

Constructed wetland systems according to new German guideline DWA A-262 (draft version: April 2016)

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Abstract

Treatment wetlands have a long tradition in Germany. Subsurface flow constructed wetlands are subject to design rule DWA A-262. This rule first published in 1989 as technical report has been updated several times representing the state of the art at current times. The new draft version (April 2016) includes all major systems which have proven robust and best treatment performances. The guideline describes subsurface flow systems for different kinds of wastewater. The main application is domestic decentral wastewater treatment for houses or small communities from separate or combined sewers. It has been experienced that the use of technical rules for design, construction and operation reduces failures and increases lifespan and overall performance. Reference performance data are shown for the wetland types: one stage vertical flow sand filter, one stage aerated gravel filters, two stage vertical flow raw wastewater filter known as French System.

Keywords

Constructed wetlands, Subsurface flow, German DWA guideline, Sustainable sanitation, French System, Aerated Wetlands

Sustainable wastewater treatment in constructed wetlands

There is a long and almost forgotten history about wastewater treatment in constructed wetlands (CW). In 1876 the first irrigation fields in Germany have been used for vertical filtration over 1 m of sand with drains discharging to receiving surface waters.

Modern sustainable sanitation approaches (NASS) according to the German water and waste association DWA separate nutrient rich yellow and brown wastewater as well as low concentrated domestic grey water from bathroom and kitchen. The aim is to make maximum (re)use of water, nutrients and energy (heat and carbon).

For any of these ecological concepts low energy demanding wetlands can be the best approach or part of a combined natural and technical process. CWs provide a completely different treatment environment than any other technical system and have the potential for very high removal rates.

Scope of DWA rules

The scope of the German guideline DWA A-262 is not a decision tool for water utilities and not a handbook on how to build constructed wetlands. It is simply a rule which limits the design of systems or single modules to useful sizing and premises in order to avoid failures for municipalities or operators. It includes traditional systems as well as innovative solutions.

EN 12566-5 which describes subsurface flow treatment wetlands has been published as technical report in 2009 and is limited to a size of 50 p.e.. This European technical report is lacking important parameters such as specific hydraulic and organic loading rates.

The draft version of guideline DWA A-262 is dedicated to provide best COD removal and good nitrification ($< 10 \text{ mg/l NH}_4\text{-N}$) for all included wetland systems without extra costs arising. It is expected that this version (published as “yellow print”) will be approved by the end of 2016

following public discussion. Changes through this process are to be expected. Usually annotations to this rule including advice for decision making on small systems will be published by DWA as technical report.

Small treatment plants for domestic wastewater without connection to sewer networks

This is the first category included: Wastewater treatment plants (WWTP) for up to 50 people are the most important category by number in Germany. Approximately 1 Million systems for single houses exist despite a general connection rate to the public sewerage system of 96 percent. It can be assumed that at least 5 percent of small WWTPs are constructed wetlands or more than 50.000 small CW systems are in operation.

For this purpose any of the proposed wetland types is suitable: vertical flow sand filter (classical version), aerated gravel filters, two stages vertical flow gravel filters incl. the *French System* which is using the first stage for sludge filtration and decomposition.

Small wastewater treatment plants (WWTP) connected to separate sewer networks

Because of unavoidable intrusion water from sewer networks the DWA guideline differentiates treatment options and explicitly excludes simple settling tanks for pre-treatment in this application. Traditional Imhoff tanks would be a possible solution in combination with wetlands. These are more common for bigger units than 50 p.e. The best option under these circumstances is the use of settling ponds with vertical flow sand filters, aerated gravel filters or raw wastewater vertical flow gravel filters as the *French System*.

Planted and aerated gravel filter beds are described in a guideline for the first time. This is based on an intense investigation phase at Langenreichenbach wastewater treatment plant in Germany.

Municipal WWTPs with separate or combined sewers

Small treatment plants for villages or small communities connected to combined sewer systems are always critical because of a highly dynamic flow. Biofilm system such as subsurface flow constructed wetlands have a huge buffering capacity for high flow rates and at the same time can very well cope with under loading.

The *French System* which now has been introduced to the DWA guideline has proven a good performance also in Germany with combined sewage accepting short time loading rates between for example 0.080 - 8 m/d which is a factor of 100 times.

Seasonal WWTPs for summer operation

For areas with seasonal influence in summer time such as in touristic regions, vertical flow wetlands may be loaded with a significantly higher loading rate of up to 50%. This is one of the greatest advantages for the use of here described wetland systems.

Conclusion

The German rule DWA A-262 describes all relevant bio-filtration wetlands for small wastewater treatment plants at its state-of-the-art. The new 2016 version covers the best working and most economic wastewater treatment technology at the time especially if operation and sludge removal is considered. However possible adaptations to special environmental conditions in other countries have to be considered.

Table of treatment results

CSO treatment

Minor headings are in 12pt bold type, not indented, with one line of space above and none below. Do not number headings.

Sub-headings. Sub-headings are typed in 12pt italic (or underlined if italics are not available), not indented, with the paragraph running on after a full stop; there is one line of space above.

New paragraphs are not indented, but are preceded by a line of space. Also please avoid using footnotes or splitting tables over two (or more) pages. The references should be indicated this way (Daims, 2001).

Formulas should be centralized and numbered on the right. For example “the cost function represents the cost of boundary flows”:

$$F = \sum c_i q_{b,i}, \quad (1)$$

where $q_{b,i}$ is a boundary flow and c_i is the price of a boundary flow.

Table 1. This is an example of table layout. It shows the dimensions of the text area to be used for *Water Science and Technology* articles and of international and US paper sizes (and the consequent recommended margin settings). Note that a minimum number of horizontal rules and (usually) no vertical rules are used.

	Text area	A4 paper		US (Imperial) paper	
	(mm)	(mm)	(in)	(mm)	(in)
Depth	250	297	11.69	279.32	11.0
Top/bottom margin	-	25	1.0	15	0.6
Width	170	210	8.27	215.84	8.5
Left/right margin	-	20	0.8	23	0.9

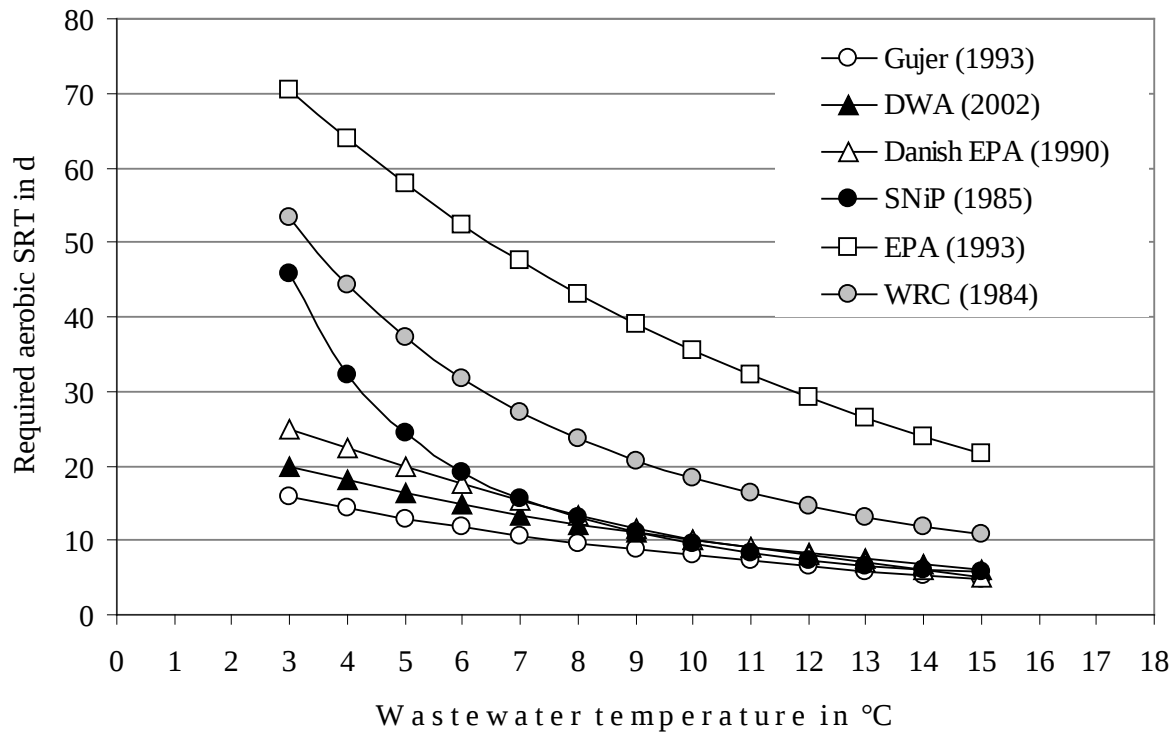


Figure 1. This is an example of figure layout.

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