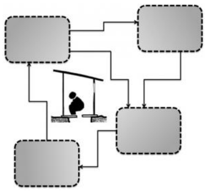
Español (/es/taxonomy/term/2657/sanitation-systems)



Author/Compiled by
Dorothee Spuhler (seecon international gmbh)
Robert Gensch (Xavier University)

Executive Summary

Sanitation (/content/sanitation) systems are a combination of different functional units that together allow managing and reusing or disposing the different waste flows from households, institutions, agriculture or industries in order to protect people and the environment. The systems are designed to address the whole water as well as the nutrients cycle, from the toilet user where wastewater is generated, over the collection, treatment up to reuse or discharge.

Introduction

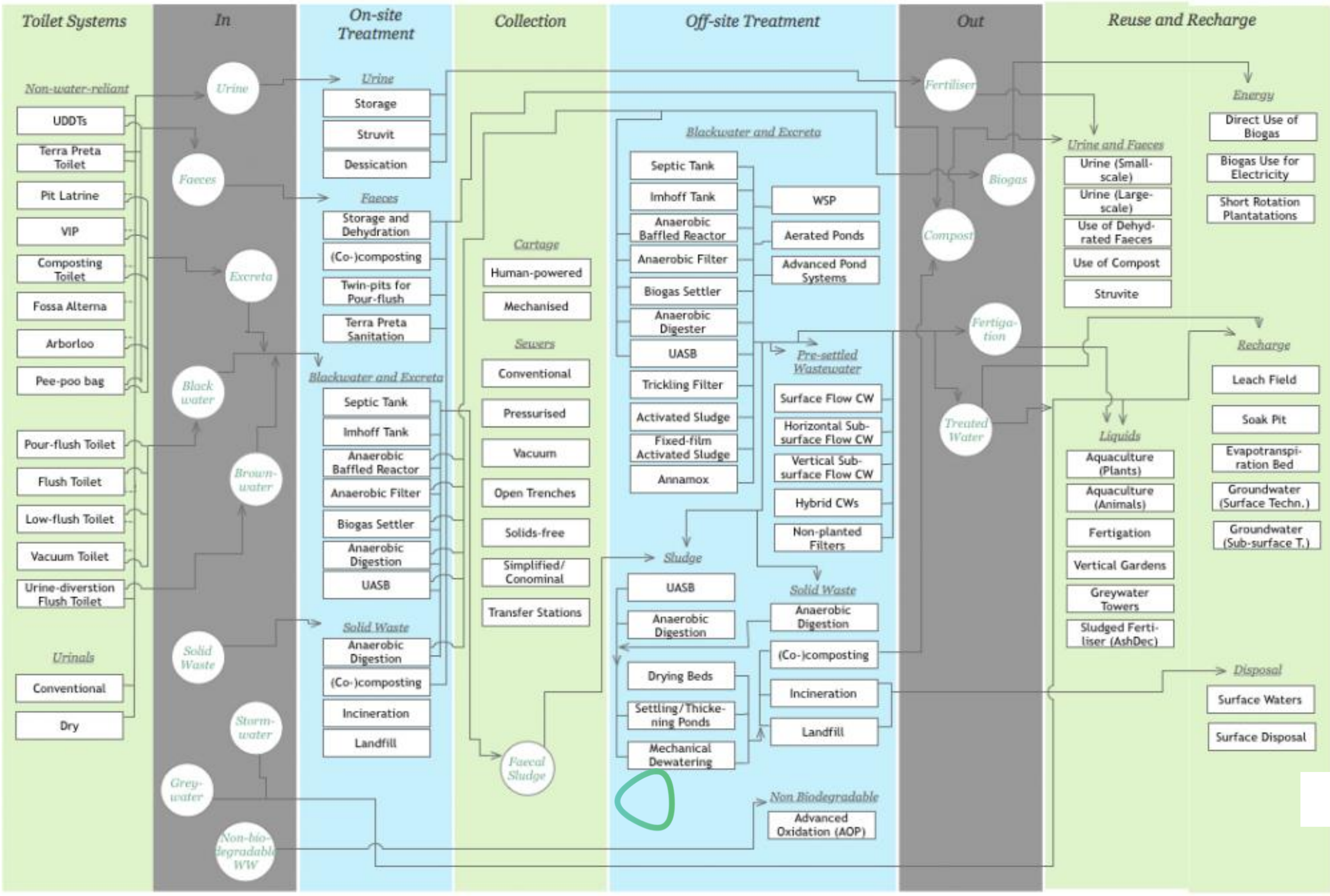
Water resources are under increasing pressure. Continuing population growth, urbanisation, rapid industrialisation as well as expanding and intensifying food production are all putting pressure on water resources (UNEP 2010). Once used, water is often discharged without any treatment - despite the urgent need for water and nutrients in agriculture and the contamination of aquatic ecosystems. In order to meet future demands for water and nutrients it is important to adopt a sustainable wastewater management.

Wastewater (/content/wastewater) management refers to the process in which wastes and wastewater are managed from the point of generation to the point of use or ultimate disposal. The hardware answers to wastewater management are sanitation systems. **Sanitation (/content/sanitation)** systems are a combination of different functional units that together allow managing and reusing or disposing the different waste flows from households, institutions, agriculture or industries in order to protect people and the environment. The systems are designed to address the whole water as well as the nutrients cycle, from the toilet user where wastewater is generated, over the collection, treatment up to reuse or discharge. In order that sanitation systems function reliably, the technical know-how for the installation of functional units as well as their management, operation and maintenance must be guaranteed.

Conventional sanitation systems generally refer to large sewer systems with centralised high-tech treatment stations. These systems may be efficient and have significantly contributed to improving the health of people and to lower environmental burden of wastewater discharge during the past decades. However, they require huge amounts of water, which is mixed with excreta and wastes, resulting in large volumes of highly polluted wastewaters. Centralised treatment stations for these slurries not only involve large costs for construction and operation, consume energy and chemicals, and have great management requirements, but also are the nutrients lost to the air or finally disposed in landfills. Conventional wastewater treatment systems have a large potential to be optimised and to be made more sustainable by reducing the use of water (e.g. dry systems) and improving the recovery and reuse of nutrients and energy.

There are many ways to improve conventional sanitation systems in order to reduce the use of water or to efficiently recycle the generated wastewater and nutrients on any level (see also TILLEY et al. 2008 for some examples).

In this toolbox, you will find the description a various functional units that can be combined in order to build a sanitation system. The different functional units, according to their position in the sanitation system, can be found in the hardware chapters of the “use”, “collection”, “treatment” and “recharge/reuse” section. Each functional unit is described in terms of function and design. You will also find information on in what context a given unit is applicable and what are the disadvantages and advantages of the technology applied. This information is particularly important as only based on that, different functional units can be combined in order to optimise water and nutrient use and achieve the sustainability of the sanitation system. Thus, by choosing the appropriate hardware tools (functional units) from the sections “use”, “collection”, “treatment” and “reuse”, together with the corresponding software tools adapted for your context, you can design an integrated and appropriate sanitation system designed particularly for your situation.
The following overall scheme is intended to give you a better overview on how what kind of functional units can be found in the toolbox and they fit together.



(/sites/default/files/toolbox/SPUHLER 2010 Overview on Sanitation Systems.jpg)

Overview on the different functional unit described in the SSWM toolbox and how they are interlinked. Source: SPUHLER (2010)

Wastewater generation

Wastewater (/content/wastewater) can mean different things to different people with a large number of definitions in use. Generally it describes water that has been used and that cannot be used any more in one site and is therefore rejected to another (UNEP 2010). In a broader perspective, wastewater can be defined as a combination of one or more of the following: domestic effluent; water from commercial establishments and institutions, including hospitals; industrial effluent; stormwater and other urban runoff; and agricultural, horticultural and aquaculture effluent. In order to optimise the water and nutrient cycle and to emphasize the fact that used waters can be reused for other purposes, depending on their composition; different terms more adapted to describe the composition of the different types of wastewater have evolved. The separation of these different streams, allows treating and reusing them more easily, particularly adapted to their composition. The term used to described the different wastewaters in this SSWM toolbox are:

- (Fresh)water (surface or ground)
- **Precipitation (/content/precipitation)** (Rain/**Stormwater (/content/stormwater)**)
- Drinking water

- **Blackwater (/content/blackwater)**
- **Faecal Sludge (/content/faecal-sludge)** (Settled / pre-treated blackwater)
- **Greywater (/content/greywater)**
- **Urine (/content/urine)**
- **Faeces (/content/faeces)**
- **Excreta (/content/excreta)**
- **Organic (/content/organic)** waste
- Non-biodegradable wastewater (e.g. industrial wastewater; agricultural water)
- Water for fertigation
- **Fertiliser (/content/fertiliser)** (e.g. stored urine, struvite, phoskraft etc.)
- **Biogas (/content/biogas)**
- **Compost (/content/compost)**/Biosolids (including humanure, terra preta etc.)

The functional units (places) generating wastewater are different for domestic, industrial and agricultural water uses.

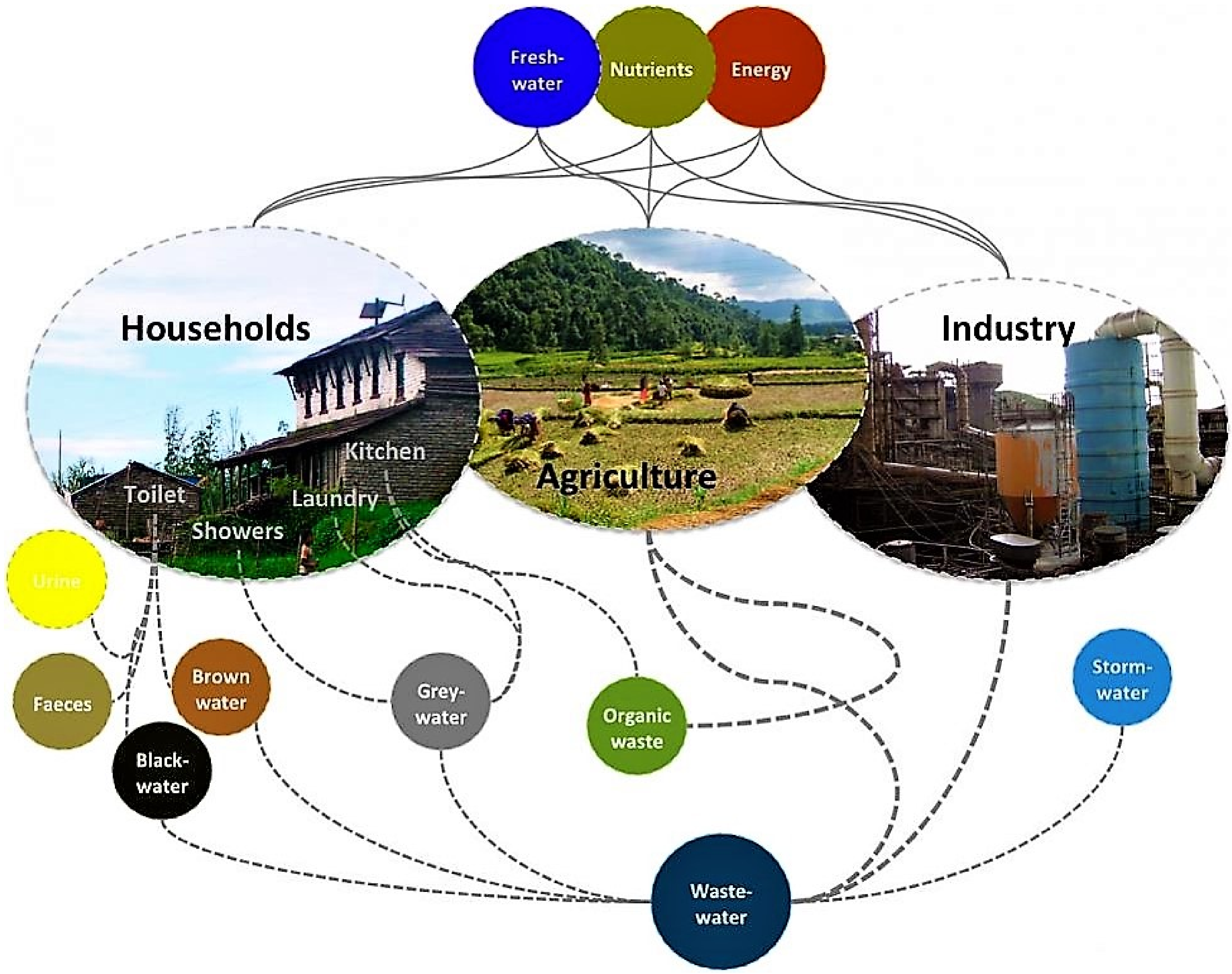
At the domestic level, wastewater is generated in bathrooms and kitchens and the hardware tools associated with this kind of wastewater generation are toilet systems, showers and water tabs.

The way that industrial wastewater are generated is much more variable and their functional units generating industrial wastewater are not described in detail. However, they are either biodegradable, and can be treated similar to blackwater or greywater; or they contain pollutants which are not biodegradable and require an advanced oxidation process for treatment. Often, industrial wastewater also just contains heat, which can be reused for energy generation or other processes (e.g. aquaculture).

Agricultural wastewater is similarly either biodegradable (the most often) and can be treated and reused as blackwater (e.g. manure from livestock); or they are not biodegradable (e.g. water containing residues of pesticides etc.) and require advanced oxidation processes for treatment.

The optimisation of water use and wastewater generation consists mainly in the reduction of water requirements (e.g. by choosing a dry or low-flush toilet) and in the separation of the different wastewaters streams to treat and use them more easily according to their composition (i.e. source separation).

Wastewater collection



Different wastewater streams form households. In addition to that, society produces wastewaters from businesses and industries, agricultural wastewaters and solid wastes (organic and inorganic). Source: SPUHLER (2010)

If the different waste flows are not treated and reused or discharged on-site, wastewater needs to be collected to be managed in semi-centralised or centralised treatment units.

This can be done either in a sewer collection system or by cartage. **Sewer (/content/sewer)** systems are generally expensive to install and require much operation and maintenance. There are many ways to optimise sewer systems, such as collecting rain and stormwater separately (or reusing them directly), simplifying the network (using less connections and less pumps or small-bore sewers) and reduce the required size (an thus operation and maintenance) by installing several DEWATS instead of one large treatment station. Manual cartage can be expensive and cause a health risk, especially when wastewater is diluted. When urine and faeces are separated both products can be transported more easily and more safely. The utilisation of a vacuum truck or a gulper can reduce the inconvenience and health risk associated with manual cartage.

Wastewater treatment

Wastewater (/content/wastewater) treatment means the preparation and transformation of wastewater and related products (e.g. blackwater, faecal sludge, greywater, non-biodegradable waters, etc.) for safe reuse or disposal in order to minimise health risks for people and protect the environment from pollution.

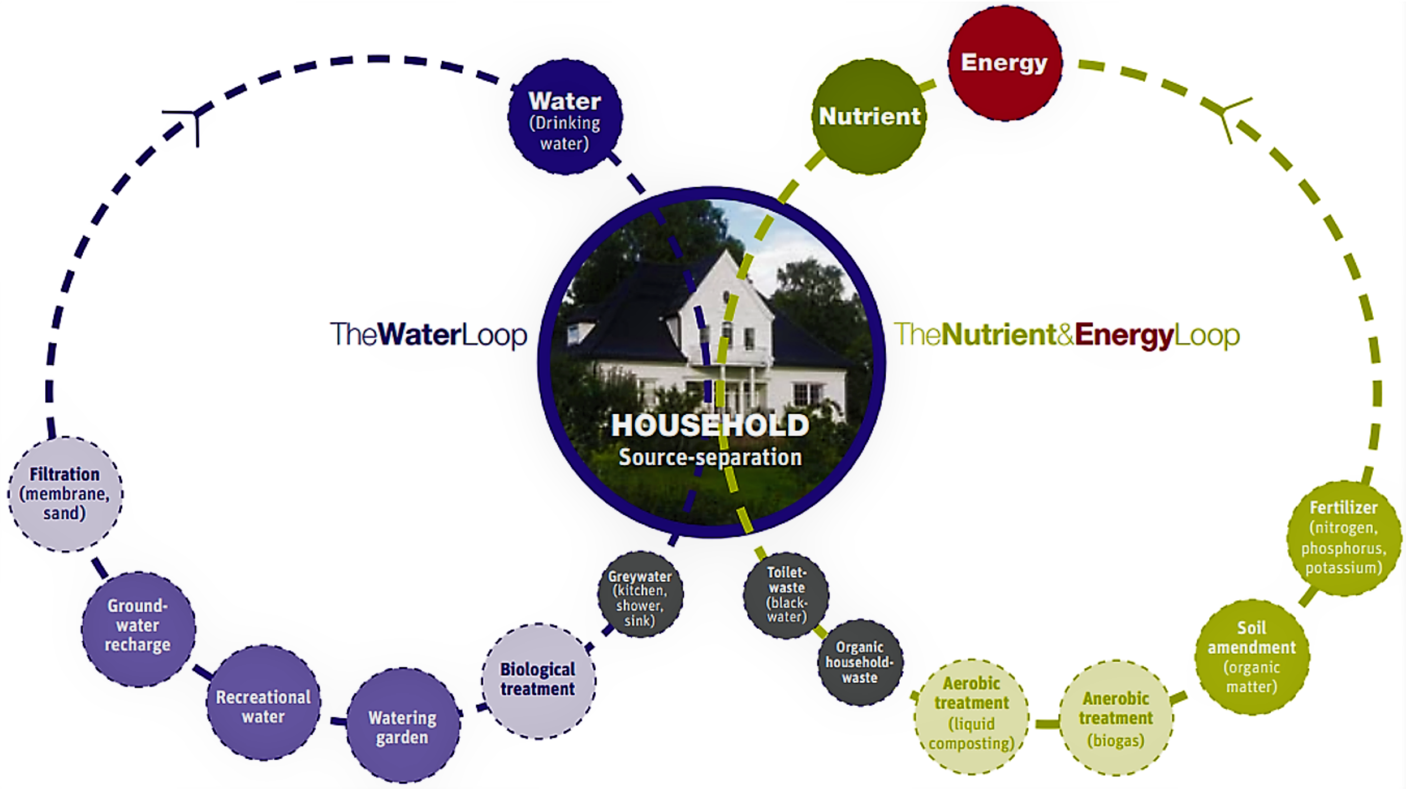
The main parameters that need to be treated/removed (depending on the reuse/recharge/discharge options) are solids (i.e. total suspended solids or TSS); the biological and chemical oxygen demand (i.e. COD and BOD); nutrients (mainly nitrogen and phosphorus); and pathogenic microorganisms (pathogens). Other pollutants that need to be treated are heavy metals or persistent organic compounds (e.g. pesticides, pharmaceuticals, micropollutants).

Domestic wastewaters are most often treated with biological wastewater treatment processes. Non-biodegradable wastewaters (for instance form the pharmaceutical industry or pesticides manufactures) need to be treated chemically (chemical wastewater treatment, advanced oxidation processes).

The optimisation of wastewater treatments depends much on the context and local conditions. The main potential of wastewater treatment optimisation lies in the reuse of the products (e.g. water and nutrients, see also sustainable sanitation), the optimisation of energy requirement (e.g. anaerobic wastewater treatment vs. aerobic wastewater treatment) and the optimisation of scale (e.g. on-site wastewater treatments or decentralised wastewater treatments vs. (semi-)centralised treatments). The main factor influencing whether a wastewater treatment is optimised or not is the suitability of a respective functional unit to a given context and the overall sanitation system.

Wastewater recharge & reuse

Wastewater (/content/wastewater) recharge and/or reuse refer to technologies and methods in which the different wastewater products (urine, faeces, biogas, compost, etc.) are safely returned to the environment. This can be done either through its productive use or alternatively — if no direct reuse is intended - its safe disposal or recharge. If possible, it is always preferable to reuse the water, nutrients and energy contained in the different waste streams. The optimisation of wastewater reuse thus depends on how these have been collected and pre-treated — thus the entire sanitation system. **Composting (/content/composting)** products from organic waste and excreta or sludge for instance are used as a soil amendment and urine can be reused much like liquid fertilizer. **Biogas (/content/biogas)** is used for cooking or energy production and pre-treated water that still contains nutrients can be used for fertigation.



Different waste streams from the household level and how they can be reused and returned to the environment. Source: ALSEN & JENSEN (2004)

Library References

Further Readings

Training Material