GERMAN
DWA-Rules and Standards

Standard DWA-A 138E

Planning, Construction and Operation of Facilities for the Percolation of Precipitation Water

April 2005

Sponsored by the
German Federal Environmental Foundation
DBU
Deutsche Bundesstiftung Umwelt

GERMAN
DWA-Rules and Standards

Standard DWA-A 138E

Planning, Construction and Operation of Facilities for the Percolation of Precipitation Water

April 2005

Sponsored by the
German Federal Environmental Foundation
DBU
Deutsche Bundesstiftung Umwelt

DWA

This Standard is addressed to town planners, architects, landscaping planners and civil engineers. It provides information on the dimensioning and design of percolation facilities and also on their construction and operation. In this Standard the latest information and procedures in this field are gathered and processed. This Standard is a valuable aid already in the planning phase.

The Standard deals with both the legal and also the technical sides of the problem. Definitions of terms are given and qualitative and quantitative principles are introduced. These are explained by means of examples.
In addition, aids for soil response are determined in the field and in the laboratory. The determination of the water permeability of the soil is here a decisive criterion.

Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.
German Association for Water, Wastewater and Waste
Theodor-Heuss-Allee 17 · 53773 Hennef · Germany
Tel.: +49 2242 872-333 · Fax: +49 2242 872-135
E-Mail: kundenzentrum@dwa.de · Internet: www.dwa.de

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.

Imprint

Publisher and marketing:
DWA German Association for
Water, Wastewater and Waste
Theodor-Heuss-Allee 17
D-53773 Hennef, Germany
Tel.: +49 2242 872-333
Fax: +49 2242 872-100
E-Mail: kundenzentrum@dwa.de
Internet: www.dwa.de

Translation:
Richard Brown, Wachtberg

Printing (English version):
DWA

ISBN-13: 978-3-937758-74-9
ISBN-10: 3-937758-74-7

The translation was sponsored by the
German Federal Environmental Foundation (DBU).

Printed on 100 % Recycling paper.

Foreword

For a long time the municipal planners have solved the problem of the disposal of precipitation water from paved surfaces by discharging it into the sewer networks. In the meantime a rethinking has taken place away from the sealing of surfaces and discharge of precipitation water into the sewer networks to unsealing and infiltration into the subsoil. The objective is the near-natural management of stormwater taking into account soil and water pollution protection.

Standard ATV-A 138 “Construction and Dimensioning of Plants for the Decentralised Percolation of Non-harmfully Polluted Precipitation Water” dated January 1990 has played a considerable part in the rethinking process. The DWA Working Group ES 3.1 “Percolation of precipitation water“ has therefore revised this Standard and increased it considerably in the area of application. In addition, the symbols used have been matched to those in Standard ATV-DVWK-A 198E published in April 2003. The recording of all surfaces providing runoff in one standard with notes on special regulations enables a comparable taking into account of the demands of soil and water pollution protection outside water protective zones.

The Standard provides planners, owners of buildings and authorities with an overview of the currently known measures and facilities for the percolation of precipitation water which have proved themselves in practice.

Authors

This Standard has been elaborated by the DWA Working Group ES-4.1 “Percolation of Precipitation Water” within the DWA Specialist Committee ES-4 “Assessment and Treatment of the Stormwater Runoff”. The editorial revision was also undertaken by this working group which, following the restructuring of the specialist committee, now belongs to Specialist Committee ES-3 “System-Related Planning” and has received a new abbreviation.

The DWA Working Group ES-3.1 has the following members:

GRAU, Arno	Dr.-Ing., Wiesbaden (Chairman)
GROTEHUSMANN, Dieter	Dr.-Ing., Hannover
HARMS, Richard W.	Dr.-Ing., Hannover
NIEHUES, Berthold	Dipl.-Geol., Bonn
PETRY, Hans-Günter	Ltd. StBD Dipl.-Ing., Krefeld
REMMLER, Frank	Dipl.-Geogr., Schwerte
SCHEUFELE, Georg	Dipl.-Ing., Hannover

Contents

List of pictures

List of tables

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 DWA 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 reognised.

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 Overview

1.1 Area of Application

The Standard presented here applies for the percolation of precipitation runoffs which occur on permeable and impermeable paved surfaces (Table 1). With this, the area of application of the January 1990 edition of the ATV-A 138 expanded from roof and terrace surfaces in residential areas to all residential areas as well as areas of stationary and moving traffic.

In water protective zones special regulations apply for the percolation of collected precipitation water which are addressed only basically in this Standard. If a percolation facility is planned in a drinking water area or an area of medicinal waters the requirements of the respective protective area ordinance are relevant which are based on the DVGW [German Technical and Scientific Association for Gas and Water] Directive for drinking water protective areas, Standards W 101 (1995) and W 102 (2002) as well as on the LAWA [German Federal States Working Group Water] Directives for Medicinal Springs Protective Areas (1998). In the new German Federal States, through the continuance of the Drinking Water Protective Zone Decisions from the time of the GDR, the Technical Quality and Delivery Conditions (TGL) 24348/01-03 (1979) and, since 1989, TGL 43850/01-06 are of significance.

In addition, for traffic areas, the following regulations apply: “[German] Standards for road facilities (RAS) Part: Drainage (RAS-Ew)” 1987, “[German] Standards for engineering measures on roads in water catchment areas (RiStWag)” 2002, “Information for measures on existing roads in water protective zones” (1993), “Advisory leaflet for water permeably paving of traffic surfaces” (1998) and “Advisory leaflet for the drainage of airfields” (1998). Of the older regulations “RAS-Ew” is being revised.

1.2 Water Management Classification

Today precipitation water in the majority of built up and other sealed surface areas no longer reaches the water circulation system via natural routes. This can lead to long-term changes to the soil and water resources, reduce the natural local regeneration of the groundwater and have effects on the chemical and biological conditions above and below the ground surface. Attention is drawn in the ATV-DVWK Advisory Leaflet M-153 (not yet available in English) to changes of the water balance in residential areas in particular with the reduction of evaporation. In addition, the harmless disposal of the surface runoff, in particular the discharge of peak flows which occur with heavy rainfall events, demands considerable technical and financial expense with the planning, construction and operation of sewer networks and wastewater treatment plants. Despite all technical measures, however, individual peak runoffs into running waters cannot be avoided completely. As a result, flooding events and increased pollution loads in small running waters, with a high share of residential areas in the catchment area, can result. Taking into account the pollution potential of the drained areas the return of the precipitation water into the natural water circulation system as near as possible to the location of where

it occurs is an ecological, water management and technically sensible objective which, under economical aspects, can be advantageous socio-economically. Therefore, taking into account the local conditions, first a reduction of the runoff and its local percolation and only then its discharge into the sewer network is to be sought.

1.3 Technical Drainage Classification

The percolation of precipitation water is, in many cases, the most sensible ecological prerequisite so that conventional combined and separate sewer systems are converted into modified networks with considerably smaller pipe cross-sections and reduced loading potential for wastewater treatment plants and running waters. Through the decoupling of drainage areas from the sewer network and through the percolation of precipitation water, bottlenecks in the sewer network can be avoided or the security against flooding increased. A prerequisite for the percolation is the technical drainage separation of the drainage areas according to the anticipated characteristics of the surface runoff. Therefore, in each case, it is to be considered carefully, which drainage concept in combination with the percolation of precipitation is ecologically sensible, technically possible and economically justifiable.

1.4 Protection of Soil and Surface Waters

In the natural water circulation system the percolation zone in general fulfils an effective and long-term protective function for the groundwater located below. This protection functions through numerous physical, chemical and biological retention and conversion processes and is essentially influenced through transport processes as well as hydrogeological properties. The intensity of the individual natural reactions varies in the subsoil. In the groundwater blanket filtration, adsorption, ion exchange, precipitation and biological degradation predominate, whereby these processes are mainly more intensive in the overgrown soil zone than in the lower part of the percolation zone. In water filled groundwater aquifers solution and dilution play a very large role. These processes stand with one another in a complex structure of effects and can adapt themselves to natural changes of the surrounding conditions.

This adaptability is, however, limited and can be permanently changed adversely both through increased peak loadings on water quantity and water contents and through long-term overloading, in particular through water content substances with various disturbance and damage effects. With the percolation of precipitation water runoffs mainly particular matter and substances absorbed on them are deposited on the surface of the soil as sediment, a part of the matter is fed into the upper centimetre to decimetre of the soil and dissolved matter with the percolation water in part transported down to the groundwater. As a result, for example, the abatement of the natural treatment capacity and the changes to the percolation water and groundwater properties connected with this or a release and depth displacement of the enriched matter in the upper soil zone can occur. These disadvantages are to be weighed against the advantages of a percolation of precipitation water. With a correct percolation the advantages prevail because the disadvantageous effects can be reduced to a tolerable degree through technical measures.

The concentration of stress substances in the soil, taking into account the German Soil Protection Law (BBodSchG) and the Federal German Soil Protection and Contaminated Site Ordinance (BBodSchV), is to be seen as being more critical than previously and is to be minimised.

Objective of a sustained soil and groundwater protection has to be permanently to maintain the natural functions of the soil, above all its efficiency as filter, buffer and transformer, and to keep groundwater as far as possible unaffected by human influences as well as to preserve soil and groundwater across the whole area from pollution or other disadvantageous changes.

From the point of view of soil protection, the weighing up between the demand for protection of soil and the demand on usage of the soil should follow the principle of relativity [6]. With the percolation water forecast the natural release potential of the concentrated substances is to be taken into account.

Percolation facilities (soakaways) are wastewater facilities. The soil in these facilities and the substances retained are parts of this wastewater facility.

The monitoring of the effects of the percolation of precipitation water on the soil and groundwater is

recommended with hydraulically and materially heavily loaded percolation facilities. The control measures and investigations are to be matched to the substances yielded and the local conditions. Information the requirements for sampling, analysis and quality assurance of the investigations is presented in the Federal German Soil Protection and Contaminated Site Ordinance and the recommendations of the Federal German Association for Soil [6]. With the scope of investigation here also the principle of relativity of the means should be observed.

Additional to the area-wide soil and groundwater protection the public water supply concern receives a special consideration, for the welfare of the general public, through the laying down of water protection charges. With this it is differentiated between Zones I to III. Different regulations and use restrictions apply for each protective zone. Special protective zones are also identified for medicinal springs and their use. In accordance with the DVGW Standards W 101 and W 102 for drinking water protective areas and the LAWA Directives for medicinal spring protective areas, the percolation of collected precipitation water in Zones I and II is not, as a rule, tolerated.

2 Definitions

For reasons of interdisciplinary communication the descriptions of terms and symbols have, as far as possible, been taken over from published standards. The terms defined in the DIN Standard Specifications are ascribed a higher rating.

2.1 Terms

2.1.1 General Terms

Frequency

Number of events, which in the long-term statistic mean within a year, achieve or exceed a value (reciprocal of the Recurrence time).

Recurrence time

Mean time period in which an event achieves or exceeds a value (reciprocal of Frequency).

Precipitation continuum

Precipitation data over several years including all dry periods in high temporal resolution.

Long-term simulation

Modelling of precipitation-runoff events in a drainage system using a multi-year precipitation continuum (long-term continuum simulation) or using relevant precipitation events from a long-term continuum (long-term series simulation).

Topsoil (Native soil)

Upper part of the mineral soil (solums), which contains an appropriate share of humus and soil organisms of the respective soil formation and which usually contrasts with the subsoil due to a darker soil colour (DIN 19731).

Soil

Upper layer of the earth's crust, so far as it is carrier of natural functions, functions such as archive of natural and cultural history as well as usage function, including the liquid components (soil solution) and the gaseous component (soil air), without groundwater and surface water beds (Federal German Soil Protection Law 1998).

2.1.2 Technical Drainage Terms

Decentralised percolation facility

Facility for the percolation of the precipitation runoff occurring on a plot of land.

Centralised percolation facility

Facility for the percolation of precipitation runoffs occurring on several plots of land.

Surface percolation

Areal percolation of precipitation runoffs without temporary storage.

Infiltration percolation

Linear or surface-shaped underground percolation of precipitation runoffs into an excavation provided with a dynamic storage material with above-ground feed pipe.

Pipe percolation

Linear-shaped underground precipitation of precipitation runoffs into a pipe bedded in a dynamic storage material with underground feed pipe.

Pipe-infiltration trench percolation

Combination of pipe and trench infiltration.