HUBER TECHNOLOGY

HUBER SOLUTIONS for Global Water Challenges

– Wastewater has value and should not be wasted
– Wastewater should be treated and reused
– Wastewater is a most dependable source of water, nutrients, bio-solids and energy
– HUBER SOLUTIONS are closing loops

The Quality Company – Worldwide

Global Challenges

About 1.1 billion people have no access to potable water, and even 2.6 billion people are without sanitation.

Lack of clean water and sanitation is the number one cause for epidemic diseases and deaths in developing countries. Over 5,000 people, most of them children, are killed every day by water pollution.

As the world population is growing and climatic conditions are worsening, water scarcity is rising.

Over 70 % of human water consumption serves for irrigation. This percentage is bound to rise further to permit feeding growing populations in arid and semi-arid regions.

Competition for water is becoming fiercer. Lack of this precious resource is already becoming a fundamental reason for violence, population displacement and war.

Not only our fossil energy resources, but also our resources of fresh water and phosphorus are gradually depleting. Energy, water and nutrients will certainly become more expensive and less affordable for the poor.

In many regions soil fertility is gradually decreased by erosion. Soil layers become thinner. Soils loose organic carbon, and thus their water and nutrient absorbing capacity. They become less fertile and need even more irrigation and fertilizer.

Sustainable Solutions

Only sustainable solutions can mitigate these global challenges.

The only really sustainable solution is to close the loops by reuse of water, nutrients and organic carbon, and by recovery of energy. In addition, we must reduce consumption.

We have to understand that wastewater is our most dependable water resource; as we use water, we produce wastewater. As we eat, we discharge nutrients and energy-rich organic carbon. As we separate and recycle solid waste, we now must begin to separate and recycle wastewater and its ingredients.

Sustainable solutions create value from waste.

Adapted Solutions

Only adapted solutions can be successful. They must be adapted to regional and local conditions: climatic, environmental, social, cultural, technical, as well as economical conditions.

Solutions must be efficient and affordable. Sanitation technology developed long ago in water-rich, industrialized and wealthy countries is not suitable for arid and poor developing countries and for emerging countries. It is a terrible mistake that “conventional” sanitation technology, which is wasting a lot of fresh water as transport medium, is still employed where it should have no place.

Different solutions are required for cities with sewers, cities without sewers, small towns, suburbs, rural villages, isolated hotels, resorts, and single dwellings. Each solution must be adapted to its application.

Reduce, Treat and Reuse

The ideal solution would be to treat all wastewater and reuse the effluents for irrigation. In this way, the world’s fresh water consumption would be reduced by the entire wastewater flow.

Decentralized treatment is required to produce irrigation water where it is needed. Treated effluent can be used for the irrigation of yards, gardens, parks, golf courses and fields in the vicinity of dwellings, office buildings, hotels or resorts.

Where not all of the wastewater is needed for irrigation, treated effluents are alternatively used as service water for flushing and washing purposes, therewith also reducing fresh water consumption.

Where more wastewater is produced than can be reused for irrigation or as service water, rain water and well treated effluents should be used for ground infiltration and groundwater replenishing wherever possible. After additional soil filtration the water can be recovered as fresh water.

Decentralized treatment and reuse make expensive and long sewer networks redundant. In addition it reduces the size and costs of water lines.

Where wastewater is treated in central plants, the effluent quality should be sufficient to permit downstream reuse for irrigation or as a fresh water resource.

Adapted and Sustainable HUBER SOLUTIONS

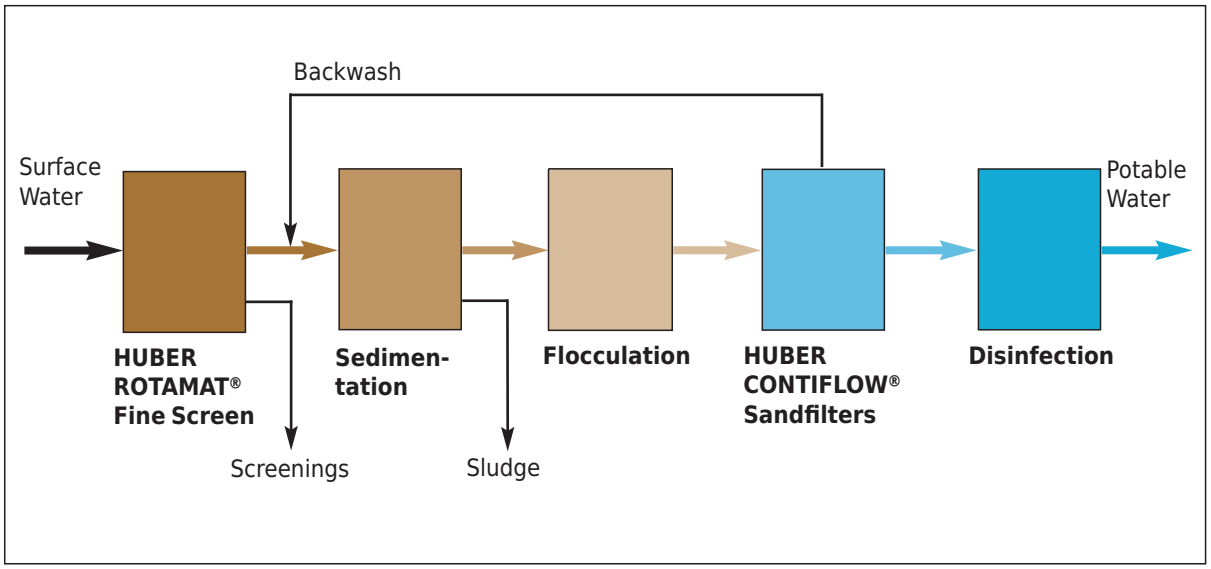
HUBER SafeDrink® Solution

Simple and Affordable Production of Potable Water

Affordable water treatment is needed in developing and emerging countries to produce safe drinking water from moderately polluted surface water.

Screening, sedimentation, flocculation, sand filtration and disinfection are the simple and basic components of our SafeDrink® Solution. Operation and maintenance are easy.

Our SafeDrink water treatment plants have a capacity of 10 m³/h or larger.



Basic and simple steps of our affordable HUBER SafeDrink® Solution

Clean potable water should not remain a luxury

HUBER CONTIFLOW® Sandfilter in Sudan

HUBER PondPlus® Solution

Lagoon Effluent Reuse for Irrigation

Wastewater lagoons or ponds are widespread as a simple technology for wastewater treatment where sufficient area is available. Their large surface has the disadvantage that a great portion of the water is evaporated in hot and arid climate. Their treatment efficiency is limited, and removal of sludge is difficult and expensive.

Our PondPlus® Solutions improve lagoon treatment efficiency and facilitate reuse of the effluent for irrigation, particularly for water saving drip-irrigation.

Our first improvement step is the addition of fine or micro-screens for wastewater pre-treatment. They prevent scum formation on the lagoons and clogging of drip-irrigation lines.

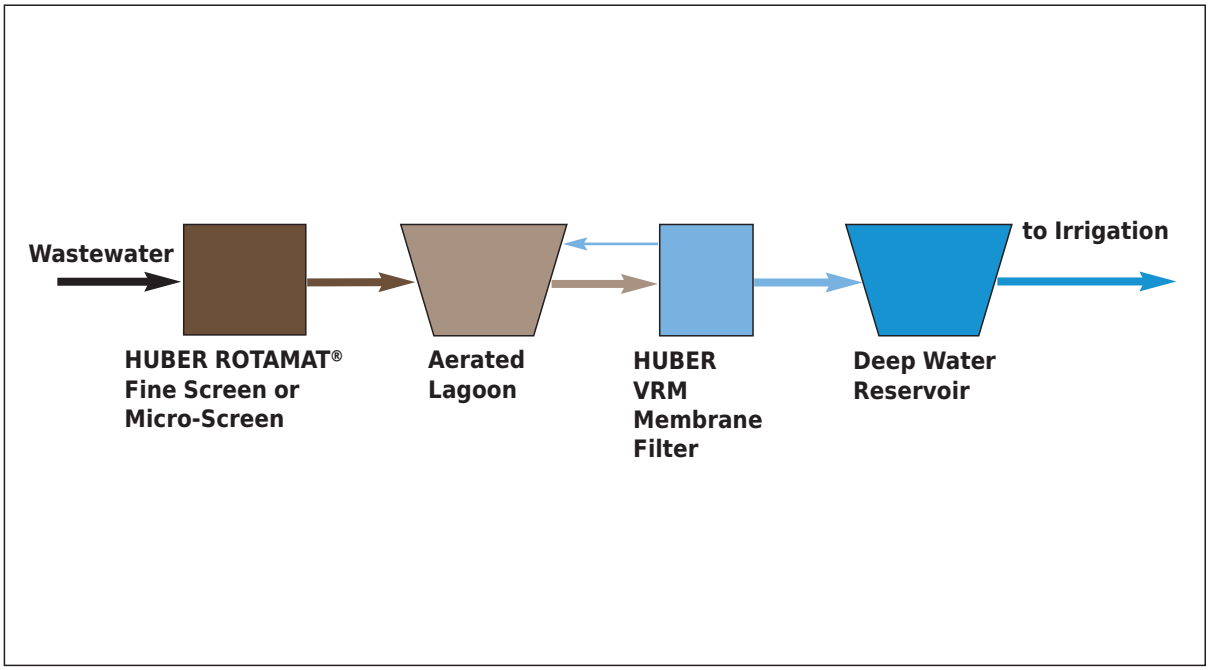
The next improvement step is filtration of the overflow from aerated lagoons through our rotating VRM® membrane filters. The membranes retain all solids and bacteria, but nutrients remain in the effluent. The retained active biomass is returned to the aerated lagoons. We greatly increase their biomass concentration, their biological treatment efficiency and capacity.

Anaerobic, non-aerated, settlement and polishing lagoons are no longer needed and can be upgraded into aerated lagoons, further increasing treatment capacity and efficiency. Massive methane emission and breeding of disease carrying mosquitoes is prevented.

We upgrade lagoons to far more compact and efficient membrane bio-reactor (MBR) systems. In this way, we also reduce their surface and evaporation losses.

ROTAMAT® micro-screens RoMem at lagoons in the Middle East

Drip irrigation with high-quality lagoon effluent



HUBER PondPlus® Solution for wastewater lagoon improvement

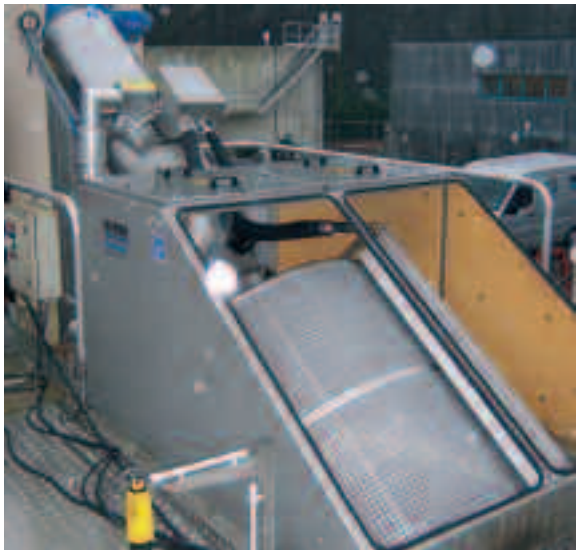
HUBER MeChem® Solutions

First Step Solutions: Most Cost-Effective Mechanical / Chemical Wastewater Treatment

Budgets for environmental projects are notoriously tight, particularly in developing and emerging countries. It is imperative to achieve the greatest possible improvement with a limited amount of investment.

Since project costs rise exponentially with treatment efficiency, basic treatment of all wastewater should come first, expensive biological treatment should come later.

Our MeChem® Solutions are a modular step-by-step wastewater treatment system. The first mechanical step with fine screening is the least expensive and most cost-effective one. The following steps further improve the effluent quality, but are increasingly more expensive.



Micro-screen ROTAMAT® RoMem

Micro-strainer ROTAMAT® RoDisc

Step **1** is fine screening, step **2** adds micro-screening. Chemical flocculation is added as step **3**, and micro-straining as step **4**. Step **5** adds disinfection and step **6** trickling filters for biological treatment.

The steps taken depend not only on the available money, but also on the effluent requirements and type of effluent reuse.

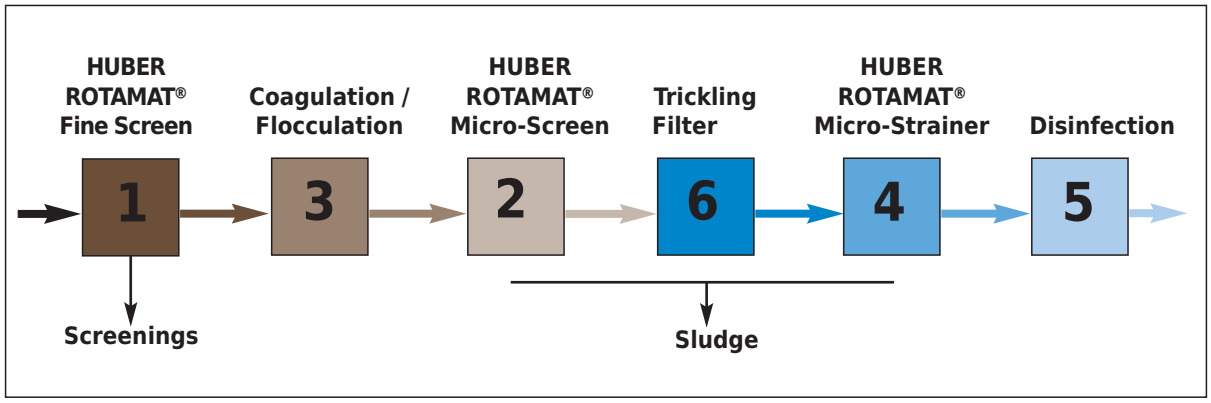
For river and sea outfalls, basic mechanical treatment may be sufficient (Steps **1**, **2** or **3**).

For outfalls into small rivers and streams, mechanical and chemical treatment should be combined (Steps **3** or **4**).

For lake outfalls, urine separation (see our Separation Solutions below) is desirable to prevent eutrophication of the lakes resulting in excessive growth of oxygen consuming algae and plants. Most of the nutrients nitrogen and phosphorus in wastewater stem from urine.

The nutrient phosphorus can be removed by chemical precipitation (Step **3**), but removal of the nutrient nitrogen and of other dissolved pollutants requires biological treatment (Step **6**). However, where the effluent is used for irrigation, high nutrient concentrations add value.

Whether disinfection (Step **5**) is needed depends on the type of crops that are irrigated and on the irrigation technique. Disinfection is also required where the receiving surface waters are used for bathing or as a potable water source.



Step-by-step implementation of modular HUBER MeChem® Solutions

HUBER SeptageTreat® Solution

Septic Sludge Treatment for Reuse

Sludge from septic tanks is odorous, offensive and corrosive. It often contains grit, gravel and stones, as well as all kinds of debris that can pass through toilets.

Where possible, septic sludge is hauled to a large central wastewater treatment plant where it is screened (we recommend our ROTAMAT® Ro 3 septage receiving stations) before it is blended into raw wastewater or sewage sludge.

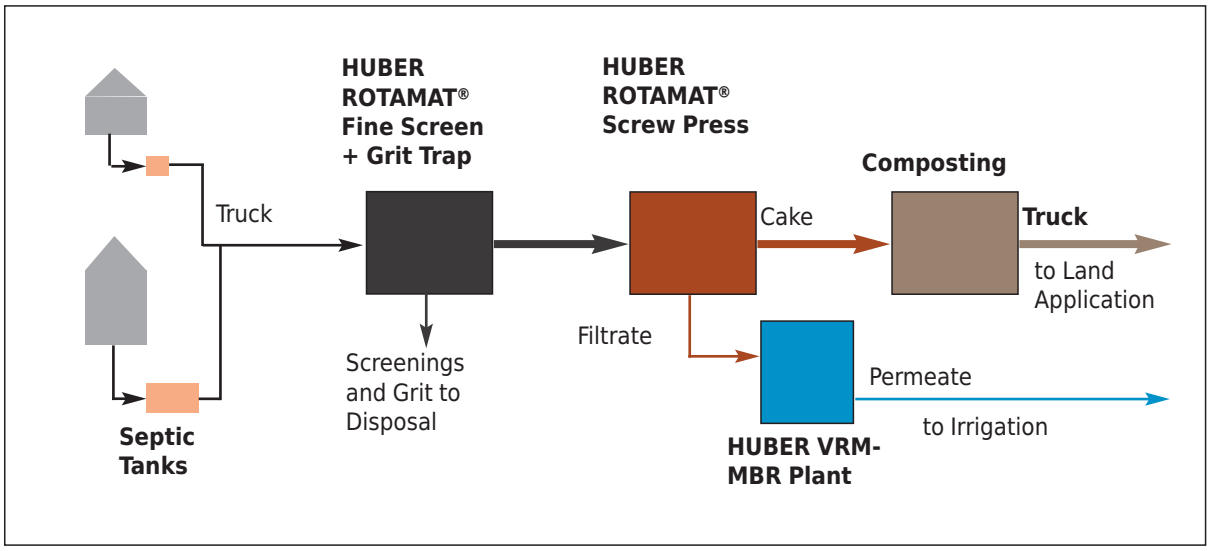
Because sufficiently large and well equipped treatment plants are usually not available in developing and emerging countries, the septic sludge is often hauled to far away deserts or wastelands. Due to its open anaerobic degradation methane is released. Methane is a 23 times stronger greenhouse gas than carbon dioxide. Methane emissions cause global warming.

Our SeptageTreat® System is the best solution for this problem. The collected septic sludge is screened, degritted and dewatered. To prevent odour nuisance and corrosion, the entire treatment is done in enclosed stainless steel machines.

The removed screenings are washed, dewatered, compacted and bagged. They are disposed of as solid waste. The removed grit can be washed and reused as a construction material, e.g. for road bedding.

The filtrate from sludge dewatering is treated in one of our compact membrane bio-reactor (MBR) systems. Since it contains valuable nutrients the treated effluent should be reused for irrigation.

The dewatered sludge cake is then aerobically composted in simple windrows on site. The biosolids are reused for land application and soil improvement. They contain valuable nutrients and much organic carbon.



HUBER SeptageTreat® Solution for the treatment and reuse of septic sludge

HUBER ROTAMAT® Screen and Grit Trap ...

... and HUBER ROTAMAT® Screw Presses in Kuching, Malaysia

HUBER DeSa/R® Solutions

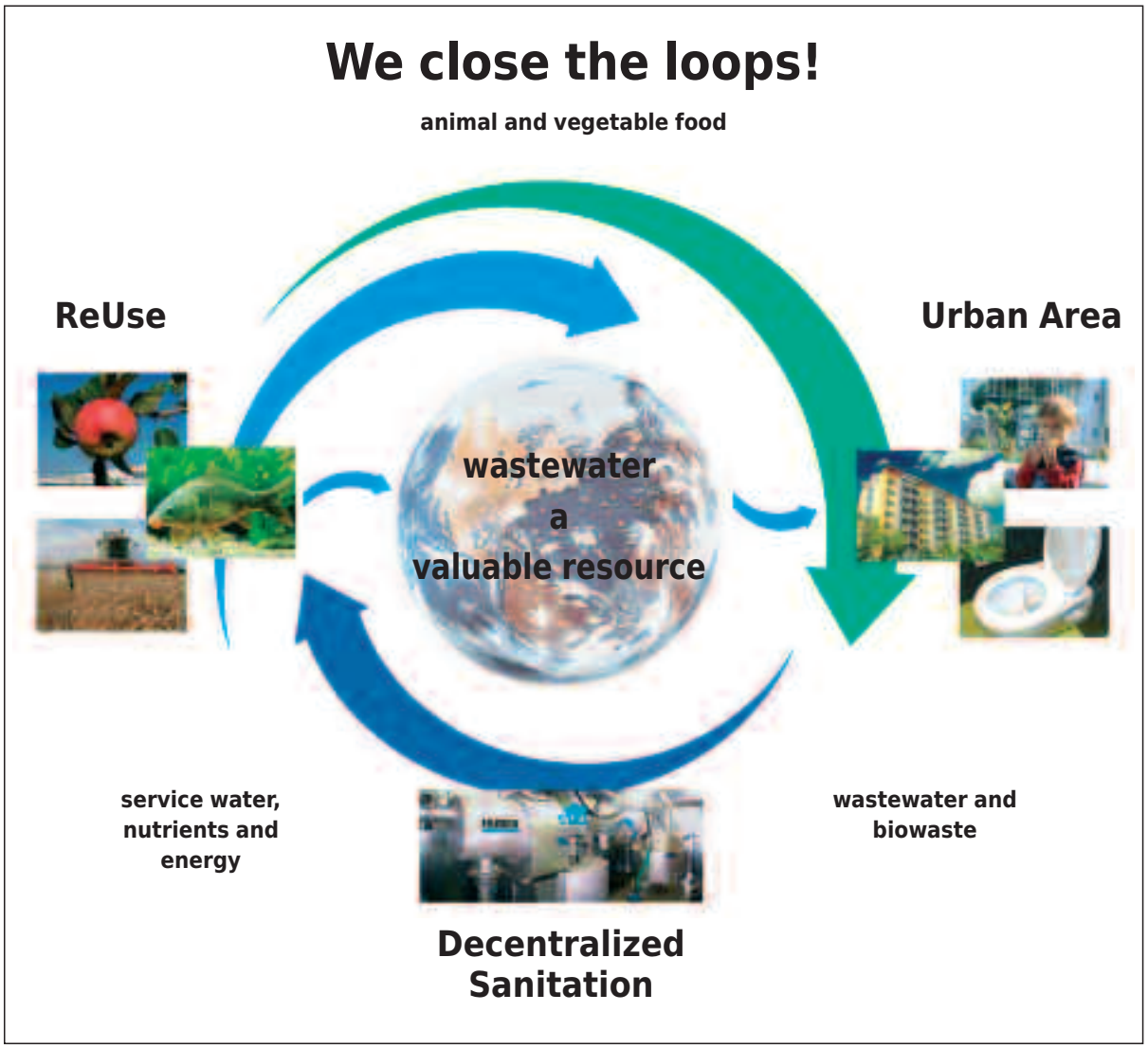
Closing Loops with Decentralized Sanitation and Reuse

The idea driving our DeSa/R® development is that wastewater is a most dependable source of water, nutrients, organic carbon and energy. We produce wastewater, this reliable source, every day.

Generally, sanitation is best done where the wastewater is produced and where it can be reused, where we live and work.

Decentralized sanitation and reuse is our best solution for global water challenges.

Decentralized or semi-centralized sanitation and reuse is not only the sensible thing to do, it is also more economical than centralized wastewater treatment. At first glance, decentralized treatment appears to be more expensive, but the enormous costs for construction and maintenance of long sewer networks are saved. In addition, decentralized sanitation and reuse reduces fresh water consumption as well as water treatment and distribution costs.



Saving our global water resources by decentralized treatment and repeated effluent reuse

HUBER SeptiMem® Solution

Upgrading Septic Tanks to Membrane Bio-Reactors (MBR) with Our MembraneClearBox® (MCB)

Septic tanks are used all over the world for very basic decentralized sanitation. However, effluents from septic tanks are still highly polluted. Treatment remains insufficient even where the effluent is percolated through well designed and built drain fields. Effluents from septic tanks pollute ground water.

Our SeptiMem® Solution upgrades septic tanks to full biological treatment, even with nutrient removal where required.

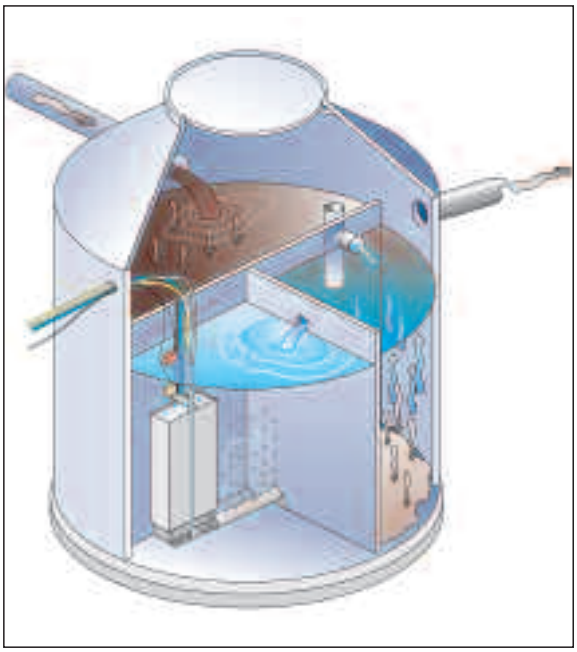
The last chamber of septic tanks is retrofitted with a HUBER MembraneClearBox® (MCB) that includes ultra-filtration membranes and an air diffuser. The last chamber is upgraded from a settling chamber to a membrane bio-reactor (MBR).

All solids and bacteria are retained by the membrane. The disinfected, high-quality effluent (permeate) can be reused for irrigation or as service water, e.g. for toilet flushing or laundry and car washing.

The effluent has bathing water quality and can be discharged even into most sensitive surface waters, or it can be used for ground infiltration and groundwater replenishing.

Our SeptiMem® Solution turns wastewater into clean effluent

HUBER MembraneClearBox® MCB...



...installed in a septic tank

HUBER ClearOnSite® Solution

Decentralized Wastewater Treatment and Reuse

Decentralized or semi-centralized treatment is preferable or necessary where one or several of the following circumstances apply:

- There are no sewers
- Reuse for irrigation on site or nearby is feasible
- Reuse as service water on site, e.g. for flushing and washing, is feasible
- Reuse for ground infiltration and groundwater replenishing is desired and possible
- The effluent is discharged into a sensitive water body, such as a stream or lake, and must have excellent quality

Reuse of the effluent and substitution of fresh water saves water and wastewater fees. Saving water is necessary where fresh water is scarce.

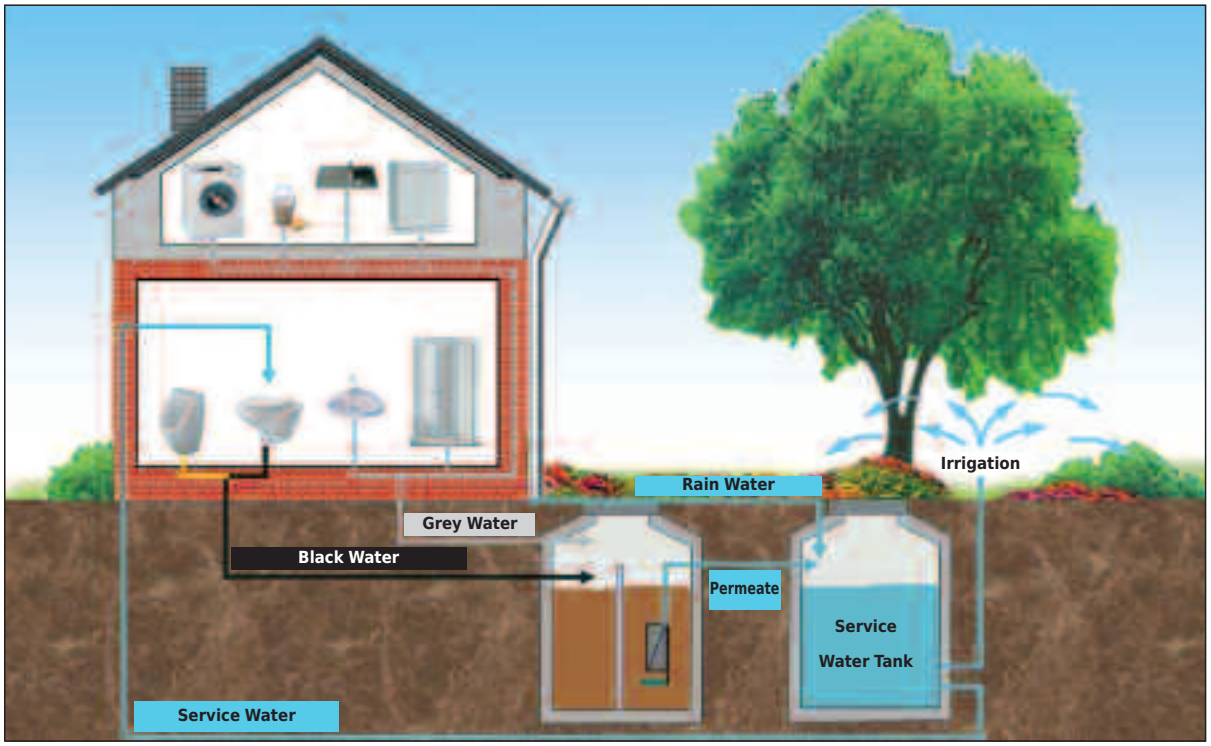
Decentralized wastewater treatment is less expensive than the construction of sewers to semi-central or central treatment plants particularly where the housing density is low.

Our ClearOnSite® solution serves for properties that are neither connected to sewers, nor provided with septic tanks. They serve for single or multi-dwelling houses, condominiums, office buildings, restaurants, hotels, resorts, recreational facilities, such as golf courses or sport stadiums, etc.

The wastewater is collected in a tank or the first chamber of a tank. An ultra-filtration membrane is installed in a second tank or chamber that serves as a compact membrane bio-reactor (MBR) where biological wastewater takes place. The effluent (permeate) is clean and clear. All solids and bacteria are retained in the membrane bio-reactor (MBR). The effluent has bathing water quality.

Nutrients that remain in the effluent add value where it is used for irrigation.

Bio-solids are reused for soil improvement in gardens, parks or on farmland.



Compact HUBER ClearOnSite® Solution for decentralized wastewater treatment and reuse

HUBER ClearNear® Solution

Semi-centralized Wastewater Treatment and Reuse

Semi-centralized wastewater treatment and effluent reuse is the ideal solution for clusters of houses, villages, housing developments and suburbs.

Semi-centralized treatment is typically less expensive than the construction of long sewers to central treatment plants. And semi-centralized treatment facilitates effluent reuse.

Reuse of the effluent for irrigation or as service water, e.g. for toilet flushing or laundry and car washing, saves fresh water and wastewater fees. Saving water is necessary where fresh water is scarce.

Our compact ClearNear® treatment plants include a fine screen and a membrane bio-reactor for biological treatment and ultra-filtration.

The effluent is clear, all solids and bacteria are retained in the membrane bio-reactor (MBR). The effluent has bathing water quality.

Nutrients in the effluent add value where it is used for irrigation. However, if required, e.g. where the effluent is reused for ground infiltration and groundwater replenishing, we also remove nutrients.

Screenings from ClearNear® plants consist mainly of paper and plastic. The screenings are washed, dewatered, compacted, bagged and then disposed of as solid waste.

Bio-solids are reused for soil improvement in gardens, parks or on farmland.

ClearNear® Solution for semi-centralized wastewater treatment and reuse; membrane bio-reactor (MBR) with HUBER Vacuum Rotation Membrane® (VRM®)

HUBER Wastewater Separation

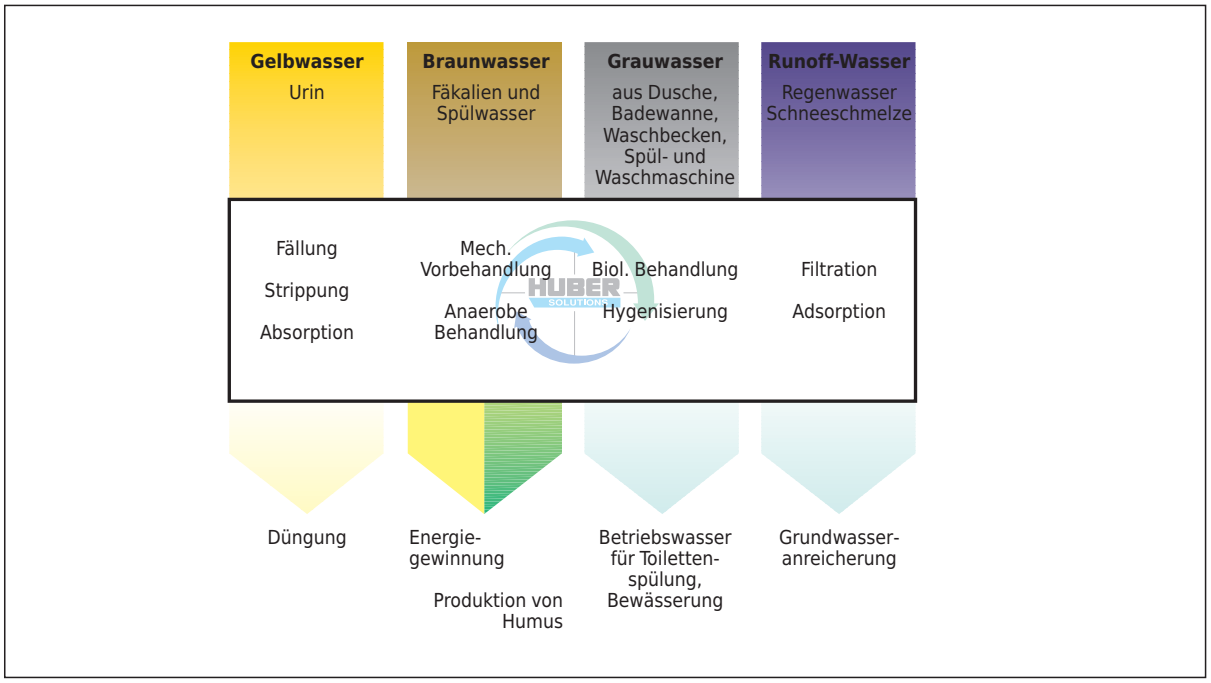
Reuse of Wastewater as Our Most Dependable Source of Water, Nutrients, Bio-Solids and Energy

On a positive note, in many industrialized countries it has become common practice to separate solid waste where it is generated to allow processing and beneficial reuse of the separated fractions.

However, we are still practicing blending and diluting all kinds of wastewater streams. At best we provide end-of-pipe treatment. Beneficial reuse of wastewater and its valuable ingredients is thus made very difficult and expensive.

Domestic wastewater is a blend of moderately polluted grey water (wash water from bathrooms and kitchens) and heavily polluted black water (toilet effluents comprised of urine, faeces and flush water). Black water

Recovery Plant at our headquarters for separate collection and treatment of yellow, brown and grey water



can be separated into yellow water (pure urine without flush water) and brown water (faeces and flush water).

Grey water is only modestly polluted and can easily be treated for reuse as irrigation or service water, e.g. for toilet flushing and laundry washing.

Yellow water, the urine, is little polluted, but contains most of the nutrients nitrogen, phosphorus and potassium. It contains few pathogens, but some micro-pollutants (residuals from pharmaceuticals and hormones that are also called endocrinic substances).

Faeces contain most of the organic carbon and energy. Highly polluted brown or black water can be blended with kitchen waste that also contains much energy. The energy can be recovered by anaerobic digestion, degradation of the organic solids and generation of biogas. The remaining bio-solids still contain stabilized organic carbon and are useful for soil improvement.

Reuse Park at our headquarters with orchards and fish ponds where water, nutrients and bio-solids are reused

HUBER GreyUse® Solution

Reuse of Grey Water for Irrigation and as Service Water (e.g. in Hotels)

Separately collected grey water from bathrooms and kitchens is only lightly polluted and easy to treat. It can be reused as flush water for toilets or for laundry washing. It can also be reused for irrigation of gardens, parks or fields.

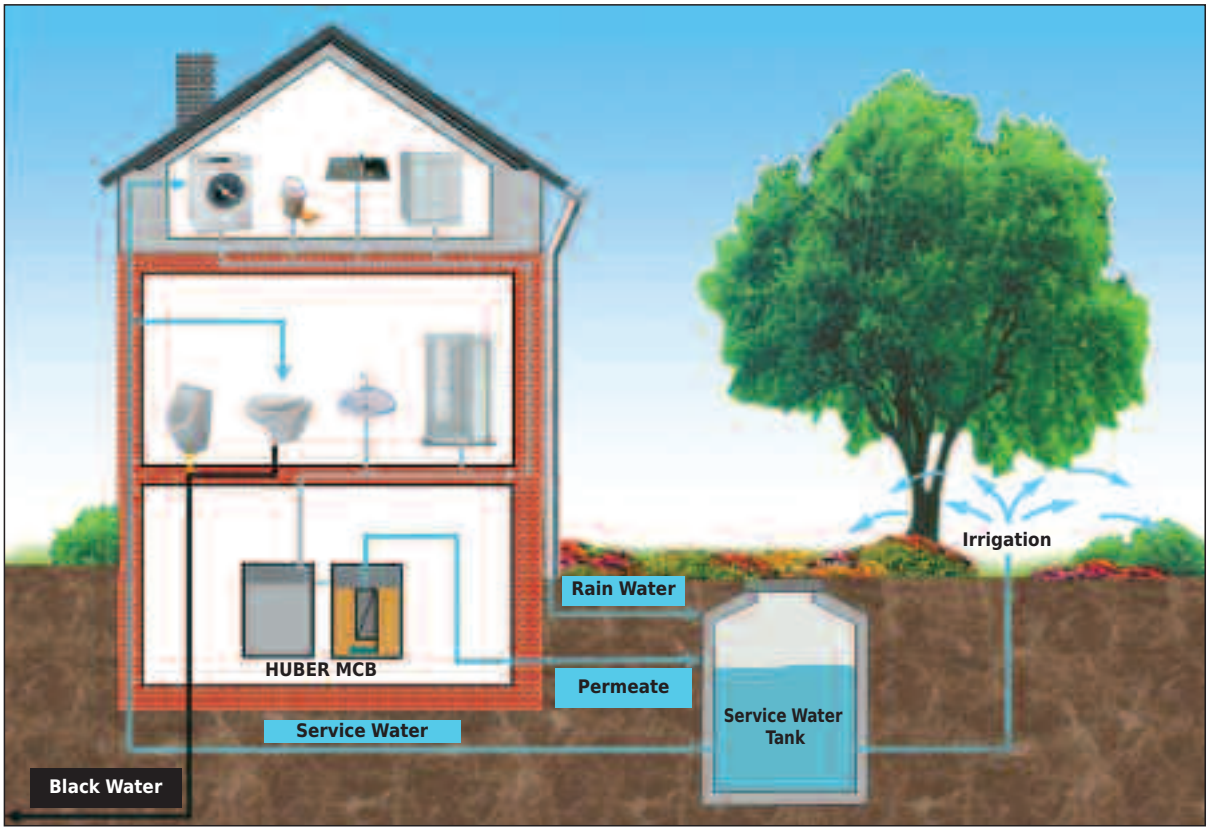
We provide compact membrane bio-reactors (MBR) for grey water treatment. They are similar to, but smaller than those that we use for our ClearOnSite® Solution (See above).

As the table shows, the effluent has excellent quality, easily complying with the German requirements for flush and wash water.

Fresh water consumption and water costs are minimized by separate grey water treatment and reuse.

Our GreyUse® Solution is mainly applied at hotels, condominiums, apartment and office complexes, and the like.

Parameter	German Guideline fbr H 201	HUBER Effluent
BOD_7	< 5 mg/l	< 2.5 mg/l
Saturation with Oxygen	> 50 %	> 50 %
Total Coliforms	< 100/ml	< 1/ml
Faecal Coliforms	< 10/ml	< 1/ml



HUBER GreyUse®: A great Solution for hotels, condominiums, apartment and office complexes

Urine Separation

- **Removal of Micro-Pollutants**
- **Reuse as Fertilizer**
- **Prevention of Eutrophication**

Urine can be separately collected by use of separation toilets and waterless urinals. Only about 1.5 litres of urine are produced per person every day.

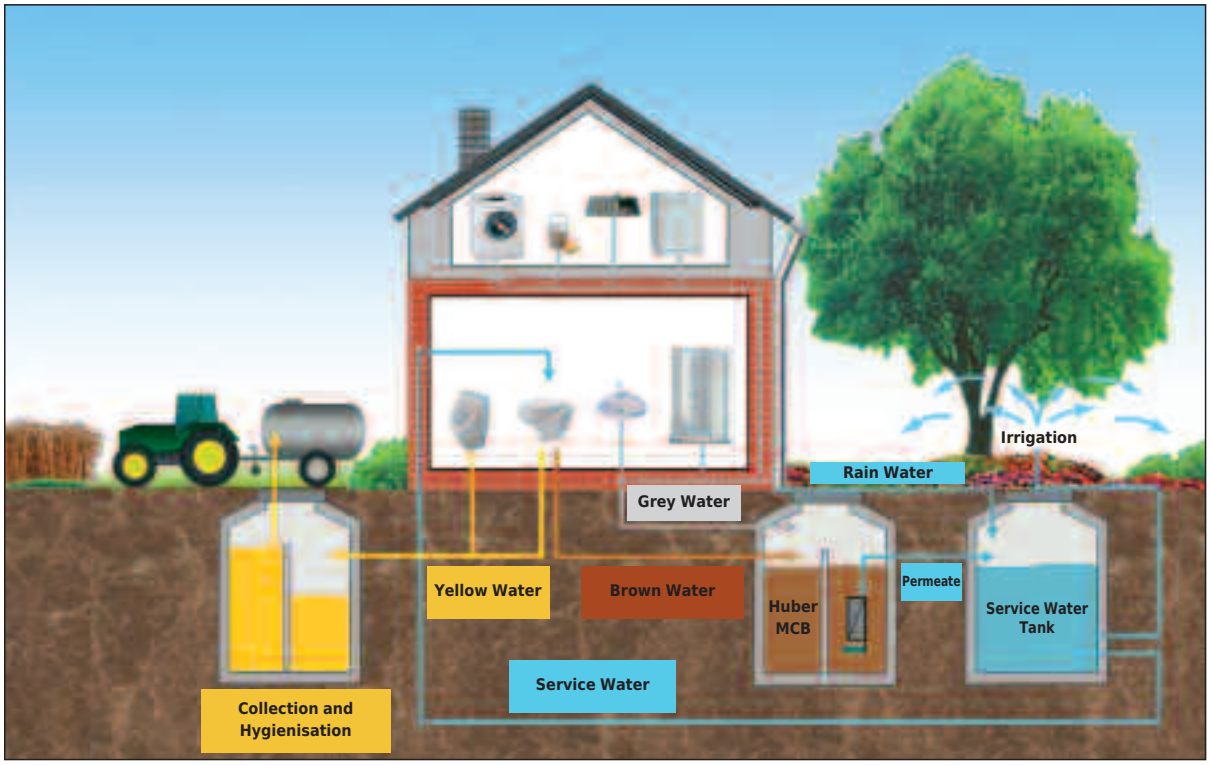
As the above diagram shows, urine contains most of the nutrients, but little organic carbon. Urine contains few pathogens, but most of the so-called micro-pollutants which are composed of excreted endocrinic substances, such as hormones, and remaining pharmaceuticals, such as antibiotics.

Urine has great value as fertilizer or as raw material for the cosmetic industry. Due to self-inhibition of its degradation by rising pH-value, undiluted urine can be stored long-term without causing odour nuisance. And it becomes disinfected during storage.

Where urine is separated, it is easier and less costly to treat the remaining wastewater. Expensive treatment for the removal of the nutrients nitrogen and phosphorus is no longer needed.

Inexpensive MeChem® Solutions (See above) for cost-efficient removal of solids and organic pollution become even more efficient when they are combined with urine separation at the source. Eutrophication of receiving water bodies is thus avoided.

As soon as removal and destruction of micro-pollutants will be required, urine separation will become a necessity. It will be far easier to remove micro-pollutants from a small volume of urine than from a large volume of diluted wastewater.



Reuse of urine as liquid fertilizer; On-site wastewater treatment and effluent reuse as service water and for irrigation

Separate Treatment and Reuse of Black or Brown Water in Combination with Biowaste

A Source of Energy and Bio-Solids for Soil Improvement

Black and brown water are both highly polluted with organics and pathogens, but they contain few nutrients.

Ground kitchen waste can be added to brown or black water to increase its energy content.

Black and brown water should be anaerobically digested. The generated biogas is a renewable and valuable energy source.

Digested bio-solids are stabilized and almost odourless. Pathogens are inactivated and the bio-solids are disinfected if thermophilic digestion at high temperature is used. The produced bio-solids contain organic carbon and are beneficially reused for soil improvement by land application.

We have developed pilot systems for anaerobic digestion of black or brown water.

Treatment of brown or black water should be centralized or semi-centralized. Tanker vehicles or vacuum systems can be used for collection and transport.

Anaerobic reactor for the digestion of black or brown water

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HUBER Solutions

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