

GERMAN **ATV-DVWK** RULES AND STANDARDS

STANDARD ATV-DVWK-A 281E

Dimensioning of Trickling Filters and Rotating Biological Contactors

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The German Association for Water, Wastewater and Waste, DWA (former ATV-DVWK), is the spokesman in Germany for all universal questions on water and is involved intensely with the development of reliable and sustainable water management. As politically and economically independent organisation it operates specifically in the areas of water management, wastewater, waste and soil protection.

In Europe the DWA is the association in this field with the greatest number of members and, due to its specialist competence it holds a special position with regard to standardisation, professional training and information of the public. The ca. 14,000 members represent the experts and executive personnel from municipalities, universities, engineer offices, authorities and businesses.

The emphasis of its activities is on the elaboration and updating of a common set of technical rules and standards and with collaboration with the creation of technical standard specifications at the national and international levels. To this belong not only the technical-scientific subjects but also economical and legal demands of environmental protection and protection of bodies of waters.

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Foreword

The revision of ATV Standard ATV-A 135 (now ATV-DVWK-A 281) has become necessary as it no longer corresponds with the status of technology.

Compared with the issue of ATV Standard ATV-A 135 dated March 1989 the following important amendments have been made:

- Basic validity for trickling filters and rotating biological contactors without limitation of the capacity (previously ≥ 500 PT).
- Removal of the determination of loading principles; a separate ATV-DVWK standard for all types of wastewater treatment processes is being prepared.
- The addition of a dimensioning approach for denitrification using trickling filters.
- Increase of tank surface area and reduction of tank depth of the secondary settling stage due to new trials results.

The biological stage of wastewater treatment plants, employing trickling filters and rotating biological contactors without sludge return feed, is dealt with in this Standard. The standard applies only for rotating biological contactors without artificial aeration for the supply of the biofilm with the required oxygen.

A detailed description of the theoretical basic elements and practical application of both the fixed bed processes is contained in the ATV Handbook „Biologische und weitergehende Abwasserreinigung“ [“Biological and Advanced Wastewater Treatment”] and „Mechanische Abwasserreinigung“ [“Mechanical Wastewater Treatment”]. The development of the trickling filter process and the rotating biological contactor as well as the factors on their treatment efficiency are covered in advanced literature.

As with all aerobic processes for biological wastewater treatment, the contact between biomass and wastewater is to be established and the biomass is to be supplied with oxygen. With the trickling filter process the wastewater is spray irrigated over the filter material so that, during the dripping process, the contact between biomass and wastewater is established. In general, aeration is without application of further energy. With rotating biological contactors the partially submerged filter material is rotated about its longitudinal axis with the application of energy. During the emergent phase of the material the biofilm can take up oxygen from the surrounding air and in the submerged phase the pollutants from the wastewater.

The following are to be mentioned as favourable characteristics of trickling filters and rotating biological contactors:

- in general they are simple and stable to operate.
- no activated sludge return is necessary.
- trickling filter and rotating biological contactor facilities enable the colonisation of micro-organisms which have long generation times. Thus even compounds which are difficult to degrade can be eliminated with little loading.
- in general the energy requirement is small.

Authors

This standard has been prepared by the ATV-DVWK Working Group KA-6.3 "Trickling filters and contactors", within the ATV-DVWK Specialist Committee KA-6 "Aerobic biological wastewater treatment processes", and the ATV-DVWK Specialist Committee KA-5 "Settling processes".

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User Notes

This Standard is the result of honorary, technical-scientific/economic collaboration which has been achieved in accordance with the principles applicable therefore (statutes, rules of procedure of the ATV-DVWK and the Standard ATV-DVWK-A 400). For this, according to precedents, there exists an actual presumption that it is textually and technically correct and also generally recognised.

The application of this Standard is open to everyone. However, an obligation for application can arise from legal or administrative regulations, a contract or other legal reason.

This Standard is an important, however, not the sole source of information for correct solutions. With its application no one avoids responsibility for his own action or for the correct application in specific cases; this applies in particular for the correct handling of the margins described in the Standard.

1 Area of Application

1.1 Preamble

The treatment of the stormwater in the sewer network and of wastewater in the wastewater treatment plant form one unit for the protection of surface waters. For the dimensioning of the wastewater treatment plant and the stormwater overflows the planning periods are to be matched to each other. The planning period should comprise not more than 25 years.

In the case of special conditions the dimensioning can often be carried out more correctly with the aid of trials and operating results of existing plants. Under certain circumstances costs can be saved through this. The trials plants for this are to be established at least on a semi-industrial scale and operated for not less than half a year under practical operating conditions with the inclusion of the cold season.

1.2 Objective

Using the dimensioning values recommended in this standard for municipal wastewater one can meet the achievable minimum effluent requirements which correspond with or undercut the requirements of the German Wastewater Ordinance dated 09.02.1999, Appendix 1, and the associated sampling specifications.

It is pointed out that short-term ammonium discharge peaks, in particular with combined wastewater in plants with large preliminary settling tanks, are unavoidable and more marked than with activated sludge plants.

If commercial or industrial wastewater with high fractions of slowly biodegradable and/or inert organic substances is discharged, a higher residual COD than with domestic wastewater can arise. The same applies for areas with low water consumption and low infiltration rate, as then the inert COD concentration increases.

In this Standard technical regulations are drawn up for the dimensioning both for

- carbon removal as well as the nitrification and denitrification using trickling filters as well as for
- carbon removal and nitrification using rotating biological contactors.

In addition, information is given for phosphorus removal.

In accordance with the requirements under [German] water law, the structural and operating requirements and the sensitivity of the surface waters the planning through parallel units, reserve equipment etc. is to be oriented towards an appropriately high operational safety.

A prerequisite for the secure function of the plant planned in accordance with this standard, is that sufficiently qualified, trained and permanently technically supported operating personnel are

employed and involved in the planning process, comp. ATV Advisory Leaflet ATV-M 271 „Personalbedarf für den Betrieb kommunaler Kläranlagen“ [Personnel requirement for the operation of municipal wastewater treatment plants].

With the systems dealt with in this Standard one is concerned with fixed bed reactors with very different types of construction and process technology. Therefore, in this Standard, trickling filters (Chapter 5) and rotating biological contactors (Chapter 6) are dealt with separately. The subjects “Basic elements of dimensioning” (Chapter 3), “Pre-treatment” (Chapter 4), “Phosphorus removal” (Chapter 7), “Waste sludge production” (Chapter 8) and “Secondary settling tanks” (Chapter 9) are presented jointly.

1.3 Scope

This Standard applies basically for the dimensioning of single-stage trickling filter and rotating biological contactors and for pre-anoxic denitrification trickling filters. Some advice is given for trickling filters and rotating biological contactors in the second stage. Attention is drawn to the ATV Report “Multi-stage biological wastewater treatment plants” [3] [currently not available in English] with regard to multi-stage facilities. ATV-A 257E applies for wastewater lagoons with intermediate trickling filters and rotating biological contactors.

Due to the peculiarities of small wastewater treatment plants attention is drawn to the ATV Standard ATV-A 122E. For small scale wastewater treatment plants with a wastewater inflow up to 8 m³/d, DIN 4261 applies. For hospital wastewater treatment plants DIN 19250 is to be additionally taken into account. ATV Standard ATV-A 129 [currently not available in English] applies for the disposal of wastewater from recreation and tourist facilities.

The Standard applies for wastewater which originates from households or from plants which serve commercial or agricultural purposes insofar as the harmfulness of this wastewater can be reduced by means of biological processes with the same success as with wastewater from households.