

Waste water treatment project

Waste water treatment in Sweden

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Introduction

Waste water treatment was introduced in Sweden quite early and has been developed ever since. The development was driven first by hygiene reasons and later because of over fertilization. There are still problems but Sweden is among the best in the world in waste water treatment.

Sweden has the hardest rules in the world when dealing with water pollution.

History of waste water treatment in Sweden

In the middle of the 19th century there were repeatedly outbreaks of cholera. Many people died. There were also problems with water damaging buildings. This was when wastewater disposal were first introduced. But there was no real cleaning of the waste water. It was poured directly into lakes and streams.

In 1930 a very popular swimming contest had to be cancelled because of polluted water. This was also when cleaning of waste water first started in Sweden.

In the middle of the 20th century the problem with over fertilization was noticed. In the lakes where the cleaned waste water was disposed algae was in over abundance and the lakes was totally filled with vegetation. To deal with this the waste water plants was equipped with chemical cleansing for removing of phosphorous.

In the end of the 20th century again the problem with over fertilization was rediscovered. This time the solution was chemical cleansing of nitrogen.

1880's – Common system for waste water and storm drainage is constructed in some cities and this makes it possible for water toilets to be introduced.

1930's – Mechanical removing of material from waste water. Mainly bigger objects.

1950's – Biological cleansing. Removal of organic waste, sludge.

1960's – Intensive expansion of the waste water systems.

1970's – Chemical cleansing. Removal of phosphorus to decrease over fertilization.

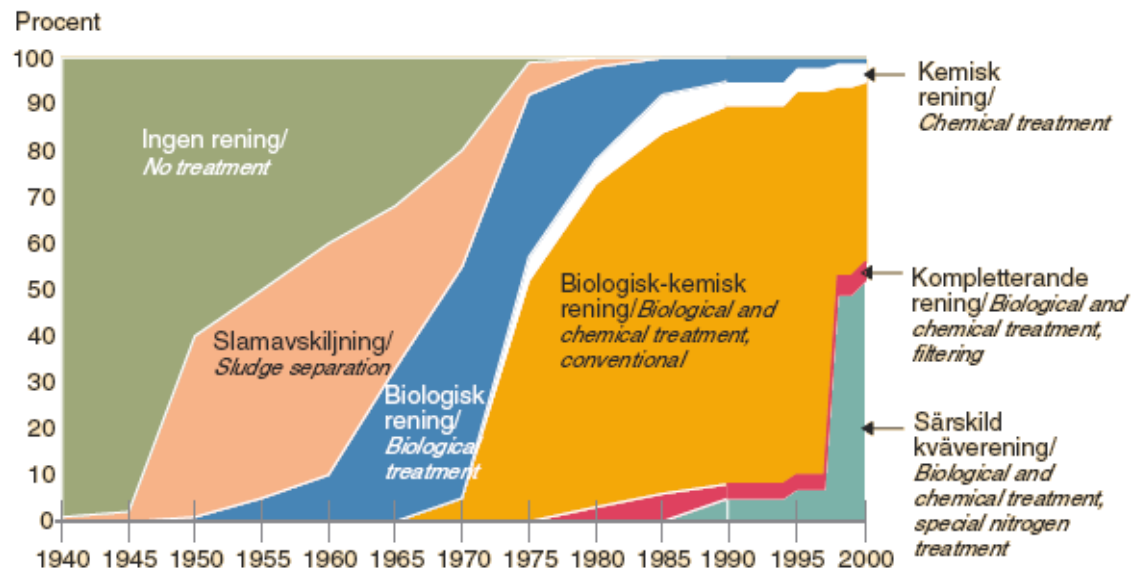
1990's – Chemical cleansing of nitrogen to decrease over fertilization.

The pollution peaked in the 1970's but it is now down to a level that corresponds to the pollution level in the late 19th century. The population has since then doubled and heavy industries have been introduced.

From being pointed at making the living standards better for the inhabitants of the cities the aim with waste water treatment has turned. Now the most important thing is to stop over fertilization and heavy metals.

Tätorternas avloppsrening 1940–2000

Municipal wastewater treatment in Sweden, per cent of the urban population



Source: www.naturvardsverket.se

Waste water treatment in Sweden today

9% of Sweden is lakes. Yearly 200 km³ of freshwater pours through from the Swedish lakes to the sea. But only 0,5% of this is used for drinking water. This puts Sweden in a very good position in water availability. Even though there are excessive amounts of water in Sweden none of it is expended, all used water is cleaned. Sweden has the hardest rules and regulations in the world when it comes to waste water pollution. These are fairly much harder than EU rules.

Today there are more than 2000 municipal waste water treatment plants in Sweden. They together clean about 1,5 km³ water a year. 1,0 km³ of this is drinking water. The rest is storm drainage.

7,7 million out of 9,1 million of the inhabitants are connected to public waste water treatment. Remaining 1,4 million people are situated in the countryside and have some kind of small scale private treatment. This little part of the population gives half of the phosphorus pollution.

240 000 tons of sludge are produced from the Swedish waste water treatment plants every year. 7000 tons of the sludge is phosphor which could be used as fertilizer in the fields. This is not however done because of the strict regulations. Sludge does contain heavy metals in some extent and something potentially dangerous is not to be used as food. There are new ways of treating sludge under development though.

Storm drainage and waste water

In the beginning waste water was not treated different to storm drainage water. Both were mixed in the same system. Because the storm drainage water is not very polluted it is today separated from waste water. This is to decrease the amount of waste water that has to be treated and thereby increase the efficiency. The output water of the plant will also be cleaner. Reconstructing of the piping from single to dual piping, waste water and storm drainage has been done in most places. In city centres it is harder due to lack of space and high cost and has still to be performed.

Modern sludge disposal

In 2005 a new law was accepted that makes it forbidden to deposit sludge on a dump. But there are many other different ways how to deal with sludge.

Composting

Sludge is put in a huge compost and oxygen is added to make the composting faster. After three months the composting is finished and the now earth like sludge is transported away for use elsewhere.

Combustion

Burnable household garbage is mixed with dewatered sludge. No benefits from drying it. The heat generated is used for district heating. Unfortunately the ashes from the combustion must be dumped.

Reed beds

Reed beds are a relatively new technology for dewatering and hygienisation of sludge.

A reed bed is built in several layers with a closing bottom layer made of plastic so that the water from the reed bed cannot poison the groundwater. Over are layers with gravel and sand. Draining pipes are put in the gravel for dewatering purposes. The reed is planted in the sand and sludge is poured over the bed with regular intervals. After ten years the sludge has been bio-composed and concentrated. It is removed and new reed bed is made.

Salix plants

Salix is a very fast growing variation of the willow. It is used for biological fuel in district heating plants. In Sweden there are many plantations of Salix and it is ready to be harvested in three to five years. Sludge is used as a fertilizer for these plantations. As much as 10% of the sludge produced in Sweden goes to Salix plantations. The advantage of this procedure is that Salix is not a product made for eating. So the issue with sludge containing heavy metals is not a big problem.

Where to put the sludge

Sludge containing large amounts of minerals, nitrogen and phosphorus should be very good to put in the fields as a fertilizer. The problem is that it also contains heavy metals. Until a way of removing them efficiently is found the sludge cannot be used as a fertilizer for food intended for humans. Instead it is often transported to mining sites for covering piles of slag to make it easier for vegetation to root. When constructing golf courses and parks sludge is also used. Composted and mixed with soil it is put as a nutritious covering layer for the vegetation.

Ryaverket waste water treatment plant in Gothenburg

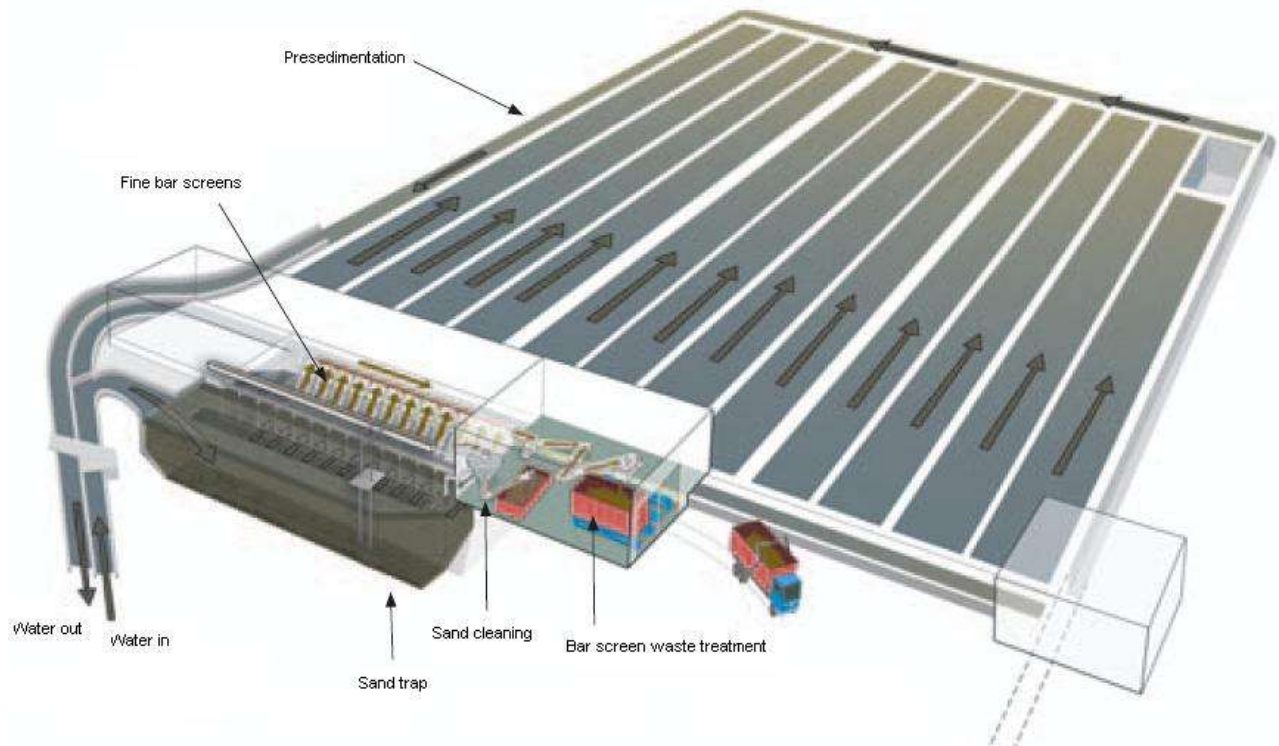
Ryaverket is a new unique waste water treatment plant constructed for treatment of the Gothenburg waste water. The main feature is the handling of floods through dynamically changing the procedure of treatment in the waste water treatment plant. Due to heavy raining and storm the amount of water to be treated can rapidly rise. Parts of the presedimentation tanks are used for chemical treatment and the water disposed from the plant is still containing less fertilizing substances than the regulations when released. The design of the pools has been carefully developed after intense studies and simulation. This makes it possible for sedimentation to occur even though very high flows.

The release goals for the waste water treatment plant Ryaverken 2005 are (mean values):

BOD₇ 8mg /L

Phosphor 0,4mg /L

Nitrogen 10mg/L

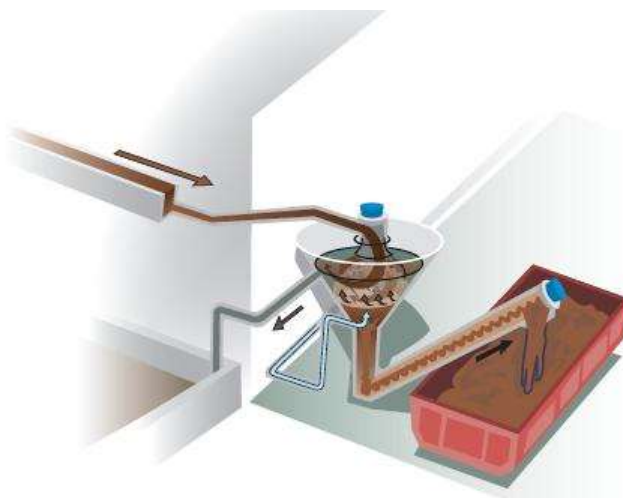


Mechanical treatment and presedimentation. Source: www.gryaab.se

Mechanical treatment

When waste water arrives in the plant it is pumped to sand traps and a very fine 2mm bar screen that stops bigger trash and particles. The trash collected here is burned for energy.

In the sand traps the water is stirred with air to make sure that only sand and not sludge sinks to the bottom. The sand is later washed in a whirl sieve and dewatered to remove more of the organic particles. The water and organic waste is lead back into the plant.



Sand washer with whirl sieve. Source: www.gryaab.se

Presedimentation

After the mechanical treatment the water is now treated in the presedimentation tanks. Here the water is flowing very slowly to let the sludge sink. There are also rakes on the surface for scraping off fat and oil.

Chemical treatment

Iron sulphate is added to start flocking of phosphates.

For getting the sludge to sink a polymer is added. Polymer is a plastic powder that will easily bio-degrade. The plastic powder will help the sludge to flock and separate from the water. This will make the small particles to form bigger particles and ahead in the process they will eventually fall to the bottom.

Biological treatment

Now the water is mixed with active sludge containing big quantities of bacteria. The water is led to an anaerob tank where the microorganisms has to breath nitrates because the lack of oxygen. When breathing out the nitrates has become nitrogen which is disposed of directly into the air.

After this the anaerob pools changes to aerob pools where air is blown in from the bottom. Now the microorganisms can breathe oxygen again which helps in degrading the organic materials.

Primary settling

This is where the active sludge settles. Half of it is pumped back to the biological treatment and the rest is taken to the sludge treatment facilities.

The cleaned water is disposed of in the sea. But first it travels trough a heat exchanger and a turbine. The turbine generates electricity which is used in the operation of the plant. The heat exchanger gives the heat to the city of Gothenburg. This covers 20% of the needed heating of the entire city.

Sludge treatment

The sludge is dewatered through a belt gravitation dewaterer and then taken to a silo. After this it is put in a rot chamber. Here bacteria are working in an anaerob environment eating sludge and producing biogas. The biogas is used in the city gas net and in a heat power plant.

The last step in the sludge treatment process is dewatering. Here the dry substance becomes 30%. It is now mixed with soil and used for constructing parks and road sides.

Future development of Swedish waste water treatment

The sludge treatment is not ideal today. The ideal situation would be to be able to put the sludge on fields. But today it is not possible due to containing heavy metals. If these could be extracted we would have an ecological circulation.

Another very interesting thing is the way of using wastewater for extraction of energy. In the Rya plant electricity, heat and biogas are extracted. This is highly ecological and definitely makes the waste water treatment plants cheaper to run.

In Sweden a lot of people are living on the country side with private small scale waste water treatment. They release as much phosphor as the public plants do even though they don't treat anyway near the same amount of water. If the private treatment facilities could be equipped with a method of taking care of the phosphor the phosphorus release would sink drastically.

Sources

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Waste water plant Rya in Gothenburg

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