desah

SAVE WATER

RECOVER ENERGY

COLLECT FERTILIZERS

sustainable, compact,
cost-effective

Wastewater Treatment

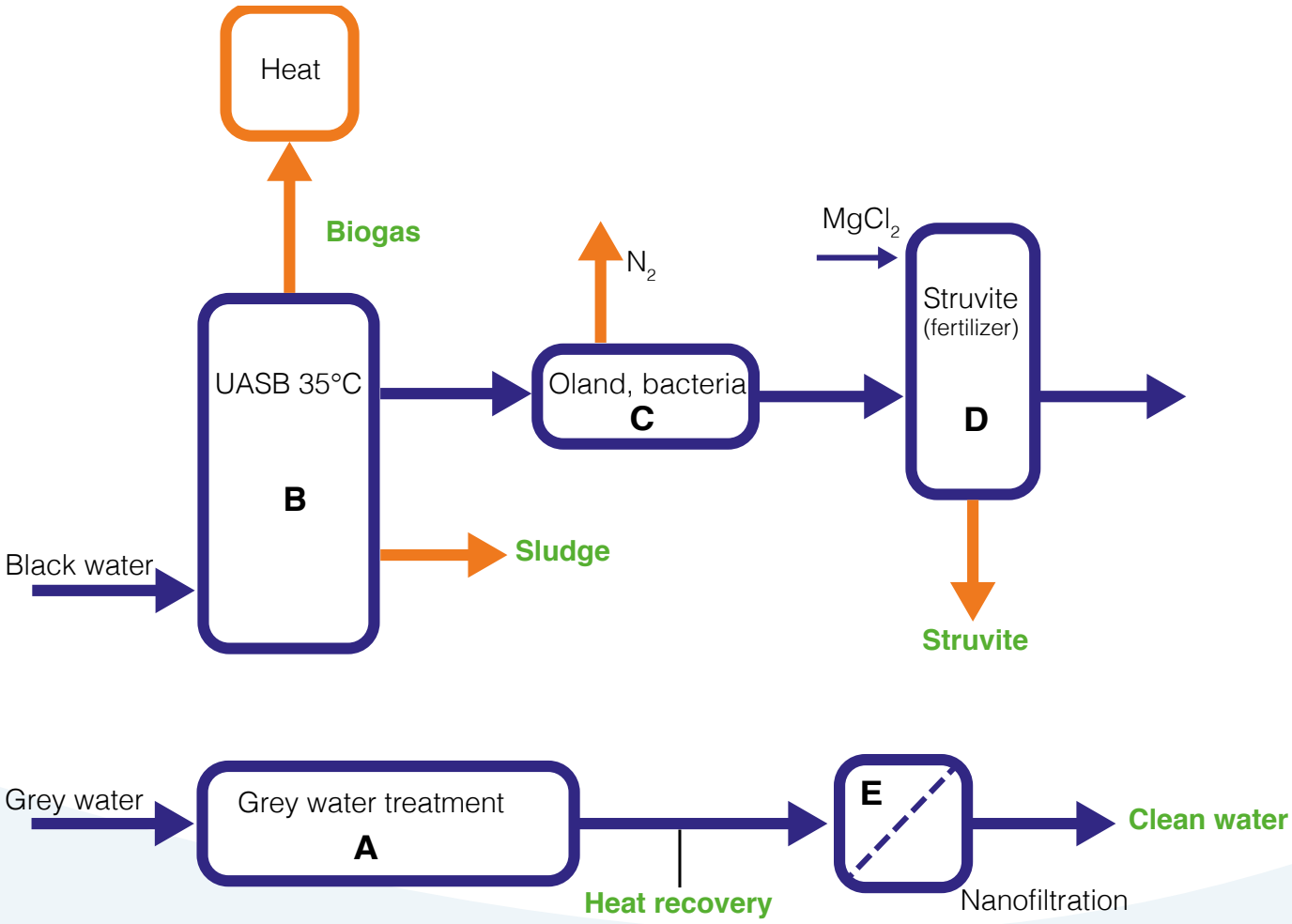
New sanitation

The Decentralised Sanitation and Recovery Concept developed by DeSaH is a circular, source-separated wastewater treatment that recovers energy, fertilizers and water.

This source-separated wastewater consists of two streams:

- highly concentrated black water stream from vacuum toilets
- warm grey water stream

The resulting treatment system allows for a more sustainable approach to wastewater management.
The DeSaH concept is suitable for newly built or renovated housing districts, high-rise buildings, remote areas and areas where the sewer capacity is full. The possibility of high-quality effluent makes the system suitable for cases where reclaimed water can be sold or reused.



Resource recovery from wastewater

Wastewater from toilets (black water) is collected for energy and fertilizer recovery. To maximize system efficiency the volume of wastewater is reduced using vacuum drainage, as water saving vacuum toilets produce approx. 90% less wastewater compared to traditional gravity toilets. As the black water is highly concentrated it can be treated effectively with less energy. First, the black water is treated in an anaerobic digester (B) where the organic matter is converted into biogas. This biogas is directly burned in a boiler. The heat can be used for heating. The digester also produces sludge which can be removed every month by a truck. This sludge contains micronutrients like zink and selenium and can be used as an organic fertilizer.

The ammonium present in the black wastewater is converted into nitrogen gas (C) in a biorotor (OLAND). In a next step phosphorous is removed (D) and a green fertilizer (struvite) is obtained. This fertilizer can be used locally in parks and gardens.

The grey water is further treated in a compact aerated wastewater system (A). The cleaned wastewater is finally polished through a membrane filtration unit which retains micropollutants (pharmaceuticals, hormones, antibiotics, personal care products and microplastics), bacteria and viruses.

The clean wastewater, after the filtration, has a relatively high temperature (20 - 25°C). This heat can be extracted by means of a heat pump. The amount of heat that can be extracted could be as high as 20 - 30% of the heating requirements of a building.

The wastewater has a very high quality (cleaner than rain water) and can be reused for e.g. toilet flushing, irrigation or cooling. The quality of the treated wastewater is much higher compared to the effluent of large scale wastewater treatment plants which still contains micropollutants, bacteria and viruses. This system can be installed where public sewage connection is not available or when the capacity or the wastewater treatement plant is limiting.

The performance of the installation is monitored online and 3 times per year maintenance of the system is required. Desah has over 10 years of experience in operating and maintaining similar systems in The Netherlands for treating the wastewater of 230 houses with further references projects located in the Netherlands, Ukraine, Sweden and Canada.

Effluent quality

	Water quality treated wastewater	**Water quality requirements for treated wastewater in the Netherlands**
Organics COD	not detectable <<10 mg/l (lower than tap water)	<125 mg/l
Total phosphorous	0,5 mg/l	<2mg/l
Total nitrogen	3,6 mg/l	<15mg/l
Hardness	<5 dH	

All values are much lower than the discharge limits for a large scale sewage treatment plant. Moreover, micropollutants and pathogens are removed in the system.

Advantages

The treatment system is a producer of very clean water, energy, and green fertilizer and has the following advantages:

Water saving and reuse

- Total amount of wastewater is reduced thanks to vacuum toilets which save 90% on flushing volume of water compared to traditional gravity toilets.
- The wastewater treatment system removes all micropollutants (pharmaceuticals, estrogens, antibiotics, personal care products and microplastics) bacteria and viruses and has therefore no negative impact on the aquatic system. These micropollutants are difficult to remove in current large scale sewage treatment plants (because of their dilution) and are currently not removed.
- The system becomes a supplier of clean water, which can be very beneficial during periods of drought.

Energy recovery

- The concentrated wastewater from the vacuum toilets is treated in a digester which produces biogas, which can be used for heating. Moreover, food waste can be added to the system by means of a kitchen grinder allowing for more biogas production.
- Heat can be recovered from the warm (20 - 25°C) treated wastewater by means of a heat pump. This amount can be up to 20-30% of the total demand of heat.
- The wastewater treatment system has a much lower energy use compared to traditional wastewater treatment plants and has therefore a lower carbon foot print.

Recovery of fertilizers

- Phosphate and ammonium from the wastewater are recovered as a solid granules. These granules are called struvite and can be used as a green fertilizer for parks and gardens.
- The digester produces sludge which can be used as an organic fertilizer for land. This is not possible with sludge from large scale sewage treatment plants which is often polluted by heavy metals from storm water and industries.

Comparison

In this comparison the gravity toilet is connected to the sewage system and treated in a central wastewater treatment plant (WWTP), whereas the wastewater of a collection system with a vacuum toilet can be treated locally.

	Gravity toilet	**Vacuum toilet**
Closing the water loop		
Water use and reuse potential	6 – 8 liters/flush not possible	0,8 liters/flush Water is treated locally and can be reused at the spot e.g. for toilet flushing, irrigation etc.
Dilution of pollution is not the solution. Whether a compound is considered as a waste or as a resource depends on its concentration	Grey and black water are mixed. In the sewage system rainwater and industry wastewater are added, thereby diluting the pollutants	Black water is separated from the less polluted grey water by means of a vacuum toilet. Black water contains: 63 % of the organic waste, 68% of the total phosphorous load, and 85 % of the total nitrogen and 100 % of the pharmaceuticals while the volume is 4,5 times lower. Concentrated waste streams can be treated more easily, more effectively and more energy efficiently.
Micropollutants	Micropollutants are diluted by: the flushing water, grey water, rainwater and industry water and are therefore difficult to treat in a central wastewater treatment plant.	Micropollutants are concentrated in the black water. The anaerobic digester removes a large part of the micropollutants. Membrane filtration of the treated water retains also the micropollutants, which are send back to the digester and get eventually degraded.
Sewage connection	Needs to be connected to central sewage system, which can have a limited capacity.	No central sewage connection necessary
Local reuse of energy from water		
Biogas production	Biogas can be generated from waste sludge at a central wastewater treatment plant	Black water collected by vacuum toilets is treated in a digester and generates 200 % more biogas compared to a central wastewater treatment plant.
Green food waste	Cannot be added to the sewage system	Can be added by means of kitchen grinders, delivers more biogas and gives an effective separation from other wastes
Heat recovery from waste water	Less favorable; flushing water cools down the wastewater; Heat is lost in the sewer system before reaching the WWTP	20-30 % of heat can be recovered by heat pump. Heat can be used in the building.
Recovery of fertilizers		
Sludge protection	2 times more, polluted with heavy metals and cannot be reused.	Sludge quality is higher, lower amount of heavy metals and can be used to improve the soil quality of the land.
Fertilizer recovery	Very limited	Recovers 250% more phosphorous in the form of struvite compared to conventional wastewater treatment plants.

Cost-effective

The costs of the collection and treatment system can be significantly lower compared to a large scale wastewater treatment plant because no central sewer system is needed and energy, clean water and nutrients can be reused locally.

The treated wastewater has a temperature of about 20-25°C. A heat pump can be used to extract the heat out of the wastewater. The coefficient of performance (COP) of a heat pump is generally much higher if heat is extracted from warm water compared to colder air. These savings can be considerable and can amount to several tens of Euros per person per year depending on the situation. The treated water is very clean and free of micropollutants, bacteria and viruses. This water can be reused locally and contribute to water and cost-savings. On average the yearly wastewater discharge per person is 35-40 m^3.

Additional savings can be obtained through the use of kitchen grinders allowing for cost savings on transport and treatment of kitchen waste. The kitchen grinders are connected to the vacuum system and the green kitchen waste is converted in biogas in the digester. Cost savings can be tens of Euros per person per year.

Modular system

DeSaH has developed different modular system components which are selected to meet discharge requirements. Desah offers 3 compact modular systems with the following capacities:

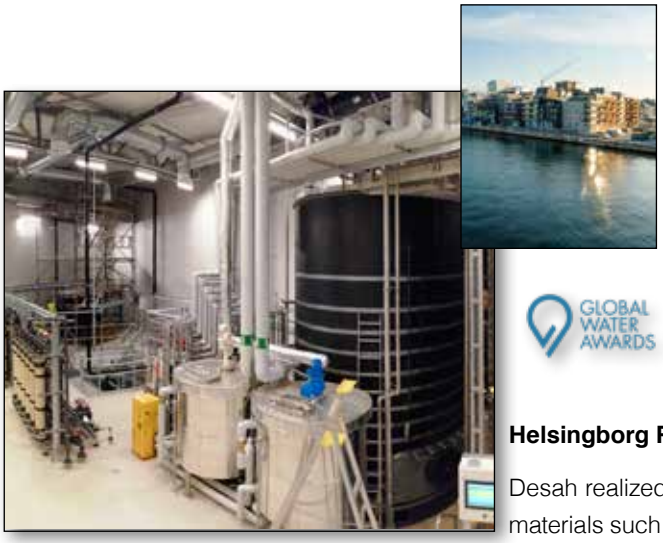
- 250 persons
- 800 persons
- 1600 persons

The modular system consists of a digester (UASB), OLAND, struvite crystallizer, greywater treatment unit and a membrane filtration unit. The whole system is monitored and controlled remotely.

References

Noorderhoek Sneek, The Netherlands (250 p.e.)

Desah has designed and build a treatment plant for 230 houses equipped with vacuum toilets and kitchen grinders in Sneek (Netherlands). Desah has also done the maintenance and operation for over 10 years of this treatment plant.



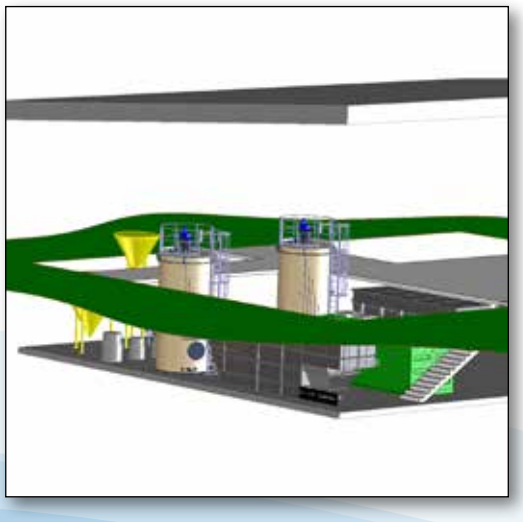
GLOBAL WATER AWARDS

Helsingborg Reco Lab, Sweden (2100 p.e)

Desah realized the new sanitation design, emphasizing the recovery of valuable raw materials such as fertilizer, water and biogas, as well as heat recovery.

Edmonton, Canada (800 p.e.)

The objective of this full-scale demonstration project is to demonstrate the relevance, feasibility and economic value of a decentralized wastewater treatment system that will be suitable for more locations in Canada. In addition, sustainable energy will be produced (biogas), nutrients will be recovered, and the use of drinking water will be reduced.



Government office building Den Haag, The Netherlands

DeSaH designed and built the installation. This new installation will pay for itself through savings on water use, water treatment levy and costs of waste treatment and energy. The Ministry building is the largest office where such a sustainable sanitation concept has been applied.

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versie nov. 2022