Annual Report 2019

KOMPETENZZENTRUM WasserBerlin

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Who we are

Kompetenzzentrum Wasser Berlin (KWB) is a non-profit water research centre based in Berlin, founded in 2001. Our shareholders are Berliner Wasserbetriebe and Technologiestiftung Berlin.

According to our mission statement, our major concern is to advance scientific knowledge and to push research & development activities in the water sector. To this end, we design research projects relating to all issues of the water cycle and carry them out together with our partners from academia, business enterprises and public authorities. The results contribute to keeping cities liveable also in the future. Our network activities link water professionals on the national and international level. Our PR communicates up-to-date information regarding all kinds of water topics to the interested public.

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as of 31 December 2019

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TECHNOLOGIE STIFTUNG BERLIN

Jörg Simon

Nicolas Zimmer

Climate change, demographic development and ageing infrastructures are huge challenges for cities worldwide, particularly when it comes to ensuring a reliable provision of public services for the inhabitants. It is obvious that the complex tasks cannot be managed without the benefits of digital transformation. This needs also to be considered for issues of advanced water management.

The Kompetenzzentrum Wasser Berlin (KWB) and its dedicated team are well versed in almost all important issues of urban water management. Its research projects produce solutions which are of particular relevance for future-proof water management in terms of energy efficiency, climate resilience, asset management, water pollution control and resource efficiency. To tackle these complicated and many-faceted tasks, the KWB scientists develop digital applications such as machine learning to analyse sewer deterioration or virtual reality to visualise processes in the groundwater, the latter being essential for Berlin's drinking water production.

The highly practical results of KWB's research projects, such as the early warning system for river bathing sites, demonstrate the benefits of smart city approaches for water management issues. It is therefore no coincidence that the KWB is a very in-demand partner in research consortia, particularly on an international level.

We, the Berliner Wasserbetriebe and the Technologiestiftung Berlin, are enthused and impressed by the enormous professional expertise that the Kompetenzzentrum Wasser Berlin has acquired in the course of its numerous research projects. We are pleased that this knowledge is in great demand in Berlin and can be used right on the spot.

We wish to thank the team of the Kompetenzzentrum Wasser Berlin for their extraordinary commitment.

Jörg Simon
Chairman of the Board Berliner Wasserbetriebe/ Board Member Berlinwasser Holding GmbH

Nicolas Zimmer
CEO Technologiestiftung Berlin

The year 2019 in numbers

33 employees

35 interns and student assistants

38 projects with an overall volume of 8,6 million euro

annual tranche 2019
2,8 million euro

86,000 euro
euro external funding per employee

Networking and Communication

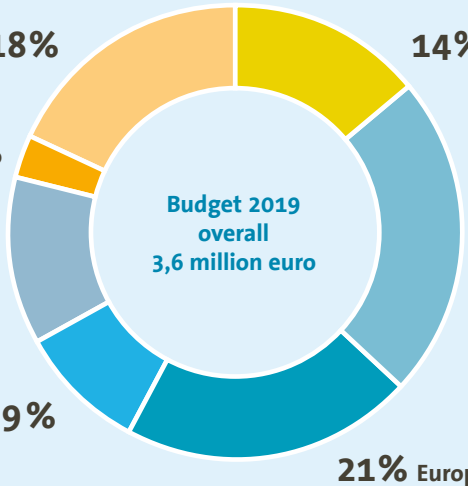
43 contributions to technical journals, conferences and monographs

7 technical conferences with 800 attendants

Participation in **10** scientific committees and professional association

Berlin Long Night of the Sciences with more than **1,000** visitors

Sources of funds



Institutional Funding **18%** Land Berlin

14% Contracts/internal funds

Contributions Shareholders **3%**

Project Sponsoring Berliner Wasserbetriebe **12%**

23% German Federal Funds (BMBF, BMWi, BMU, UBA,DBU)

Berlin Programme for Sustainable Development (BENE) **9%**

21% European Union (Horizon 2020, Interreg, Life)

as of 31 December 2019

Regina Gnirß

Edith Roßbach

The weather events of the past year again demonstrated that climate change is in full swing. Even if we do our utmost to keep the greenhouse gas emissions within the internationally agreed limits, we have to cope with the climate phenomena now being experienced. The climate change won't stop suddenly.

We all know that the man-made climate change has a very direct and immediate impact on water management. For years, we have addressed the resulting challenges, since it is our first concern that cities remain liveable in the future. Our Annual Report provides you with an overview of the activities we are performing to achieve this goal.

The water sector's main mission is to secure public services, but we are convinced that in addition it can also make a contribution to slowing down climate change. Wastewater is the last item in a long processing chain of urban life, but still contains usable resources and energy. The research projects relating to these fields can be recognised in this report by the corresponding icons for "Energy Efficiency" and "Resource Efficiency".

Of course, water protection must always be the top priority of urban water management. Our projects relating to the technical optimisation of wastewater treatment are marked with the corresponding icon.

The water infrastructure of our cities is not yet prepared for the upcoming extreme weather events due to climate change. In addition, it also needs considerable renovation. Projects featuring the icons "Climate Resilience" and "Infrastructure" are dedicated to the development of practical solutions to these issues.

Digitisation is an important tool for the implementation of all smart city approaches. As it can be recognised by the corresponding icon, most of our projects use digital tools: forecast models, process data analysis, measurement data acquisition and transmission. The digital-water.city project systematically examines approaches to support water management processes by digital tools.

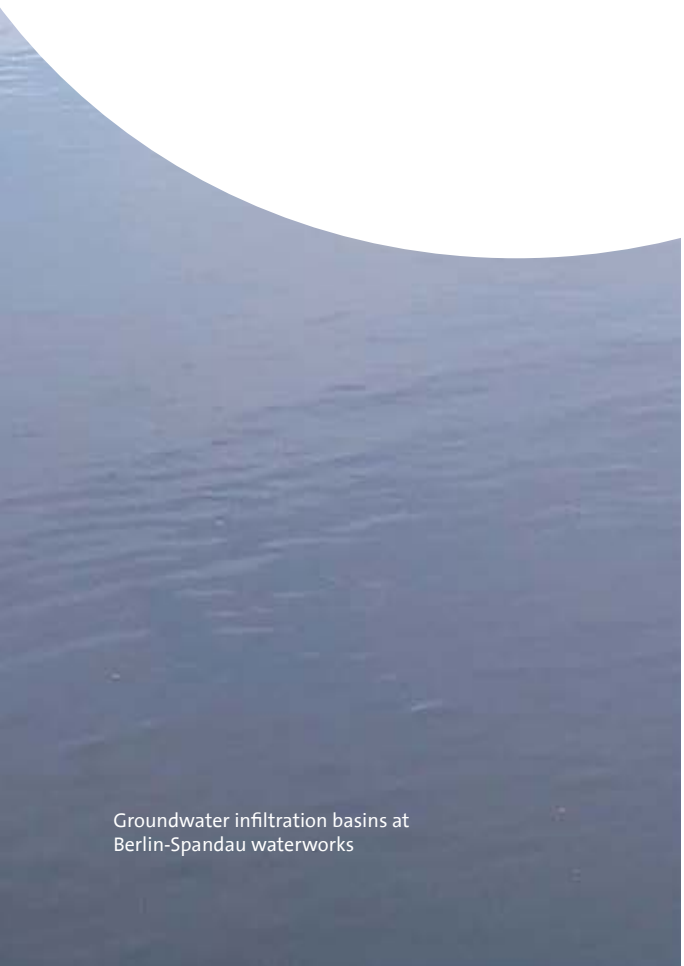
We are glad to have the opportunity of thanking all our national and international project partners, in particular our shareholders Berliner Wasserbetriebe and the Berlin Technologie Stiftung for their support, and finally the funding bodies and the Berlin municipalities for providing institutional funding.

Particular thanks must go to the employees of Kompetenzzentrum Wasser Berlin. Thank you very much for your creativity, motivation and commitment! This underpins our success.

Edith Roßbach, Regina Gnirß
Managing Directors
Kompetenzzentrum Wasser Berlin

What can be done if the groundwater level drops?

The summer of 2019 was the third hottest and third driest since records began in 1881. These consequences of climate change also have an impact on natural groundwater reserves. KWB is investigating ways to cope with this challenge.



Groundwater infiltration basins at Berlin-Spandau waterworks

The deep layers in which Berlin's groundwater deposits were generated are more than 10,000 years old. All the drinking water that gushes from taps and drinking fountains in Berlin comes from these deposits. Around 60 percent of the groundwater consists of bank filtrate, which is obtained from surface water of the rivers Spree and Havel as well as the connected lakes. Around 650 drinking water abstraction wells, 30 to 140 metres deep and surrounded by water protection areas, slowly draw the water from the rivers and lakes into the groundwater. On its months long journey through the deep soil layers (underground passage) the water is cleaned from bacteria, organic material or even drug residues by sand and microogranisms. So bank filtration works without chemical additives. The wells pump the groundwater to the city's nine waterworks, where it is processed to drinking water.

Another 30 percent of Berlin's groundwater is constantly being replenished naturally through the infiltration of precipitation and surface water. If the quantities generated this way are not sufficient to meet the demand, the groundwater is recharged with pre-treated surface water. That is the remaining ten precent. Thus, in total, 70 percent of our drinking water comes from rivers and lakes. But don't worry: In terms of quality and taste it reaches top values.

Well examination at Berlin-Spandau waterworks

Delving into groundwater

Hotter, drier summers lead to reduced natural groundwater recharge. "If the demand for water remains constant or is increasing, we have to replenish and pump more groundwater ", explains Hella Schwarzmüller, head of the Groundwater Unit at KWB. However, the groundwater could be affected by contaminated sites such as former industrial sites or by salty water rising from deep layers of rock. This is why regular monitoring of the groundwater quality is so important. "We use monitoring systems to control the groundwater level and the groundwater temperature, and in individual cases also the proportion of dissolved salts or the redox potential of the water," says Hella Schwarzmüller. Redox potential refers to the ability to absorb or release electrons. It is considered one of the most important quality characteristics. "From the temperature curves of surface water and bank filtrate we can calculate the residence time of the water in the underground passage and estimate whether pathogens for example are efficiently retained." The measured data on the groundwater level are in turn used to set up numerical flow models which simulate, for example, flow directions and velocities in the porous rocks (aquifers). "In the EU Horizon 2020 project digital-water.city (DWC) we want to combine such numerical modelling with Augmented and Virtual Reality techniques in order to be able to delve into groundwater, so to speak," says Hella Schwarzmüller.

Replenishment rather in winter

In the research project HYDRA (Hydraulics in Berlin's artificial groundwater recharge under changing climatic conditions), KWB is investigating potential impacts of climate change on artificial groundwater recharge. Rising temperatures also influence the physical properties of water, especially its viscosity: "As a result, the residence time of water in

„We use monitoring systems to control the groundwater level“

the underground passage in summer is shorter and thus fewer bacteria may be retained," explains Hella Schwarzmüller. "At the same time, more biological processes and algae growth may take place in the recharge basins, which can clog the sandy layer at the basin bottom." At the Berlin-Spandau waterworks, where the groundwater is recharged with treated surface water, the higher temperatures had far less influence on the quality of the water than the KWB scientists had expected. "However, treatment efforts increase if the properties of the surface water change, for instance due to higher temperature." The researchers therefore suggest that groundwater recharge should be carried out rather in the winter months when sufficient surface water is available and the overall water demand is lower. Moreover, the HYDRA project has demonstrated that additional groundwater recharge provides for sufficient drinking water even in a worst-case scenario: In other words, even if we face 30 percent less natural groundwater recharge due to climate change impacts, increasing water demand and less water flows into the Spree and Havel rivers.

Microbiological risk assessment

To compensate for seasonal fluctuations in water availability, it is common practice in many places to store excess water in the geological subsoil in addition to artificial groundwater recharge and to recover it when the demand is high. This sustainable resource management is called "Managed Aquifer Recharge" (MAR). In the international research project SMART-Control (New methods for monitoring and control of groundwater recharge processes), scientists at KWB, among others, are developing web-based monitoring and control systems to reduce risks in the MAR process - for example due to hygienically relevant bacteria or viruses in surface water. SMART-Control uses an online monitoring system that determines the number of bacteria in water in real time and assesses potential risks to health and the environment. "The groundwater level and the water temperature in the recharge basins, in observation wells and from selected drinking water abstraction wells are transmitted via the radio-based LoRaWan IoT network technology to a web platform where they are visualised," explains Hella Schwarzmüller. The task of KWB is to develop a microbiological risk assessment and to quantify the removal of microorganisms in groundwater recharge. In 2019, we installed the data loggers and set up the radio transmission. This year, the scientists are developing the corresponding evaluation programmes. "The tool should be up and running by the end of 2020," says Hella Schwarzmüller.

For all KWB research projects responding to the impacts of climate change for groundwater management please refer to kompetenz-wasser.de/de/forschung/

“No climate resilience without digitisation”

About digital revolution, demands on young scientists and the opportunities of large data-amounts to achieve climate resilience and energy system transformation in Berlin. A discussion on digitisation with Edith Roßbach and Regina Gnirß, the managing directors of the Kompetenzzentrum Wasser Berlin (KWB).

Ms Roßbach, Ms Gnirß - Digitisation in the water sector? Is it a hype or a revolution?

Edith Roßbach: It’s rather a revolution. Digitisation creates completely new possibilities for us to work on complex contexts. In research, we started doing this long before digitisation was hype elsewhere.

What do you consider to be the most significant achievements?

Regina Gnirß: Berlin gets its drinking water from groundwater. Using digital sensors and mathematical models, we can now predict how the quality of groundwater will change. This has decisively improved sampling and analysis processes. In the EU-Call "ICT4Water" KWB was approved for funding with its project proposal as one of only four projects and now provides solutions for standardisation and interoperability of digitisation in the "Water Action Plan" of the European Union.

What are the concrete benefits of digitisation?

Regina Gnirß: The simulations run on powerful networks and, by means of digital measuring instruments, enable us to make increasingly precise predictions. In the past, if we wanted to know something about the spread of substances in groundwater, we had to add a dye to the water at one point and measure it again and again until the substance arrived at the particular well and we could determine the flow times. Today we can provide reliable forecasts almost by pushing a button.

What is the benefit - beyond research interest?

Edith Roßbach: Today, water bodies are subject to very strong competition for use. Water is not only the most important foodstuff. It is also used in private households, serves for agricultural and industrial purposes and for recreational activities. Of course it is expected that the drinking water is of excellent quality. But people also want to be sure that their bathing waters in Berlin doesn’t turn into a health risk. In the analogue world, bathing waters were sampled and microbiologically tested. With our digital water models linked with the weather forecast, we can now determine the sanitary water quality for Berlin several days in advance and publish these values daily on the website "badegewaesser-berlin.de". We are now using the microbiological tests above all to constantly improve the reliability of our forecasts.

Edith Roßbach during press conference on launch of EU-funded project „Digial-Water.City“

„In terms of managing scarce water resources, we can contribute the knowledge we have gained during the international projects we performed in Italian and Spanish cities. “

How have the tasks of water management changed?

Edith Roßbach: The tasks are becoming more complex: We want to protect water as a valuable resource in the long term, but we pollute it in many ways during its use, as shown by the occurrence of trace substances, abrasion particles from road traffic, nicotine and much more in water. We consume large amounts of energy during the cleaning process, and it costs a lot of money to maintain the infrastructure. Climate change confronts the water industry with the problem of managing rainwater in such a way that sufficient water is available in dry seasons and the city is not flooded during heavy rainfall. On the basis of large amounts of data, digital tools and models can identify and provide patterns and predictions which help to cope with these tasks.

What is the technical driving force behind digitisation?

Regina Gnirß: Particularly in terms of the sanitary assessment of water bodies, the potential of digitisation is growing in parallel to the technical development of measuring instruments. In addition to conventional parameters such as water temperature, oxygen content or redox potential, these instruments yield the concentrations of indicator bacteria using fluorescence sensors. At sewage treatment plants numerous online measuring devices monitor the cleaning processes, but they are polluted by wastewater, too. By means of artificial intelligence the necessary specific cleaning intervals for each device are indicated. This contributes significantly to saving operating costs.

Edith Roßbach: Digitisation means relating complex data sets to one another and analysing them with intelligent algorithms.

Regina Gnirß: Let’s take the inspection of pipelines as an example. Camera robots provide us with hundreds of hours of film-footage about television inspections of Berlin's sewers. This camera inspection data are linked with other infrastructure data and evaluated with the aid of artificial intelligence to develop scenarios for the strategic rehabilitation of sewers. This assistance scheme selects the suitable rehabilitation proposals from the very complex data basis. By this way the "predictive maintanance" of infrastructure systems becomes possible.

What challenges in water management can be tackled through digitisation?

Edith Roßbach: Digitisation is indispensable for building climate resilience. We need to be prepared both for increased droughts and increased heavy rainfall rates in urban areas. We can cope with this new situation by smart digital systems only. This applies to the field of digital water management in the narrower sense, but also to applications that do not appear to be digitisation topics at first glance. For example, it has been recommended to plant more trees in Berlin. These trees keep the city cool during longer periods of heat. But to water these trees, you also have to keep water resources available and distribute them well-considered. Smart control systems ensure that the water gets to where it is needed; other tools transfer the information where it is needed, sometimes even at the level of individual trees. In terms of managing scarce water resources, we can contribute the knowledge we have gained during the international projects we performed in Italian and Spanish cities.

Regina Gnirß: In the KURAS project we have made the planning processes necessary for integrated rainwater management transparent for stakeholders. We are now developing this work further through model calculations of rainwater runoff in neighbourhoods and, together with the Berlin Rainwater Agency, we are putting new scenarios for better climate resilience up for discussion. The next issue is the energy transition, which means the coupling of water and energy management. Our waste-

Regina Gnirß during press conference on launch of EU-funded project „Digial-Water.City“

Edith Roßbach, Head of Finance and Administration of the Technologiestiftung Berlin, and Regina Gnirß, Head of the Research Department of Berliner Wasserbetriebe, have jointly managed the Kompetenzentrum Wasser Berlin as directors in recent years.

Both have put their focus on Smart city and digitisation topics und thus extended KWB's research portfolio, which has so far been characterised by conventional urban water management. This strategy has opened up completely new perspectives for tackling challenges cities will be facing in the future. An important example of this new direction is the international joint project "digital-water.city". After a Europe-wide call for proposals KWB has been selected to receive funding from the European Union's Horizon2020 programme (see also page 37) and will be managing the project for three years.

water treatment plants have a huge potential to store energy and also to adapt their energy requirements to the fluctuating supply of renewable energies. This is only possible through smart control, in other words through load management. Also this group of topics is addressed by KWB.

In your opinion, what are the biggest challenges of digitisation?

Edith Roßbach: On the one hand the models require a certain openness of data, on the other hand systems become more vulnerable to attacks the more open they are. And it is obvious that water supply must be safe for people. We must therefore bring together the world of open data and the security interests of critical infrastructures.
Another challenge of concern is how to take advantage of the options of digital applications and to make them available for our issues and, as a consequence, to give new impetus to research projects. This will depend to a great extent on individual initiatives and on further systematisation. If we could find the right way to push things forward and to transfer this development to other areas, it would be an important contribution to organise digital transformation.

What does digitisation mean for today's students and young scientists?

Regina Gnirß: Nowadays, data mining, programming and the use of innovative data evaluation tools are part of every degree course or, at the latest, in research. At KWB, we benefit greatly from the clusters of excellence in the Berlin-Brandenburg metropolitan region.

Digitisation - is this something that a water utility or research institution can do on its own?

Regina Gnirß: There are already strong networks within the water sector, and digitisation even contributes to their consolidation. Challenges like data security and data rights, but also computer-based modelling, are global. Due to the activities of the Kompetenzzentrum Wasser, the Berlin region is well connected with European research associations and international professional associations.

Edith Roßbach: Networking and bringing together large amounts of data is what digitisation is all about and what a single entity can no longer manage on its own. The digital-water.city project, in which digital technologies are tested specifically to solve water management problems, brings together five major European cities. Such cooperations facilitate the pooling and efficient use of knowledge. Due to its many years of experience, KWB is familiar with the management of large networks and ensures that all partners benefit from the joint project work.

We would like to have you look into your crystal ball: What will digital water management look like in Berlin in 2040?

Edith Roßbach: Digitisation is a prerequisite for sustainable water management, which we hope to achieve in Berlin in 2040. Data on the quality of both underground and river water will be cross-linked with data from sewage treatment plants and discharges. Berlin will then be able to return the withdrawn and used water to the water cycle in clean condition and in equal quantities.

Regina Gnirß: In terms of future water management, Berlin is well positioned. KWB did a good job in the last years, so we already know a lot about the water courses in and below the city. In order to achieve a future-proof water management having positive effects on economic, ecological and social conditions, digitisation is an indispensable prerequisite.


DIN EN124 D400
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Algorithms bring light into the dark

Berlin's sewerage system extends over more than 9,700 kilometres. Most of it is not accessible. Artificial intelligence is being deployed in order to assess its condition more precisely and develop efficient rehabilitation strategies.

Curious people stand in line when the Berliner Wasserbetriebe (BWB) opens the gates to the underworld on "Open Canal Day". Up to 2,000 people then walk under the pavement of Schöneberg through a tunnel that was built between 1901 and 1905. In the 4.20 metre wide and 2.40 metre high brick tunnel, memories of the wild chase in the classic film "The Third Man" come to mind. However, the event may be rained off quickly: When it rains too much, the underground structures fill up - and the curious people have to stay on top.

As well-known as the tunnel under Schöneberg may be: In most of Berlin's sewer system, such insights are generally impossible, even during dry periods. This applies even to employees of Berliner Wasserbetriebe - and makes their work a great challenge: About 95 percent of the sewer system has a diameter of less than one meter and is therefore not accessible..

Pipes all the way to Tokyo

And yet it is urgently necessary to keep an eye on the sewer pipes. Their structural condition deteriorates over time, i.e. the pipes crack, corrode or bend. The Berlin sewer network has a total length of more than 9,700 kilometres, which is roughly equivalent to the distance between Berlin and Tokyo. "Maintaining this gigantic infrastructure for wastewater collection and transport is expensive and requires considerable investment", says Nicolas Caradot, project manager at the Berlin Centre of Competence for Water (KWB). "In Germany alone, cities and municipalities have to bear annual costs of several

CCTV inspection of a sewer pipe

Berlin's sewerage system extends over more than

9,700

kilometres

hundred million euros for maintenance and renewal." It is important to regularly assess the condition of the sewer system: "Only by knowing when and where damage occurs can we avoid failures and maintain the quality of service," says Nicolas Caradot. So far, small robots, equipped with a camera and spotlight, have been used to drive through the previously cleaned sewer sections. "The camera images are then viewed on the computer screen by an employee and translated into a series of text codes," explains Nicolas Caradot. "For example, certain sequences of numbers and letters precisely describe the length, width and position of a crack." An immediate repair or renewal is not always necessary. However, the data records are stored so that BWB staff can keep an overview on the condition of the network.

Leaving the boundaries of conventional inspections

But with this approach, municipalities are reaching their limits. On the one hand, camera inspection is time-consuming, it cannot be carried out everywhere and at all times for reasons of cost. On the other hand, it only provides a snapshot of the pipe condition at the time of inspection, but no information on future developments. It would take years to repeatedly monitor the sewer condition of an entire city. Therefore it is difficult to develop long-term strategies for maintaining the condition of the infrastructure. To close this gap, so-called deterioration models have been developed. They are based on the results of already inspected pipes and make it possible to forecast their future condition as well as the condition of sewer pipes which have not been inspected yet. The models correlate the sewers characteristics such as the age or material with the pipes condition so that a prediction becomes possible. The models can be applied to forecast the evolution of the condition of the sewer network as a whole or of specific groups of sewer with similar characteristics; model outputs can then be used to develop long-term rehabilitation and investment strategies. Models can also be applied to predict the condition of each individual sewer pipes; in this case, model results are useful for the scheduling of inspection programmes and targeting of pipes in poor condition.

KWB puts the models to the test

Deterioration models need to be as accurate as possible so that utilities and municipalities trust their predictions and use them to plan efficient inspection, rehabilitation and investment strategies. Prediction quality is exactly the topic KWB is addressing: "In various cities, we have checked the quality of prediction of the available deterioration models, also depending on the quality and availability of inspection data." The work has focused mainly on a statistical model and a machine learning model (Artificial Intelligence), called "Random Forest".

The models were fed with inspection data from the cities of Brunswick and Berlin. "We used all kind of data that could provide information about the condition of the sewers: for example, the material of a pipe,

Team of Berliner Wasserbetriebe during routine cleaning of a sewer pipe

its diameter and how old it is," says Nicolas Caradot. “Also, the issue of open data is particularly important in this context: by using publicly available urban data such as soil type, traffic density or the presence of trees, the accuracy of the predictions could be significantly improved."

The results of this work are impressive. “The models are able to simulate the condition of the entire network with an excellent accuracy close to 100 percent. It is also interesting that machine learning algorithms perform better than statistical models to predict the condition of individual sewers”, says Caradot, who did his PhD thesis in the project. “With Random Forest, we can correctly identify sewers in critical conditions by almost 70 percent. Algorithms are not perfect and will never be able to outperform camera inspection”, says Caradot. "But with new data we can train and continuously improve the performance of artificial intelligence." The more data are fed into the simulation, the more accurate it becomes. Simulation results can be verified by subsequent inspection of the infrastructure, and the algorithms can then be recalibrated accordingly.

Looking to the future

Using existing data from more than 170,000 sewer pipes in Berlin, researchers at KWB and BWB have developed a prediction tool for the management of the Berlin infrastructure: SEMA-Berlin. "In the first project phase of SEMA-Berlin, we tested various statistical and AI-based model approaches for the prediction of sewer deterioration," says Nicolas Caradot. "Two of the models tested have proven to be particularly reliable and are now being put into practice." One model focuses on where inspections should be carried out because there is an acute need for major rehabilitation. The other serves the strategic planning of investments over a period of up to 60 years in order to maintain or improve the condition of the infrastructure in the long term.

"With these new tools, we can determine the current condition of the network more precisely and save money," emphasises Caradot. "They also give us a more accurate perspective of what to expect in the future." Where and when a pipe needs urgently to be rehabilitated and investments need to be made: The sewer utility can now carry out predictive maintenance and efficiently renew the infrastructure - and thus keep investments and expenses low. These tools can be applied not only in Berlin, but worldwide for wastewater infrastructure, even in cities where the sewer utility has less available data. This is one of the reasons why the SEMA-Berlin project was awarded in 2019 the Innovation Prize of the Association of Municipal Utilities (VKU), which is assigned every two years for "outstanding innovations by municipal utilities".

The development of these tools is set in a broader context: In June 2019, the European innovation project digital-water.city (DWC) was launched. Under the leadership of KWB, 24 partners from ten European countries will investigate until 2022 the potential of new digital solutions for water management. In Berlin, machine learning approaches already developed for sewer networks will be transferred to support the predictive maintenance of drinking water wells.

Research for a Liveable City

Our research activities contribute to improving the quality of life in our cities.

The research unit „Urban Systems“ addresses all issues relating to rainwater and wastewater as well as to sewer network operation.

The research unit „Process Innovation“ focuses on technical challenges in terms of water and wastewater treatment.

The research unit “Groundwater” deals with issues connected to drinking water production and well management.

Our projects are strongly based on topics of the future which are essential for the development of smart city concepts and consequently contribute to integrating water as a medium of public interest in Smart City approaches.

ENERGY EFFICIENCY

Processes for water supply and particularly for wastewater treatment require a lot of energy. We are looking for technical solutions which contribute to reducing energy requirement and consequently the emission of greenhouse gases.

CLIMATE RESILIENCE

Heat waves, droughts and floods are impacts of climate change which will affect urban life. Urban water infrastructure systems have to be adapted to these changes. We work on the appropriate concepts.

INFRASTRUCTURE

Being the basic components of water management structures, wells, sewers, wastewater treatment plants, rain basins are essential for the proper operation of water supply, wastewater treatment and water protection. With our research we support the responsible operators in coping with their tasks.

WATER PROTECTION

According to § 1 of the German Federal Water Act, waters shall be protected as part of the natural environment, as the basis of human life, as a habitat for animals and plants, and as a usable good. With our research we support operators of water management systems in the implementation of these stipulations.

RESOURCES

The areas of water, agriculture and conventional energy production are inseparably linked. We are working on solutions closing the loop between the energy and water cycles.

DIGITISATION

Digitisation has covered almost all areas of our private and economic life. In many of our projects, we use and develop digital systems: process control and optimisation; collection, evaluation and interpretation of measurement data; model development for the prediction of water quality; tools for predicting sewer ageing. Since mid-2019, we have been intensifying these activities as part of the EU project "digital-water.city", which is managed by KWB.

Demonstrating synergies in combined natural and engineered processes for water treatment systems

AquaNES – Demonstrating synergies in combined natural and engineered processes for water treatment systems

aquanes-h2020.eu

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Duration	06/2016-05/2019
Project Volume	10,7 million euro KWB: 595,000 euro
Financing	EU Horizon2020 (Grant Agreement No. 689450)

Partners
Kompetenzzentrum Wasser Berlin gGmbH (KWB) in a consortium of 30 partners from Europe, Israel and India, coordinated by the University of Applied Sciences and Arts Northwestern Switzerland

Horizon 2020
European Union Funding
for Research & Innovation

Processes for water and wastewater treatment systems can be substantially improved through the systematic combination of engineered and natural components. The EU-funded project AquaNES operates 13 pilot plants in Europe, Israel and India to demonstrate the benefits of these combinations on a technical scale. Two demonstration sites are located in Berlin. One scheme combines ozonation processes with natural post-treatment constructed wetlands for elimination of trace organic compounds and pathogens in wastewater effluent (also in comparison to technical filters). At the second site, the combination of bank filtration and capillary nanofiltration (NF) is demonstrated for removal of sulphate and trace organic compounds during drinking water production. Besides its activities in Berlin, KWB coordinates a work package related to constructed wetlands with test sites in Germany, the UK and Greece. In addition, KWB is responsible for the development of an interactive web tool for microbial risk assessment (QMRA).

OBJECTIVES

- Technical demonstration of combined natural and engineered processes (cNES - combined natural and engineered systems) for water and wastewater treatment
- Improved elimination of micropollutants and pathogens in WWTP effluent (WWTP Schönerlinde)
- Removal of sulfate and micropollutants during drinking water production (WWTP Tiefwerder)
- Development of design guidance for cNES and identification of new market opportunities

RESULTS

- The pilot plant at WWTP Tiefwerder featuring capillary nanofiltration for the treatement of oxygen-free bank filtrate has achieved good removal efficiencies of sulphate, EDTA and other trace organic compounds even after long periods of operation. For the necessary cleaning of the membrane suitable chemicals were tested and consumption and frequency optimised.
- The combination of ozonation and constructed wetlands is suitable to remove organic and microbial contamination from WWTP effluent. It was successfully demonstrated that transformation products generated during ozonation, such as NDMA and aldehydes, are retained by the constructed wetlands.
- In cooperation with the Dutch research institute KWR, an online tool for the assessment of hygienic risks (QMRA) in water reuse was completed and presented to interested users at the "12th IWA International Conference on Water Reclamation and Reuse".
- AquaNES was completed on schedule in mid-2019. The results were presented during the "Blue Planet Berlin Water Dialogues". Lectures, workshops and an accompanying exhibition convinced the expert audience of the highly practice-oriented solutions developed in the project.

AquaNes team visits construction area of modified retention soil filters at Erft-Verband.

Development of decision aids to reduce the entry of pharmaceutical residues into the Baltic Sea

OBJECTIVES

- Monitoring to identify relevant entry paths of APIs and evaluation of technical and non-technical measures to minimise the entry of APIs into the Baltic Sea.
- Evaluation of pilot- and full-scale ozonation plants and post-treatment options in Kalundborg (DK), Linköping (SE), and Berlin (D) including ecotoxicity tests, impact on APIs/transformation products as well as process control options.
- Provide a guideline for operators, municipalities, and water authorities on how to plan, start, operate and control advanced wastewater systems.

RESULTS

- In Finland, Sweden and Estonia model calculations for the determination of API loads in the WWTP inflow yielded the best match to actually measured values. In Germany only 20% of the trace organic compounds examined showed a corresponding match. This is due to the fact that the consumption figures are subject to great uncertainties and the different EU countries do not use the same database.
- Several measurement campaigns demonstrated that the installation of an additional ozone level leads to an effective reduction of detectable ecotoxicological impacts (e.g. estrogen effects) in WWTP effluents. Mutagenic effects occasionally caused by ozonation (measured by AMES test) in the WWTP effluent can either be reduced or completely removed by a tertiary treatment step.

Emissions of active pharmaceutical ingredients (API) into the aquatic environment and the Baltic Sea are a topic of growing interest. Within CWPharma, decision-making tools will be developed and recommendations given to support politics, administrations, and municipalities tackling this issue systematically. Besides an intensive monitoring to identify relevant APIs and their entry paths, technical and non-technical measures will be evaluated in order to reduce the overall API emissions. Within the project, KWB leads the work package regarding technical measures, which has a special focus on the advanced wastewater treatment with ozone.

CW Pharma – Clear water from pharmaceuticals – reducing pharmaceutical emissions into the Baltic Sea region

cwpharma.fi

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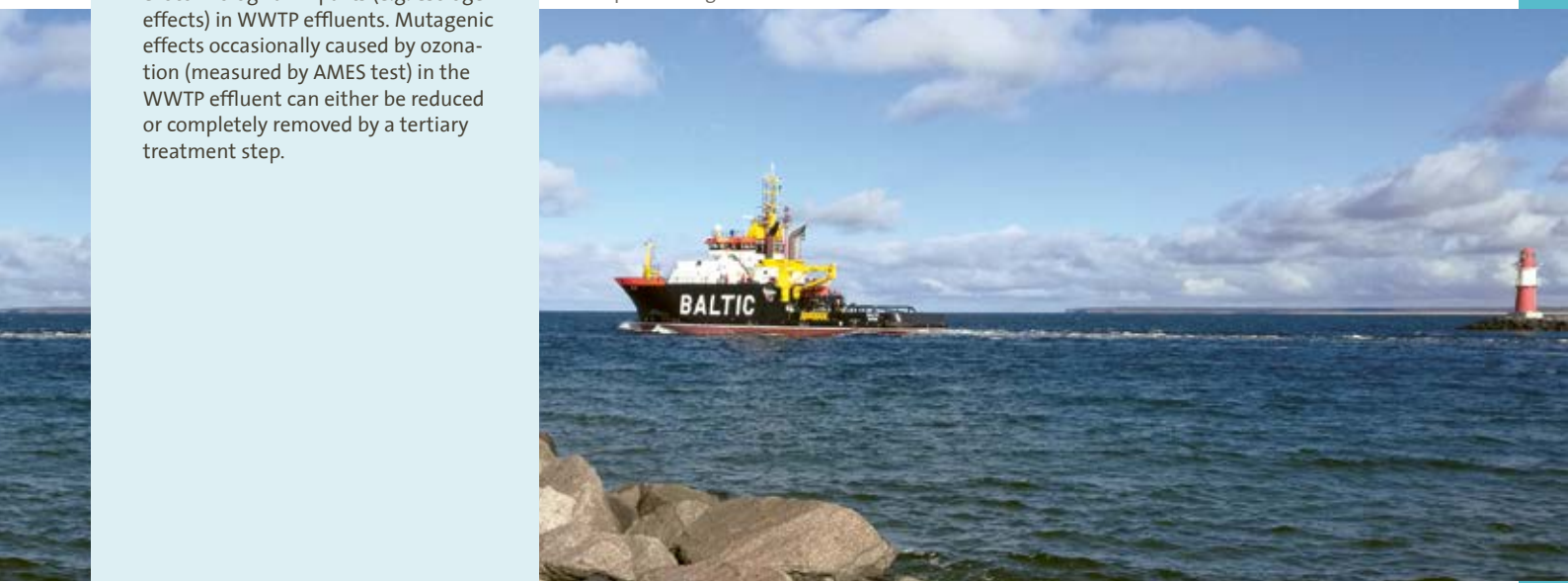
Duration	10/2017-09/2020
Project Volume	3,7 million euro WB: 321,100 euro
Financing	EU-INTERREG (Baltic Sea Region, #R055 CWPharma), Berliner Wasserbetriebe

Partners
Kompetenzzentrum Wasser Berlin in a consortium of 15 partners and 18 associated organisations from seven Baltic Sea states.

Sample drawing in Baltic Sea catchment



MeReZon

Reliable online-measurements and process control schemes for ozonation plants

MeReZon – Optimised process control for advanced wastewater treatment with ozone

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Duration 08/2017-12/2019
Project Volume 217,000 euro
Financing German Federal Ministry of Education and Research (BMBF), Programme KMU Innovativ

Partners
TriOS Mess- und Datentechnik GmbH (coordination); KWB; Berliner Wasserbetriebe (associated partner)

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Federal Ministry of Education and Research

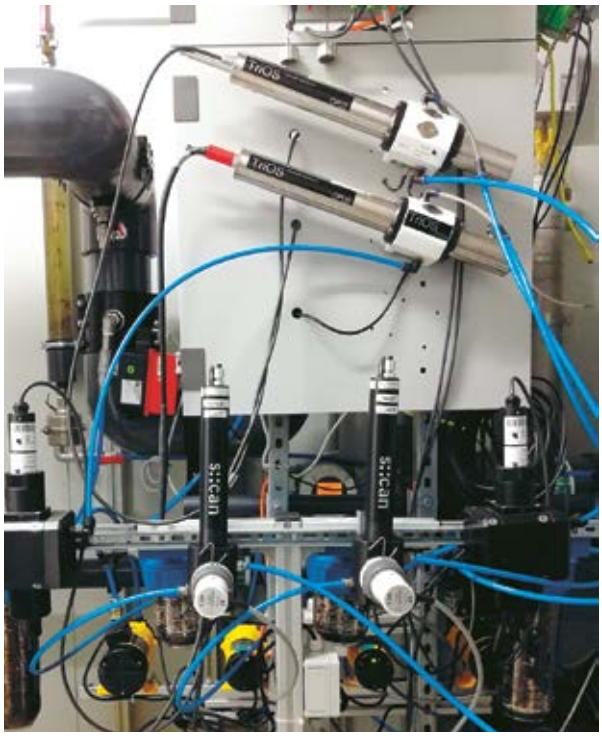
Elimination of pharmaceuticals by advanced wastewater treatment with ozone is expected to become more common in the near future. Thus, mature process control options are required to adapt the ozone dose to a varying ozone demand by a change of the water matrix in order to avoid too low or too high ozone doses. However, practical experiences with closed-loop process control options, e.g. working with reduction of UV254, are currently limited. In addition, maintaining a robust and reliable online-measurement is a key element for operators of ozonation plants.

OBJECTIVES

- Investigation of the reliability of different photometric online measurements (e.g. UV254, UV-VIS-spectra) at an ozonation pilot.
- Development of an innovative process control scheme for a robust and optimal ozone dosing.

RESULTS

- The optimised process control scheme for an adequate ozone dosing was successfully tested under real conditions.
- It could be shown that fluorescence online-measurement (fDOM) is also suitable for process control and monitoring of an ozonation plant.
- Compared to UVA254, abatement of fDOM reacts more sensitive to a changing ozone dose and was less impacted by fouling if operated in an alternating modus using only one online sensor.



Online sensor installation in a pilot ozone system at WWTP Schönerlinde

Fouling of online sensor during operation

Nutrient recovery in the European agriculture and food sector

In the EU project Circular Agronomics, processes in circular economy are developed and optimised in order to improve their efficiency. The project focuses on food and agricultural waste and wastewaters. Valuable substances such as phosphorus, nitrogen and carbon are recovered and thus, made available for a demand driven application in agriculture. Simultaneously, new processes are investigated in order to slash emissions of greenhouse gases and ammonia. Those investigations are conducted at six study sites in Spain, Germany, Austria, Italy, the Netherlands and Czech Republic. In this frame, the Berlin Kompetenzzentrum Wasser Berlin (KWB) leads the work package "carbon and nutrient valorization from food-waste and food-processing-wastewater".

OBJECTIVES

- Review of the "best available techniques"
- Elaboration of new concepts for carbon and nutrient valorisation
- Investigations in a vacuum degasification pilot plant for ammonia recovery and the production of ammonium sulphate (typical mineral nitrogen fertiliser)
- Evaluation of nutrient valorisation using life cycle assessment
- Dissemination and exploitation of the results, e. g. by simulation games with different actors
- Elaboration of concept studies for interested biogas plant operators

RESULTS

- Laboratory experiments to investigate the vacuum degassing process in agricultural fermentation residues have shown that up to 90% of the ammonium can be recovered under favorable process conditions.
- Pilot plant for vacuum degasification and production of ammonium sulphate was constructed.
- A first rough analysis of literature data suggests that wastewater from the sugar industry, animal feed processing, meat processing and dairies are suitable for nitrogen recovery. However, anaerobic treatment should be inserted to increase the ammonium content of the total nitrogen, which would also provide added value with regard to the biogas yield.
- Policy working group was founded and had its first meeting.

Circular Agronomics – Efficient carbon, nitrogen and phosphorus cycling in the European agri-food system

circularagronomics.eu

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Duration 9/2018-8/2022
Project Volume 7,0 million euro
KWB: 598,440 euro
Financing EU Horizon 2020
(Grant Agreement
No. 773649)

Partners
IRTA Institut de recerca i technologia agroalimentaries (coordination), Pondus Verfahrenstechnik GmbH, Institute of Agricultural and Urban Ecological Projects affiliated to Berlin Humboldt University (IASP), Kompetenzzentrum Wasser Berlin (KWB), Wageningen University, Teagasc – Agriculture & Food Development Authority, Rural Investment Support for Europe Foundation, and 11 further partners & 27 associated partners

Horizon 2020
European Union Funding
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Pilot plant for vacuum degasification and production of ammonium sulphate

SMART-Plant

SMART-Plant – Scale-up of low-carbon footprint material recovery techniques in existing wastewater treatment plants

smart-plant.eu

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Duration 06/2016-05/2020
Project Volume 9,7 million euro
KWB: 291,000 euro
Financing EU Horizon 2020
(Grant Agreement
No. 690323)

Partners
KWB in a consortium of 26 partners from Europe and Israel, coordinated by the University of Ancona (IT)

Horizon 2020
European Union Funding
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Material recovery from wastewater

Domestic wastewater contains many valuable raw materials, which have not been tapped so far. Organic matter can be converted into biogas for energy recovery, or can act as a carbon source for bioplastic (PHA) production by specialised bacteria. Plant nutrients nitrogen and phosphorus can be recovered to substitute mineral fertiliser needs in agriculture. Cellulose fibres from toilet paper can substitute structural material in bio-composites or asphalt. The project SMART-PLANT demonstrates technical options for the recovery of valuable materials in pilot scale for the entire value chain up to marketable products.

OBJECTIVES

- Industrial-scale demonstration of technical processes to recover valuable materials from municipal wastewater such as biopolymer (PHA), cellulose, plant nutrients and fertilisers
- Demonstration of entire value chains including downstream processing of recovered materials into marketable products
- Development and evaluation of new business models for the operation of recovery processes and marketing of recycling products
- Assessment of environmental benefits and risks of value chains for recycling products

RESULTS

- The recovery of cellulosic fibres, biopolymer, and nutrients from municipal wastewater could be successfully demonstrated in pilot scale.
- The downstream processing of recovered materials to high-value products is technically feasible, but may not yet be economically viable.
- Aside from recovered products, operational benefits such as lower energy demand and disposal costs for sewage sludge are important drivers for the WWTP operator.
- Material recovery can lower the environmental footprint of a WWTP if the processes can yield operational benefits and a marketable product with reasonable input of energy and chemicals.
- New business models and incentive schemes should be developed to promote the implementation of circular economy concepts in the wastewater sector.

Field site visit of SMART-Plant project partners at phosphorous recovery plant at WWTP Waßmannsdorf, owned by Berliner Wasserbetriebe/ SMART-Plant

Water reuse, nutrient and energy recovery from wastewater

OBJECTIVES

- Development of a technology evidence base for knowledge collection and transfer for "NextGen technologies" related to water reuse, material and nutrient recovery as well as energy recovery
- Evaluation of specific technologies using life cycle assessments and risk analyses
- Optimisation of the heat management in biogas production with an additional thermal pressure hydrolysis
- Accomplishment of "Communities of Practise" in order to increase the acceptance of recyclates and to analyse the optimal fertiliser design with farmers
- Analysis of the regulatory framework for the recovery of water

RESULTS

- The concept for the technology evidence base was elaborated. This interactive database will be published in the Internet.
- A quantitative microbial risk assessment showed that an additional implementation of a "regenerated" membrane in the tertiary treatment train of the effluent from the secondary treatment can decrease the infection risk of the reuse water to a level that complies with the hygiene criteria of the WHO.
- The operation of the full-scale nutrient recovery and of the enhanced energy recovery units at the wastewater treatment plant in Brunswick, Germany was started. First results show an increase in the methane yield of 20% due to the implementation of the new thermal pressure hydrolysis in the sludge treatment train.
- Farmers, actors from authorities and the fertiliser industry as well as scientists met for the first "Community of Practice" (CoP) in Brunswick. They came to the conclusion that the recyclates produced will need further processing. The precise requirements for this post-treatment will be defined by further CoP's.

The global demand for water continues to grow – from water use in industrial processes and agriculture to increased urban demand. Therefore, the consortium of the NextGen project aims to develop innovative technological systems and circular economy concepts in the water sector.

NextGen is coordinated by the Dutch Water Cycle Research Institute KWR. It unites 30 partners out of eleven European countries from economy, small and medium-sized enterprises as well as research institutes. In eight different countries, innovative technologies are being investigated in ten case studies covering topics such as water reuse, nutrient recovery and energy production.

In Germany, a special focus is put on full-scale investigations in order to recover nutrients from wastewater and to enhance energy production from sewage sludge using anaerobic digestion in combination with a thermal-pressure hydrolysis. In this context, the Kompetenzzentrum Wasser Berlin collaborates closely with the Wastewater Association Brunswick (AVB).

Next Gen – Towards a next generation of water systems and services for the circular economy

nextgenwater.eu

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Duration	7/2018-6/2022
Project Volume	11,4 million euro KWB:527,000 euro
Financing	EU Horizon 2020, Programme "Water in the context of circular economy" (Grant Agreement No: 776541)

Partners
KWR Watercycle Research Institute (coordinator), EURECAT, FHNW University of Applied Sciences and Arts Northwestern Switzerland, Cranfield University, Strane Innovation SAS, European Science Communication Institute, Kompetenzzentrum Wasser Berlin (KWB), Wastewater Association Brunswick (AVB) and 22 other partners.

Horizon 2020
European Union Funding
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N-recovery system with two units at WWT-plant Brunswick-Steinhof: ammonia stripping unit and ammonia gas scrubber

Recycled fertilisers contribute to the protection of resources and surface waters

CLOOP – Closing the nutrient loop by development of nutrient recyclates AshDec and struvite into next-generation fertilisers

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Duration	11/2017-10/2020
Project Volume	353,359 euro
Financing	German Federal Ministry of Education and Research (BMBF)

Partners
Outotec GmbH & Co KG (coordination), German Federal Institute for Materials Research and Testing (BAM), KWB, Universität Bonn, The University of Queensland (Australia), Universidade de Sao Paulo (Brazil)

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The joint project CLOOP aims to demonstrate that mineral nutrient recyclates recovered from the wastewater path, such as phosphorus, can achieve higher agricultural yields than conventional fertilisers. This is crucial for sustainable water pollution control and for an efficient use of resources.

Against this background, the project focuses on testing a new generation of fertilisers which are actually recovered from the wastewater path and, unlike conventional fertilisers, feature high plant availability and low water solubility at the same time. These include struvite and a product recovered from sewage sludge ash by means of the AshDec process which contains calcium sodium phosphate. These recyclates are tested under a variety of climatic conditions on agricultural land in Germany, Australia and Brazil.

Within the joint project, the Kompetenzzentrum Wasser Berlin is responsible for the selection and procurement of secondary fertilisers from sewage treatment plants. Furthermore, Kompetenzzentrum Wasser Berlin also leads the work package “Evaluation and Life Cycle Assessment”.

OBJECTIVES

- Development of nutrient recyclates from wastewater path into next-generation fertilisers
- Improving the efficiency of fertiliser use in agriculture
- Evaluation of the entire process chain from recovery to fertiliser use

RESULTS

- Life Cycle Assessment has been performed for various scenarios of the AshDec process. The results show that, compared to the currently practiced direct sludge ash application on farmland, the process requires more energy but on the other hand the phosphate obtained has a higher plant availability with positive effects for agricultural practice: Phosphorus fertiliser generated this way can be used sparingly and undesired emissions from overuse into receiving waters are reduced. In addition, the AshDec process produces less toxic (heavy) metals. This process is now to be implemented in full scale in Bavaria.

Intermediate substances during manufacturing of grannulated Phosphorous recycling products from sewage sludge ash

Nutrient recyclates for organic farming

The aim of organic farming is to minimise the consumption of finite resources and to concentrate on "Circular Economy". Closing regional nutrient cycles is therefore one of the corner stones to ensure sustainable agriculture.

Nutrients recovered from bio-based materials and wastes offer the opportunity to promote the transformation towards sustainable agriculture and circular economy. So far, nutrient cycles are not sufficiently closed, be it in conventional or organic agriculture. This accounts in particular for the case of phosphorus. The only allowed mineral source to compensate phosphorus losses from organic farming systems is fossil based phosphate rock with its arguable fertilising efficiency and potential contamination with the toxic elements Cadmium and Uranium.

OBJECTIVES

- Examining to what extent phosphorus-containing products will be acceptable and can be approved for organic farming
- Introducing the scientific findings to the corresponding German and European approval bodies
- Creating the basics for amendment of the European regulations for organic farming (EC 889/2008).
- Involving farmers, trading companies and scientific institutions

RESULTS

- Acceptance criteria for the use of recyclates were determined jointly with actors from organic farming.
- The recycled product struvite fulfills these criteria to a high degree and is well accepted by actors in organic farming.
- Approval dossiers for the revision of EC 889/2008 by the legislator have been created.

nurec4org – Nutrient recyclates for organic farming

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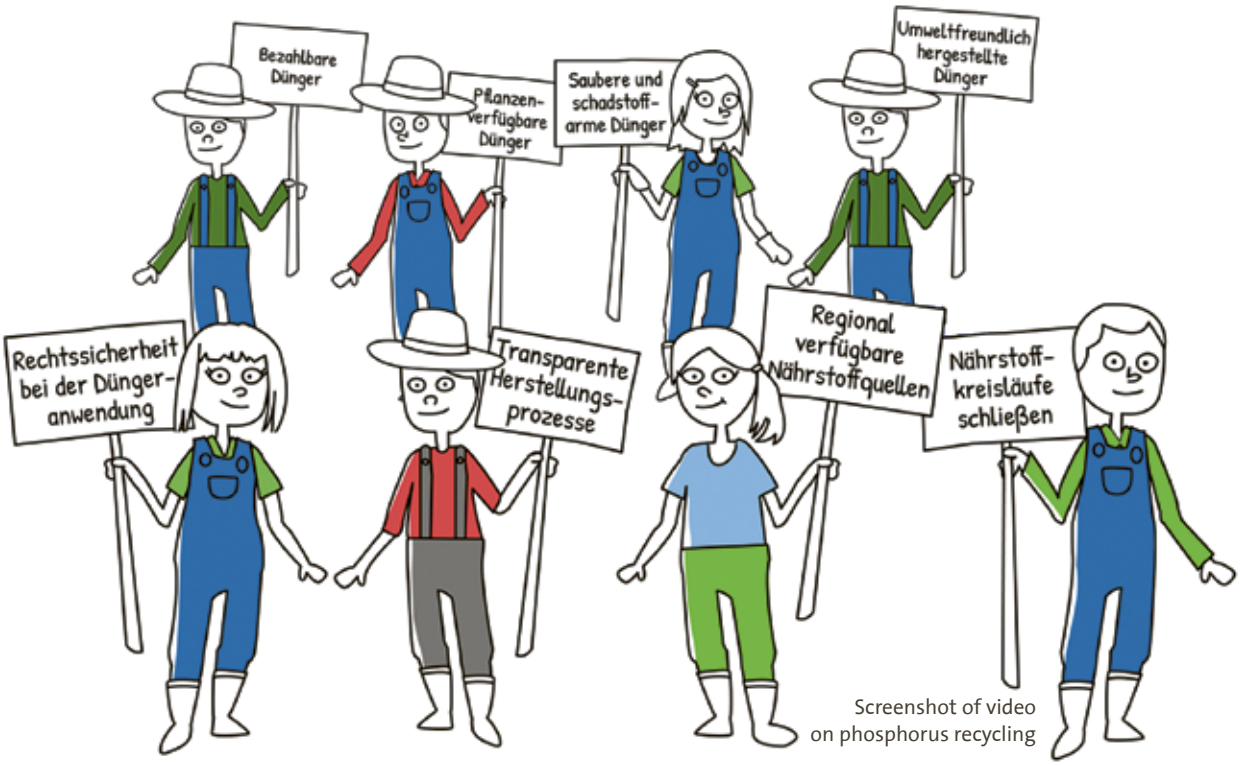
Duration 01/2017-03/2019
Project Volume 354,000 euro; KWB: 178.000 euro (Funding: 133,000 euro)
Financing German Federal Environmental Foundation (DBU)

Partners
Bioland Beratung GmbH, Institute of Agricultural and Urban Ecological Projects affiliated to Berlin Humboldt University (IASP)

sponsored by DBU Deutsche Bundesstiftung Umwelt www.dbu.de



Screenshot of video on phosphorus recycling

Lidköping Innovation Wastewater Eco-Hub (LIWE)

LIWE – Large-scale implementation of tertiary treatment and phosphate recovery in Lidköping, Sweden

angensarv.se

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Duration	07/2018-06/2023
Project Volume	7,6 million euro KWB: 97,691 euro
Financing	EU Life (LIFE17 ENV/SE/000384), Municipality of Lidköping (SE)

Partners
Municipality of Lidköping (SE), University of Lund (LTH), Kompetenzzentrum Wasser Berlin (KWB), Federation of Swedish Farmers (LRF)

Tertiary treatment and resource recovery at a new wastewater treatment plant in Sweden

The Lidköping Innovation Wastewater Eco-Hub (LIWE) is planning a new local wastewater treatement plant with the focus on enhanced "trace organic" removal through ozonation and simultaneous phosphorus recovery. The project is being financed by the EU Life programme.

Kompetenzzentrum Wasser Berlin consults Lidköpings municipality in terms of implementation and operation of an ozonation plant for tertiary wastewater treatment and phosphorus recovery from sewage sludge. In addition, Kompetenzzentrum Wasser Berlin will test the suitability of fluorescence sensors for process control and monitoring of the ozonation process and will train the local staff.

OBJECTIVES

- Elimination and significant reduction of emerging pollutants and pathogens (pharmaceuticals, hormones and microplastic particles) in the effluent of the Lidköping sewage treatment plant
- Phosphorus and nitrogen recovery from the wastewater path and direct reuse of these resources by local industrial and agricultural enterprises and the municipality

RESULTS

- The sewage treatment plant of the Lidköping Municipality is in planning stage. KWB accompanied this process during several on-site technical meetings.

Water circulation in Lidköping

Phosphorus recycling - external treatment of sewage sludge ash makes sense to Berlin

The amendment of the German Sewage Sludge Ordinance of 2017 obliges all operators of large sewage treatment plants to recover the phosphate contained in wastewater from 2029 onwards. Phosphate is a finite resource and an important element for the production of plant fertilisers. For this reason, WWTP operators such as the Berliner Wasserbetriebe are facing the challenge of designing sewage sludge disposal in such a way that it will be viable even after the official deadline.

Against this background, the 6-month bePhor project was launched to prepare a decision-making basis for the development of a holistic phosphate recycling concept adapted to the specific requirements of large WWTP operators, using the example of Berliner Wasserbetriebe. The results were evaluated in cooperation with experts from the Berliner Wasserbetriebe.

OBJECTIVES

- Evaluation of various technical options of phosphorus recovery according to ecological, economic and legal aspects
- Performance and evaluation of technical tests:
  - Phosphorus resolution from mixed sludge using organic acidification
  - Phosphorus resolution from sewage sludge ash using mineral acids
- Design of an overall strategy for phosphorus recovery for the Berliner Wasserbetriebe

RESULTS

- Via bio-acidification a potential recovery rate of minimum 10-30% is likely for Berlin's sewage treatment plants. Considering the future legal framework, this rate however, is too low.
- The project outcomes recommend the recovery of phosphorus from sewage sludge ash:
  - The process must eliminate heavy metals.
  - recovery on-site a waste water treatment plant is not recommended since the use of acids to dissolve the ash is very complex in terms of the necessary technology and logistics.
- To establish the recovery from sewage sludge ash, a cooperation with e.g. chemical parks is recommended, since the required acids can be made available without great effort and costs.

bePhor

bePhor – Concepts for phosphorus recovery and recycling from sewage sludge and sewage sludge ash for Berlin and surrounding areas

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Duration 02/2019-07/2019
Project Volume 87,000 euro
Financing German Federal Ministry of Education and Research (BMBF)

Partners
Berliner Wasserbetriebe (associated)

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Digestion towers at WWT-plant Wassmanndorf

Energy consumption and greenhouse gas emissions from wastewater treatment plants can be further reduced

E-VENT – Evaluation of process options for the reduction of energy consumption and greenhouse gas emissions of Berlin sewage treatment plants

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Duration	03/2017-07/2020
Project Volume	862,500 euro
Financing	Berlin Programme for Sustainable Development (BENE, project no. 1158-B5-O) and Berliner Wasserbetriebe (BWB)

Partners
KWB (project management), Berliner Wasserbetriebe, Technische Universität Berlin

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Senate Department for Urban Development and the Environment | be Berlin

Berliner Wasserbetriebe

Despite optimised energy demand and biogas use for the local production of electricity and heat, Berlin's six sewage treatment plants still contribute to the energy needs and the related greenhouse gas emissions in Berlin. The project E-VENT investigates and assesses innovative processes for wastewater and sludge treatment to decrease this impact of sewage treatment plants by using latest mature technology and its integration into holistic schemes. This will help the wastewater sector to contribute to the regional and national climate goals.

OBJECTIVES

- Energy optimisation of the activated sludge process with alternative options for nutrient and carbon removal: Laboratory and pilot tests with aerobic granular sludge
- Improvement of the biogas yield during sewage sludge treatment by thermo-chemical hydrolysis and thermo-pressure hydrolysis

RESULTS

- Pilot trials with granular sludge at WWTP Stahnsdorf showed very good biological elimination of pollutants by the process.
- A post-treatment stage after this process is required to comply with the strict legal discharge standards of Berlin.
- The pilot plant for thermo-chemical hydrolysis increased the production of biogas by up to 19%.
- With the results of pilot trials and monitoring (e.g. N_2O emissions), the new processes can now be assessed comprehensively based on reliable performance data.
- The potential of innovative technologies for the decrease of energy demand and related greenhouse gas emissions will finally be modelled for an exemplary sewage treatment plant of Berlin.

Pilot plant for thermo-chemical hydrolysis at WWT-plant Wassmansdorf

Creating synergies between municipal solid waste and wastewater management

The potential of municipal wastewater and waste management systems in terms of increasing energy efficiency and renewable energy production has not yet been fully tapped. The REEF 2W project, funded by the EU INTERREG Central Europe (CE) programme, is therefore designed to develop and implement inter-sectoral solutions for increasing energy efficiency and renewable energy production in public infrastructures. KWB is responsible for investigating new technical options on waste water treatment plants, i.a. biogas cleaning and grid injection, or innovative power-to-gas approaches.

OBJECTIVES

- Conducting case studies relating to different process combinations at wastewater treatment plants (e.g.: co-digestion, thermal hydrolysis, biogas treatment, power-to-gas)
- Development of a decision making tool for operators regarding the use of new technologies optimising wastewater treatment plants
- Environmental assessment of new technologies in their carbon footprint

RESULTS

- The decision support tool was tested and optimised for selected waste water treatment plants.
- Biogas cleaning and grid injection yields environmental benefits mainly in relation to the energy transition, as the sectors of heat production and transport can be supplied with green biomethane.
- The power-to-gas concept is not economically viable yet due to the high investment and operational costs.
- In close communication with Berliner Wasserbetriebe and the Berlin Senate Administration, approaches and concepts of REEF2W are checked with regard to the Berlin Energy and Climate Protection Programme BEK 2030 and its updating in the future.

REEF 2W – Increased renewable energy and energy efficiency by integrating, combining and empowering urban wastewater and organic waste management Systems

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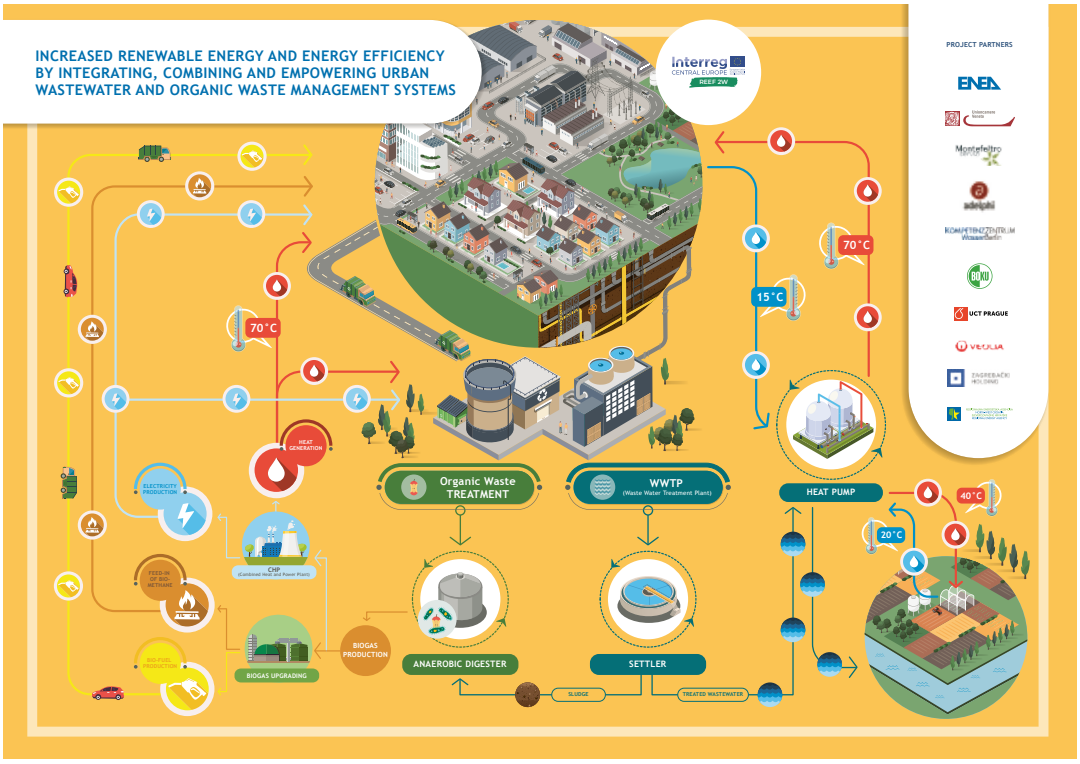
Duration 06/2017-05/2020
Project Volume 2,3 million euro
KWB: 212,000 euro
Financing EU-INTERREG (CE946), KWB with cofinancing by Berliner Wasserbetriebe

Partners
KWB in a consortium of 12 partners led by ENEA (Italy)



ABLUFT-2

ABLUFT-2 – Evaluation of the treatment of exhaust air in the aeration tank

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Duration 11/2018-10/2020
Project Volume 190,600 euro
Financing Berliner Wasserbetriebe

Aeration systems for wastewater treatment plants still have optimisation potential

The exhaust air from aerated sand traps usually contains hydrogen sulphide, which is corrosive and in certain concentrations is harmful to health. At the WWTP Berlin-Schönerlinde exhaust air in the aerobic zone of the aeration tank will be treated for the first time by oxidising hydrogen sulphide to non-hazardous sulfate. The technical implementation of this process step will be demonstrated under real conditions. Furthermore, two different materials for aeration elements will be tested in terms of their corrosion resistance. In addition, long-term investigations at the WWTPs Schönerlinde, Münchehofe and Waßmannsdorf are expected to deliver an optimised aeration regime with regard to its energy efficiency. In this context, the use of a "sliding pressure control" will be tested in comparison to a "constant pressure control".

OBJECTIVES

- Determination of an optimised operation of the exhausted air treatment in the aerobic zone of the aeration tank in summer and in winter (max. volume flow rate without H_2S emissions from the aeration tank)
- Investigation of the potential effect from the H_2S addition into the aeration tank on the microbial community
- Analysis of the energy demand of the wastewater treatment plants in Schönerlinde, Waßmannsdorf und Münchehofe due to the operation of the aeration system with "constant pressure control"
- Simulation of a „sliding pressure control" and the assessment of energy savings in comparison to the operation with "constant pressure control"
- Evidence of the energy savings due to the operation with „sliding pressure control" under real conditions

RESULTS

- The analysis of the specific energy consumption of the blowers in Schönerlinde indicated for some of them potential unfavourable positions of their diffusors.
- Based on the specific energy consumption of the aeration systems, an optimised operational blower sequence was developed. The simulation suggested an energy saving of 4%.
- An additional implementation of a „sliding pressure control" might even lead to an additional energy saving of 2%.
- Investigation of the exhaust air treatment is planned for 2020 after the start of operation of the new full-scale units.

Exhaust air aeration system with the suction line (left) and the pressure line (right)

Digital solutions for membrane bioreactors

The use of digital technologies in the water industry is rapidly increasing. This applies also to decentralised sewage treatment plants. The project MBR 4.0 is designed to investigate possible applications of digital technologies in the field of decentralised wastewater treatment by membrane bioreactors (MBR). In particular, the operation and the sensitive area of maintenance of MBR systems are to be improved by digital systems.

OBJECTIVES

- Process monitoring, control and visualization in real-time and development of a smart maintenance application
- Optimisation of MBR process operation by means of modelling and simulation
- Optimisation of aeration in terms of energy efficiency by means of smart load-dependent control
- Optimisation of maintenance operations by means of predictive maintenance of critical components
- Operation of an MBR pilot plant featuring optimised control and maintenance at a WWTP site in Berlin
- Development of new business models for digital transformation and increase of export qualification

RESULTS

- The project was started with research on the regulation and control technology for MBR systems and subsequent selection of the appropriate measurement technology for the MBR pilot plant.
- Simulation System SIMBA# was successfully adapted to the requirements for MBR processes and is being used.

MBR 4.0 – Development of digital solutions for the optimisation of membrane aeration bioreactors

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Duration 08/2019-07/2021
Project Volume 595,456 euro
KWB: 196,896 euro
Financing German Federal Ministry of Education and Research, Funding Programme KMU innovativ

Partners
MARTIN Systems GmbH (coordinator), KWB, Berliner Wasserbetriebe (associated partner)

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Federal Ministry of Education and Research

Membrane tank in MBR plant of Martin Systems GmbH

Technical treatment of groundwater featuring elevated sulphate levels

SULEMAN – Technical treatment of groundwater featuring elevated sulphate levels: Advanced options and limits of a resource and energy efficient drinking water management

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Duration 06/2018-05/2021
Project Volume KWB: 291,490 euro
Financing 6th Energy Research Programme "Research for an environmentally-friendly, reliable and affordable energy supply" of the German Federal Ministry for Economic Affairs and Energy (BMWi), Berliner Wasserbetriebe

Partners
DVGW Research Centre of the Hamburg University of Technology (Coordination); Hamburger Wasserwerke GmbH; Berliner Wasserbetriebe; KWB; INGE GmbH; Surflay Nanotec GmbH

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Berliner Wasserbetriebe

Rising sulphate concentrations in groundwaters and bank filtrates are challenging many water utilities in terms of drinking water supply. In certain regions, it has become increasingly difficult to meet the threshold concentration for sulphate (250 mg/L according to the Drinking Water Ordinance) without additional technical measures. The project investigates commercially available processes of sulphate removal for efficiency in resource and energy consumption at locations of the water utilities HAMBURG WASSER and Berliner Wasserbetriebe under real operating conditions.

OBJECTIVES

- Investigation of resource and energy efficiency of low pressure reverse osmosis compared to ion exchange
- Further development and optimisation of new modified ultrafiltration membranes (LbL-UF)
- Life cycle assessment of the studied process concepts for the removal of sulphate from groundwater

RESULTS

- Low-pressure reverse osmosis pilot plant was put into operation with results of drinking water treatment:
  - Sulfate removal below the limit of quantification (6 mg/L); the method could be used in partial flow, since sulphate must not be total removed
  - Reduction of softening up to 60%
  - Approximately 20-25% of the water to be treated is waste water produced during treatment which must be disposed of or treated further. Options are still being examined.

Pilot plant of low-pressure reverse osmosis at water works Berlin-Friedrichshagen (front and back view)

Use of digital tools in the European water sector

Against the background of climate change, demographic development and ageing infrastructures, European cities must gradually change the management of their water systems. Under the leadership of Kompetenzzentrum Wasser Berlin gGmbH (KWB), 24 partners from 10 European countries are investigating the benefits of a panel of innovative digital solutions to address major water-related challenges.

The project consortium consists of experts from science, industry and water utilities. A total of 15 pioneering digital approaches such as sensor networks, online measurement methods and machine learning will be advanced and tested in the cities of Paris, Milan, Copenhagen, Sofia and Berlin. The project addresses topics such as the performance and efficiency improvement of water infrastructures, issues of hygiene hazards in bathing waters and new applications designed for public involvement in urban water management.

OBJECTIVES

- Developing and demonstrating innovative digital solutions for decision support in urban water management
- Reducing health risks in water reuse for agricultural practice and bathing waters
- Improving the performance of urban water infrastructures by integrating sensor networks and Machine Learning methods
- Using visualization methods such as Augmented Reality for information and public awareness raising in terms of (ground)-water management challenges
- Ensuring the transferability and interoperability of sensors

RESULTS

- The implementation planning of the case studies was started in cooperation with local stakeholders. Indicators for assessing the local benefits of the solutions aimed for were defined.
- The monitoring campaign of bathing water quality was started in Berlin and Paris.
- A protocol was developed to identify the governance framework and non-technical barriers which are crucial for the implementation of new digital solutions.
- The dialogue with external stakeholders, the "Communities of Practice", was started. This way, local decision-makers are involved in the project and can provide their own input.

digital-water.city (DWC) Leading urban water management to its digital future

digital-water.city

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Duration	6/2019-12/2022
Project Volume	5,9 million euro KWB: 724,500 euro
Financing	EU Horizon2020 (Grant Agreement No. 820954)

Partners
KWB (coordination) with 25 partners from Belgium, Bulgaria, Denmark, Germany, France, the Netherlands, Norway, Israel, Italy and Spain

Horizon 2020
European Union Funding
for Research & Innovation

Real-time monitoring of hygiene parameters of bathing waters with the ALERT sensor by FLUIDION

Press Conference: Launch of EU-funded Project digital-water.city from left to right: Nicolas Zimmer, CEO Technologiestiftung Berlin, Edith Roßbach, Managing Director of KWB, Christian Rickerts, Secretary of State at the Berlin Senate Department for Economics, Energy and Public Enterprises, Regina Gnirß, Managing Director of KWB and Head of R&D Department of Berliner Wasserbetriebe, Jörg Simon, Chairman of the Board of Berliner Wasserbetriebe

Implementation of sponge city concepts in China

KEYS – Implementation of sponge city concepts in China

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Duration	8/2018-7/2021
Project Volume	3,0 million euro KWB: 420,740 euro
Financing	German Federal Ministry of Education and Research (BMBF), Funding Programme CLIENT II - International Partnerships for Sustainable Innovations

Partners
Institute for Sanitary Engineering and Waste Management of the Leibniz University Hanover ISAH (Management); Kompetenzzentrum Wasser Berlin gGmbH; Dahlem Beratende Ingenieure GmbH & Co. Wasserwirtschaft KG; Steinhardt GmbH Wassertechnik; LAR Process Analysers AG; NIVUS GmbH; MARTIN Systems GmbH; AKUT Umweltschutz Ingenieure Burkard und Partner; BPI Hannover Verworn Beratende Ingenieure. Academic partners in China: Tsinghua University, Harbin Institute of Technology

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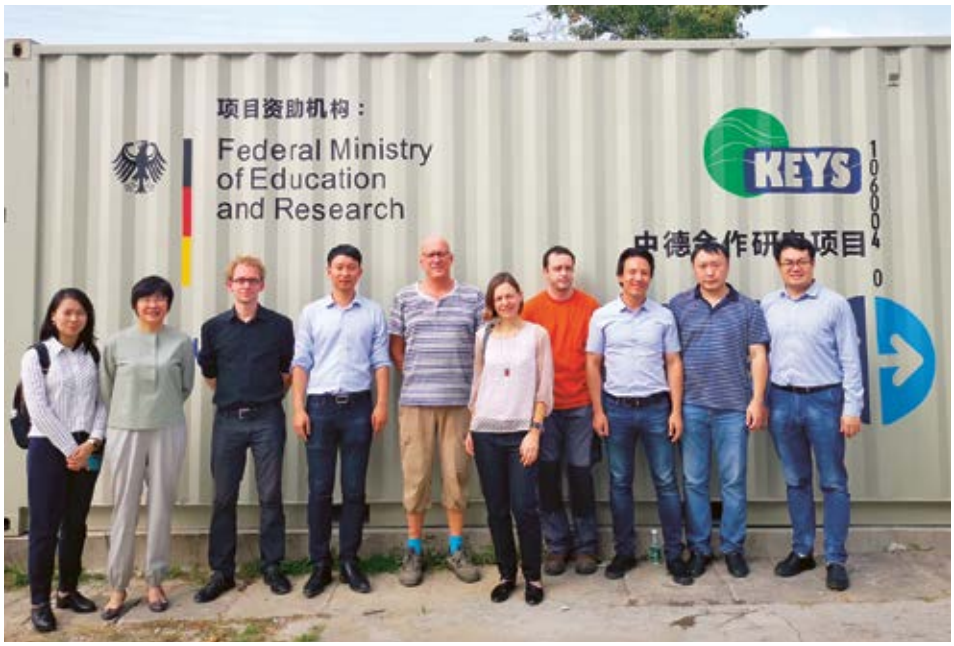
In cooperation with partners from China, the joined project KEYS aims to promote the demand-based implementation of stormwater management measures (Sponge City) in China. Model regions are the cities of Shenzen and Beijing, both of which have been designated as 'pilot Sponge Cities'. The project was developed in close cooperation with the Chinese Ministry of Science and Technology (MOST).

OBJECTIVES

- Investigation of advanced and "smart" components of stormwater management (SMART SPONGE CITIES) allowing for the protection against flooding and the retention of pollution loads
- Implementation of eco-sensitive and particularly energy-efficient wastewater treatment methods featuring new approaches like deammonification, aerobic granular sludge technology and membrane processes
- Development of integrated approaches and methods facilitating the identification and reduction of pollution loads from urban catchments into surface waters.

RESULTS

- The presumed relation between the hydrological performance of green roofs and the local climate was confirmed on the basis of the available data and plausibly illustrated by SWMM models. This means that green roofs as a part of rainwater management have the potential to contribute to flood protection. These results were presented at an international symposium.
- For the analysis of primary pollutant entry paths, data were collected for the urban area south of the Beiyun River in Tongzhou and successfully evaluated by means of the water balance model (ABIMO) with regard to the pollution loads.
- In June 2019, the membrane bioreactor pilot plant was installed and commissioned at the Luofang sewage treatment plant in China. The evaluation of the first measurement data revealed that the optimisation strategy for nitrogen removal works.



Field site visit with project team of KWB together with partners of HIT, MS and the head of BMBF-Project Office Shanghai at Luofang WWTP in China

Planning of climate-resilient water infrastructure for the city of the future

The design of a climate-resilient cities requires an integration of urban development and infrastructure planning. The Centre of Competence for Water is responsible for "natural-scientific and technical assessment". On the one hand existing evaluations of water infrastructure are simplified and extended by resilience. On the other hand, a goal-oriented planning method, developed in the project KURAS, is applied in actual planning projects and adapted in this process.

OBJECTIVES

- Coupling of grey, green and blue elements of stormwater and wastewater infrastructure aiming at the sustainable transformation of urban areas, exemplified for the two partner cities of Berlin and Norderstedt (grey = technical infrastructure, green = urban green; blue = water bodies).
- Development of common guidelines and goals at different urban levels.
- Assessment of factors that determine the resilience of urban infrastructure.

RESULTS

- The KURAS methodology was expanded to the planning of coupled grey, green and blue infrastructures considering especially process water use.
- Specific materials were developed and tested to support the planning processes (info cards, evaluation and charts for the catchment area analysis and cost-benefit assessment).
- The planning method was successfully applied with the stakeholders in five different catchment areas of Berlin.
- Resilience evaluation of water infrastructures proposed by KWB turned out to be robust and sound.

Estimation of resilience factors during a stakeholder workshop in Berlin-Pakow

netWORKS4 – Resilient networks: Contributions to urban supply systems for climate justice

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Duration 10/2016-09/2019
Project Volume 1,0 million euro; KWB: 121,000 euro
Financing German Federal Ministry of Education and Research (BMBF), KWB with cofinancing by Berliner Wasserbetriebe

Partners
Kompetenzzentrum Wasser Berlin, ISOE - Institute for Social-Ecological Research (project management), German Institute for Urban Affairs (Difu), Ramboll Studio Dreiseitl, Berliner Wasserbetriebe, Berlin Senate Administration for Urban Development and Housing, Berlin Senate Administration for the Environment, Transport and Climate Protection, City of Norderstedt

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RessourcenPlan im Quartier

Securing resource efficiency at the start of urban development projects

R2Q – Resource planning for urban districts

Contact
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Duration	03/2019-02/2022
Project Volume	2,9 million euro KWB: 148,675 euro
Financing	German Federal Ministry of Education and Research (BMBF)

Partners
University of Applied Sciences Münster (coordination), Stadt Herne, RWTH Aachen University, Technische Universität Berlin, KWB, Jung Stadtkonzepte, Abbruchtechnik Exkern, Institut für technisch-wissenschaftliche Hydrologie, Gelsenwasser AG

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FONA
Forschung für Nachhaltige Entwicklung
BMBF

Zukunftsstadt

Eine Initiative des Bundesministeriums für Bildung und Forschung
RESOZ
Ressourceneffiziente Stadtquartiere

Cities require a lot of energy and many resources like water, land and building materials. Already now, cities around the world are responsible for the consumption of 80 percent of the energy produced and up to 70 percent of the consumption of resources, with tendency to rise.

The project R2Q aims to develop and test novel and pioneering approaches allowing for the sustainable management of resources in cities. The example of two districts of the city of Herne, where both residential and commercial areas as well as traffic areas are located close together, will be used to investigate how water, urban areas, materials - for example building materials - and energy can be used more efficiently by linking all residents. To this end, R2Q will develop a resource plan coordinated with professionals, citizens and policy makers, which can be used for future construction and redevelopment measures in city districts, also outside of Herne.

The KWB contributes its expertise in rainwater management and water pollution control to the project and will develop tools to assess the impact of the resource plans on the quality of water bodies. The particular challenge is to create as functional and simple evaluation and model approaches as possible to support the planning.

OBJECTIVES

- Identification of synergies and trade-offs between different resources - water, materials, energy, landscape
- Development of a "ResourcePlan", which accounts for efficient and sustainable use of resources at the beginning of urban planning projects
- Demonstration of the "ResourcePlan" for two quarters in the city of Herne

RESULTS

- The interdisciplinary dialogue - among researchers from the fields of energy, water, building materials, landscape, climate protection and communal experts from the city authority of Herne - is well underway.
- A first full catalogue of indicators has been established as a basis for interlinking the different resources.
- KWB contributed a systematical overview of urban impacts on surface waters.

Vision for the resource efficient city Herne

Façades of newly constructed buildings can leach the biocides diuron and terbutryn

Despite good water monitoring there is only little knowledge, which pollutants can leach during storm events from urban construction and redevelopment areas, possibly leading to the exceedance of environmental quality standards in receiving urban surface waters. Within a three-year research contract with the Federal Environment Agency (UBA), a combination of product tests and on-site investigations will be carried out to determine which building products can be responsible for the suspected leaching of relevant compounds.

OBJECTIVES

- Enhanced understanding of the interaction of construction materials with stormwater
- Identification of relevant pollutants released from construction materials during rain events and determination of event-based loads
- Application of a model for transfer of results to different meteorological conditions
- Development of a guideline with recommendations for measures contributing to the reduction and avoidance of the entry of pollutants from construction materials into the urban environment.

RESULTS

- It was demonstrated that the biocides diuron and terbutryn applied in building products are leached from façades and reach storm water sewers.
- After more than one year of monitoring (three years after construction of investigated buildings) concentrations are consistently high and are around 1000 µg/L for diuron in façade runoff.
- Mecoprop in roof runoff of one area and large runoff quantities from roofs resulted in the highest loads of all analysed organic micropollutants in runoff of this area.
- In addition to biocides and herbicides, high concentrations and loads of zinc and aluminum were found.
- Model calculations and monitoring data show that façade emissions depend on building orientation and are highest on the west side.

UFOPLAN BaSaR – Construction and renovation materials as a source for pollution in the urban environment

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Duration	07/2017-07/2020
Project Volume	447,000 euro
Financing	German Federal Environment Agency (UBA)

Partners
KWB (coordination), HSR University of Applied Sciences Rapperswil, Switzerland; Berliner Wasserbetriebe

Installation of an automatic sampler

Preparation of hand samples during a rain event

New filter materials should also remove biocides in stormwater runoff

SpuR – New measures to reduce water pollution of trace organic compounds in urban rainwater runoff - Two novel technologies and a planning guideline (SpuR)

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Duration	05/2019-05/2021
Project Volume	339,000 euro KWB: 162,700 euro
Financing	German Federal Environmental Foundation (DBU)

Partners
KWB; Funke Kunststoffe GmbH; Brillux GmbH;HSR University of Applied Sciences Rapperswil, Switzerland

sponsored by DBU Deutsche Bundesstiftung Umwelt
www.dbu.de

In urban areas, stormwater runoff can be contaminated by trace organic compounds such as biocides, plasticizers and flame retardants. During rain events, these substances are washed off from building surfaces such as façades and roofs as well as from traffic areas. Depending on weather conditions and urban structure, these pollutants are often discharged directly into surface waters via the rainwater drainage system without prior treatment.

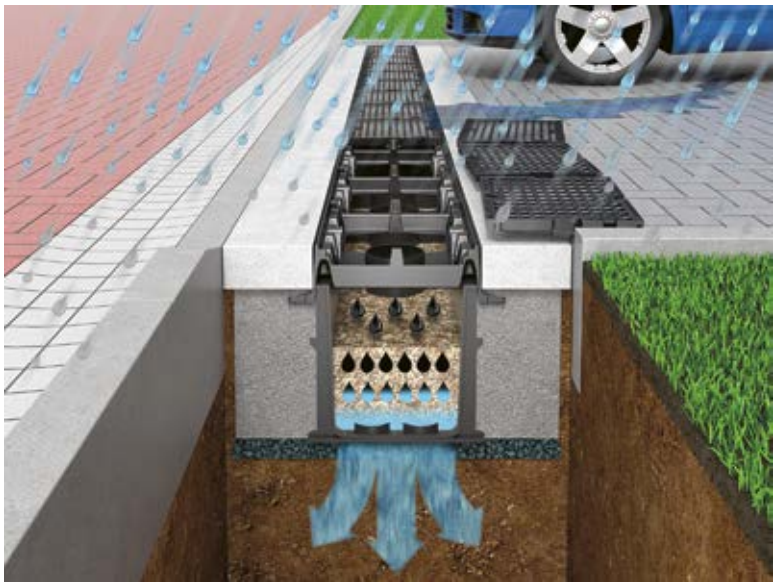
Based on findings from other projects of KWB (BaSaR, OgRe), the SpuR project will investigate strategies and specific technical measures of participating companies leading to a reduction of such entries.

OBJECTIVES

- Application of new façade coatings to reduce pollution "at the source"
- Application of new filter materials for rainwater treatment systems as "end-of-pipe technology"
- Development of a planning guideline to reduce the entry of trace organic compounds to stormwater runoff

RESULTS

- The existing filter material for rainwater treatment systems could be significantly improved and achieved a retention of up to 99% for biocides such as diuron and mecoprop in laboratory column tests.
- Inoculation of the substrate with different cultures of bacteria and fungi for increased degradation within the substrate did not show relevant effects.
- The coating of a façade with the new façade paint parallel to a conventional product has been completed and monitoring has started.



Installation of a sewer network

Improving bathing water quality in Barcelona and Berlin

Stormwater and combined sewer overflows are one of the main pollution sources with strong impact to the quality of urban water bodies, which are more and more used as bathing waters. New real-time control strategies of urban drainage systems as well as new and rapid analytical devices are promising solutions for reducing discharges from the combined sewer system. In addition, information systems and prediction models provide for quick information of the population about bathing water quality. In Berlin and Barcelona, these options are to be developed and tested.

OBJECTIVES

- Implementation of a web platform for real-time control of sewer systems in Barcelona aiming to reduce the number of short-term pollution events caused by heavy rainfalls and to minimise the related health risks of bathing waters.
- Improvement of real-time information on bathing water quality in Berlin by using rain radar data and novel measuring devices
- Assessment of the potential to further reducing combined sewer overflows by optimising control strategies.

RESULTS

- Three novel measuring devices of ADASA (AQUABIO) were installed on the Spree and Havel rivers to monitor the hygienic water quality. They facilitated the reliable detection of short-term water pollution caused by combined sewer overflows.
- By means of RADOLAN data (radar online data) provided by the German Meteorological Service which complement the rain gauges of the Berliner Wasserbetriebe previously used, the prediction accuracy of bathing water quality could be improved.

iBathWater

iBathWater – Advanced urban water management to efficiently ensure bathing water quality

Contact
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Duration	9/2018-12/2021
Project Volume	KWB: 222,240 euro
Financing	EU Life (Grant Agreement No. LIFE17/ENV/ES/000396)

Partners
Fundació Eurecat (Coordination); ADASA Sistemas (S.A.U.), Barcelona Cicle de l'Aigua, Barcelona City Council and KWB; Berliner Wasserbetriebe, Berlin State Office for Health and Social Affairs (LAGeSo), Berlin Senate Administration for the Environment, Transport and Climate Protection, German Federal Environment Agency (UBA) (associated partners)

Project team visits one of the online-monitoring devices of iBathWater, installed on the pilot plant for surface water treatment "Flussbad-Berlin"

Research for clean bathing waters

FLUSSHYGIENE – Hygienically relevant microorganisms and pathogens in multi-functional water bodies and hydrologic circles – sustainable management of different types of water bodies in Germany

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Duration	06/2015-11/2018
Prolongation	10/2019
Project Volume	2,7 million euro KWB: 713,000 euro
Prolongation	280,000 euro KWB: 180,000 euro
Financing	German Federal Ministry of Education and Research (BMBF) with additional co-financing by Berliner Wasserbetriebe

Partners
Partners after prolongation: KWB, inter 3 Institute for Resource Management, German Federal Environment Agency (UBA), Berliner Wasserbetriebe, Technologiestiftung Berlin (subcontract)

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Berliner Wasserbetriebe

The pollution of Germany's rivers has been visibly reduced in the past decades. Nevertheless, out of the 2,000 sites which comply with the EU Bathing Water Directive there are only 30 bathing areas situated along rivers. This is due to the fact that rivers in particular are subject to short-term pollution loads resulting from unpredictable stormwater entries and combined sewer overflows which can turn recreational bathing into a health risk.

The project was extended by 12 months to digitise the developed products and make them available online via the website of the German Federal Environment Agency (UBA).

OBJECTIVES

- Development of models for the short- and long-term prediction of the sanitary water quality of rivers
- Implementation of early warning systems on river bathing sites for the short term prediction of pollution events
- Gaining a better understanding of the self-purification processes of rivers in terms of pathogenic viruses and indicator bacteria
- Analyses of the socio-economic conditions to be taken into account in the development of new river bathing sites

RESULTS

- During the extension phase of the project, a web application was developed which supports the responsible authorities in setting up their own early warning systems for predicting bathing water quality. In a joint workshop on Federal Government and Federal States level carried out with the project partners, information was given on the possible uses of this application.
- The early warning system running in Berlin was validated by a monitoring programme performed during the 2019 bathing season and continues to inform Berliners about the current bathing water quality at selected bathing sites (badegewaesser-berlin.de).
- In summer 2019, the project was awarded the Berlin AQUA AWARD. By this annual prize, AQUANET Berlin-Brandenburg, the water network for the capital region, recognises outstanding achievements of the Berlin water sector.

Bathing site at Havel River in Berlin

Optimisation of sewer asset management strategies

The maintenance of wastewater infrastructure systems is expensive. The costs for replacement and maintenance amount to several millions of euros which have to be procured by cities and communities. Many cities face the problem of an aging infrastructure in need of extensive and ongoing repair, rehabilitation or renewal.

OBJECTIVES

- Development of tools to support municipalities and wastewater disposal companies in the definition of cost-efficient sewer inspection and rehabilitation strategies for their sewer systems

RESULTS

- To simulate rehabilitation strategies for sewers, an innovative numerical model was developed and tested in Brunswick and Sofia.
- The results show that the tool can provide tangible proofs of the annual rehabilitation planning and sewer infrastructure investment needs.
- Age is a key variable for deterioration modelling. A new method can estimate missing construction years in the utility database with a prediction error less than seven years.

Reliable Sewer

Reliable Sewer – Optimisation of sewer inspection and rehabilitation strategies

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Duration	04/2016-09/2019
Project Volume	n/s
Financing	Veolia / VERI (Veolia Recherche et Innovation)

Partners
Veolia / VERI
(Veolia Recherche et Innovation)

View to a combined sewer system in Berlin

Precise prediction of sewer condition by means of deterioration models

SEMA-Berlin 2 – Support of sewer inspection and investment strategies by means of deterioration models

Contact
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Duration	05/2018-06/2021
Project Volume	201,311 euro
Financing	Berliner Wasserbetriebe

Partners
Berliner Wasserbetriebe

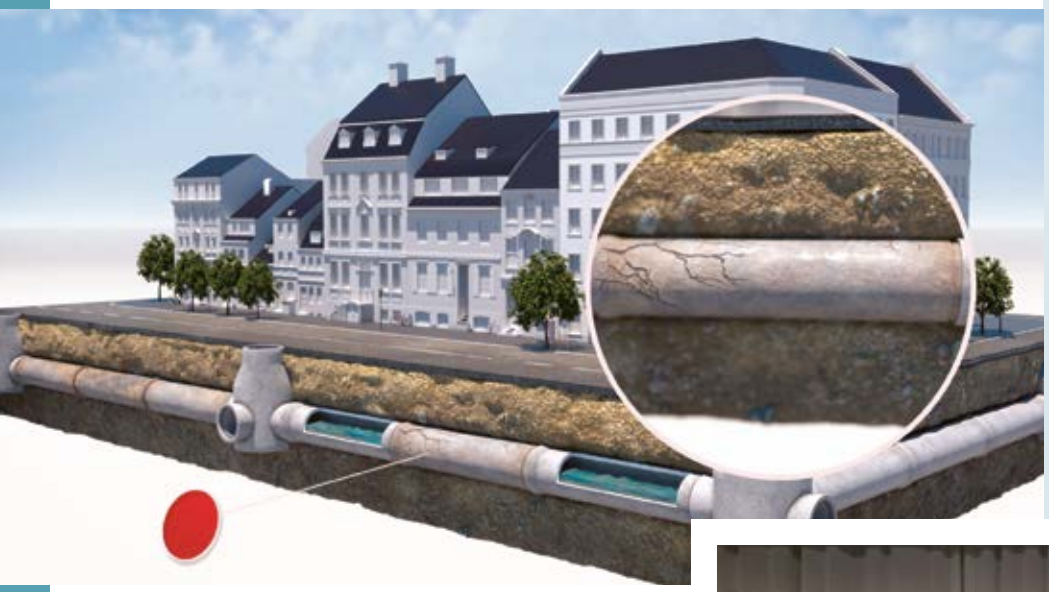
Recent studies show that current investments in sewer rehabilitation are not sufficient to tackle the ageing of the networks. One obstacle are missing planning tools adapted to the requirements of end-users. In SEMA-Berlin 2 statistical and data-driven modelling approaches for the simulation of the sewer condition are combined with model components for repair, renewal and renovation of sewer pipes. The developed approaches support municipalities and water utilities with decisions on rehabilitation and investments and the development of efficient inspection programmes.

OBJECTIVES

- Enhancement and improvement of the tested deterioration models
- Development of approaches for the consideration of rehabilitation effects
- Analysis of effects of different rehabilitation strategies on network condition, age, remaining value and rehabilitation costs
- Analysis of uncertainties and their propagation in models
- Prioritisation of single sewer pipes and areas for short-term inspection and rehabilitation planning

RESULTS

- By means of the improved deterioration model the sewer condition can be predicted with high accuracy.
- By coupling the deterioration model with model components for sewer rehabilitation, various renovation strategies can be examined with regard to their long-term effect on condition, repair costs and network age (Predictive Maintenance).
- The obtained results were awarded with the innovation prize 2019 of the German association of utilities and municipal enterprises (VKU).



Part of a video animation about sewer condition prognosis modelin

VKU Innovation Award Ceremony for Sema-Berlin in March 2019: Katherina Reiche (VKU Chief CEO), Regina Gnirß, Nic Lengemann (BWB), Mathias Riechel (Kompetenzzentrum Wasser Berlin), Elke Eckert, Frank Bruckmann, Andreas Schmitz (BWB) und Michael Ebling (VKU President) (from left to right)

Standards for the assessment and classification of the remaining value of sewers and manhole infrastructures

A survey conducted by the DWA (German Association for Water, Wastewater and Waste) in 2015 highlighted that the total length of the German sewer network was about 576,000 km. Replacement costs of sewer pipes are estimated at around 910 billion euro without even considering the rehabilitation needs for manholes, house connections and other infrastructures.

Sewer systems can be considered as the largest municipal infrastructure. The survey also revealed that approximately 25-30% of the sewers have medium to serious defects and would need to be rehabilitated within the next 10 years.

Many network operators are therefore looking for solutions allowing for a forward-looking budget planning and the subsequent implementation of the necessary construction measures, taking into account the necessary maintenance of the remaining value. Against this background, the SubKanS project is developing a standardised and practicable method to assess and classify the remaining value of sewers and manhole infrastructures.

OBJECTIVES

- Development of a standardised and practice-oriented methodology for the evaluation and classification of the sewer structure in conjunction with rehabilitation measures
- Disclosure and transparency of the classification algorithm to provide a reference for sewer operating companies and users
- Establishing a set of rules in the form of an advisory leaflet according to the national standard DWA M-149-3

RESULTS

- The preparation of a glossary created an important basis for carrying out independent comparable sewer structure classification.
- The development of a model for the advanced classification of the entire sewer structure was started. To prepare the validation of this model, data sets from different sewer network operators were compiled.

Installation of a sewer network

SubKanS – Development of a national standard for the assessment of the remaining value of sewer and manholes infrastructures

Contact
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Duration	01/2019-12/2020
Project Volume	1,2 million euro KWB: 174,780 euro
Financing	BMWi in programme WIPANO - Knowledge and Technology Transfer through Patents and Standards

Partners
Aachen University of Applied Sciences (coordinator), Magdeburg-Stendal University of Applied Sciences, S & P Consult GmbH, Franz Fischer Ingenieurbüro GmbH, Ingenieurbüro Dr.-Ing. Klaus Hochstrate, Dr.-Ing. Pecher und Partner Ingenieurgesellschaft mbH, 3S Consult GmbH, SiwaPlan Ingenieurgesellschaft mbH, hanseWasser Bremen GmbH, Gelsenwasser AG, KWB

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag
WIPANO

HYDRA

Investigation of climate change impacts on groundwater recharge

HYDRA – Hydraulics for MAR schemes in Berlin against the background of changing climatic conditions

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Dr. Alexander Sperlich (BWB)
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Duration 01/2018-12/2019
Project Volume 100,173 euro
Financing Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) and Berliner Wasserbetriebe

Partners
Berliner Wasserbetriebe
Berlin Senate Department for the Environment, Transport and Climate Protection (associated)

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

Berliner Wasserbetriebe

When examining the possible impacts of climate change on groundwater augmentation the question is to what extent varying surface water discharge may lead to restrictions in managed groundwater recharge in the near future. Another focus of the project is to determine the impact of increasing temperatures on the hydraulic performance of groundwater recharge during infiltration and subsurface passage until abstraction.

OBJECTIVES

- Quantification of the impacts of rising water temperatures on the hydraulic properties of groundwater recharge
- Identification of the impacts of rising water temperatures and higher nutrient loads on technical surface water treatment
- Identification of operational control and adaptation options to cope with a limited use of groundwater augmentation in times of limited availability of surface waters

RESULTS

- The hydraulic modelling detected that higher water temperatures lead to increased infiltration rates and reduced residence times of the infiltrate in the underground passage.
- To evaluate the options for adaptation, the numerical model analysed three scenarios: (i) a groundwater recharge rate reduced by 30%, (ii) in addition a demand increased by 50% and (iii) in addition a groundwater recharge quantity increased by 50%. The scenarios delivered the following results:
  - A compensation by increased groundwater augmentation is possible, but causes conflicts along the Havel River which serves as source water. It was therefore recommended that the recharge activities are rather shifted to the winter months.
  - The correlation of meteorological (air temperature, precipitation, sunshine duration) and operational data of the surface water treatment plant Berlin-Spandau (e.g. water temperature, nutrient load, suspended solids) has revealed a relation between the water temperature and the nutrient load with phosphorus. This probably entails an increased need for flocculants and a significant reduction in filter runtimes in summer.

Measurement of temperature profiles in groundwater infiltration

Development of standardised processes for research data management

Research data management (RDM) comprises all activities related to the processing, storage, archiving and publication of research data. The importance of research data management has grown immensely in recent years due to the large amount of data generated in the course of digitisation and automation. Their administration and processing can hardly be managed with the existing tools.

OBJECTIVES

- Implementation of a sustainable research data management scheme as a case example for small research institutions

RESULTS

- As scheduled, a RDM scheme adapted to the specific needs of small research institutes was developed and tested. The results are transferred to KWB's data management standards and quality management system.
- A tool supports the staff in observing the "best practices", e.g. naming conventions (path analysis tool); another tool serves as a prototype for a web-based institute-wide knowledge database.
- In a one-day workshop, the results were discussed with representatives of small non-university research institutions.

FAKIN

Development of standardised processes for research data management

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Duration 05/2017-04/2019
Project Volume 157,665 euro
Financing German Federal Ministry of Education and Research (BMBF)

SPONSORED BY THE

Federal Ministry of Education and Research

SMART-Control

Development of a web-based, real-time monitoring and control system for managed aquifer recharge

SMART-Control – Smart framework for real-time monitoring and control of sub-surface processes in managed aquifer recharge applications

Contact
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Duration	02/2019-01/2022
Project Volume	119.000 euro (part KWB)
Financing	Water JPI, Bundesministerium für Bildung und Forschung (BMBF)

Partners
TU Dresden (coordination), Kompetenzzentrum Wasser Berlin gGmbH, Umwelt- und Ingenieurtechnik GmbH Dresden, Adelphi research gGmbH, BRGM, Lyonnaise des Eaux/Suez, Universidade Federal de Paraíba, Universidade Federal de Pernambuco, University of Cyprus

SPONSORED BY THE

Federal Ministry of Education and Research

Local and seasonal shortfalls of groundwater availability may be compensated by groundwater augmentation with surface water into an aquifer. In Berlin, about 10 percent of drinking water is obtained by groundwater augmentation. The SMART-Control project is designed to reduce the risks in the application of groundwater augmentation through the development and implementation of an innovative web-based, real-time monitoring and control system in combination with risk assessment and management tools. The approach is tested at several MAR sites located in Germany, France, Cyprus and Brazil.

The Kompetenzzentrum Wasser Berlin is responsible for the real-time calculation of the hydraulic boundary conditions (e.g. subsurface residence time) and for the development of a microbiological risk assessment for groundwater augmentation. The case study is situated at Berlin-Spandau water works. For the first time, bacteriological measurements are carried out directly in the groundwater by means of a fully automated flow cytometry system. At the same time, microbiological samples are analysed for pathogens and indicators using conventional cultivation methods. The subsurface residence time of the infiltrate is to be calculated on the basis of temperature measurements in the well and infiltration basin to obtain information about the hygienic retention capacity of the site's geological subsoil.

OBJECTIVES

- Reduce the risks of groundwater management techniques by real-time web-based monitoring, control and process system
- Development of online tools allowing for the detection of the hydraulic boundary conditions and the evaluation of microbial risks

RESULTS

- For the first time, high-resolution measurements with an automated flow cytometry system were carried out in the groundwater.
- Cultivation methods confirm that pathogenic microorganisms are removed after short residence time in the subsurface
- Online data loggers were installed on-site feeding data into the web platform.

Groundwater augmentation pond at waterworks Berlin-Spandau

Water sample taking at drinking water well to quantify hygenic parameters

Small funded projects and contracts

Projekt	Auftraggeber	Bereich	Contact
Determination of the CO2 footprint of water infrastructure options in two selected urban districts	Institute for Social-Ecological Research (ISOE) GmbH	Process Innovation	Dr.-Ing. Christian Remy
Calculation tools for GHG emissions and primary energy consumption for the infrastructure of the tertiary treatment step and production or reactivation of activated carbon	VSA Platform, Switzerland	Process Innovation	Dr.-Ing. Christian Remy
Joint treatment of municipal and industrial wastewaters	Kalundborg Forsyning, Sweden	Process Innovation	Dr.-Ing. Ulf Miehe
Sampling and analysis of bathing sites in Offenbach Harbour	Mainviertel Offenbach GmbH & Co. KG	Urban Systems	Dr.-Ing. Pascale Rouault
Environmental Atlas - Scientific enhancement of the urban water balance model ABIMO	Berlin Senate Department for Urban Development and Housing	Urban Systems	Dr.-Ing. Pascale Rouault
Development and implementation of a simulation tool to support the strategic planning of sewer inspection and investment strategies	Berliner Wasserbetriebe	Urban Systems	Dr.-Ing. Pascale Rouault
Combined sewer rehabilitation - review and enhancement of assessment approaches for water quality and its application to Berlin water segments (MISA)	Berlin Senate Department for the Environment, Transport and Climate Protection	Urban Systems	Dr.-Ing. Pascale Rouault
Development of early warning systems at three additional bathing sites in Berlin	Berlin State Office for Health and Social Affairs	Urban Systems	Dr.-Ing. Pascale Rouault
R software & programming training	Berliner Wasserbetriebe	Urban Systems	Dr.-Ing. Pascale Rouault
Data analysis of geogenic salination in the Berlin groundwater	Berliner Wasserbetriebe	Groundwater	Dr. Christian Menz
Construction and operation of drainage wells at opencast mining sites	RWE Power AG	Groundwater	Dr. Christian Menz
Scientific support and analysis relating to 4 topics of the German case study within the AQUARES project (Interreg Europe Programme)	Water Board of Oldenburg and East Frisia (OOWV)	Groundwater	Dr. Christoph Sprenger

Network and Communication

In addition to our research activities, our tasks include informing the (professional) public about the results of our work, current research trends and developments in the water sector. For this purpose, we organise both professional events and events for the interested public and communicate with journalists.

Based on our network of actors from science, industry and public administration, we promote communication both at national and international level.

BLUE PLANET Berlin Water Dialogues

Keynote speach by Stefan Uhlenbrook, Coordinator and Director of UNESCO World Water Assessment Programme

The BLUE PLANET Berlin Water Dialogues is a series of events initiated as a platform for dialogue in 2011 by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Berlin Senate Department for Economics, Energy and Public Enterprises. The aim is to bring together experts from research and industry across sectors and on international level. In 2018 the series was continued as a cooperation project between Kompetenzzentrum Wasser Berlin and the business network German Water Partnership.

Will the smart combination of technical and natural processes be able to tackle specific challenges in water management? This question was discussed during a one-day conference in April 2019. Under the umbrella of BLUE PLANET Berlin Water Dialogues which was held at the Berlin-Brandenburg Academy of Sciences, the EU-funded research project AquaNES was invited to present its international research activities and practical results with promising answers. Practical workshops, a specialist exhibition and a concluding panel discussion contributed to stimulating professional exchange between the 160 participants.

Berlin Long Night of the Sciences

Berlin Long Night of Sciences with „Info-Game“ about pollutants in stormwater runoff

Under the slogan “All about Rainwater”, KWB again contributed to Berlin’s "Long Night of Sciences", this time in close cooperation with Berlin’s Rainwater Agency. In the Science City Berlin-Adlershof, 1200 visitors were the proof of the high relevance of the topics presented. By means of exhibits, tours, lectures and interactive games, the visitors learned about rainwater management in Berlin, the challenges to be faced with and the issues currently being investigated.

International Conference “Water Reuse” in Berlin

Jens Scheideler, Xylem, Regina Gnirß, Berliner Wasserbetriebe and Dr. Ulf Miehe, Kompetenzzentrum Wasser Berlin (f.l.t.r.)

Under the umbrella of the "IWA International Water Association", more than 400 experts from all over the world met in Berlin for four days to exchange information on the progress achieved in the field of “Water Reuse”. KWB scientists contributed several technical lectures to the conference programme. The KWB presented its projects also at the accompanying exhibition. A great attraction was the serving of a beer branded as "Reuse Brew", which was specially brewed for the conference from highly treated wastewater from the Schönerlinde sewage treatment plant in a joint initiative by the company Xylem, the Berliner Wasserbetriebe and the Kompetenzzentrum Wasser Berlin. The Reuse Brew impressively demonstrates that there is nearly no limit to the technical possibilities for treating wastewater to a potable standard.

Digital Solutions for Urban Water Management – Project Kick-off “DWC-Berlin”

Presentation of EU-project DWC during press conference on 5 September 2019

The European project digital-water.city (DWC) started in early June 2019 and is being managed by the Kompetenzzentrum Wasser Berlin. The project aims to develop digital solutions for water management. 24 partners from 10 European countries are involved in the project which will run until 2022. In Berlin, specific activities are planned, which will be implemented in close cooperation between the municipality, water utilities, research institutions and key players in digitisation and water management innovation. To ensure the necessary professional exchange and knowledge transfer, corresponding workshops will take place at regular intervals. As part of a kick-off event at CityLAB Berlin, the project “digital-water.city” was presented to Berlin stakeholders. The attendants agreed upon the organisation and design of the future workshop series “DWC-Berlin”.

Berlin Water Workshop

Water Workshop no 48 in cooperation with German Institute of Urban Affairs (Difu)

The event series “Berlin Water Workshop” created in 2004 by the KWB for the Berlin water professionals, was continued with three events. In Berlin’s water research landscape, this series has developed into a brand for scientifically sound information stimulating the dialogue between water professionals. The event’s format is at the same time the formula for its success: consolidation of current water (research) topics, which are presented in a tight timeframe of two hours in the early evening and a subsequent get-together. The topics dealt with in 2019 focused on "Advanced wastewater treatment with constructed wetlands", "Entering the age of phosphorus recycling" and "Urban climate and water", the latter in cooperation with and at the premises of the German Institute for Urban Affairs (DifU). All presentations held are available on the KWB website.

MEMBERSHIPS

DPP Deutsche Phosphor-Plattform e.V.

The German Phosphorus-Platform DPP is a network to establish phosphorus recovery as well as the sustainable use of recycled products.

deutsche-phosphor-plattform.de

Deutsche Vereinigung für Wasserwirtschaft

The German Association for Water, Wastewater and Waste is a politically and economically independent association supporting sustainable water management and the promotion of research and development.

dwa.de

German Water Partnership

German Water Partnership is a network of private and public companies from the water sector involving commercial enterprises and research institutions.

germanwaterpartnership.de

IAH International Association of Hydrogeologist

The International Association of Hydrogeologists (IAH/AIH) is a scientific organisation for professionals dealing with groundwater issues.

Iah.org

International Ozone Association

The International Ozone Association is a non-profit organisation established to foster the world-wide scientific dialogue and research activities on all aspects of technical ozone applications.

ioa-ea3g.org

International Water Association

The International Water Association is the largest membership association for water professionals in the global water sector.

iwa-network.org

The National Ground Water Association

The National Ground Water Association is the community of groundwater professionals working together to advance groundwater knowledge.

ngwa.org

Water Reuse Europe

Water Reuse Europe is a not-for-profit association aiming to share good practices, knowledge, techniques, research, and experiences on water reuse.

water-reuse-Europe.org

Watershare®

Watershare® is a water knowledge platform initiated by the Dutch KWR Watercycle Research Institute.

watershare.eu

Water Europe

Water Europe was initiated by the European Commission (EC) in 2004 as the European Technology Platform (ETP) for water with the name WssTP to improve coordination and collaboration in the European water sector and beyond.

waterEurope.eu

KOMPETENZZENTRUM WasserBerlin

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