

Greywater recycling with heat recovery



Whitepaper

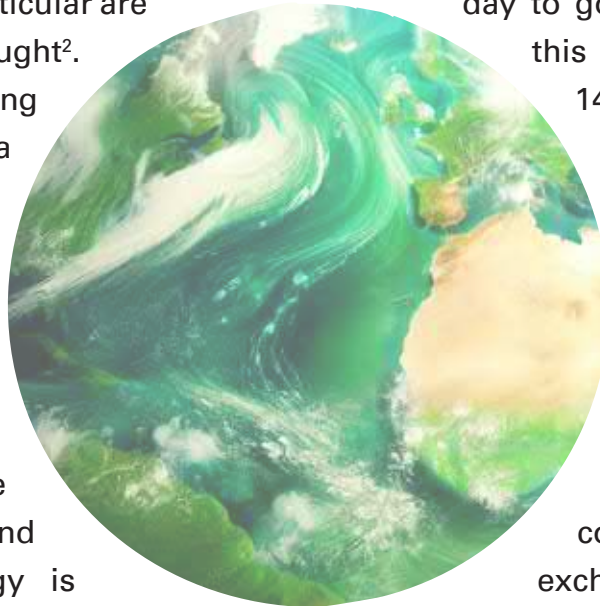
DEHOUST
ENERGY. HEAT. WATER.

Background and relevance

The world is changing. Changes are noticeable in every area of life. One of the most obvious changes and challenges of our time is climate change¹ - with all its consequences for humans, animals and the environment.

While Germany is increasingly being hit by floods and high water events, southern Europe is struggling for water. Spain and southern France in particular are suffering from drought².

The days when drinking water was seen as a neverending resource and treated accordingly must come to an end, because it is not a luxury good that we can live without. At the same time, the demand for water and energy is increasing worldwide due to increased population growth, urbanization and industrialization. As global warming progresses, Germany will also be confronted with increasingly frequent periods of drought³. Some municipalities are already banning garden watering in summer⁴,



while the solution is literally flushed down the toilet: Each person uses around 40 liters of drinking water every day to go to the toilet. In total, this amounts to more than 14,000 liters per year⁵.

A sensible alternative in this context is the recycling and use of greywater. This can reduce the water consumption of an inhabited building by up to 50 percent. In conjunction with a heat exchanger and buffer tank, the thermal energy of the waste heat is also stored and made usable. This increases not only the efficiency of the system, but also that of the building - a thoroughly positive contribution to the environment.

What is...

...greywater?

Greywater is slightly contaminated wastewater from domestic or commercial applications. This typically occurs in the kitchen, bathroom or laundry room and primarily contains small dirt particles, skin cells, soap residue and grease. An example of this is wastewater from showers, washbasins and washing machines. In contrast to black water, it can be treated with comparatively little effort due to its significantly lower pollutant load and can therefore be used for flushing toilets, watering the garden, or even the washing machine. The typical amount of greywater is 50 to 80 percent of the total wastewater produced by a building.

...blackwater?

Blackwater is wastewater that comes from the toilet. It is particularly contaminated with pathogens and pollutants due to the faeces it contains. Direct reuse or utilization - without prior thorough treatment in a sewage treatment plant - is not possible due to the high health risks.

...process water?

By common definition, process water is not drinking water. This water, which is usually treated, is used in technical, commercial, agricultural or domestic applications - for example in cooling systems, cleaning processes, or production processes. It is frequently referred to as service or industrial water. Process water often contains thermal energy that can be recovered.



Greywater recycling using the biological process

Dehoust uses a three-stage chemical-free, biological process to treat greywater. The first step is mechanical filtration. In this first step, the greywater is separated from solids such as hair, soap residue and other solid matter using a coarse filter and then transferred to a collection tank. In this tank, the greywater is first revitalized through extensive aeration. This is followed by biological treatment in a filtration tank. In this tank, organic pollutants such as shower gel or soap are broken down aerobically and biologically by wastewater bacteria. Frequently used systems are planted soil filters or bioreactors. By controlling the aeration times in the filtration tank, particles and suspended solids settle to the bottom as sediment before the next filtration step. The treated greywater is pumped out via the filtrate pump with floating extraction and treated by the GWtec membrane filter. The latter consists of many fibers, each of which contains seven capillaries. In the filtration mode, the water is pushed through the capillary. Processes such as ultra- or nanofiltration ensure a high degree of purification. With a pore width of the UF membrane of just

20 nanometers, even bacteria and viruses are reliably and safely retained. Treated greywater is referred to as process water. If the water quality requirements are particularly high, the final step is to disinfect the process water. This is done using UV light or ozone, which reliably kills any pathogens. The treated process water complies with the European standard EN 16941-2⁶ and is therefore hygienically safe, colorless, free of suspended solids and odorless. The water is stored in a service water tank until it is used. If there is not enough service water available, the system is topped up with drinking water via a break tank.



Heat recovery in greywater recycling

Greywater from the shower, hand basin or washing machine contains residual heat from previous use. This heat can be used to reduce the energy demand for a heating system. In the case of GWtec, heat recovery is achieved using a heat pump. To decouple the process water and heating water networks, the waste heat is first transferred to a plate or pipe heat exchanger in a counterflow process and then to the heat pump. There, the flow temperature is raised to make the waste heat from the grey water system usable. The heat pump transfers the recovered heat to the heating system. In view to the energy requirements of a building, this is

ideal for combining with renewable energy sources such as solar thermal energy or photovoltaics. There is no waste heat storage in the system. Instead, the use of a process water storage tank for thermal energy storage in the heating circuit is recommended. In this way, the heat pump can operate at any time when thermal output is available in the service water, thus preventing the loss of thermal energy. The larger the greywater system is designed, the greater the potential for heat recovery. With smaller systems, heat recovery can be integrated as a decentralized system for individual buildings. With large systems, central use of the recovered heat energy in local heating networks for entire districts is also possible. Heat recovery based on plate or tubular heat is particularly efficient in buildings with constant hot water consumption such as hotels or fitness studios.



Advantages

There is no unlimited supply of clean drinking water in this world. However, the treatment of greywater can reliably counteract possible shortages. The global economic and political turbulence of recent years, on the other hand, has shown that energy is also a sometimes fragile resource. After all, it is not possible to generate a

of treated greywater, GWtec is already very economical. The use of heat recovery also makes it possible to utilize the residual thermal energy of the greywater and thus reduce the heating energy required for a building. Not only does this save money, but it also saves the energy resources



sufficient amount of electricity purely from renewable sources such as wind or solar thermal energy within a very short time period. For this reason, it is important to Dehoust to make greywater recycling as efficient as possible. With a consumption of 0.3 to 0.5 kilowatt hours per cubic meter

required for the heating system, and it helps to reduce your carbon footprint. The recovered heat can be fed into the hot water circuit or the heating circuit. Feeding it into the hot water circuit is more efficient, as the heating systems are usually switched off during the summer months.



Ecological advantages

By treating greywater, fresh water consumption in residential and commercial buildings can be reduced by up to 50 percent. This saves precious drinking water resources. At the same time, the volume of wastewater is reduced, relieving the burden on sewer systems and improving the water quality of natural waterbodies. In combination with heat recovery, energy is saved and CO₂ emissions are reduced. This contributes to achieving climate targets.



Economic Advantages

Investments in greywater recycling and heat recovery pay for themselves quickly, especially for large systems. This is due to the high savings in water, wastewater and energy costs. In the long term, high economic savings can be achieved. The use of sustainable technologies can also give companies a competitive advantage. An environmentally friendly positioning strengthens the brand image and creates customer confidence.



Regulatory and social benefits

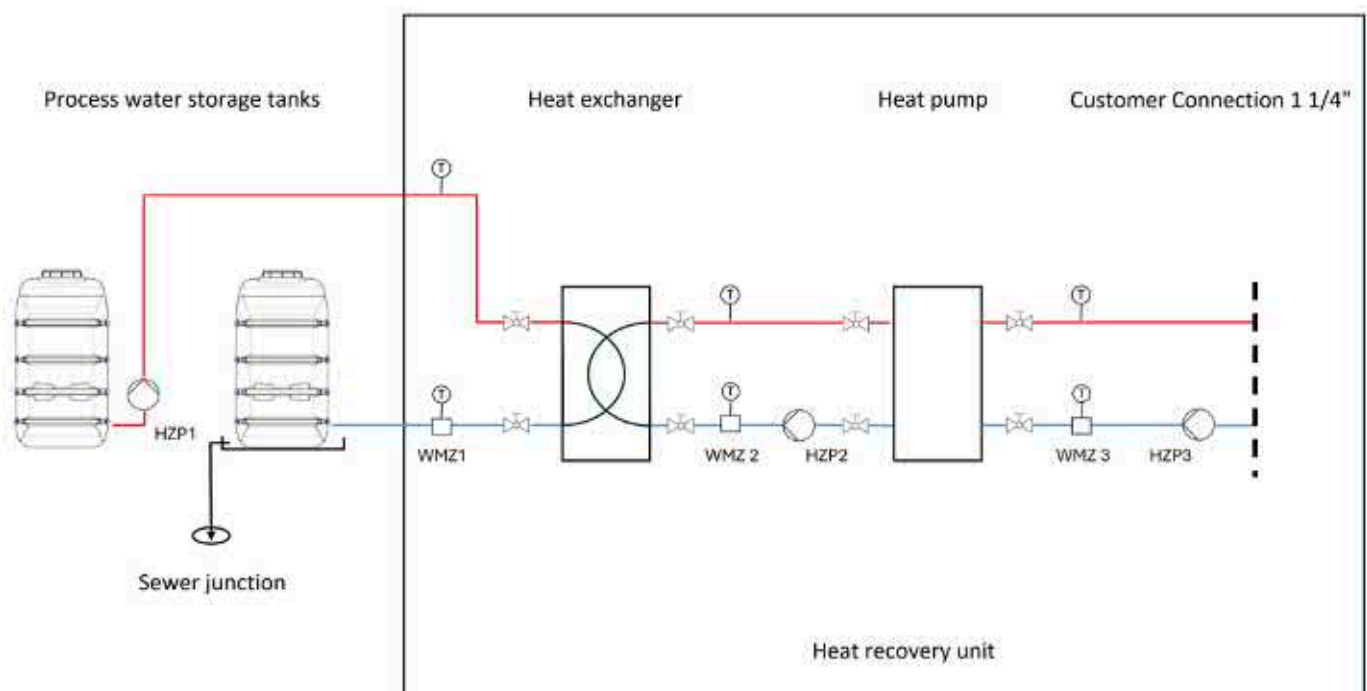
The use of sustainable technologies makes it easier to comply with strict environmental regulations, which is of great added value for industry in particular. In addition, the savings in water and energy resources benefit the public weal.

Design requirements

The installation of a greywater recycling system requires prior design and installation of an additional piping system for the process water and greywater.

It must not be possible to mix process water and drinking water at any point within the system.

At critical intersections, the purity of the potable water system must be ensured by a break tank. The use of heat recovery results in increased space requirements. In addition to the heat pump and heat exchanger module, at least one additional process water storage tank must be designed. These components require additional piping to connect the heat recovery with the greywater system. A condensate tray must be installed around the service water storage tanks to collect the condensate. It is also advisable to install a buffer tank so that excess thermal energy can be stored.



Areas of application

Treated greywater can be used wherever the use of food-grade water is not mandatory. This means that greywater can be used in buildings, for example, to flush toilets or for washing machines, as well as in public and semi-public areas such as hotels and hospitals. Greywater use is permitted also for garden irrigation or cleaning purposes. Besides residential buildings, the recycled greywater can be used as process water to reduce fresh water

requirements and wastewater volumes in industrial processes. In combination with heat recovery units, its use in swimming pools leads to a considerable reduction in heating costs through recovering the heat of waste water from the shower. For the industry, the use of waste heat to preheat raw materials or production facilities is interesting and economically worthwhile.



Application examples

Germany

The **Forum der Senioren** retirement home in Viernheim features 24 residential units and 143 permanent care places. It was equipped with the GWtec 140 in July 2020. With a treatment capacity of 6,000 liters per day, the wastewater from showers and hand basins in the guest and staff rooms is recycled for flushing the toilets. Two 3,000-liter tanks were installed to store the greywater and service water. The saving of around 2,000,000 liters of drinking water per year shows in a significant way that successful greywater treatment is also possible in particularly hygiene-relevant areas such as retirement homes.



The **Betriebshof Darmstadt** is responsible for the implementation of municipal tasks and services. There are showers and washbasins in the staff rooms for the approximately 200 employees. The wastewater from these is not only reused for flushing toilets but also for cleaning the city's streets. The GWtec 140 has been reliably treating around 6,000 liters per day for more than a decade. The additional use of Dehoust Connect enables simple remote maintenance of the system and guarantees particularly easy fault analysis and rectification in the event of a malfunction.



Application examples abroad

The [Greek National Opera House in Athens](#), with a 28,000 square meter auditorium includes the National Opera, the National Library of Greece and a large park. Two GWM 2,000 greywater treatment plants have been in operation here since 2009. With a total daily treatment capacity of 4,000 liters per day, the plants convert wastewater from showers and washbasins into clean process water for flushing toilets, watering the parks, and cleaning the buildings. Like many southern countries, Greece suffers from extreme periods of drought every year. Park maintenance in particular therefore benefits greatly from water treatment.

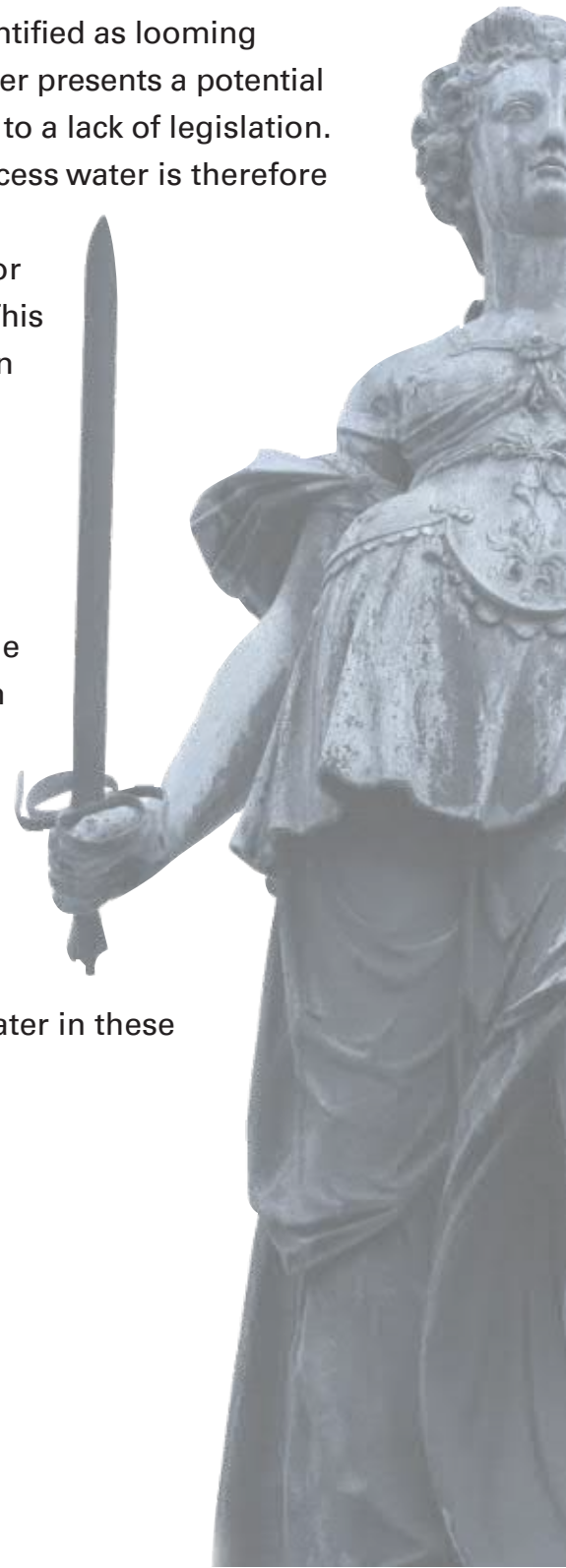


At home in the world of financial news and data delivery, [Bloomberg](#) has built its European headquarters in London. The 1.1 million square meters, spread over nine floors, provide space for around 4,000 employees. After treatment, the greywater produced from showers and hand basins feeds the building's WC flushing systems. Two greywater treatment systems from Dehoust, the GWM 12,000 and GWM 22,500, were put into operation for this purpose in 2017. The treatment capacity of 35,000 liters per day contributed to the head office receiving the highest BREEAM rating ever awarded at the time of design at 99.1 percent⁸.



Legislation

Climate change and water scarcity are known and identified as looming problems. At the same time, the treatment of greywater presents a potential solution that is not being used to its full potential due to a lack of legislation. The question of possible areas of application for process water is therefore primarily a political one. The EU Water Framework Directive (WFD) creates the regulatory framework for the protection of all waters, including groundwater. This also includes the fact that no quantitative deterioration of groundwater may occur since the directive came into force in 2000. Saving drinking water is therefore a fundamental requirement. Currently, however, only the use of service water for flushing toilets, washing machines and watering gardens is permitted. The water for showers and baths is subject to the hygiene requirements of the amended European Directive on the quality of bathing water and its management. The process water treated by GWtec even exceeds these requirements and therefore exceeds the requirements for the quality of treated greywater. Treated process water from GWtec could even be used in dishwashers. This is in contrast to the legislation, which only permits the use of drinking water in these areas.



Political challenges



Climatic changes and the simultaneous increase in demand for drinking water justify the need. Greywater treatment plants are already capable of providing high-quality service water and manufacturers are experiencing an ever-increasing interest in the systems. It is now up to politicians to create the necessary framework conditions to make water recycling available to the masses and thus counteract the consequences of climate change. However, it is not only the legislation on the areas of application of process water that needs to be adapted. Subsidies or tax benefits could be a decisive incentive for the installation of greywater systems and heat recovery and thus accelerate the expansion. At the same time, grants for research and development could provide manufacturers with the necessary support to drive forward the development of efficient and cost-effective technologies and thus further improve water quality. However, benefits and subsidies alone are not enough. The relevance of the topic needs to reach the public. One effective means would be to integrate greywater recycling into existing and future climate protection plans at a federal level. Different building regulations between countries or regions can unnecessarily complicate the expansion.

Subsidies and the future

There are currently no nationwide subsidies for the installation of a greywater system. The only exception for private individuals is the state of Bremen⁹. Companies throughout Germany can apply for funding via the KfW environmental program¹⁰.

funding area	funding type	eligible persons	provider	sum
Bremen	subsidy	associations, private persons, companies	senator for environment, climate and science	up to 40 % of the eligible costs, up to a maximum of 5,000 €
Germany	loan	companies	BMUV	100 % of the eligible costs can be financed

Greywater recycling and heat recovery from process water are key technologies for a sustainable future.

They offer solutions to the most pressing challenges of our time: conserving water resources, reducing energy consumption, cutting CO₂ emissions and, as a result, combating climate change. Integrating these technologies into building and industrial applications is not only what is called for now, but also an economically attractive option.

The potential of these technologies can be fully exploited through research, innovation and targeted funding. Pilot projects and pioneering roles by companies and public institutions can help to increase social acceptance. Governments, industry and society are equally called upon to create the conditions for widespread implementation. Together with manufacturers, this can pave the way for a resource-conserving and climate-friendly future.

Contact us!

About us

Dehoust GmbH, based in Leimen and with branches in Nienburg, Heidenau and Eitorf, has been active for almost 70 years and has played a key role in the development of the heating oil tank market.

Today, Dehoust manufactures tanks made of polyethylene. Double-walled plastic tanks for liquid fuels and raw materials form the backbone of production. Large-volume storage tanks made of steel and stainless steel are a central component of production. Buffer storage tanks are designed at Dehoust as systems for heating and cooling. Dehoust, as the pioneer in water management systems with over 20 years of experience, is consistently expanding rainwater and greywater utilization as well as Cat-5 break tank booster systems. Would you like to find out more about our services in the field of greywater treatment or do you need advice and support with a current planning process? Then please do not hesitate to contact us. Our experts are on hand to answer all your questions about efficient greywater recycling with and without heat recovery.

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