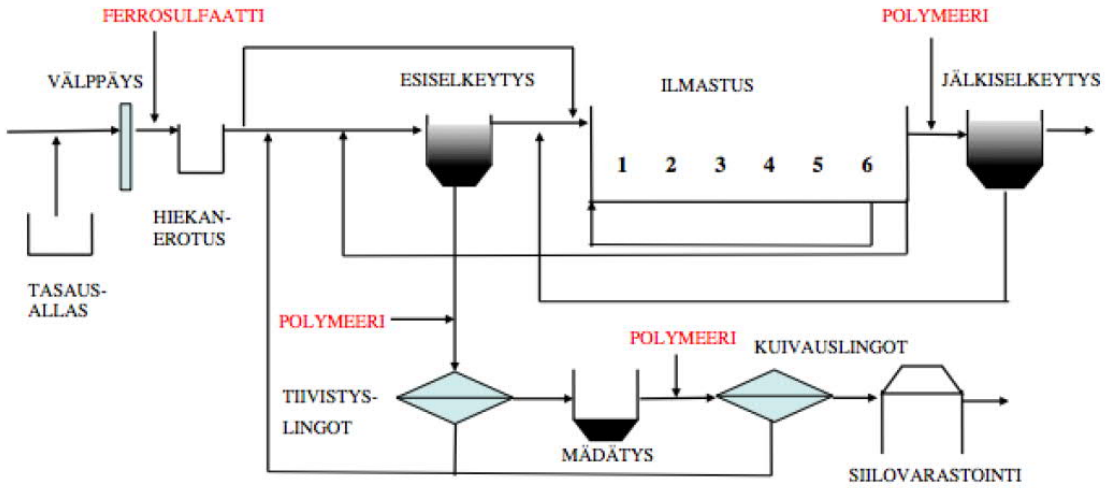

Figure 1: Klaukkala wastewater treatment plant.

The second step is a primary settling. It is in this part, all the sludge, raw and waste activated sludge, is removed from the process. The produced sludge is mixing with a polymer and goes to in the sludge treatment line which is composed of centrifuges, digestion and centrifuges for the digestate. The dewatered sludge storage is inside sludge silos.

The next step is the biological part. In this part, the nitrogen and the organic matter are removed by reaction ensured by microorganism. The ammonium is removed by the reaction of nitrification which produce nitrates. This nitrate and the organic matter are removed by the reaction of denitrification. The biological reactor is divided into six parts. Each part is separated by walls. The zones from 3 to 5 have an independent aeration system with bottom air diffusers and dissolved oxygen measurement. In these reactors, the nitrification takes place. The zones from 1 to 2 are anoxic reactor. They are equipped with a mixer and there the denitrification takes place. The sixth part corresponds to a deox zone with a tank to prevent the biomass sedimentation.

The last part is a secondary settling. This settling is also based on clarification. Before this clarification, the water goes into two basins where polymer is added. The polymer flocculates the smaller flocs and improves the sludge sedimentation.

The treated effuent is discharged into Luhtajoki river which joins later on Vantaajoki river and flows in the Gulf of Finland (Baltic Sea).

There are three recycle flows:

- an internal nitrate recycle: inside the biological reactor between the last compartment and the first one, its goal is to bring back the sludge with produced nitrate into the first part to be consumed by the denitrification;

- the waste activated sludge flow: between the biological reactor and prior the primary clarifier where the flow is mixing with the influent. This recycling permit to extract the excess sludge

to ensure the good operation of the activate sludge process;

- the return activated sludge: between the secondary settler and the biological reactor, all the ow of the secondary sludge is recycled to ensure the good functioning of the activated sludge;

All the process tanks are located in the rock tunnels.

The performance of the WWTP

The wastewater treatment plants need to respect the national and European standards about quality to respect the receiving environment of treated water. The measured parameters for these standards are the BOD_7, the CODCr, the total phosphorus and the total nitrogen and the requirement are shown in the following table:

Table 1: Treatment requirements for Klaukkala WWTP.

	Max concentration	Minimum removal
	mg/l	%
BOD7	10	95
COD Cr	125	75
Total phosphorus	0,4	95
Total nitrogen	15	70
Ammonium nitrogen	4	90
Suspended solids	35	90

The plant has typically performed better than the permit requires. Results from years 2015 and 2016 are shown in the following table:

Table 2: WWTP results from 2015 and 2016.

	2015			2016		
mg/l	Influent	Effllluent	Removal-%	Influent	Effllluent	Removal-%
BOD_7	340	3,3	99	330	4,3	99
COD_{Cr}	740	28	96	760	30	96
Total phosphorus	7,9	0,15	98	8,2	0,11	98
Total nitrogen	54	8,9	84	63	8,9	86
Ammonium nitrogen	38	0,56	99	42	1,2	97
Suspended solids	690	6,6	99	420	5,9	98

Control of the WWTP

At the WWTP of Klaukkala, the biological process is controlled by adjusting the recirculation rates of RAS and nitrate recycle, oxygen concentration and sludge age. The process is monitored by measurements as shown in table 3.

Table 3: Measurement for the WWTP automation of Klaukkala.

Process	Measurements
Influent	Flow rate, temperature, pH
Primary clarifier	Raw sludge flow rate (includes WAS)
Aeration	MLSS, DO, temperature, pH, air flow rates, nitrate recycle flow, WAS flow rate
Secondary clarifiers	RAS flow rate
Effluent	SS, Ammonium and nitrate nitrogen, phosphate phosphorus