

Requirements for the reuse of water in urban water management

Fields of application

Reused water can be used within urban water management as service water for different purposes. Fields of application are the irrigation of public parks, green areas, roadside trees (possibly also golf courses or similar facilities) as well as street cleaning. Provided there are dual pipe systems, the water can also be used for domestic purposes like flushing toilets, irrigating ornamental gardens, operating washing machines and for different cleaning purposes (e.g. car cleaning).

Quality and usage requirements in Germany

In Germany, quality requirements for service water are usually based on the Bathing Water Directive of the European Union. The German Professional Association for Service Water and Rainwater Utilization (Fachvereinigung für Betriebs- und Regenwassernutzung, fbr) is basing their quality requirements on the recommendations for the reuse of treated wastewater released by the World Health Organization (WHO). In one of their publications (fbr-Hinweisblatt H 201) they mention different fields of application for service water: On the one hand the domestic use and on the other the irrigation of green areas or the use for plant production. Especially for decentralized and semi-central processing plants, the processing can be specified qualitatively for a precisely defined purpose. If, as in MULTI-ReUse, treated wastewater from a central sewage treatment plant is processed into service water, disinfected service water according to DWA M 277 is released with

consistent quality. For garden irrigation, the quality of service water allows the use for green areas, trees and ornamental plants. The irrigation of vegetables is not intended.



Figure 1: Willy-Brandt-place in Bochum, Germany (Source: Frank Vincentz, Wikimedia Commons)

The parameters shown in table 1 refer to the treatment of household service water; they can be recommended for MULTI-ReUse applications in Germany. The domestic use of process water in Germany is restricted by the Drinking Water Ordinance. Certain usages, like the cleaning dishes or cooking utensils, are not allowed. The internal service water pipes and their tapping points must be permanently marked in such a way that they can be easily and safely distinguished from the drinking water pipes; they must also be registered with the health authority.

Table 1: Recommended quality parameters for service water for domestic use in Germany

Suspended matter, odor, color and turbidity	almost free of suspended matter, almost odourless, colourless and clear
turbidity	< 2 NTU
BOD₇	< 5 mg/l
O₂ saturation	> 50 %
pH	6.5–9.5
total coliforms	< 10,000/100 ml
<i>E. coli</i>	< 1,000/100 m
<i>Pseudomonas aeruginosa</i>	< 100/100 ml

Service water distribution

For reasons of economic efficiency and for logistical purposes, the operator will generally offer only one quality of service water for customers in the residential water management sector. Just the installation and operation of a dual water supply (drinking and service water distribution network) is capital-intensive.

In addition, it will not be possible to lay multiple supply networks in the area of public roads for reasons of space alone. Such networks with three or more different water qualities can be found in the area of chemistry parks. Instead, a service water is produced that can be used for as many different fields of applications



Figure 2: Labels on service water pipes (Source: MULTI-ReUse)

as possible. Consequently, the same quality requirements are applied for the different purposes; this also applies in cases where industrial customers are supplied in addition to domestic customers.

International perspective

On EU level, water reuse has a high priority. Here, the focus lies on water reuse for agricultural irrigation and artificial groundwater recharge.

In some European countries, especially in Mediterranean countries (including Cyprus, France, Greece, Italy, Portugal and Spain), there are regulations at the level of laws and ordinances governing the reuse of water. These regulations are mostly limited to irrigation in agriculture as well as parks and green areas. The use of process water for the other purposes of urban water management is not dealt with there. In fact in Europe industrial water has long been used for other purposes, such as street cleaning.

Currently the lack of a supporting and interrelated institutional framework for water reuse is a large barrier within the EU. That is the reason why the European Commission is currently developing tools for the promotion of water reuse. Minimum requirements (at least for irrigation and groundwater recharge) are in preparation too.

A similar situation also exists in the other continents of the earth. In the international context, it is also recommended to orient oneself on the parameters of Table 1 due to the large number of different regulations regarding the quality requirements for service water for domestic use from the MULTI-ReUse project network. If the disinfection is carried out with chlorine, the corresponding value for the residual chlorine content must not be exceeded.

Table 2: Additionally recommended quality parameters for service water for domestic use in an international context

Legionella	< 100 CFU(*)/l
Nematodes	< 1 egg/10 l
Residual chlorine content	1 mg/l Cl ₂

(*) colony forming units

Conclusion

Central prerequisites for the use of the MULTI-ReUse process to generate process water for domestic purposes are the presence of water stress (or political decisions to increase the use of so-called alternative water resources such as wastewater), sufficient wastewater volumes and framework conditions for a very high implementation of the innovation in terms of process quality (including very high warranty payments in the operation).

Ideal target markets are arid and semi-arid areas and especially islands and coastal areas. Furthermore, water reuse in urban water management can reduce the pressure on local water resources in densely populated areas.



Figure 3: Sprinkler at North Carolina School of Science and Mathematics (Source: Ildar Sagdejev, Wikimedia Commons)

Irrespective of the quality requirements for reused water and other prevailing conditions, the choice of system for transporting industrial water is a central question to be clarified. For Israel, for example, it is being discussed whether the use of industrial water should be decentralised by recycling grey water, but not by centralised waste water treatment.

Water reuse for drinking water purposes will only be practised under special hydro(geo)logical, social and political conditions and will probably not play a role in Germany or the EU area in the foreseeable future. There are currently only two prominent case studies worldwide, namely Windhoek/Namibia and Singapore.

Literature

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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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