Transnational Industry Workshop

Decentralized Wastewater Treatment for SMEs

Backgroundpaper

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Background Paper „Decentralised Waste water and Rain Water Treatment“

1 Outline of the Current Technical Potential of Waste water and Rain Water Treatment/Characterisation of the Field of Technology, especially relating to SME

Considering demographic changes, climate change and the scarcity of resources in many countries of the world, the necessity to rethink existing settlement structures and infrastructure increases.
Within this field, closing the loop on water streams plays a major role.
The decentralised waste water and rain water treatment will be of particular interest in Europe. Individual concepts can be realised with isolated solutions, consisting of smaller treatment units for several houses or smaller settlements.
Water reuse systems as well as storm water management to protect the resource water are key elements of a sustainable water management. The goal is not only to recycle used water to the point that it can be fed back safely to the environment, but to treat it to a level for reuse. With the decentralisation, the existing demand for water supply and waste water disposal can be covered efficiently. This is a chance for SMEs (Small and Medium Enterprises), since an adapted water management leads to the reduction of investment and operation costs. /1/

In addition to the conventional decentralised waste water treatment with small waste water treatment systems and small sewage treatment plants, sustainable sanitation concepts can be applied. Sanitation concepts concerning the collection and direct treatment of separated waste water streams such as rain water, grey water, faeces and urine to produce process water or fertilisers, contribute to the reduction of resource consumption and have been moved into the focus of attention in the past few years. The application areas of treated water such as grey water and rain water are versatile. They can be used as process water in the household, on sports facilities, on camping sites or even in hotels. Furthermore, treated water is suitable for the irrigation of lawns, golf courses or parks. Treated water can be used in the industrial, commercial and public domain. The most important condition for the reuse of treated water is good water quality and the prevention of health risks. /2, 3, 4/

In Germany new sanitation concepts are mainly realised in pilot projects.
The application of small waste water treatment systems in areas not connected to the public sewer system and the use of rain water have been established in the last 20 years. Around 1.5 million small waste water treatment systems are currently in operation in Germany. According to estimates, there are around 1.3 million rain water utilisation systems in private households. /5/

The fast and complete rain water disposal, as it is still nowadays mainly realised in settlement areas, must be replaced by more sustainable concepts such as rain water management. The performance of decentralised systems often surpasses conventional systems in regard to the reduction of peak discharges. Furthermore, decentralised systems lead to the protection of the water balance, since the discharge amounts can be kept low. A very good treatment efficiency of rain water is ensured by soil percolation. Decentralised systems are qualified particularly for development areas and areas not yet connected to a drainage system. /6/

In the domain of decentralised waste water and rain water treatment, there are several other business oppotunities beyond development, production and distribution of decentralised treatment units SMEs. The planning and consulting for individually adjusted concepts for waste water disposal or rain water management as well as the monitoring and maintenance of the plants require a professional and competent support. A cost management will be necessary for new sanitation concepts to distribute the expenses amongst the individual users. The treatment of waste resulting from the operation of decentralised waste water and water plants is also of particular importance with regard to the recycling economy.

For small and medium-sized enterprises who want to establish themselves in the outskirts of cities or rural areas without the complete infrastructure for public water supply and waste water disposal, decentralised concepts offer an economical and financial possibility for its realisation. An in-house water recirculation system, process water production with grey water and rain water treatment are conducive to the reduction of water costs and make the company more independent from water supply and waste water management companies. These new systems provide a considerable contribution to environmental.

2 Characterisation of the Legal Framework

Waste water and rain water treatment plants are subjected to the water law. For the construction, operation and use of the plants, further technical requirements and standards are relevant. Decentralised waste water plants are usually construction products and so they are subjected, in addition to the water law, also to the construction legislation. For rain water utilisation and water preparation plants there are additional legal and technical regulations and standards concerning the reuse of the water. Since the percolation of rain water can also carry pollutants into the soil legal requirements for soil protection must be taken into account. /7/

The water framework directive, the directive on urban waste water treatment as well as the construction products directive form the significant framework legislation for Europe in this area. Every member state is obliged to implement and substantiate the guidelines from these directives in their national legislation.
Hereafter, the focus is on the regulations resulting from the water law in Europe and the regulations on the German federal level. In Germany, further *Land* laws and bylaws need to be taken into account.

2.1 Water Legislation on the European Level

2.1.1 2000/60/ EC Water Framework Directive

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 Establishing a Framework for Community Action in the Field of Water Policy (WFD) /8/

With the “Directive 2000/60/EC of the European Parliament and of the council of 23 October 2000” (hereinafter referred to as WFD), the commission of the European Union (EU commission) has realigned the water protection policy. The directive which came into effect in December of 2000 pursues a new approach to water resources management. The goal of this directive is the establishment of a framework for com-

munity action for the protection of inland surface waters, transitional waters, coastal waters and groundwater for the purpose of:

- Prevention of the deterioration of the waters,
- Protection and improvement of water quality,
- Promotion of sustainable water use,
- Long-term protection of the existing resources,
- Reduction and gradual phasing-out of discharges and emissions,
- Reduction and prevention of the pollution of ground water,
- Reduction of the effects of floods and droughts,

Every Member State is obliged to account for their river basins and put up management plans which should be sent to the EU commission by March 2010. The goals “good ecological status” and “restoration of the ecological function of the waters” are planned to be achieved by the year 2015.

2.1.2 91/271/EEC Urban Waste Water Treatment

Council Directive 91/271/EEC of 21 May 1991 Concerning Urban Waste Water Treatment /9/

The purpose of this directive is to protect the environment from harmful effects caused by waste water. This directive comprises the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water of certain branches of industry.
In this directive, urban waste water is defined as domestic waste water or a mixture of domestic and industrial waste water and/or rain water.
The member states are obliged to equip all communities with more than 2000 PE with a sewer system. Furthermore, it must be ensured that communal waste water discharged into sewer systems receives a secondary treatment or an equivalent treatment before being discharged into waters. In order to discharge industrial waste water into the sewer system and into communal waste water treatment plants, regulations need to be set and/or a permit has to be issued by the competent authority.
If the establishment of a sewer system is not justified, because it would not involve a benefit for the environment or would be associated with excessive costs, individual systems or other suitable measures which ensure the same level of environment protection are necessary. A permit for the discharge of communal waste water from waste water treatment plants from municipal areas with less than 2000 PE may only be issued, if a process and/or disposal system ensures that the receiving water bodies comply with the relevant quality objectives of the provisions given by every relevant guideline of the community.
According to **article 12**, purified waste water should, if possible, be reused. Contamination of the environment is to be kept to a minimum.
Requirements for communal waste water are defined in **annex I**. **Annex II** shows criteria for the designation of sensitive and less sensitive areas.

2.2 Water Legislation on a Federal Level in Germany

Germany is a federal republic, where state matters are divided between the federal government and the states (*Länder*). Until the federalism reform in 2006, the federal government had the competence to issue framework legislation in the area of water rights. With the reform, this was changed into the competing legislative competence.

New federal laws such as the new water resources act (WHG) replace the former framework legislation. The goal of the new regulation is a higher standardisation and better system for the water rights in Germany. It establishes the requirements for a nation-wide realisation of the European water regulations. The *Länder* maintain the right to issue regulations differing from the national laws, if these do not concern detailed aspects about plants and substances. /28/

2.2.1 WHG – Federal Water Act from 31 July 2009 /10/

The demands of the water framework directive are implemented in the water resources law. The German federal water act (WHG) constitutes amongst others the legal basis for the planning of facilities for the decentralised treatment of waste water and storm water management.
The purpose of this law is to protect the waters as part of the ecosystem and as a basis for life. According to the WHG, the discharge of rain water into surface waters as well as the infiltration of purified waste water from small waste water treatment systems and from collected rain water (run off from constructed/paved surfaces) count as the use of a water body and therefore require an official permission under § 8 WHG. The permission under § 8 WHG of the water law grants the revocable and limited possibility for the use of waters; in the case of an impairment of the public welfare, the permission may be refused. According to § 46 WHG, the *Länder* are authorised to determine the conditions for a permission-free use of the groundwater for the discharge of rain water.

The paragraphs 54 to 61of the WHG are also relevant for waste water and the run off rain water from constructed/paved surfaces (also defined as waste water under § 54 (1) with requirements about the definition of waste water, principles of waste water disposal, the obligation to dispose of waste water, the discharge of waste water and about self-monitoring.

The disposal of waste water comprises the collection, transmission, treatment, discharge, infiltration and irrigation of waste water as well as the dewatering of sewage sludge within the waste water disposal and the disposal of sludge accumulated in small waste water treatment systems. In general, waste water is to be disposed of in a manner so that the public welfare is not impaired. This also affects the domestic waste water disposal from decentralised systems.

Rain water is to be percolated, irrigated or discharged into waters directly, or discharged by using a sewer system without mixing it with waste water locally. Guidelines from the water legislation, further guidelines from other public legislation and/or water management issues may not conflict with this.

Waste water is to be disposed by an entity of the public law, who is obliged to do so according to *Land* legislation.

For public water supply and waste water discharge in Germany, there are usually public networks belonging to the city or community. Cities and communities can order the “connection and utilisation constraint”, which includes the mandatory discharge of waste water into the public sewer system. The operation of a small waste water treatment system and the percolation of the purified waste water are prohibited in this case. Exceptions from the connection and utilisation constraint within the jurisdiction

allow only for narrow interpretation. The reason for this is that the connection and utilisation constraint serves an proper public waste water disposal and thereby ultimately serves the public health. For the economical operation of communal waste water systems, sufficient users are required. Therefore, the obligatory connection to the sewer system has a financial function as well. The connection and utilisation constraint is usually regulated by the waste water bylaws of the respective community. This bylaw also determines which properties are subjected to the connection and utilisation constraint. The right of the communities for the regulation of the connection and utilisation constraint is given by the municipal code of the respective Land. /11/

Operators who discharges waste water into waters or waste water treatment plants are obligated to let the waste water be analysed by qualified personnel or a suitable inspection authority (self-monitoring). Furthermore the operator of a waste water treatment plant is obligated to monitor its condition, functionality, maintenance and operation as well as the type and amount of waste water and waste water quality. Additionally, records of this monitoring must be made, stored and presented to the responsible authority on demand.

2.2.2 AbwAG – Waste Water Charges Act

Act Pertaining to Charges Levied for Discharging Waste Water into Waters /12/

A charge (waste water charge) shall be paid for discharging waste water into a water, which shall be levied by the federal *Länder* (§ 1).
Flat-rate calculations are made for rain water, domestic waste water and similar types of polluted water (§ 7, § 8). For this, units of noxiousness[1] depending on the type of discharge or respectively on the so-called population equivalent number are determined. The *Länder* may determine, under which circumstances the discharge may stay partially or fully free of charge. The discharge from small waste water treatment systems is free of charge, if the waste water treatment plant is built according to the generally recognised rules of practice and the proper sludge disposal is ensured.

2.2.3 AbwV – Waste Water Ordinance

Ordinance on Requirements for the Discharge of Waste Water into Waters /13/

This ordinance specifies the minimum requirements to be stipulated when granting a permit for the discharge of waste water depending on the source of origin, e.g. from the food industry, (appendix 3-11), chemical industry (appendix 22), textile industry (appendix 38). Further requirements from other legal provisions remain unaffected by this.

[1] The waste water charge shall depend upon the noxiousness of the waste water, which shall be determined on the basis of the oxidisable substances, of phosphorus, of nitrogen, of the organohalogens, of the metals mercury, cadmium, chromium, nickel, lead, copper and their compounds, as well as of the toxicity of the waste water to fish eggs, expressed in units of noxiousness in accordance with the Annex to this Act. The noxiousness is expressed in “units of noxiousness”. One unit corresponds roughly to the wastewater accrued by one inhabitant (population equivalent) per year. The lower the noxiousness of the wastewater, the lower the wastewater charge. The wastewater charge was established to motivate users to reduce the noxiousness of wastewater by introducing techniques without waste water or little waste water production and by creating environment-friendly products. The wastewater charge per “unit of noxiousness” amounts to 35.79 € since the beginning of 2002. /13,25,26/

Upon application, the permission is issued by the so called local water authorities. Waste water may only be discharged into waters (direct discharge), if the amount and harmful effects of the waste water are kept as low as possible in accordance with the technical state of the art and if the discharge is consistent with the requirements for the water quality.
The following requirements apply to the discharge of domestic and communal waste water into waters for the size category 1 (less than 60 kg/d BOD_5 (raw)) in **appendix 1** of this ordinance:
COD[2] ≤ 150 mg/l
BOD_5[3] ≤ 40 mg/l

Appendix 1: C (4) AbwV
“(4) In the case of small discharges within the meaning of Article 8 in conjunction with Article 9 (2) second sentence of the Waste Water Charges Act (*Abwasserabgabengesetz*), the requirements for size category 1, pursuant to paragraph (1) above, shall be deemed to have been met if a waste water treatment plant authorised by a general building - inspectorate approval, by a European-oriented technical approval pursuant to provisions of the Act on Construction Products (*Bauproduktengesetz*) or otherwise authorised in accordance with *Land* law is installed and operated in keeping with the relevant authorisation. The relevant authorisation must also set forth the requirements for proper function of the facility, with respect to installation, operation and maintenance of the facility.”

The legislator wants to prevent the endangerment of the groundwater with this, since purified waste water from small waste water treatment systems is usually percolated. If the small waste water treatment system does not fulfil the technical state of art or if it is in a poor operating condition, water pollution caused by the discharge of waste water cannot be ruled out. /11/

The states may set different requirements if the connection to a public waste water treatment plant is to be expected in the near future.

2.2.4 TrinkwV – Drinking Water Ordinance
Ordinance on the Quality of Water Intended for Human Consumption /14/

The new drinking water ordinance (TrinkwV) is effective as of 1 January 2003. This ordinance is not affiliated with the water rights. This regulation serving health protection is subject to the food law. The TrinkwV is relevant for the use of rain water. According to the TrinkwV, the owners of the rain water utilisation plant have to notify the authorities, usually the health office, of its operation. In certain cases, the TrinkwV stipulates the monitoring of such plants by the health authorities.
Water utilisation plants may not have any connection with drinking water system and must be colour-coded. The contamination of drinking water must be ruled out in a secure and durable manner.
Besides the requirements from the TrinkwV, the respective water supply bylaws are to be followed, which also regulate the so-called “utilisation constraint”. Usually, the entire water demand must be covered by the public water supply system. Exceptions

[2] chemical oxygen demand
[3] biochemical oxygen demand

from this obligation (e.g. garden irrigation) and the possibility to be exempted from the utilisation constraint are defined in the bylaws. /7/

3 Outline of the Problems and Reasons for these Problems in the Sector of Waste Water and Rain Water Treatment

Innovative living concepts and new technological possibilities are leading to a structural change; this requires a sustainable spatial development. However, conventional settlement structures and infrastructures are often opposed to such a development. The water management in Germany is arranged in central organisation structures. Many technologies are orientated towards previous settlement forms and ways of life. At the moment, decentralised waste water and rain water treatment play a significant role at most in rural areas. In the medium and long term, existing infrastructures can only be changed at high costs and with a high amount of resources. /5/

Besides climatic changes, which may lead to increased heavy rain events, floods, droughts and therefore to an increase in groundwater pollution, further environmental aspects and economical reasons argue for decentralised systems for water management, which are becoming more and more important.
In Europe, one of the most important resources – drinking water – is used for different purposes than drinking, which do not necessarily require drinking water quality. Increased water costs, the water scarcity in many countries and an increased awareness for the protection of water resources have lead to a rethinking throughout the society.
Besides the storm water management, which will gain in importance in the future, sustainable sanitation concepts, especially in decentralised systems, will play an important role in the further ecological and economical development.
These kind of innovative projects still have model character at the moment. The demographic change leads to changes in the settlement density and therefore often to technical and economical problems of under-utilisation of the existing infrastructure. This aspect, as well as dependencies on climatic, topographic, ecological, social, cultural and technical requirements of the social environment, are integrated into these model projects. /16/

The current legal and institutional requirements in Germany including the connection and utilisation constraint and the monitoring regulations lead to narrow confines for the implementation of innovative sanitation concepts. The development of innovative concepts together with decision-makers from politics and administration as well as the adjustment to the legal situation will allow for the realisation of new projects.

The treatment of rain water from settlement and circulation areas in Germany is currently the responsibility of the environmental management. So far, the main goal was the protection of areas from water logging and flooding. Sewer systems are mostly constructed in the area of streets, with which the incidental rain runoff is collected and discharged. The rain water is either discharged with the polluted water (combined system) or separately (separate system) in its own pipe system. Certain negative effects on the water regimen of an area are connected with the discharge of rain water:

- The regeneration of groundwater is reduced,
- Hydraulic stress for waters during rainfall, which have negative effects on the flora and fauna,

– In the case of combined systems, heavy rain events lead to combined water discharge into the waters. This leads to a decrease in water quality. /6/

In many German river basins, the contamination caused by rain water discharge and rain water runoff from streets today is higher than the sum of the pollution caused by the industrial, commercial and domestic waste water.
In 2008, North Rhine-Westphalia achieved a similar TOC load for the combined water discharge (12%) as for the industrial direct discharge (11%). The load from storm water overflow from separate systems and rain water run-off from streets is even higher, amounting to 25% and 23% of the water pollution. In total, 60% of the TOC load in North Rhine-Westphalia’s waters are a result of rain water disposal. /27/
Storm water holding systems are being built to reduce peak discharges. In separate systems, separators, storm water sedimentation tanks and retention soil filters serve for the reduction of water pollution, whereas combined systems mainly use storm water tanks with overflow, sometimes even soil filters. However, these only show an insufficient effect. Especially during heavy rain events, the waters are loaded unnecessarily with contaminants. Furthermore, the negative effects of the rain water discharge into the water regimen are nearly irreversible. Peak charges can be subdued with storm water tanks; a uniform basic discharge however is not even attainable with naturally designed plants. /6, 13/

4 New Legal Requirements (European Water Framework Directive WFD) with Regard to the Increased Operation of Decentralised Systems

The European water framework directive and the subordinate legal policies from the separate member countries support the application of technologies which promote the sustainable use of water based on long term protection of the existing resources. Decentralised waste water treatment and storm water management concepts can contribute immensely to this. The protection of the water regiment and a steady water balance can be flexibly and safely realised by decentralised systems. In regions with heavy rain events, a decentralised water management is suitable for the prevention of groundwater pollution. A further demand from the water framework directive for the “reduction of the effects of floods and droughts” can be fulfilled with specific storm water management. Concepts must take centralised as well as decentralised solutions into account, so as to be as economical and effective as possible. /8/

The amendment to the water resources act WHG /10/ also promotes the decentralised storm water management. § 55 WHG demands local percolation, land treatment or discharge into waters using a sewer system for rain water without mixture with polluted water. /10, 17/
The deconstruction of the current combined systems will not result from these demands, since this would not be economically sensible. For the construction of new settlements however, this amendment means a considerable change for the planning. Sustainable solutions such as decentralised storm water management are in demand and are therefore gaining in importance.

In addition, § 57 WHG holds a further aspect for future water management concepts. Not only does it consider the pollutants of the sewage, but also the amount and harmfulness of the waste water. A permit for the discharge of waste water into waters (direct discharge) may only be issued, if this is kept as low as possible in compliance with the appropriate process according to the state of the technology.

Consequently, hydraulic factors will play a greater role in the future. The decentralised water management with arrangements for the reduction of the discharging rain water amount including rain water utilisation are especially significant. /18/

5 Presentation of the Inhibiting and Supporting Influences on the Operation of Decentralised Systems

5.1 Inhibiting Influences on the Operation of Decentralised Systems

In Germany, now and in the future, ca. 10 % of the domestic waste water is treated in small waste water treatment systems. This small proportion of waste water disposal causes depending on the parameter up to 25 % of the pollution of waters.
At the moment, there is no obligation for the official monitoring of small waste water treatment systems. In regulations by the *Länder*, the qualified self-monitoring is often regarded as sufficient. This qualified self-monitoring is usually executed by a specialist monitoring service. Type and frequency of such monitoring is regulated by specific regulations or guidelines.
In practice /BDZ[4] 2010/, effluent concentrations of small waste water treatment plants are sometimes higher than effluent limits specified by the law. The reasons for insufficient effluent quality are usually incorrect plant operation, inadequate self-monitoring, poor maintenance support performance or insufficient surveillance. Authorities cannot provide the manpower necessary for monitoring. Monitoring systems for the automatic surveillance of small waste water treatment plants are currently under discussion. This means that, for example, external service providers may monitor the decentralised waste water plants. /19/
The use of small waste water treatment systems as a decentralised solution for industry and business is restricted, since often this wastewater cannot be treated safely by conventional plants. Small waste water treatment systems and usually also small sewage treatment plants (up to 2,000 PE) are usually constructed for waste water from households and small enterprises. Business and industrial enterprises require individual solutions for their specific waste water with partly very high loading of organic pollutants or other special substances according the industrial sector. Single solutions are often more expensive than product series.

The monitoring and surveillance of the operated plants is also of great importance to new sanitation concepts with the separated collection of different waste water streams. Technical establishments must ensure that no waste water such as grey water may leak from the grey water plant to the drinking water supply network.
The problems with user acceptance often lead to the rejection of new sanitation systems, because users fear odour problems and other disadvantages in comparison with conventional plants. Furthermore, higher health risks and an insufficient water quality are expected. The implementation of an eco-label or a certification of new sanitation systems could offer more security to the user and the designer during the selection of appropriate systems.

The hygienic risks posed by the use of rain water are assessed differently.
The quality of rain water depends substantially on the absorption of substances on its way through the atmosphere and on the place of its impact. To avoid the reproduc-

[4] Training and Demonstration Centre for Decentralized Sewage Treatment – BDZ e.V.

tion of bacteria during storage, rain water storages must be kept under dark and cool conditions. The physical, chemical and bacteriological properties of the water are crucial for the further utilisation possibilities, such as for cooling water, process water or for irrigation.
The basic conditions under which rain water may be collected and used must be taken into account for the use of rain water in industries and business. For example, courtyard areas and streets in business and industrial areas with significant air pollution, special areas, e.g. truck parking or truck traffic are often polluted. Individual concepts for rain water collection and use are necessary, which cause higher investment costs. /6/

Hygienic problems can be prevented with technical measures. In practice, faulty installations, insufficient monitoring or other incorrect handling does not only endanger the rain water users, but also the other drinking water users, because contaminated water is discharged into the public network. Up to 70 % of the rain water plants in Germany are in bad condition after operation of several years. This circumstance can be traced back to an incorrect distance concerning the separation of drinking water and rain water systems or even to a direct connection between the two pipeline systems. Properly installed, operated, monitored and hygiene-controlled rain water utilisation plants – those which were planned, constructed and operated according to state-of-the-art technology – maintain the hygienic quality even after many years of operation. Willingness of the operator is necessary to invest in the correct installation of these systems and to finance the costs for operating and maintenance. /7/

5.2 Research Programmes/Funds

Research for sustainable development are currently of high priority on all support levels in Germany, Europe and International. Especially decentralised systems for water management will gain even more importance in the future. Ministries such as the BMBF[5], the BMU[6] and the BMWi[7], federal institutions such as the UBA[8] or the GTZ[9], the KFW[10] bank and other sponsors are therefore supporting relevant research projects with aid programmes. Subsequently, some current aid programmes are shortly illustrated.

5.2.1 BMU: Environmental Innovation Programme

http://www.bmu.de/foerderprogramme/pilotprojekte_inland/doc/2330.php
In the scope of this programme, demonstration projects, which show for the first time in which way modern procedures for the prevention or reduction of environment loads can be realised, are funded on an industrial scale. Objectives include the further development of the environmental legal framework, standards and the state-of-art technologies as well as funding projects with a high demonstration effect. At the beginning, the focus of support was on end-of-pipe cleaning technologies, such as air filters and waste water treatment facilities. Today, this focus has shifted to integrated environmental protection measures and activities in the areas of renewable energies

[5] Federal Ministry of Education and Research
[6] Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
[7] Federal Ministry of Economics and Technology
[8] Federal Environment Agency
[9] The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)

[10] The Kreditanstalt für Wiederaufbau

and energy efficiency. Small and medium-sized enterprises have priority for funding. Research and development are not fundable.

5.2.2 BMZ: 400 million Programme for Climate Protection

http://www.bmu-klimaschutzinitiative.de

The federal environment ministry has launched an extensive climate protection initiative. The new programmes fund investments in energy efficiency and sustainable energy realised by the industry, municipalities and consumers. For this, up to 400 million Euros have been made available by the sale of CO_2 emission rights. Of this, 280 million Euros are invested in national activities, 120 million Euro are for international projects. /24/

Following programmes are interesting for decentralised water management.

- a programme for the aid of projects for the optimisation of the energetic use of biomass,
  Against this background, the Federal Ministry for Environment funds projects for the further development of open questions concerning the generation of electricity, heat and fuels from biomass. A focal theme is the development and use of biogenic waste materials. This could, for example, include the use of sewage sludge.
- Climate Protection Impulse Programme for the Installation of Mini-CHP-Plants (CHP: combined heat and power) in Private Households and Businesses,
  Owing to the great demand for this project combined with the parliamentary decision for the budget 2010 to cut and partially suspend the budget resources of the federal environment ministry (BMU), no further means will be available in 2010. The allotted applications fully exhaust the available budget of the national climate protection initiative of the BMU for 2010. Therefore, no further funds for the granting of Mini-CHP-applications are available.

5.2.3 BMBF: Framework Programme Research for Sustainable Development

http://www.foerderinfo.bund.de

The BMBF framework programme “Research for Sustainable Development” was created in February 2010. More than 2 billion Euro will be made available by the BMBF until 2015.

Central Theme: Sustainable Development and Resources

The goal is to create a basis of knowledge and decision-making and to find realisation strategies to bring national economies and the global economy to a path of sustainable development. The research results to be expected should contribute to the concretion and realisation of national and international sustainable strategies. In doing so, system solutions for a sustainable economy should be developed. Thematically, the research funding is concentrated on: the resource nature, a sustainable water management, efficient and sustainable value chains as well as biogenic raw materials.

5.2.4 BMBF: “Decentralised Water Supply and Waste water Disposal Systems”

www.fona.de

The objective of the research is to develop planning tools by means of which the increasing demand for water can be met in such a way that the resource can be secured on a long-term basis.

The objective of the research is to develop and analyse sustainable water technologies, such as decentralised supply and disposal concepts, new methods for water

extraction and treatment as well as integration of the latter. /20/

5.2.5 BMWi: “ZIM-Programme” Aid for Small and Medium-sized Enterprises

www.zim-bmwi.de

An example for the funding of small and medium-sized enterprises (SME) is the ZIM-Programme (central innovation programme) of the BMWi. This programme is a nationwide aid programme, open for different sectors and types of technologies, which offers SME support for their innovative activities. /21/

5.2.6 European Union: LIFE+ Programme

http://ec.europa.eu/environment/life/

Furthermore, there are European aid programmes, such as the LIFE+ programme of the European Union. LIFE is a funding instrument of the EU which supports programmes for the protection of the environment in the European member states, acceding countries and adjoining countries. One of the main objectives of the funding of these projects is the further development of the European law with the help of the results. LIFE was initiated in 1992. In the meantime, LIFE+ has co-financed more than 3000 projects. /22/

5.2.7 Federal States

http://www.wasserunion.com/de/news/in/Foerderung/

The ‘Wasserunion’ shows the status quo for funding small waste water treatment systems and small sewage treatment plants in Germany.

Private customers who want to invest in a small waste water treatment system – no matter if for a new construction or a retrofit of an existing plant – are interested in whether they can expect governmental aid and if so, how much. Every *Land* in Germany decides about the amount and type for the funding. The aid can depend on individual prerequisites. For the successful application for aid, it is advised to prepare the waste water disposal concept of the responsible bodies in advance, which should show that no centralised disposal solution is provided for the site of the treatment plant. /23/

6 Brief Descriptions of Single Technologies with Competing Alternatives of different SME and Significance for other European Countries

Below, different single technologies are introduced and their fields and possibilities of application are summarised. The list of producers for the single technology gives only an exemplary overview. Further information concerning the companies and technologies can be found in the online Act Clean[11] data bank under http://www.act-clean.eu.

6.1 Membrane Technology

Technology	Company	Field of Application/ Suitability for SME	Significance for other European Countries
Membrane Technology	• HUBER SE/ Berching • Martin Systems AG/ Sonneberg • Busse Innovative Systeme GmbH/ Leipzig • Mall GmbH/ Donaueschingen [1] Koch Membrane Systems/ Aachen [2] ItN Nanovation AG/ Saarbrücken	• paper- and cellulose industry, • chemical and cosmetic industry • *renewable energy/ renewable raw material* • food industry • breweries and beverage industry • restaurants • laundry services • metal, electronic, automotive industry • textile industry and more	• rural areas • high water quality/ water disinfection; protection of the local water resources (wells, groundwater etc.) • water reuse in regions with low precipitation (as water for irrigation, process water et al.) • The process can be used stationary or mobile. • Suitable for waste water treatment in areas declared as sensitive areas. • compact system; suitable in case of small space

Example: HUBER VRM®-Membrane Activated Sludge Process by HUBER SE
Purpose: Treatment of municipal and industrial waste water
Target group: Municipalities, industry, businesses
Industrial sector: Waste water Technology (Sewage Technology)

Description (Internet www.huber.de):
The HUBER VRM® process is a system of ultrafiltration membranes submerged into the aeration tank. The HUBER VRM® system is a combination of biological waste water treatment and high-efficient solids/liquid separation. The waste water is treated biologically and all solids within the flow (particles, bacteria, viruses) are removed by the ultrafiltration membrane in accordance with the low-pressure principle.
The principle of membrane filtration is based upon the separation of solids suspended in a watery solution by means of a pressure difference. While the water per-

[11] Act Clean by the European Aid Programme INTERREG:
INTERREG is a EU community initiative of the European fund for regional development for the cooperation between the regions and the European Union. The INTERREG project ActClean (**Ac**cess to **T**echnology and Know-How on **Clean**er Production in Central Europe) supports small and medium-sized enterprises (SME) in central Europe who want to introduce and expand environment-friendly production processes. It aids environment-friendly technologies and management systems by joining supply and demand: on one hand, the enterprises have easier access to know-how and technologies and on the other hand it offers providers of innovative solutions new sale opportunities in all of central Europe.

meates through the membrane, the solids, bacteria and even most viruses are retained on the concentrate side on the membrane surface where they are removed by relative movement. The pressure differential necessary to pass the liquid through the membrane depends on the membrane pore size and membrane quality.

Alternative: siClaro® Process by Martin Systems AG
Purpose: Treatment of municipal and industrial waste water
Target group: Municipalities, industry, business
Industrial sector: Waste water technology (Sewage Technology)

Description (Internet www.martin-systems.de):
In comparison to conventional activated sludge plants, the siClaro® technology offers numerous advantages as a combination of established activated sludge technology and innovative membrane technology. The siClaro® membrane filters are placed directly into aeration tanks or downstream filtration chambers and ensure a safe retention of activated sludge, bacteria and viruses. Therefore, a conventional secondary settlement tank is no longer necessary to achieve the highest discharge quality. The ultrafiltration membrane employed in the siClaro® waste water treatment physically separates even the finest particles up to colloids from liquids, due to its predefined pore size (<0.1 µm). The membrane holds back these substances without altering them physically or chemically. This prevents the formation of dangerous substances.

6.2 Sequencing Batch Reactor (SBR)

Technology	Company	Field of Application/ Suitability for SME	Significance for other European Countries
SBR	• utp pöhnl umwelttechnik GmbH/ Seybothenreuth • ATB Umwelttechnik GmbH/ Porta-Westfalica • Kordes KLD Wasser u. Abwassersysteme GmbH/ Vlotho • Rhebau Rheinische Beton- und Bauindustrie GmbH/ Dormagen • solid-clAir water systems GmbH & Co. KG/ Buxtehude	• decentralised waste water treatment • municipal waste water • industrial waste water u.a.	• applicable in the decentralised/rural area • applicable especially for different hydraulic conditions • applicable as retrofit for existing plants • high reliability

Example: SBR-Process/klärofix® by utppöhnl umwelttechnik GmbH
Purpose: decentralised waste water treatment
Target group: waste water treatment up to 50 PE
Industrial sector: Waste water technology (Sewage Technology)

Description (Internet www.klaerofix.de):
klärofix® is a SBR – small waste water treatment plant, basically partitioned into two treatment steps. With free fall the waste water run into the mechanical primary treatment. Coarse solids are sedimented in the primary treatment and are stored with the secondary sludge from the SBR reactor in the sludge storage. By means of a filling device operated by compressed air, the biological stage is charged with pretreated waste water within a very short period of time with a defined minimum quantity (cycle volume). The nitrification and de-nitrification phases are followed in case of an appropriate load by the settlement phase during which a clear water as well as a sludge layer are formed. The clear water layer is drawn off through the outlet by means of a com-pressed-air sewage lifting unit. Surplus activated sludge is brought into the primary treatment and is stored there together with primary sludge.

Alternative: SBR-Process *solid-clAir*
Purpose: decentralised waste water treatment
Target group: Municipalities, industry, business
Industrial sector: Waste water technology (Sewage Technology)

Description (Internet www.solidclair.de):
The solidclAir – process is based on the SBR-system with membrane aeration.
All treatment and pump facilities are operating with air lifting units. The plant consists of construction kits. All components could be changed in short time and with little effort.

6.3 Fixed film technology

Technology	Company	Field of Application/ Suitability for SME	Significance for other European Countries
Fixed film technology	Biological contactor • Kingspan Environmental GmbH/ Wesel • Stählermatic®-System der Stähler GmbH/ Hadamar Biological filter/Trickling filter • Kordes/Vlotho • BBW Abwassertechnik/ Weissensee • Nordbeton/ Friesoythe Granular media filter • WSB Martin Bergmann Umwelttechnik GmbH/ Penig • Zapf/Bayreuth • EES Klär- und Umwelttechnik GmbH/ Wiesmoor	• waste water with high organic load • municipal waste water • agriculture • fish farms • fruit and veg farms • aerobic sludge digestion • landfill leachate u.a.	• applicable in the decentralised/rural area • high reliability • The process can be used stationary or mobile.

Example: rotating biological contactor/BioDisc® by Klargester (Kingspan Environmental GmbH)/ Wesel
Purpose: Treatment of municipal and industrial waste water
Target group: Municipalities, industry, business
Industrial sector: Waste water technology (Sewage Technology)

Description (Internet www.klargester.de):
The plant consists of a primary settlement tank, a two-part biological zone, and a secondary settlement tank with a return activated sludge pump. The scooping bucket system is built into the bio-rotor. For the rotating biological contactor process, several packages of round, perforated discs are attached next to each other on a driveshaft. They are partially immersed in the waste water. Microorganisms accumulate on these discs as a bacteria bed/biological film. During the immersion, this film gathers dissolved organic substances. In the upper segment of the circle, the aerobic part of the biological treatment step, the oxygen necessary for the metabolism reaches the film. The organic contamination is oxidised or converted to a new film.

Alternative: Biological contactor/Stählermatic®-System by Stähler GmbH
Purpose: Treatment of municipal and industrial waste water
Target group: Municipalities, industry, business
Industrial sector: Waste water technology (Sewage Technology)

Description (Internet www.staehlergruppe.de):
The STÄHLERMATIC®-System (STM® -System) for the biological treatment of waste water consists of a powerful oxygen transfer aggregate in the form of a wheel, which combines the biological contactor with the activated sludge process. With this process it is possible to achieve an almost entire nitrification with simultaneous denitrification. The STM® system is used in new plants or for the expansion and technical innovation of existing activated sludge plants as well as for the improvement and re-trofit of existing waste water treatment plants. The mobile tank construction as a compact or container plant has been successful for temporary solutions or for small waste water treatment systems.

6.4 Rain water treatment

Technology	Company	Field of Application/ Suitability for SME	Significance for other European Countries
Rain water treatment	lamella separator • MALL GmbH/ Donaueschingen filtration systems • iWater Filtersysteme/ Sankt Augustin • Mall GmbH/ Donaueschingen • REWA GmbH/ Kürten • H&W Regenwassernutzung/ Gundremmingen • 3P Technik Filtersysteme/ Donzdorf	• rain water treatment • drainage of parking areas, streets, industrial zones u.a.	• applicable for rain water management in regions with low precipitation • cost reduction by using rain water • applicable in decentralised (industrial) areas

Example: rainwater treatment/MALL- lamella separator by MALL GmbH
Purpose: rainwater treatment
Target group: Municipalities, industry, business

Description (Internet www.mall.info/produkte.html):
The MALL - lamella separator is applicable for the treatment of rain water resulting from surface run off before discharging into the waters or groundwater. In comparison to sedimentation plants the lamella separators consist of smaller units. The construction of the lamella separators allow the treatment of rainwater from big areas by using small buildings.

Alternative:	Rain water filter by i-Water Filtersysteme
Purpose:	rainwater treatment
Target group:	Municipalities, industry, business

Description (Internet www.i-water.de):
The rainwater is accumulated and smoothly transported across the cascades, so that a preliminary purification can result. The dirt is transported directly across the cascades into the canalisation. Preliminary purified water flows across the sieve surface. (mesh size 0,65 mm). Due to the special textile structure and the steep position of the sieve the dirt is transported into the canalisation. This means less maintenance effort. The purified water flows into the cistern.

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