SJÖLUNDA
WASTEWATER
TREATMENT PLANT
One of Sweden’s largest wastewater treatment plants

The Sjölunda Wastewater Treatment Plant is situated in the northern part of Malmö Harbour, and receives 1,350 litres of wastewater per second, which is equivalent to 420 bathtubs per minute. The water is received from the greater part of Malmö, together with Burlöv and parts of the municipalities of Lomma, Staffanstorp and Svedala. Approximately 300,000 residents are connected to the plant, which came into operation in 1963. This makes the Sjölunda Plant one of Sweden’s largest wastewater treatment plants.

REDUCING SOCIETY’S ENVIRONMENTAL IMPACT

The goal of the Sjölunda Plant is to ensure safe wastewater treatment for residents in the neighbourhood, as well as for the community in general. The best possible wastewater treatment methods are combined with specialist competence to achieve a sustainable process that is well adjusted to the ecological cycle, having a minimum environmental impact.

Why treat wastewater?

The average Swede uses approximately 190 litres, or about one bathtub full, of water every day. Water flushed from toilets or washed down the drain is directed to our wastewater treatment plants, where it is treated and then discharged back into the natural water courses.

REMOVING NITROGEN AND PHOSPHORUS

The purpose of wastewater treatment is to protect the environment, animals and people from the harmful substances in wastewater. For example, nitrogen and phosphorus can result in eutrophication (enrichment of an ecosystem with nutrients, typically compounds contain nitrogen and/or phosphorus) of our waterways, causing algal blooms and other problems. High amounts of organic substances in the water result in the depletion of oxygen, as oxygen is consumed when these substances are degraded, and this can have serious effects on many aquatic organisms.

Welcome to
Sjölunda Wastewater Treatment Plant
The sewerage system

The Sjölunda Plant receives and treats wastewater from several uptake areas. There is a large pumping station in the downstream part of each uptake area. The wastewater is pumped into a pressurized sewerage system that leads to the Sjölunda Plant. The largest pumping stations are called Turbinen, Rosendal and Spillepengen, and the other pumping stations are the Harbour and Södra Sallerup. Malmö has both a combined sewerage system with sewage and stormwater running in the same sewers, and a duplicate system with separate sewers for stormwater and sewage.

How is the treatment process controlled?

The main task of the Sjölunda Plant is to handle and treat wastewater in compliance with wastewater treatment regulations. A computerized control system is used to continuously monitor and regulate the treatment process, to ensure that these requirements are met.

COMPUTERIZED MONITORING

Various meters are used to continuously measure the phosphorus concentration, the water flow and other parameters. Wastewater samples from the different stages of the process are also analysed in the plant’s laboratory. The advantage of continuous monitoring is that it is possible to detect changes in the treatment process as soon as they occur, and to adjust the process accordingly. Laboratory analyses take longer, but they are often more accurate than the meters.

Future challenges

Malmö and the region surrounding it are expanding. The number of residents is increasing, which means that new homes are being built, placing increasing demands on wastewater treatment plants. More stringent restrictions can also be expected, as greater emphasis is being placed on protecting the environment in our communities.

CONTINUOUS IMPROVEMENTS

At our wastewater treatment plants, we follow the general trend in society of endeavouring to make use of the available resources in the best possible way. Some of the environmentally friendly measures we have taken include advanced control to reduce the electricity demand, optimal utilization of the produced biogas, minimizing the amount of chemicals used in the treatment process, and the recycling of nutrients.
Historical landmarks

1963 Sjölunda Wastewater Treatment Plant was commissioned.

1972 A research station was built for the development of wastewater treatment technology together with the Faculty of Engineering at Lund University.

1974 Pre-precipitation with ferrous sulphate was implemented in order to meet new standards for phosphorus removal. A sludge dewatering process was installed.

1978 A new gas boiler was installed and connected to the district heating network, making it possible to utilize all the biogas produced at the plant.

1980 A large sludge storage facility was constructed. Sludge started to be used as a fertilizer on farm land.

1988-1995 Research and tests were performed on pilot scale, as well as full scale, to develop concepts for the improved removal of nutrients.

1995 Two gas engines for electricity production came into operation.

1999 The plant was upgraded for enhanced nitrogen removal.

2008 A wet weather overflow facility was completed in order to reduce the number of overflows at the Sjölunda Plant.
The treatment process

1. FLOW EQUALIZATION
The trunk sewers between the large wastewater pumping stations in the sewerage network and the Sjölunda Plant are utilized for equalization of the wastewater flow into the plant.

2. INLET PUMPING STATION
During dry weather conditions, the wastewater is transported into the Sjölunda Plant by three pumps. When it rains and the flow increases, inlet sluices are opened and the wastewater is transported directly into the plant by the pumping stations in the sewerage network. If the wastewater flow exceeds the capacity of the plant, the overflowing wastewater is pumped, by overflow pumps, into an adjacent overflow plant, in order to avoid overflow of untreated wastewater (see item 16).

3. SEPARATION OF SCREENINGS
The wastewater is passed through screens where particles larger than 3 mm, called screenings, are removed. The volume of screenings varies depending on the weather and the flow rate. Under dry weather conditions and low flow rates, the screenings accumulate in the sewers. When it starts to rain, the rate of flow increases, and the screenings follow the wastewater into the wastewater treatment plant. This places a considerable hydraulic load on the plant for a short period. The separated screenings are washed to remove organic material, and are then dewatered. The screenings must be washed to meet the requirements for their incineration in the combustion plant where energy is extracted.

4. GRIT REMOVAL
Grit is removed in aerated basins. Particles lighter than water follow the wastewater further downstream, while heavier particles such as sand sink to the bottom. The grit is then pumped to the grit treatment stage. In order to remove particles of the desired size it is important to use the appropriate water velocity. Aeration helps in obtaining the correct velocity.

5. GRIT TREATMENT
The grit is washed and dewatered in grit washers to remove the organic material, as it is forbidden by law to deposit organic material. The grit and sand is then transported to an external site where it is being used as construction material.

6. PRE-AERATION/PRE-PRECIPITATION
After removal of the grit, the wastewater is led to the pre-aeration basins, where a ferrous-based precipitation chemical is added in order to remove phosphorus by precipitation. The precipitation substance also improves the sedimentation of particles.

7. PRIMARY CLARIFICATION
In the primary clarifiers, particles with a density greater than water sink to the bottom and form primary sludge. The primary sludge is pumped to the sludge treatment.

8. FLOW MEASURING DEVICES
The wastewater flow is measured in special measuring flumes (channels) called Parshall flumes.

9. ACTIVATED SLUDGE PROCESS
The first biological treatment stage is an activated sludge process. Sludge with a high concentration of microorganisms decomposes the organic material in the wastewater in an aerobic (oxygen-rich) environment. The air is provided by air blowers, and is regulated so that only the amount of air required for the process is added. Some of the basins are not aerated in order to create a so-called anoxic environment, where oxygen-intolerant microorganisms convert nitrate into nitrogen gas using the easily accessible carbon source in the wastewater.

10. SECONDARY CLARIFICATION
In the secondary clarifiers, the activated sludge is removed from the wastewater. Most of the sludge is transferred back to the activated sludge basins and is called return sludge. The purpose of this is to maintain an adequate sludge content in the aeration basins. A small amount is removed as waste activated sludge and pumped to the sludge treatment.

11. NITRIFYING TRICKLING FILTERS
Nitrogen in the form of ammonia in the wastewater is converted into nitrate in four trickling filters packed with a fixed plastic material with a large surface area. Conversion takes place in an aerobic environment with the help of microorganisms growing on the plastic material. Oxygen is added by natural draught through the trickling filters. The wastewater is distributed over the filters by rotating spreaders. It is also possible to re-circulate the out-flowing water to the trickling filters in order to use the easily accessible carbon source available there for denitrification of the nitrate into nitrogen gas. Re-circulation of the water once more over the trickling filters also improves ammonia removal.

12. POST-DENITRIFICATION
Nitrogen is removed from the wastewater in basins filled with small plastic carriers. Microorganisms growing in the biofilm that form on the carriers convert nitrate into nitrogen gas, which is discharged to the atmosphere. Methanol is added at the inlet of the basins as an easily degradable carbon and energy source for the bacteria. (The methanol is stored in large storage tanks.) The anoxic basins are kept completely mixed by mechanical mixers. The amount of methanol added is controlled by means of nitrate meters and flow meters, which operate continuously.

13. FLOTATION
The final stage in the wastewater treatment process at the Sjölunda Plant is flotation where particulate material is removed from the wastewater. The particles are mostly biological flocs consisting of microorganisms formed in the nitrogen removal stages. Tiny air bubbles are added to the flotation basins to lift the flocs to the surface. A layer of sludge is formed on the surface, which is scraped off and then pumped to the sludge treatment. A coagulant can be added to enhance the removal of particulate material and phosphorus, which results in post-pre-precipitation.
14. OUTLET PUMPING STATION
The effluent wastewater is discharged into the sea, Öresund, the Sound between Sweden and Denmark, by gravity. However, pumping is required when the hydraulic load is high, or when the water level in Öresund is high. The outlet pumping station consists of six large centrifugal pumps.

15. OUTLET PIPES
The treated wastewater is discharged into Öresund about 3 km from the coast, through two large concrete pipes.

16. WET WEATHER OVERFLOW PLANT
During wet weather, the water flows into the plant are high, and wastewater exceeding the plant capacity is pumped to a large overflow basin where screenings are removed. The basin is divided into two parts. At the inlet of the second part, ferric chloride and polymer can be added to bring about so-called direct precipitation, in order to precipitate phosphorus and to coagulate particulate material. The wastewater is passed through lamellae where the particles are caught, to improve the sedimentation of particles. They slide down the lamellae to the bottom of the basin. If the hydraulic load on the plant diminishes before the basin is full, the wastewater is pumped back again. The overflow basin then functions simply as a temporary storage facility. If the hydraulic flow is persistently high and the basin becomes full, the treated wastewater flows to the outlet sewer under the force of gravity. When the influent flow to the overflow basin has stopped, the wastewater is pumped back to the main plant and the overflow tank is emptied. The sludge remaining on the bottom of the tank is washed into a flume by a series of waves, created by rapidly opening sluices to water-filled washing compartments. The sludge is pumped back into the inlet pumping station of the plant for separation in the primary clarifiers.

17. PRIMARY SLUDGE THICKENING
Before the sludge reaches the thickeners, it is passed through screens in order to remove screenings. The screenings are washed and pressed before being transported to a combustion plant, where energy is extracted. The sludge from the primary clarifiers contains large amounts of water. It is therefore pumped into gravity thickeners, where particles sink to the bottom of the basins, and the water phase at the surface is pumped back into the inlet section of the main plant. In this way, the sludge is dewatered, greatly reducing the volume.

18. SURPLUS SLUDGE THICKENING
The surplus sludge also contains large amounts of water. Surplus sludge pumped from the secondary clarification stage and sludge from the flotation plant are transported to a mechanical thickening stage where a polymer is added in order to achieve better recovery of particles. The sludge is then transported on filter belts which allow water, but not larger particles, to pass through. The water phase is directed back to the inlet of the plant.

19. ANAEROBIC DIGESTION
The thickened sludge is pumped to digesters where part of the organic material in the sludge is degraded by microorganisms and converted into energy-rich biogas consisting mainly of methane and carbon dioxide. The plant has three parallel lines with two digesters each, which are charged consecutively. Digestion takes place in an anaerobic environment at a temperature of 35-37 °C. The sludge is heated in heat exchangers.

20. RECEPTION STATION FOR ORGANIC MATERIAL
Different types of external organic material can be received in a special reception station. Sludge from grease removal tanks at restaurants is an example. The organic material is delivered by tankers and pumped into two storage tanks, before it is pumped into the digesters, where a large part of the organic material is converted into biogas.

21. BIOGAS HOLDERS
The amount of biogas produced can fluctuate. In order to equalize the gas flow to the following treatment units, the gas is collected in gas holders.

22. GAS ENGINES
Biogas has a high energy value. Biogas can be transported to two gas engines where it is converted into electricity and heat, which is used in the operation and heating of the wastewater treatment plant. The remaining heat is delivered to the district heating network. If necessary, a gas boiler can be utilized where the biogas is converted into heat. If the gas treatment units are not in operation, the biogas is burned in a gas torch to prevent methane from being released to the atmosphere.

23. BIOGAS UPGRADING
Most of the biogas is refined (upgraded) to produce vehicle fuel. Carbon dioxide, particles and other unwanted substances are removed from the biogas. After a small amount of propane has been added, the refined biogas has the same energy content as natural gas, and the gas is delivered to the natural gas network.

24. BUFFER TANK FOR DIGESTED SLUDGE
If necessary, the digested sludge can be stored temporarily in a large storage tank, before sludge dewatering.

25. SLUDGE DEWATERING
The digested sludge is dewatered in centrifuges. A polymer is added to the sludge before entering the centrifuges, so that the sludge flocs release water more readily. This provides a higher dry solids concentration and a clearer sludge liquor. The dewatered sludge is transported to a silo before loaded on trucks and transported to the sludge storage facility.

26. REJECT WATER TREATMENT
The water phase removed during sludge dewatering is called reject water. The reject water contains a high amount of ammonium, and is treated in a separate activated sludge process in a sequencing batch reactor (SBR). Microorganisms convert ammonium to nitrite while the process is aerated in sequences. Sodium hydroxide is added in order to adjust the pH value in the reactor. The effluent from the SBR is pumped to the main plant where the nitrite is later removed in the non-aerated section of the activated sludge basins by conversion into nitrogen.

27. SLUDGE UTILIZATION
The sludge produced each month is stored separately in two large sludge storage facilities to guarantee the quality and traceability of the sludge. The dewatered sludge is certified, which means that it has a sufficiently high quality to be used as an organic fertilizer on agricultural land. A soil product can also be produced by adding sand and other construction material to the sludge.
Everyone can contribute to improving the environment by reducing the demand/hydraulic load on wastewater treatment plants. You can do this by not wasting water, and by not disposing of harmful substances down the drain. If we all increase our “water awareness” the environment will benefit, and we can preserve both the flora and fauna in nature.

RETURN OLD MEDICINES TO THE PHARMACY
It is very difficult, and sometimes impossible, to decompose pharmaceuticals in a wastewater treatment plant. Most pharmaceuticals simply pass through the treatment plant and end up in our water courses, where they can have a highly detrimental effect on aquatic organisms. Always return expired and surplus medicines to a pharmacy.

HAZARDOUS WASTE BELONGS IN A RECYCLING CENTRE
Hazardous waste, such as paint, glue and other chemicals (such as solvents), should be taken to a recycling centre. Never pour these down the drain or throw them away in the refuse bin. You can read more about recycling centres and hazardous waste on SYSAV’s website: www.sysav.se.

GREASE CLOGS THE PIPES
Grease clogs pipes and promotes the growth of microorganisms that interfere with the wastewater treatment process. A good tip is to wipe your frying pan with kitchen paper and throw it in the bin before washing the pan.

KEEP A WASTE BIN IN YOUR BATHROOM
We frequently have problems at treatment plants caused by “foreign objects” such as tampons, sanitary towels, condoms, cigarette ends, snuff, hair, cotton swabs and cat litter. These should be thrown in a bin instead. If you don’t already have one, place a small pedal bin in your bathroom.

WHAT YOU DO MATTERS
Wastewater treatment, more than most other environmental areas, is directly influenced by what we do as individuals. We can all help to save our natural resources through a few simple measures.

Remember that the toilet is not a waste disposal unit. The only things you should flush down the toilet are poo, wee and toilet paper.

Glossary

ACTIVATED SLUDGE PROCESS: A biological treatment stage in which microorganisms decompose organic material and convert ammonia into nitrate and nitrogen gas

AEROBIC: Containing oxygen

ANAEROBIC: Being completely devoid of oxygen

ANAEROBIC DIGESTION: Anaerobic biological decomposition of organic material resulting in the production of biogas (mainly methane)

ANOXIC: Containing oxygen only in the form of compounds such as nitrite, nitrate and/or sulphate

BOD: Biochemical Oxygen Demand or Biological Oxygen Demand, a measure of the content of biodegradable substances in the wastewater

CLARIFICATION: Settling of heavy particles in the water by gravity

DENSITY: Mass per unit volume, g/cm³ or kg/m³

EUTROPHICATION: A process in which excessive amounts of nutrients, for example, phosphorus and nitrogen, are deposited in soil or water

OVERFLOW: During periods of high water flow, the flow of wastewater sometimes exceeds the capacity of the plant, and incoming water has to be diverted past some stages of the treatment process

POST-PRECIPITATION: Chemical precipitation of residual phosphorus after the biological treatment

PRE-PRECIPITATION: Chemical precipitation of phosphorous in the primary treatment

SEWAGE: Wastewater from households and industrial processes

SLUDGE: The material produced during wastewater treatment, consisting of decaying products in the wastewater

STORMWATER: Rainwater and snow melt run-off
**Technical data**

### THE SEWERAGE SYSTEM
- Malmö uptake area: 65 km²
- Total length of sewers: 800 km
- Pumping stations for wastewater: 50
- Pumping stations for stormwater: 76
- Number of stormwater storage tanks: 40
- Number of sewage storage tanks: 7
- Percentage of combined sewerage system: 29%
- Percentage of duplicate sewerage system: 71%
- Percentage of active duplicate sewerage system: 85%
- Sewerage system overflows: 26

### DESIGN DATA
- Population equivalents: 550,000
- BOD₇ load: 40 ton/d
- Average wastewater flow: 1,650 l/s
- Qmax to biological treatment: 4,400 l/s
- Qmax to nitrogen removal: 2,200 l/s
- Qmax to post-treatment: 4,400 l/s

### INCOMING AND OUTGOING QUANTITIES DURING 2015

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<th>Outgoing (kg/d)</th>
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<td>Flow</td>
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### EFFLUENT REQUIREMENTS (TARGET VALUES)

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<td>BOD,</td>
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<tr>
<td>Total phosphorus</td>
<td>0.3 mg/l (monthly average)</td>
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<tr>
<td>Total nitrogen</td>
<td>10 mg/l (annual average)</td>
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### POST-TREATMENT
- Flocculation basins
  - Number: 16
  - Total volume: 3,960 m³
- Flotation basins
  - Number: 16
  - Total area: 2,000 m²
- Tanks for precipitation chemical
  - Volume: 2 x 28 m³

### WET WEATHER OVERFLOW PLANT
- Flocculation basins
  - Number: 16
  - Total volume: 1,140 m³
- Flotation basins
  - Number: 16
  - Total area: 2,000 m²
- Primary clarifiers
  - Number: 8
  - Total area: 5,600 m²
  - Total volume: 7,900 m³

### SBR REJECT WATER
- Equalization tanks
  - Number: 2
  - Volume: 154 + 323 m³
- Reactor
  - Number: 1
  - Volume: 1,920 m³
- Storage for sodium hydroxide
  - Number: 2
  - Volume: 2 x 25 m³

### SLUDGE STORAGE
- Digested sludge
  - Number: 1
  - Volume: 5,000 m³
- Surplus sludge
  - Number: 1
  - Volume: 2,000 m³
- Dewatered sludge storage area
  - Number: 2
  - Area: 50 + 10,000 m²
  - Volume: 300 + 15,000 m³

### PUMPING STATIONS
- Inlet pumping station
  - 3 x 750 l/s
- To aeration basin G4
  - 3 x 1,100 l/s
- To trickling filters
  - 2 x 450 l/s
  - 3 x 750 l/s
- To denitrification
  - 4 x 733 l/s
- Bypass to flotation
  - 2 x 1,000 l/s
- Effluent pumping station
  - 6 x 1,850 l/s
- Wet weather overflow plant
  - 3 x 1,800 l/s
VA SYD supplies fresh drinking water, treats wastewater and is responsible for waste management for over half a million people. We encourage you to drink tap water, sort your household waste, and be careful about what you dispose of down the drain. Together we can actively contribute to sustainable urban development. For the environment, near you.