From food waste to new resources
Sysav’s pre-treatment plant for food waste
Harnessing energy and nutrients

Leftover food accounts for almost half the weight of a standard household refuse bag. Food waste is also generated in restaurants, large-scale kitchens, grocery stores and food industry. Sorting food waste and treating it biologically can harness both the energy and the nutrients found in the waste.

In Sysav’s pre-treatment plant, food waste is converted into slurry, a pumpable, viscous liquid which is the plant’s end product. The slurry is then used to produce two useful resources – biogas and biofertiliser. The biogas can be used to fuel vehicles, while the biofertiliser replaces other fertilisers in agriculture.

The pre-treatment plant for waste is one of several Sysav plants. Sysav receives waste from households and businesses in southern Skåne, Sweden’s southernmost province. A combination of methods are used to ensure the waste is harnessed as a resource in the best possible way. In addition to biological treatment, these methods include energy recovery from incineration, re-use and various forms of recycling, management of hazardous waste and landfill.

Sysav’s pre-treatment plant came into service in 2009. The technology for pre-treating food waste is still very much in its infancy, and several of the technical solutions at Sysav’s plant cannot be found anywhere else.
How the plant works

1. Receiving tank
2. Buffer tank
3. Intermediate tank (sand trap)
4. Exhaust air hose
5. Tanker loading and unloading
6. Pallet inverter
7. Piston press
8. Receiving bin
9. Ladder conveyer
10. Shredder
11. Mixing unit
12. Screw extruder
13. Slurry collection tank
14. Screw conveyer for combustible fraction
15. Perforated diffuser for ionised supply air
16. Control room
Food waste – a resource

Separation and processing of food waste have been taking place at various locations in Sweden for several years. It is a national goal that 35% of all food waste should be treated biologically. This is why Sysav’s owner municipalities are introducing separation and separate collections of food waste from households, large-scale kitchens, restaurants and grocery stores.

Households and businesses sort their food waste into special paper bags which are placed in a separate waste container. Large-scale kitchens and restaurants can also use disposal grinders, whereby the food waste is collected in a tank. Shops and food producers can leave waste which is still in its consumer packaging.

Effective pre-treatment of food waste is important to ensure that subsequent treatment in a biogas plant works well. The food waste is processed into a pumpable slurry. This is the plant’s end product. There is also a residual product in the form of combustible waste, which is used for energy recovery in Sysav’s waste-to-energy plant.

Sysav’s pre-treatment plant can receive three main types of food waste:

1) Pumpable liquid food waste
Pumpable liquid food waste is pumped directly from a tanker to a receiving tank. Liquid waste includes food waste from disposal grinders and fat separation sludge, for example.

2) Pre-packed liquid food waste
Pre-packed liquid food waste, such as juice and milk in cartons, comes in on pallets.

3) Separated solid food waste
The majority of food waste received at the plant is standard, separated food waste from households, restaurants and large-scale kitchens, for example. The waste is tipped into the receiving bin and must only contain leftover food and the paper bags it is placed in. Limited quantities of pre-packed food from industry and retail may be included in this waste.

Breaking down of waste in the biogas plant

The pre-treated food waste leaves Sysav in the form of a pumpable slurry, which is transported to a biogas plant. In the plant’s oxygen-free environment, carbohydrates, proteins and fats are broken down in several stages by bacteria, including methane-producing micro-organisms. This process continues for just over three weeks. The end products are a methane-rich biogas, along with a liquid biofertiliser which retains the nutrients from the food waste.
The pre-treatment plant has three treatment lines. Two of these are for liquid food waste: one for waste from tankers and one for pre-packed waste on pallets.

**Receiving tank**

Pumpable food waste arrives by tanker and is deposited in a receiving tank. This waste could be from disposal grinders and fat separators at restaurants and large-scale kitchens. The waste is pumped from the tanker, via an intermediate tank where any stones and grit are removed, and on into the receiving tank. Liquid food waste still in its packaging on pallets is also pumped into the receiving tank once it has been treated.

**Piston press for pre-packed liquid waste**

Part of the plant is designed to deal with pre-packed food waste. This waste must be liquid and be in plastic or paper packaging. This type of waste primarily comes from food producers and wholesalers, and comes in on pallets.

During the process, the packaging is punctured and compressed. This is done in batches. The liquid is squeezed out and runs down into a collection tank, and then on to the receiving tank. The compressed packaging is transported by a screw conveyor and finally ends up in the waste bunker at Sysav’s waste-to-energy plant.

**Liquid food waste**

Solid food waste, which is also treated at the plant, usually needs to be diluted. The waste in the receiving tank is relatively liquid and can be used for this purpose. The liquid used to dilute the food waste is primarily liquid food waste from the receiving tank, and secondarily water.

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**Receiving tank**

Volume: 65 cubic metres. The tank is insulated and equipped with agitators. A sand trap stops gravel and grit from entering the tank.

**Buffer tank**

Volume: 200 cubic metres. The tank is insulated and equipped with agitators.

**Piston press**

Pre-packed liquid food waste is transported by truck to a pallet inverter and emptied into a receiving hopper. Packaging is punctured and compressed in the piston press.
The majority of the food waste consists of solid waste which is tipped into a receiving bin. This includes the waste separated in households, as well as much of the food waste from restaurants, large-scale kitchens and shops. The waste is usually sorted into paper bags, which do not have any adverse impact on the treatment.

The treatment is based on separating waste that can be treated biologically from waste that has to be combusted. This is carried out using a screw extruder.

As the waste is about to be tipped, a lid on the receiving bin opens. The lid forms a tight seal and closes between each deposit of waste to prevent smell spreading to the surroundings. Using a bottom conveyor, the waste is transported to the short side of the bin, where it is shredded using three milling drums.

**Shredder**
The waste is transported from the receiving bin by the screw conveyor and ladder conveyor to a shredder. In the shredder, the food waste is shredded into small pieces by blades on a rotating shaft.

**Screw extruder**
The finely shredded food waste is carried by screw conveyor to a mixing unit where the waste is homogenised. It is then worked in a screw extruder. Using a screw, the waste is pressed onto a cone that provides counter-pressure. The pressure can be regulated. The thick slurry is extruded through holes on the sides.

**Combustible fraction**
The remaining combustible fraction is transported by screw conveyor to the bunker at Sysav’s waste-to-energy plant.

**Slurry – an end product**
The slurry from the pre-treated food waste is finally collected in a 200 cubic metre buffer tank. The buffer tank is insulated and equipped with agitators to prevent sedimentation. The slurry in the buffer tank is then transported to a biogas plant.

**Solid food waste comes from households, for example.**
Exhaust air from tankers
When the slurry is collected, a flexible hose is connected to the tankers to deal with the air in the tank. This prevents the spread of waste odour. The collected air is ionised before being released.

Operator
There is an operator on site to manage and monitor the pre-treatment plant. The operator opens and closes doors and the tipper-receiving bin and checks that the solid waste has been separated correctly before tipping. Individual wrongly sorted objects can be removed with a crane.

Monitoring and odour control
To ensure a good work environment and prevent bad odours, ionised air is used in the plant’s ventilation system. Perforated plastic diffusers are suspended from the ceiling. They are placed around the receiving bin and the machines, and gradually release ionised air which neutralises any odorants in the plant.

When the lid on the receiving bin is opened, ionised air flows in and forms a sealing layer over the waste. Exhaust air is sucked from the machines in the plant and beneath the receiving bin.

The pre-treatment plant is located in the same building as Sysav’s waste-to-energy plant. Exhaust air is led to the waste-to-energy plant’s bunker, and from there to the incinerators.

Ionised air from perforated plastic diffusers is the secret to preventing bad smells at the plant. The air is ionised as it passes through an electronic valve which increases the concentration of negative oxygen ions. The ions combine to form large clusters of oxygen. The foul air reacts with the ionised air and is neutralised.

Unwanted objects in the receiving bin can simply be removed by crane.
Biogas and biofertiliser

Thanks to the pre-treatment process, the food waste can be used as a resource in more than one way. Biogas and biofertiliser are recovered from the slurry in a biogas plant.

An energy-rich gas

Biogas is a clean, renewable fuel and therefore an important complement to petrol and diesel.

Biogas is largely made up of the energy-rich gas methane. Because this is not a fossil substance but is recovered from a biological source, using biogas does not increase the concentration of carbon dioxide in the atmosphere. Emissions of nitrogen oxides, hydrocarbons and dust are also lower than with petrol or diesel. Moreover, biogas is safer to handle than petrol.

There are special filling stations for biogas. It can also be distributed in the same network as natural gas, which also consists of methane.

An alternative to commercial fertilisers

Biofertiliser from food waste has a high nutritional value and a good composition of the nutrients crops need. Biofertiliser, which is generally spread in the same way as other liquid fertiliser, also contains humus and micro-organisms that are good for the soil. Using biofertiliser restores nutrients and humus to the natural eco-cycle, rather than letting them go to waste. It can also reduce the need for commercial fertilisers, which leads to several benefits. Phosphorus, which is present in commercial fertilisers, is a finite resource and another component, nitrogen, requires large amounts of energy to produce.

Electricity and district heating – by-products

The end residue that remains after pre-treating food waste is used as fuel in Sysav’s waste-to-energy plant. The combustible waste comprises packaging and other dry material. It is carried in a screw conveyor via a band weigher to the bunker in the waste-to-energy plant, which is in the same building as the pre-treatment plant. The waste is burnt at a high temperature and an advanced process is used to clean the flue gas. Energy is produced in the form of district heating and electricity.

Purity and quality control

Well-separated waste and close control throughout all stages of the process are important to ensure a high-quality biofertiliser. Sysav follows a quality control system for food waste to make sure that biofertiliser can be returned to productive arable land.

Operating data

**LINE 1**

Reception of pumpable food waste
Design & planning: Purac & Sweco
Supplier: Purac
Receiving tank: 65 m³
Agitators: Stamo, 3 propellers, 7.5 kW
Recirculation pump: Landia, cutting centrifugal pump, 150 m³/h
Buffer tank: 200 m³
Agitators: Stamo, 3 propellers, 15 kW
Recirculation pump: Landia, cutting centrifugal pump, 150 m³/h
Dry matter sensor: Ventim, Mass Flow Sensor, Optimass MFS 7000

**LINE 2**

Pre-treatment of packaged liquid food waste on pallets
Supplier: OP system AB
Capacity: 2 tonnes/h
Pallet inverter: Nimo KG, SK 800 MK
Piston press: Puhler, MSV 500

**LINE 3**

Pre-treatment of source-sorted food waste from households, retail, large-scale kitchens, restaurants and industry
Supplier: OP system AB
Capacity: 10 tonnes/h
Receiving bin: Havelberger: H100-30, 30 m³
Shredder: Doppstadt, DW 2060
Screw extruder: Doppstadt, DSP 20-5
Conveyor screws: FAS
Band weigher: Emve

VENTILATION
Supplier: YIT Sverige AB
Air conditioning unit: Swegon, GOLD SD-40/60/08/04, GOLD PX-08
Ionisation unit: EKOion, 5-F, 5-E

CONTROL SYSTEM AND ELECTRICAL INSTALLATIONS
Supplier: YIT Sverige AB
Receiving hall 600 m²

In its next life it wants to drive a car. By recovering biogas and biofertiliser from food waste, we reduce the use of fossil fuels, thereby contributing to lower carbon dioxide emissions.