Press release

Clean water for the future

The worldwide first semicentralized Resource and Recovery Center (RRC) is opened in Qingdao, P.R. China

On the occasion of the "World Horticulture Exposition 2014" (WHE) in Qingdao, China, the Resource and Recovery Center (RRC) Qingdao of the project SEMIZENTRAL, will be opened April 27, 2014. It is the worldwide first reference plant following the semicentralized, integrated infrastructure approach. The center will serve approximately 12,000 people.

The opening – celebrating a milestone in innovation

On April 27, 2014, the RRC will be officially opened, with an extensive program and many high-ranking guests from China and Germany representing the fields of politics, industry, and science. The center is considered a milestone in German-Chinese knowledge transfer with global impact. It is also the result of more than 30 years of cooperative partnership between the Tongji University Shanghai and the Technische Universität Darmstadt.

WHE 2014 in an upcoming metropolis

The World Horticulture Exposition 2014 with its motto „From the Earth, for the Earth" is widely regarded as the global "Olympics of Horticulture". More than 12 million people are expected to visit the exhibition from April to October, 2014.
By organizing the WHE, the city in the eastern province of Shandong underlines its claims to realize "green" growth. This is the motivation for the City of Qingdao and the WHE Group to invest in trend-setting infrastructures: Investment as well as operating costs are financed by Chinese institutions.

At present, about 8 million people live in the emerging megacity with a rapidly increasing tendency. Besides two harbors of nationwide importance, Qingdao's economic strength is based on the electronics industry, as well as classic industry branches like chemical, metal, textile, engineering. In close cooperation with German partners in particular, the city is currently experiencing a development based on ecological and sustainable concepts that is trend-setting not only for comparable regions in China but also for the whole world.

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SEMIZENTRAL – From Darmstadt to Qingdao

For many years, Qingdao has been suffering from severe water scarcity. Only one seventh of the water amount that is regarded as the average for China is available to the city's inhabitants. As in many other metropolitan areas worldwide, water and energy play a decisive role in urban development.

Based on an idea by Prof. Dr.-Ing. Peter Cornel from the Chair of Wastewater Technology (IWAR) of the TU Darmstadt, his team, together with partners from science and industry, has initiated and continuously developed the SEMIZENTRAL approach. Their work is supported by public and private organizations.

Owing to the trend-setting infrastructure approach, the demand for fresh water as well as the amount of wastewater in the catchment area is reduced by about 30-40% each. The reuse of water (e.g. street cleaning, irrigation, firefighting) facilitates savings in significantly higher scales. Biogas and subsequently energy are generated in the RRC by co-treating sewage sludge and household biowaste. This way, the operation of the center is also energy-autarkic and largely climate-neutral. The project participants are pleased that the main objective of the project has been achieved: to have developed an adaptable, resource-efficient water infrastructure system that facilitates flexible extension according to the growth of its urban environment.

Integration and cooperation for safeguarding the future

For Dr.-Ing. Susanne Bieker, leader of the research focus SEMIZENTRAL at the TU Darmstadt, the reference plant of the SEMIZENTRAL project represents trend-setting technology for the sustainable handling of water and energy. SEMIZENTRAL in Qingdao is not only the result of a long-lasting Chinese-German partnership in research and knowledge transfer, but it also shows the fundamental significance of integrative and cooperative approaches towards a future worth living in.

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SEMIZENTRAL GERMANY

TECHNISCHE UNIVERSITÄT DARMSTADT

IWAR Wastewater Technology

SEMIZENTRAL Germany:

Joint research group

During the last 10 years, the SEMIZENTRAL approach has been developed under the general management of the Chair of Wastewater Technology, Institut IWAR, at the Technische Universität Darmstadt, in close cooperation with numerous industry partners from Germany as well as scientific partners from Germany and China. The project is supported by research funding from BMBF and MoST.

Project partners in Germany

Chair of Wastewater Technology – consortium leader (TU Darmstadt, Institut IWAR)
Kocks Consult GmbH
Endress + Hauser Conducta GmbH + Co. KG
Bilfinger Water Technologies GmbH
Emscher Wassertechnik GmbH
m+p consulting Süd GmbH
Institut für sozial-ökologische Forschung (ISOE) GmbH
Chair of Land Management, TU Darmstadt
Chair of Design and Urban Development, TU Darmstadt
Institute for Construction, TU Darmstadt
Cosalux GmbH
Far Eastern - Fernost Beratungs- und Handelsgesellschaft mbH
Gebrüder Heyl Vertriebsgesellschaft für innovative Wasseraufbereitung mbH
Fachhochschule Köln, Gummersbach Environmental Computing Center

Scientific project partners in China

Tongji University Shanghai
Qingdao Technological University

Research funding in Germany

Federal Ministry of Education and Research (BMBF)

Duration of the current project

2013 – 2016 (accompanying research during implementation)

Further information

For further information see http://semizentral.de/

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semizentral@iwar.tu-darmstadt.de

The RRC in Qingdao © Simon Gehrmann & Susanna Neunast

The SEMIZENTRAL management team at IWAR: Prof. Peter Cornel (center) with Prof. Martin Wagner (left) and Dr. Susanne Bieker (right) © IWAR, Semizentral

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SEMIZENTRAL GERMANY

TECHNISCHE UNIVERSITÄT DARMSTADT

IWAR Wastewater Technology

Frequently asked questions

SEMIZENTRAL at the World Horticultural Exposition 2014

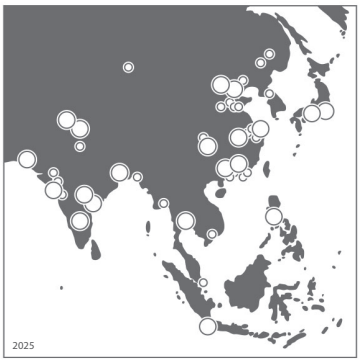
What is SEMIZENTRAL?

SEMIZENTRAL is an infrastructure approach for future cities. It is an alternative for extensive, centralized systems with long lead times and insufficient scalability. The innovative approach towards semicentralized Resource and Recovery Centers has been developed to serve new-build residential areas in fast-growing metropolitan environments. Each urban district is provided with a flexible integrative infrastructure system for water, wastewater, and waste, adaptable to the respective need.

1. The RRC in Qingdao

Where does the SEMIZENTRAL approach come from?

In the 21st century, there is a pressing need for action regarding infrastructure planning and development in fast-growing metropolitan areas. Worldwide, urban growth involves an increasing consumption of basic resources, resulting in serious consequences for infrastructure, water supply as well as the treatment and disposal of wastewater and solid wastes. Due to insufficient or non-existent treatment facilities for wastewater and waste, it is not only the quality of life that is impared, but the environment, as well, is at serious risk. In order to meet these extensive challenges, concepts that facilitate increasing resource efficiency are needed. The SEMIZENTRAL approach is such a modern, efficient and trend-setting infrastructure concept.



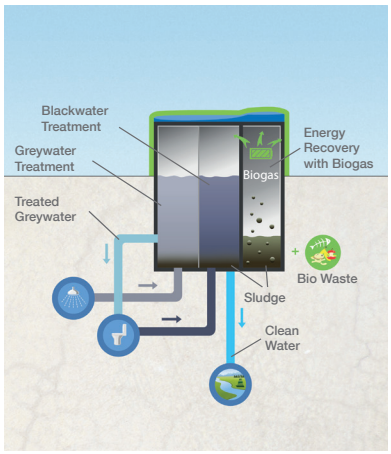
2. City growth in Asia 2025

What is the advantage in comparison to conventional systems?

SEMIZENTRAL shows an outstanding flexibility. A semicentralized Resource and Recovery Center (RRC) integrates different technologies and makes a 30-40% reduction in the drinking water demand possible, via intra-urban water management and, in parallel, reduced wastewater loads. In addition, biogas generation for energy production enables an overall energy-autarkic plant operation.

How is this done?

The SEMIZENTRAL approach combines the traditionally separated sectors of water, wastewater, waste, and energy. Before being treated in the Resource and Recovery Center, wastewater streams (so-called grey water and black water) are collected separately. Sewage sludge is co-treated with organic waste to produce biogas which in turn is used for energy generation.



3. Conceptual scheme of a semicentralized RRC

Why Qingdao?

In organizing the WHE, the megacity in the eastern province of Shandong underlines its claims to realize "green" growth. Qingdao with its 8 million inhabitants fa-ces significant water scarcity. To date, only one seventh of the water amount that is regarded as Chinese average is available to the city's inhabitants. This is the reason the city council as well as private developers invest heavily in trend-setting infrastructure systems.

What does WHE 2014 stand for and what is SEMIZENTRAL doing there?

The World Horticultural Exposition 2014 (WHE) takes place in Qingdao from April to October 2014.

The WHE is organized by the Qingdao Municipal Government and the Executive Committee of 2014 Qingdao International Horticultural Exposition. The Chinese minister Mr. Wan Gang (MoST), with the participation of all research partners and sponsors, will inaugurate the WHE, regarded as the "Olympics of Horticulture", and the SEMIZENTRAL Resource and Recovery Center on April 25, 2014. The organizers expect about 12 million visitors at the WHE, which presents the current worldwide trends and technologies in the horticulture sector.

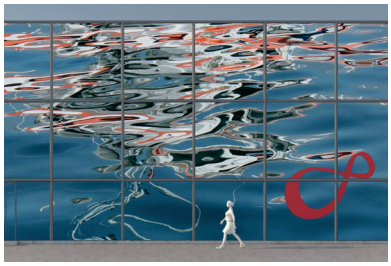
In the course of the WHE, two residential areas and a WHE village as well as two hotel complexes for a total of about 12,000 inhabitants are established. In this context, within 6 months, the semicentralized RRC Qingdao was constructed as the worldwide first reference plant. The RRC will collect and treat the settlement area's wastewater according to the SEMIZENTRAL approach. The purposes of the plant are wastewater treatment, production of service water, and the generation of biogas for energy.

Who is responsible for the artistic design of the RRC façade?

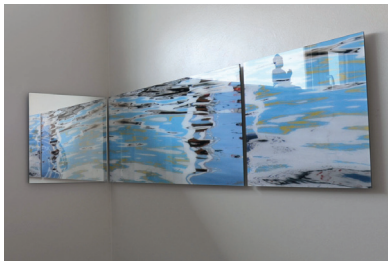
The German artist Susanna Neunast has developed an expansive art installation that decorates the outer façade of the entrance building as well as parts of the interior. She uncovers the extraordinary in the seemingly ordinary medium water. That's how Susanne Neunast captures the fascination and beauty of water to make it emotionally accessible, and she communicates unexpected perspectives of perception. Beside the artistic installation, the RRC lobby welcomes its visitors with especially developed, well-founded professional visual information installations on the plant and the semicentralized approach.

4. WHE in Qingdao

5. Ministerialdirektor Dr. Karl Eugen Huthmacher (BMBF) at the RRC consruction side in Qingdao, March 2014



6. Art installation façade – Susanna Neunast



7. Art installtion interior – Susanna Neunast

Who are the cooperation partners?

During the approximately three years of planning and operational attendance of the semicentralized RRC Qingdao, 14 partners from Germany, the Tongji University Shanghai and the Qingdao Technological University worked together in a cooperative consortium. The TU Darmstadt maintains a partnership of more than 30 years with its Chinese partners.

Project partners in Germany

Chair of Wastewater Technology – consortium leader (TU Darmstadt, Institut IWAR)
Kocks Consult GmbH
Endress + Hauser Conducta GmbH + Co. KG
Bilfinger Water Technologies GmbH
Emscher Wassertechnik GmbH
m+p consulting Süd GmbH
Institut für sozial-ökologische Forschung (ISOE) GmbH
Chair of Land Management, TU Darmstadt
Chair of Design and Urban Development, TU Darmstadt
Institute for Construction, TU Darmstadt
Cosalux GmbH
Far Eastern - Fernost Beratungs- und Handelsgesellschaft mbH
Gebrüder Heyl Vertriebsgesellschaft für innovative Wasseraufbereitung mbH
Fachhochschule Köln, Gummersbach Environmental Computing Center

Who finances the semicentralized RRC Qingdao?

Investment as well as operating costs are paid for by the WHE development company. The German Federal Ministry of Education and Research (BMFT) financed the joint research group's scientific support during implementation. MoSt supports the Chinese universities in research. The Chair of Wastewater Technology, Institut IWAR, of the TU Darmstadt heads the joint research project.

The following supporters and sponsors have made important material contributions towards the realization of the SEMIZENTRAL approach. Our sincere thanks go to:

Wilo SE (pumps and mixing devices)
Aerzner Maschinenfabrik GmbH (blowers)
Auma Riester GmbH & Co.KG (gearboxes for valves)
OTT System GmbH & Co.KG (aeration elements)
Binder GmbH (valves and electronic control devices for aeration)
LAR Process Analyzers AG (measuring technique)

From the development departments of these institutions and companies originate a multitude of innovative components and machinery. They are now part of the RRC facilities with its state-of-the-art technology. The sponsors' great commitment and extensive know-how have played a decisive role in the high-quality layout and thus the realization of the worldwide first semicentralized Resource and Recovery Center in Qingdao.

Image sources:

1 – © Simon Gehrmann & Susanna Neunast
2 – © Bieker 2009, adapted by Burdett and Rhode 2007
3, 5 – © IWAR, Semizentral
4 – © WHE www.qingdaoexpo2014.org
6– © COSALUX GmbH & Susanna Neunast
7– © Susanna Neunast

SEMIZENTRAL GERMANY

TECHNISCHE UNIVERSITÄT DARMSTADT

IWAR Wastewater Technology

SEMIZENTRAL

Integrated supply and treatment systems for fast-growing regions

1. The RRC in Qingdao

Background

In many Chinese cities, as in many growing cities in newly-industrialized and developing countries, local water resources are insufficient to supply the population with clean drinking water. This results in a pressing need for action in the affected cities. The SEMIZENTRAL approach meets the requirements for flexibility and adaptability of infrastructure systems and sets new standards in the matter of resource efficiency.

2. View of the skyline of Qingdao

Dr. Bieker, how did SEMIZENTRAL start?

Dr. Bieker: Research on the SEMIZENTRAL idea started in 2003, led by Prof. Peter Cornel, head of the Chair of Wastewater Technology at the Institut IWAR. Since then, investigations regarding different research aspects have been and are stilled carried out together with partners from Germany and China, always focusing on an integrated infrastructure approach with high flexibility, adaptability, and resource efficiency. On the German side, research is funded by the Federal Ministry of Education and Research (BMFT), on the Chinese side by the Ministry of Science and Technology (MoST).

What are the advantages of the SEMIZENTRAL approach?

Dr. Bieker: Generally, conventional infrastructure systems are centralized systems. With respect to wastewater treatment in China, this means, wastewater from millions of people is collected in one system and transported to the wastewater treatment plant. In Shanghai, there are sewers with diameter the size of train tunnels. The advantages of these centralized systems are the many years of operating experience and professional operation. However, there are various disadvantages: long lead times for planning and implementation, long periods of under-utilization, high capital lockup and therefore a high path dependency. That is why they are not flexible and only adaptable to changing conditions to a very limited extent. In contrast to these centralized systems there are decentralized systems, forming small units, on building level for example. However, so far, it is not possible to operate such systems in a professional way, excluding them as a serious alternative in densely populated urban areas due to hygiene problems.

Is this the challenge the research project addresses?

Dr. Bieker: Yes. SEMIZENTRAL occupies a position between centralized and decentralized. It eliminates the drawbacks of the classical approaches and combines their benefits. In other words: We are “as large as necessary” to enable professional operation and “as small as possible” to work resource-efficient by closing material cycles on a small scale.

What is the focus of SEMIZENTRAL?

Dr. Bieker: In addition to the scale of the system, SEMIZENTRAL focuses on the integration of the infrastructure sectors water, wastewater, waste, and energy. This enables the interaction and coordination between the sectors and creates synergy effects, such as the reduction in water demand by 30% and more. It also facilitates the energy-autarkic operation of the Resource and Recovery Center and contributes to greenhouse gas reduction.

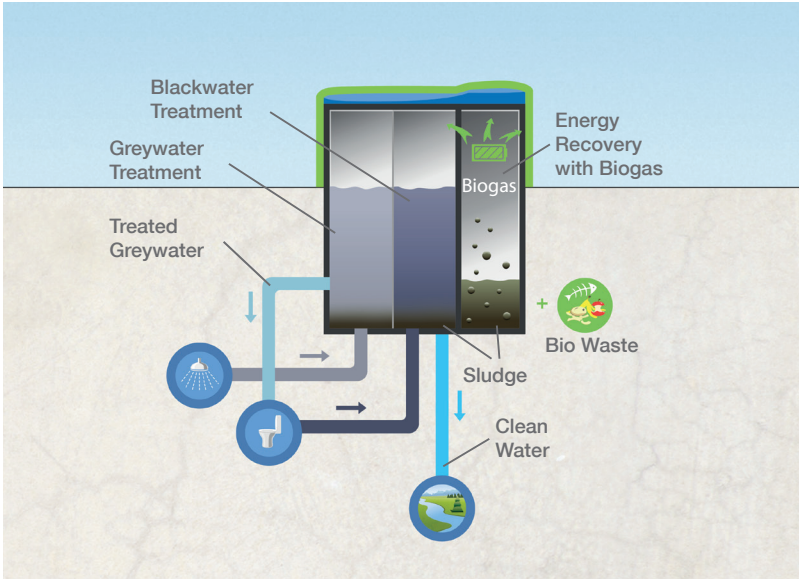
Thank you very much for this interview.

3. Dr. Susanne Bieker, TU Darmstadt/IWAR

Since 2009, Dr. Susanne Bieker heads the interdisciplinary research focus SEMIZENTRAL at the Institut IWAR of TU Darmstadt. In this interview she explains the innovative supply and treatment approach for fast-growing urban areas in the 21st century.

The concept

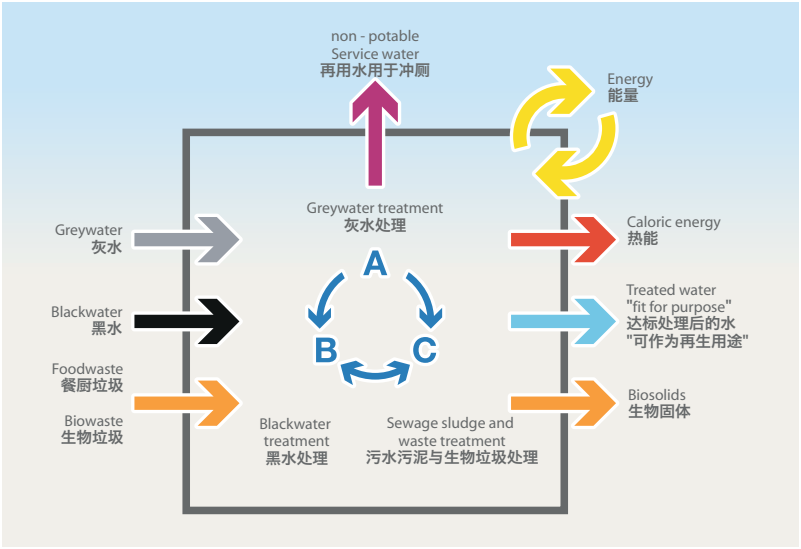
The unique characteristic of SEMIZENTRAL is its integrated approach. Conventional systems focus on the strict separation of water supply, wastewater treatment, and waste treatment. In contrast, SEMIZENTRAL integrates these sectors into a holistic approach. It enables the coordination between the sectors, creating synergy effects such as energy-autarkic operation and the reduction of greenhouse gases. Compared to conventional centralized infrastructure systems for water supply and wastewater treatment, the benefits are the potential for at least a 30-40% reduction in water demand, energy conservation (covering the energy demand of the RRC for wastewater and waste treatment through its own generation of biogas), greatly reduced transport demand, round-the-clock guarantee of water supply with consistent quality, as well as substantial planning and capital cost security.
The approach was presented for the first time to the general public at the Expo 2010 in Shanghai.



4. Visualization of a Resource and Recovery Center (RRC)

Integrated approach

Semi-centralized supply and treatment systems offer a future-oriented and resource-conserving alternative to conventional centralized systems. They consist of three process units. Module A covers greywater treatment. Wastewater from showers and washing machines is treated and reused as service water for toilet flushing. This reduces daily water consumption by almost one third. In module B, blackwater from toilets and kitchen drains is treated. Module C – the energy center – includes the anaerobic (thermophilic) treatment of biowaste and sewage sludge from modules A and B. The resulting biogas is used for the production of electricity. The generated amount of heat and electricity is, in total, sufficient for all other treatment processes in the RRC.



5. Functional scheme of a semicentralized Resource and Recovery Center

Water and energy for Qingdao

On June 27, 2011, in the presence of Premier Wen Jiabao and Federal Chancellor Dr. Angela Merkel, a joint declaration on the research and innovation program "Clean Water" was signed by the Chinese Ministry of Science and Technology (MoST) and the German Federal Ministry of Education and Research (BMBF). This declaration is the basis for the construction of the first semi-centralized RRC in China, in Qingdao.

Investments and operation are provided by the Chinese side. The development company of the World Horticultural Exposition, WHE 2014, in Qingdao, has joined the project as an investor and the operator is the Qingdao Water Group.

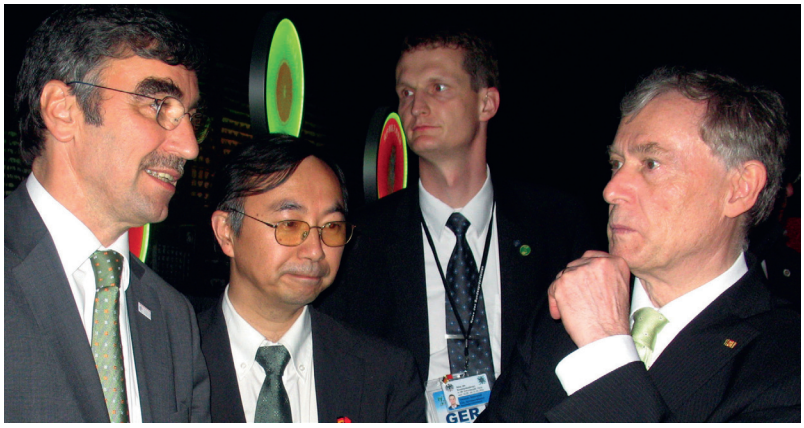
On the research side, the Technische Universität Darmstadt, the Tongji University Shanghai, and the Qingdao Technological University are working together. The accompanying research undertaken by the 14 partners is supported by the German Federal Ministry of Education and Research.

Since 2004, the SEMIZENTRAL research has been financed by the German Federal Ministry of Education and Research (BMBF) and the Chinese Ministry of Science and Technology (MoST). In addition, in 2011, the project succeeded in adding the organizers of the World Horticulture Exposition as investors and operators. Besides the implementation of the worldwide first RRC, a showcase for vacuum technology has been realized in the ShiYuan building on the WHE site.

6. Ministerialdirektor Dr. Huthmacher visiting the RRC construction site, March 2014

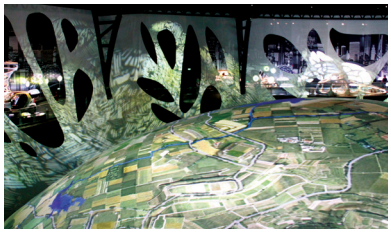
7. RRC construction site, Qingdao, March 2014

Shanghai EXPO 2010



8. Prof. Cornel (TU Darmstadt, li.) and Prof. Dai (Tongji University, second from left) in a conversation with the German Federal President Köhler (right) during his visit at the EXPO Shanghai 2010

10. View of the Botanical Pavilion at the WHE 2014



9. View of the central exhibit of the Urban Planet Pavilion: media show "Planet Earth"

11. View of the exhibits in the Urban Planet Pavilion at the EXPO Shanghai 2010

A SEMIZENTRAL RRC for the WHE 2014

The RRC was built in close proximity to the exhibition area of the WHE. The WHE (World Horticulture Exposition) is regarded as the "Olympics" of the horticulture sector. The area surrounding the RRC contains in total, three new residential areas, an offi ce complex, and two hotel complexes. In keeping with SEMIZENTRAL's approach, greywater and blackwater will be collected and treated separately. The accruing sewage sludge, together with leftovers, will be used to generate energy.

SEMIZENTRAL – a project of many partners

Prof. Peter Cornel is the "conceptual father" of the SEMIZENTRAL approach. Together with his team, he leads the joint research group that includes partners from science and industry. What is so special, is the realization of the project on an industrial scale. This became possible through more than 30 years of partnership with the Tongji University Shanghai, whereby Prof. Martin Wagner, a member of the team, acted as the liaison for this work during the entire period. This has provided the basis for forming a consortium of 14 partners who will now support the operation scientifi cally. The project demonstrates that such landmark cooperation between research institutions and private enterprises makes it possible to meet future challenges of supplying and treating water in cities.

With respect to SEMIZENTRAL research, numerous scientists at respected universities in Darmstadt, Shanghai, and Qingdao have been cooperating since 2003. The highest recognition that this Chinese-German partnership has received, to date, was the acknowledgement at the EXPO 2010 in Shanghai, that the research provides a trend-setting solution for future cities. The fi rst RRC worldwide implemented as part of the WHE 2014 in Qingdao, represents a further milestone for German-Chinese cooperation.

TECHNISCHE UNIVERSITÄT DARMSTADT

12. Prof. Dr.-Ing. Peter Cornel Institut IWAR

13. Prof. Dr.-Ing. Martin Wagner Institut IWAR

14. Prof. Bi Xuejun (TU Qingdao), head of the local planning team

15. Prof. Chen Hongbin (Tongji University), coordinator of the planning team

16. Dai Xiaohu (Tongji University), head of the planning team China

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

TECHNISCHE UNIVERSITÄT DARMSTADT
Institut für Baubetrieb

IWAR Wastewater Technology

Institut für sozial-ökologische Forschung

est fachgebiet entwerfen und stadtentwicklung

TU DARMSTADT
FG LANDMANAGMENT

EMSCHER WASSERTECHNIK GmbH

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KOCKS INGENIEURE

BILFINGER WATER TECHNOLOGIES

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COSALUX

Far Eastern Consulting

HEYL NEOMERIS

Fachhochschule Köln
Cologne University of Applied Sciences

Gummersbach Environmental Computing Center GECO

SEMIZENTRAL and its important sponsors

Six sponsors have contributed decisive support for the realization of the SEMIZENTRAL concept. Their great commitment and invaluable know-how made it possible to provide the semi-centralized RRC facility with state-of-the-art technology. It incorporates many trend-setting components supplied by the sponsors that had to be brought together and coordinated with high precision during the planning phase. This high-quality equipment makes it possible to validate the SEMIZENTRAL approach on a large, industrially realistic scale and will contribute to its future propagation.

AERZEN

AERZEN blowers and compressors supply industrial facilities worldwide with gaseous media. Experience collected in 150 years of company history is reflected in their innovative mechanical engineering. Their range of products includes rotary lobe compressors, positive displacement blowers, turbo blowers, screw compressors, and gas meters. AERZEN's blowers, compressors, and gas meters are quality controlled and certified according DIN EN ISO 9001. The spectrum covers standard products as well as customized special-purpose solutions. In addition, AERZEN's after-sales service offers a complete range of services, from all-inclusive maintenance contracts to repair and modernization of existing plants.

auma®
Solutions for a world in motion

No industrial process without automation. No automation without actuators. Actuators are the decisive components for the safe and economical transport of gases, liquids, sludges and granules through the pipes of industrial plants. In every plant and in every industrial process, the various energy and material flows develop individually and as novelties. Optimal control demands a flexible and modular concept that can, on the one hand, provide customized responses to specific requirements and, on the other hand, offer maximum reliability and safety. This is exactly the AUMA concept: Solutions for a world in motion.

wilo

The Wilo Group is one of the world's leading manufacturers of pumps and pump systems for heating, ventilation and air conditioning as well as water supply and sewage disposal. With a firm focus on the future, the company is heavily involved in research and development and increasingly markets itself as a system supplier rather than a manufacturer of individual products. In the international pumps market, Wilo is synonymous with high-tech solutions. The Wilo Group supports the innovative and future-oriented SEMIZENTRAL project of the Technische Universität Darmstadt in Qingdao, China, with its products.

BINDERGROUP MEASUREMENT & CONTROL

For several decades, the BinderGroup in Germany has been manufacturing gas meters and related products for use in wastewater treatment plants. VACOMASS® is a unique modular system, based on building blocks, for the air distribution and control in aeration tanks. Only the precise calibration of the air fl ow meter in the CAMASS®-calibration technique and the system integration in the air distribution system guarantees the optimal interaction of the system components. The main advantages for the operator are the high process stability and the reduction of energy costs. The thermic COMBIMASS® gas meter and the COMBIMASS® gas analyzer can be used to monitor and control the formation of gas in purification plants. Mobile and stationary analysis tools identify the typical components in the gas.

OTT GROUP

For more than 25 years, OTT has had a passion for quality and effi ciency in biological wastewater treatment. The company manufactures fi ne bubble tube diff users as well as the modular AirRex® piping system. OTT also develops and installs highperformance aeration systems for municipal and industrial wastewater processing. With its HE® program, OTT off ers customers comprehensive options for sustainable energy savings and optimization of aeration systems in their wastewater treatment plants.

LAR PROCESS ANALYSERS AG

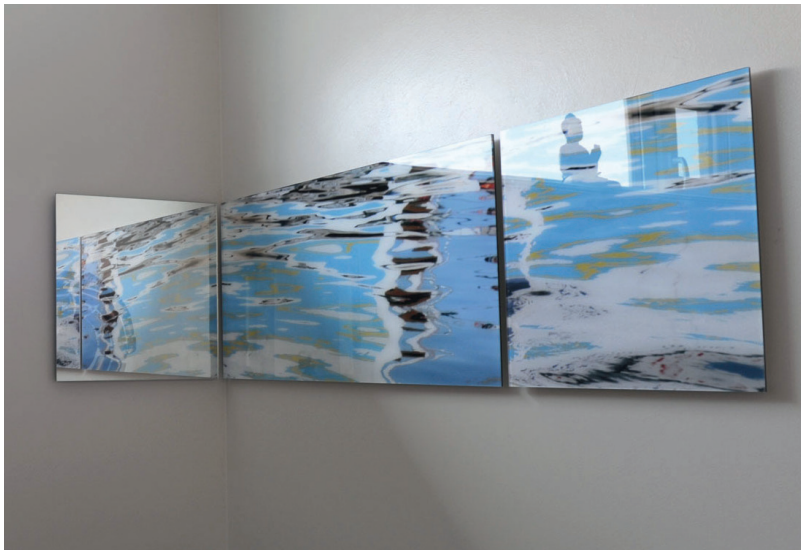
LAR Process Analysers AG is a leading supplier of online analyzers for the determination of important sum parameters in water like TOC, COD, BOD, TNb, TP and toxicity. A patented sample withdrawal system, as well as product add-ons and relevant services are also part of the product range off ered by LAR AG. The analyzers are deployed in industrial and municipal wastewater technology, process monitoring, and pure water analysis for condensation water and pharmaceutical water (HPW, WFI). The LAR AG online-analyzers help to control industrial plants and to optimize processes. Due to the steadily increasing signifi cance of environmental protection, their technological market leadership – made in Berlin – ensures their participation in the water resources market in the future.

17. Façade of the Qingdao RRC: Art installation by Susanna Neunast

SEMIZENTRAL offers unexpected perspectives

The artist Susanna Neunast has occupied herself for many years with the topic "water". She captures the fascination and beauty of water to make it emotionally accessible and, with her photos, creates an unexpected view of this apparently well-known element. With Susanna Neunast's installations in and around the RRC, water becomes part of the building. A large, refl ecting water surface – a central element of the facade – draws the attention of visitors to the uniqueness of the building from afar. When visitors enter the building, they become part of the moving water surface.

The RRC lobby becomes a spatial installation with the visitor in the center. In the installation, which consists of water photos and numerous mirrors that simulate a moving water surface, viewers become part of the water. The reflections of the water photos and of the visitors merge to form a new entity.

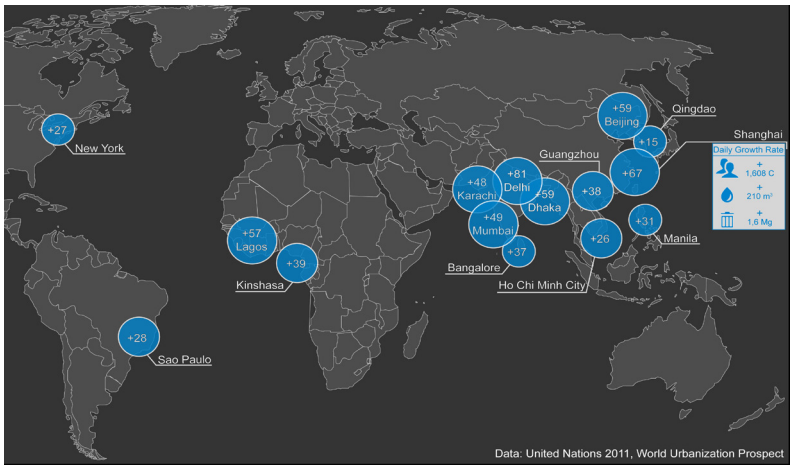


18. Art installation of the RRC interior by Susanna Neunast

Prospects with SEMIZENTRAL

In the 21st century, there is an enormous need for action regarding infrastructure planning and development in fast-growing metropolitan areas. Worldwide, urban growth involves an increasing consumption of basic resources, resulting in serious consequences for infrastructure, water supply as well as the treatment and disposal of wastewater and solid wastes.

IDue to insufficient or non-existent treating facilities for wastewater and waste it is not only the quality of life that is impaired in many regions in the world. The environment, as well, is at serious risk. Resource-efficient concepts are needed. The SEMIZENTRAL approach is such a concept – resource-efficient via the application of state-of-the art technologies, and flexible enough to meet the challenges the world will face in the future.



19. Urban growth and associated resource requirements: persons per hour

(source: Bieker 2009, adapted by Burdett and Rhode 2007)

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SEMIZENTRAL in Qingdao

Technical Information – Semicentralized Resource Recovery Center (RRC)

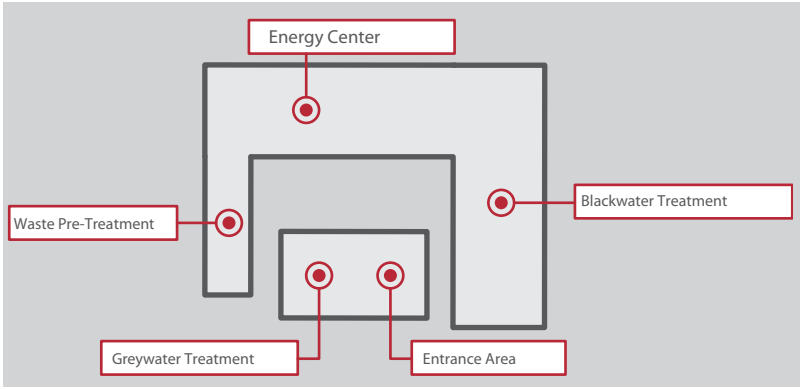
The SEMIZENTRAL Approach

In many fast-growing urban areas resources are scarce. Cities are challenged by the great demand for drinking water and energy as well rapidly increasing amounts of wastewater and waste.

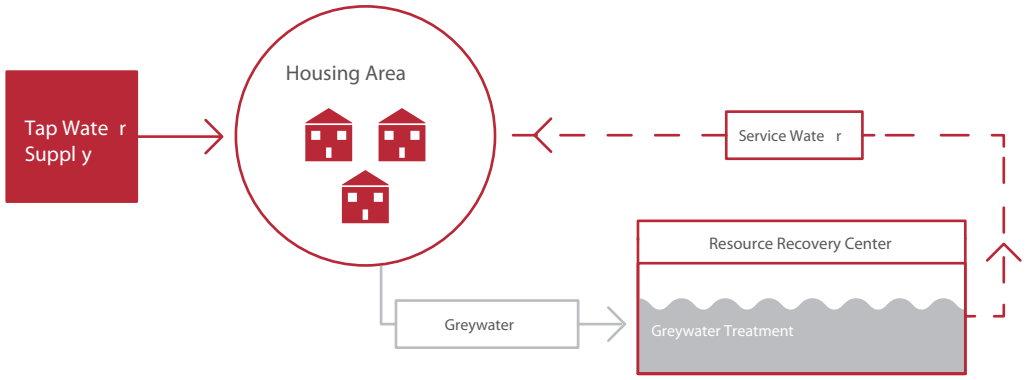
One possible approach to address these challenges are so-called semicentralized supply and treatment systems. These systems focus on the integrative assessment of the different material and energy flows, in particular considering water, wastewater and waste.

In contrast to conventional wastewater treatment plants, the treatment of waste and wastewater in semicentralized supply and treatment systems is carried out in so-called semicentralized Resource Recovery Centers (cf. Fig. 1) that are located close to the consumers. All treatment steps/units are established in only one building. This way, floor space requirements for treatment (and thus investment costs for land purchase) are reduced and disturbing emissions are prevented. By co-treating biowaste from the adjoining settlement area and sewage sludge biogas production increases, thus facilitating the energy-autarkic operation of the RRC.

One of the key components of SEMIZENTRAL is the reuse - after treatment and disinfection - of the partial wastewater flow that derives from showers and washing machines. This way, the daily demand for fresh water is reduced by 30-40%, resulting also in the reduction in the amount of treated wastewater to be discharged into water bodies. Besides, significant savings in energy are another advantage.



1. RRC Qingdao – building units and their functions



2. Greywater collection and treatment in semicentralized supply and treatment systems

Technical process in the semicentralized RRC in Qingdao

The innovative approach on semicentralized supply and treatment systems was developed for application in new settlement areas in fast growing urban areas in China. Basically, the SEMIZENTRAL approach is process-neutral, i.e. it defines the conceptual frame of material separation and integration, however does not specify the processes to be applied in the single treatment steps.

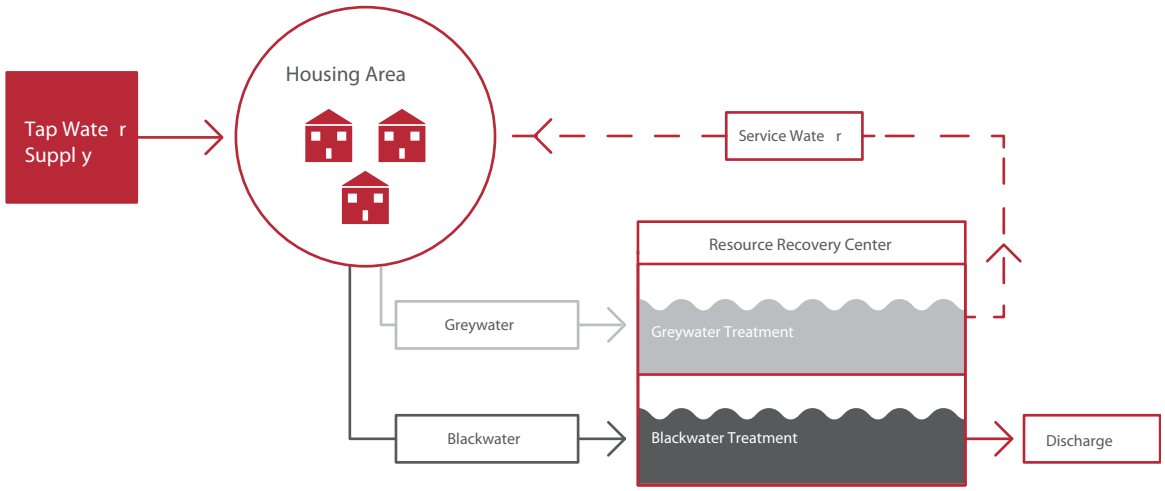
Separate collection and treatment of wastewater flows

In each household, wastewater flows from showers, hand washbasins and washing machines are collected separately as so-called greywater. They are conveyed separately from kitchen and toilet wastewater, the so-called blackwater (cf. Fig. 2 and Fig. 3). The wastewater flows are transported to a semicentralized Resource Recovery Center (RRC) that is assigned to the respective settlement area and, in the case of Qingdao, serves 12,000 inhabitants. As in the People's Republic of China, new settlement area are mostly developed as (purely) residential areas with few industrial facilities, treatment of industrial wastewater is normally not accounted for in the RRC.

The specialty of the Qingdao location is the composition of the RRC catchment area: Beside residential areas, there is a large administration center with guest houses (the so-called WHE village) as well as two hotel complexes within the semicentralized supply and treatment system.

Greywater treatment consists of mechanic pre-treatment, biological treatment (elimination of organic carbon compounds) and disinfection. In order to meet the strict quality standards for service water, biological treatment in a membrane bioreactor (MBR) is advisable. Via membrane filtration particles and bacteria are retained very well. After disinfection by chlorine the treated greywater is discharged - as service water - into a separate (from the drinking water system) pressure system. The semicentralized RRC Qingdao will provide service water for toilet flushing to the consumers within the WHE village. In addition, service water is used for street cleaning.

Kitchen and toilet wastewater, so-called blackwater, is also conveyed to the RRC and treated separately from greywater (cf. Fig. 3). In contrast to greywater treatment and due to the specific composition of blackwater, the elimination of nutrients is required in addition to the elimination of carbon compounds. In case the treated blackwater is to be discharged into a water body, the treatment process might be simpler in comparison to greywater treatment, e.g. the sequencing batch reactor (SBR). In the case of the RRC Qingdao, the world-wide first implemented RRC, the MBR process was chosen, as the treated wastewater is to be used for irrigation in the WHE village. According to the legal requirements, chlorine disinfection is requisite for water reuse in irrigation.



3. Collection, treatment and discharge of blackwater in semicentralized supply and treatment systems

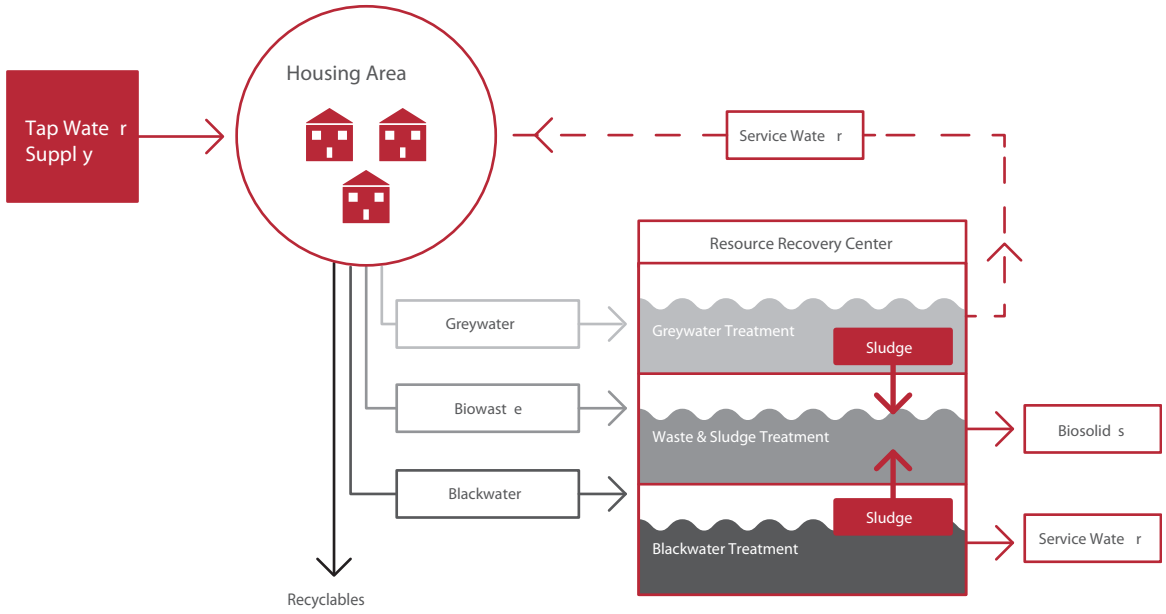
Waste and sewage sludge treatment

The third important material flow within the semicentralized system is biowaste. After pre-treatment, biowaste can be treated together with the sludge that accumulates during wastewater treatment. Depending on the local boundary conditions and the accruing waste streams, biowaste generated outside the households can be treated in the RRC, as well. Accordingly, biowaste from local restaurants and canteens is co-treated in the RRC Qingdao.

Waste to be co-treated with sewage sludge (cf. Fig. 4) has to be pre-treated. The objectives are elimination of interfering substances (e.g. plastic, chopsticks, crockery) and waste homogenization. Following the separation of interfering substances, shredding and mashing, the biowaste is mixed with sewage sludge. The mixture is then fed to the digester for biological treatment. The waste/sewage sludge mixture is degraded under thermophilic anaerobic conditions, resulting in the generation of biogas. Given a sufficient retention time (20 days), the hygienization of the treated material is sufficient for applying the digestate in agriculture, as so-called biosolids.

Before the material can be applied, it has to be dewatered (e.g. via chamber filter press), to achieve a sufficient solids contents. This process also results in a highly loaded wastewater flow (rejected water) that can to be pre-treated (e.g. de-ammonification) or fed directly into the blackwater treatment unit.

In the areas of waste and sewage sludge treatment in particular, but also in the other parts of the RRC the collection and treatment of the waste air flows is essential to prevent (odor) emissions. At the Qingdao RRC, waste air is treated via biofilter.



4. Integrated waste and sewage sludge treatment in semicentralized supply and treatment systems

Biogas and energy generation

In the RRC, biogas deriving from anaerobic treatment is used for internal energy recovery. A combined heat and power unit (CHP) generates electricity and heat from biogas. Heat from a CHP can also be used outside the RRC: It is possible to pre-heat water streams via the RRC's waste heat, e.g. for laundries or swimming pools. In Qingdao, however, this way of energetic optimization was not feasible.

The heat is exclusively used for processes within the RRC (e.g. heating the waste/sewage sludge mixture). Generated electricity is used for RRC operational tasks, as well. By co-treating waste flows the biogas yield increases to such a degree that an overall energy-autarkic operation is possible.