MULTI ReUse

Water reuse – a topic for German municipalities, industry and agriculture?

Germany is a country with plenty of water bodies – but in some regions public water supply, industry and agriculture compete for limited groundwater resources. For this dilemma solutions such as the long distance water supply from the low mountain ranges or the so called groundwater recharge, where surface water from rivers or reservoirs is injected into the groundwater body, have been implemented. Wastewater is not used as a resource in Germany yet – but why not?

Advantages of water reuse

So far waste water mainly is perceived as environmental pollution. It is treated in wastewater treatment plants to be fed into rivers and streams afterwards. A lot of treated wastewater is available locally – often even very close to potential customers, e. g. industry. Treated wastewater is suitable for a further treatment because of its moderate salinity, a reduced nutrient content, low solids content and the usually consistent quality.

If water is used as cooling water in the industry, requirements like “low concentration of suspended matter” and “no pollution through potential pathogens, e. g. legionella” have to be met by treatment through micro- or ultrafiltration. If the water is used as boiler feed water for steam generation it additionally has to have as little dissolved minerals and metals as possible so that corrosion and the formation of solid matters will be avoided during the process. This quality of water is reached by reverse osmosis and ion exchange.

For the irrigation during agricultural use not only technical and human health aspects play an important role. In this field of application the requirements of the plants regarding e. g. salt or nutrient content and the preservation of the soil quality have to be taken into consideration too. Furthermore, the impact on ground and surface waters through anthropogenic trace substances has to be minimized to eliminate a risk for soil, ground- and surface waters. To remove organic trace substances oxidative processes such as ozonation and adsorption with activated carbon are used. The reuse of water for the mentioned application scenarios reduces the strain on groundwater resources.

Examples for water reuse in industry and agriculture

Industry: Case study Terneuzen, Netherlands

Terneuzen is an important seaport in the Southwest of the Netherlands. It is roughly at sea level and constantly threatened by seawater intrusion into the shallow aquifers. The Dow Chemical Company operates the second largest location worldwide with a high demand for cooling water and process water for steam generation.

The region at the river delta of the Schelde suffers from increasing water stress because of the high water demand of the industry, agriculture, the surrounding municipalities and local recreation areas. The region imports fresh water for decades already from a water source that is 120 km far away in order to meet the demands for drinking water and industrial water.

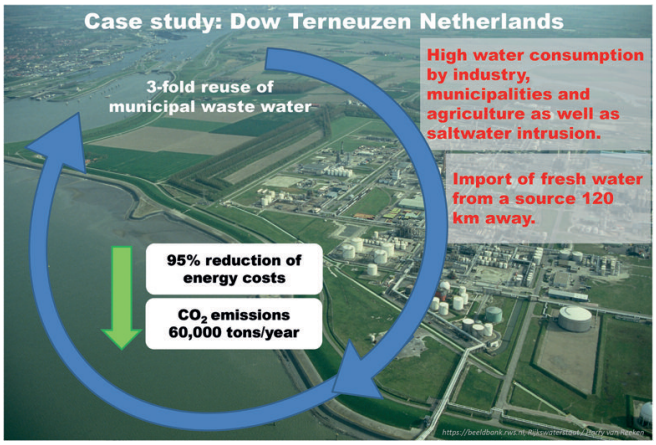

Figure 1: Terneuzen, Netherlands (Source: Rijkswaterstaat/Harry van Reeken, https://beeldbank.rws.nl)

The water is used by the municipality before it undergoes treatment at the local wastewater treatment plant, followed by further treatment through membrane filtration (membrane bioreactor followed by reverse osmosis) for the reuse as boiler feed water and additional cooling tower water (Groot 2013; Pentair 2017). After use it is either evaporated into the atmosphere or fed into the rivers after another treatment.

Agriculture: Case study Water Conserv II in Orange County, Florida (USA)

Water Conserv II is one of the biggest projects in agricultural water reuse worldwide and is seen as a milestone in the irrigation of food crop with reused water.

Main goal was to reduce nutrient- and pollutant inputs from the wastewater pipes of the region into the Shingle Creek to prevent an eutrophication of the lake Tohopekaliga. 60 % of the treated wastewater are used for the irrigation of citrus fruit (1,800 ha) (Andrade 1999). Further objectives of water reuse in Orange County are mainly the reduction of agricultural ground- and surface water extractions as well as groundwater recharge.

The wastewater is treated with the following procedures: mechanical cleaning (screening, sedimentation), biological cleaning (activated sludge process), multilayer filtration and disinfection by means of chlorination.

The farmers have higher earnings with crop plants and the pressure on the aquifers is reduced. At the same time there are lower nutrient- and pollutant entries into the water systems, which leads to a higher biodiversity in the waters.

Figure 2: Orange plantation in Florida, USA (Source: Mmacbeth, Wikimedia Commons)

Water reuse in Europe

In some regions of Europe an overuse of water resources takes place. More water is extracted than naturally recharged. In Mediterranean regions the reason for this is irrigation agriculture. But also urbanization and economical activities are factors of overuse. Climate change and the expected rise in water demand (e. g. in overhead irrigation agriculture) are going to intensify those resource problems.

These circumstances led to an implementation of measures for water reuse. In Italy for example, treated wastewater is used for drop irrigation of olive trees, where the nitrogen in the water serves as nutrient at the same time. In Great Britain in Flag Fen a power plant is being supplied with highly treated water from the neighbouring municipality. Frontrunner for water reuse within the EU is Spain, where a legal framework for water reuse exists since 2007. 75 % of the reused water are used for agriculture (Magno o. J.).

Legal requirements for water reuse in Germany

Even after the three classical treatment steps in a wastewater treatment plant (mechanical, biological and chemical) the wastewater is still charged: microorganisms, suspended solids, dissolved heavy metals,

Table: General requirements for water reuse

Economic criteria	Business criteria	Ecological criteria
Water scarcity; competitive situation about water use between industry/agriculture/municipalities	Possibility for optimization/closing of a water circle	Ecological requirements (e. g. reduction of percentage of wastewater in streams and rivers)
Social acceptance; technical readiness	Availability of funds/assets for water treatment	Serious impairment of the local ground and surface water quality
Administrative requirements (e. g. subsidies)	Cost-intensive use of local water resources	

as well as colouring, smell and organic trace substances set limits to a further use. Without additional treatment it is not or only partially suitable for reuse – depending on the intended field of application. But not all applications need drinking water quality so that a few simple treatment steps often are sufficient. Most required however is a constant water quality and the prevention of regrowth of microorganisms.

According to the precautionary principle, cases have to be avoided where a risk to human health and environment can be expected, even if the probability of an actual occurrence can't be ascertained scientifically. The current legal framework therefore limits water reuse in Germany. From a precautious perspective also the exposure to chemicals released to the environment and trace substances e. g. in agriculture and for groundwater recharge has to be limited. The MULTI-ReUse procedures allow a targeted treatment to reach the desired process or irrigation water quality.

Is water reuse going to be important in Germany?

Outside of Germany water reuse already is a successful water management measure, to meet the rising water demand caused by an expanding population or economy and to preserve the natural water bodies. Those measures are not only popular in arid regions but also for moderate climatic zones: here the issue is the competing use of groundwater. Requirements for water reuse are that the resource wastewater is reliably available and the adequate treatment technology is used for the respective application purpose.

Barriers for water reuse in Germany in industry and agriculture are the lacking legal and organizational frameworks, open questions about environmental and health risks as well as questions about the costs for suppliers and users. Based on a case study in northern Germany, MULTI-ReUse is working on guidance notes to show if it is useful to use treated wastewater for water reuse in the mentioned fields of applications. MULTI-ReUse therefore can support interested municipalities, water associations and regional planners in their assessments and decision making.

Literature

Andrade, A. (Ed.) (1999): Reclaimed Water Guide. Southwest Florida Water Management District

Groot, C. (2013): Fresh thinking to improve business and sustainability. http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_08d9/0901b803808d92c4.pdf?filepath=liquidseps/pdfs/noreg/609-50111.pdf (26.07.2017)

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Short description of the MULTI-ReUse project

Treated wastewater is an important part of the water cycle. It usually is fed into rivers, something that is acceptable from an environmental point of view but for the use in agriculture or industry the water often is unsuitable. MULTI-ReUse closes this gap by developing and implementing of new procedures for the reuse of service water. The aim of MULTI-ReUse therefore is the development, demonstration and evaluation of a modular water treatment system, in order to offer service water in different qualities and quantities for the different purposes and to competitive prices.

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Imprint

This factsheet was produced within the research project MULTI-ReUse, funded by the Federal Ministry of Education and Research (BMBF) under the number 02WAV1403 and within the WavE support measure.

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November 2018

SPONSORED BY THE
Federal Ministry of Education and Research
FONA Sustainable Water Management BMBF