

Young Water Professionals Programme 2010 in Munich (IFAT/Entsorga)



September 12 – September 17, 2010

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Participants of the Programme:

Sponsored by DBU (Knowledge Transfer Programme and Alumnis):

- Venera Asenova, Bulgaria
- Vera Asenova, Bulgaria
- Maya Baneva, Bulgaria
- Igor Bojadjiski, Macedonia
- Ana Borisavljevic, Serbia
- Boyan Borisov, Bulgaria
- Mihai Grozavescu, Romania
- Paulius Gutauskas, Lithuania
- Tanya Igneva-Danova, Bulgaria
- Milica Jovanova, Macedonia
- Kalina Kalcheva, Bulgaria
- Mariana Petrova Koleva, Bulgaria
- Marcela Krenkova, Czech Republic
- Laura Mähar, Estonia
- Marius Marcu, Romania
- Cristina-Maria Medrea, Romania
- Daniel Mihai, Romania
- Stefan Musat, Romania
- Anna Pakuluk, Poland
- Dejan Peric, Serbia
- Radu Pop, Romania
- Joanna Sieradocha, Poland
- Eduard Adrian Stan, Romania
- Marina Stoykova, Bulgaria
- Nadezhda Taneva, Bulgaria
- Eszter Toth, Hungary
- Razvan Vaida, Romania
- Valentina Vladimirova, Bulgaria
- Magdalina Zaharieva, Bulgaria



Sponsored by IPSWaT:

- Farzana Afreen, Bangladesh
- Firas Hameed Al-Janabi, Iraq
- Wifag Hassan Mahmoud, Sudan
- Tohidul Islam, Bangladesh
- Shyamal Karmakar, Bangladesh
- Megenagna Tadesse Minalu, Ethiopia
- Santosh Nepal, Nepal
- Benjamin Sarfo Okrah, Ghana
- Vanesa Rodriguez, Bolivia
- Ruth Schaldach, Germany
- Mohammad Salah Uddin, Bangladesh
- Thi Yen Phi Vo, Vietnam
- Dorothea Weingärtner, Germany
- Tekalegn Ayele Woldesenbet, Ethiopia
- Ke Zhu, China



Dank an die Messe München für die Einladung zur Eröffnungsfeier und die weitere großzügiger Unterstützung!



Evaluation

Young Water Professionals Programme 2010

1=very good

2=good

3=satisfactory

4=not so good

Average:		1,50
Programme in general	1,65	
Applicability/usefulness of the programme	1,46	
Career Event (12.09.2010)	1,37	
EWA - Symposium on Sustainable Water Management (14.09.2010)	1,95	
EWA - Symposium on Sustainable Water Management (15.09.2010)	1,84	
Excursion Munich Water Works	1,24	
Excursion Wastewater Treatment Plant	1,08	
Excursion to Channel Building Site	1,39	
Communication between group members	1,28	
Communication with guide	1,30	
Group atmosphere	1,28	
Opening festivity	1,29	
Standparty	1,77	
Sightseeing	1,86	
Expectations met?	1,68	

THE 2ND IWA YOUNG WATER PROFESSIONALS WORKSHOP



12TH SEPTEMBER

MUNICH

Presented by:

Farzana Afreen, Bangladesh

Firas Hammed Al-Janabi, Iraq

Boyan Borisov, Bulgaria

Maya Baneva, Bulgaria

Wifag Hassan Mahmoud, Sudan

Thomas Pochwyt, Germany

Valentina Vladimirova, Bulgaria - Guide

Tekalegn Ayele Woldesenbet, Ethiopia

Ke Zhu, China

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Introduction:

This year the 9th Young Water Professionals (9YWP) Program, which is yearly organized by the German Association for Water, Wastewater, and Wastes (DWA), took place from 12 – 17 September in Munich within the vicinity of IFAT Entsorga 2010.

The YWP program launched on September 12th with the 2nd IWA YWP workshop named Career Event. The workshop consisted of three sessions with numerous presentations, where tomorrow challenges in water sector and the career development opportunities for the YWP have been presented and discussed. This report is meant to highlight in details the objectives of the workshop.

I. Meeting Tomorrow's Challenges – What YWPs can do for the Water Sector

1. Future Developments of the water sector , Ruediger Heidebrecht, DWA

At the opening presentation Mr. Heidebrecht has outlined that the water sector faces deep changes. He has emphasized the changing challenges that civil engineers must consider when realising their projects. Through the past decades engineers in general had to rely mainly on their knowledge just about a specific area. Meanwhile, in the last years civil engineering has become more and more holistic. The main challenge nowadays is to manage to integrate a wide range of aspects such as adapting social and transboundary issues, landscape planning etc.

When it comes to river management planning, the European Water Framework Directive advises the river managers to consider the whole river catchment including groundwater protection.

The tasks of the river management planning are shown at the example of the Ruhrverband situated in Essen. Reservoir and discharge management are organised in the area of catchment of the Ruhr by the Ruhrverband. Problems that have occurred when including public into decision processes have been shown by the Dhuenn-Project of the Wupperverband.

Other challenges that have a link between each other:

- Climate change;
- Water scarcity problems in certain regions;
- Flood protection etc.

Being involved in a network of expertise, inventing a harmonising standard systems, implementing alternative processes into the considerations and using a proper safety management are some of the steps that should be made by the decision makers and can finally lead to a better workflow. The aim of all these is to make a widely accepted decision.

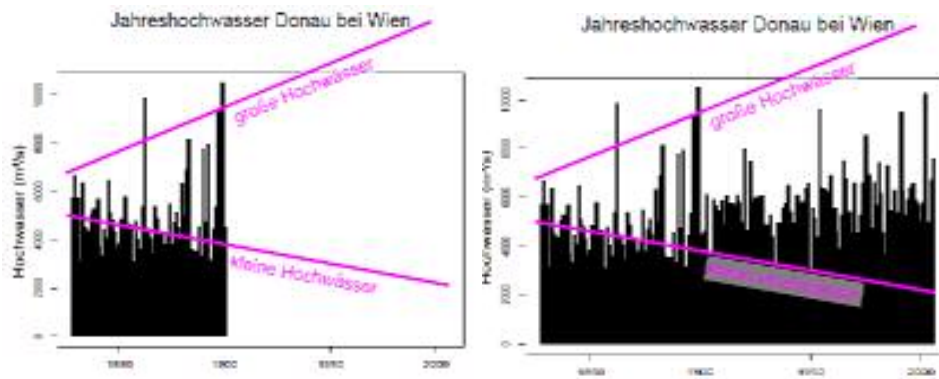
2. Climate Change and Water Management, Helmut Kroiss, Institute for Water Quality, Resources and Waste Management, TU Wien

Climate influences on water quantity and quality depends on the specific local situation. It's a slow process (decades, centuries) and may have natural or anthropogenic causes. Weather conditions at a location (region) cause changes in water flow and availability and quality from hour to hour, from day to day, from year to year and also from decade to decade with much higher variability than climate change.

For development of an adaptation strategy for water management it is necessary to have a team of experts in the area of climatology, hydrology and water quality management. When it comes to strategy, it is necessary to evaluate the statements according to their scientific basis. Climate models are based on physics and relate the temperature increase to the increase of CO₂, CH₄ and N₂O concentrations in the atmosphere.

Models, Data analysis, Trend analysis (past), Scenarios (future) and Uncertainty considerations are one of the most common used tools.

High flow trend analysis



Source: Mr Helmut Kroiss's Presentation

II. Career Compass - Opportunities for developing the YWP's career

1. International careers in the water sector - Professor Jackson Roehrig, University of Applied Science, Cologne

Professor Roehrig has presented the international careers in the water sector and has gave details about the water sector itself, the national and international employers, the disciplines and the skills required.

He mentioned that the water sector can be divided into the following groups: drinking water supply, urban drainage, river basin management, irrigation and drainage, hydropower and navigation.

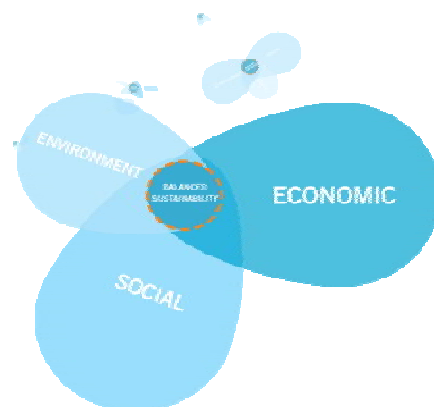
The national employers that provide interesting career opportunities to the young water professionals are the planning and consulting bureaus, the construction companies, the subcontractors, the different industries and laboratories, the river basin and governmental agencies, the universities and the NGOs. There are also a great number of international employers on the market such as the World Bank, the ADB and the IADB, some scientific -technical co-operations, e.g. GTZ, DED, DANIDA, etc., a lot of planning and construction companies and NGOs.

As it appears, all these employers are interested mainly into hiring young professionals capable of one or more of the three main disciplines - Engineering, Natural Science and

Human Science. Important skills that are required are the interdisciplinary teamwork and thinking, the fluency in different languages, the ability of mobility and last but not least - of intercultural competence.

2. PÖYRY: Gateway to global Consulting and Engineering, Kathrin Haid

PÖYRY is a global consultancy and engineering company dedicated to the balanced sustainability. It has been involved in projects concerning sustainable dimension for decades. Balanced sustainability is a holistic, multidimensional approach to sustainability strives to achieve a balance between economic, environmental, social dimensions, as most appropriate to the nature of the project and PÖYRY is working with all these.



Source: Ms Kathrin Haid Presentation

The company sees its vision as the globally thought leader in engineering balanced sustainability for a complex world. Therefore, the organization provides services in various fields of engineering that includes management consulting, environment, and water supply and sanitation; among others. Many projects are already executed worldwide (Middle East, Africa, South America, Asia, and Europe).

Pöyry contributes to the development of the YWP career by offering a two years entry program to junior professionals. During this period, the junior professional will be get to be part of the industrial consulting business as well as to be a member of team of professionals, technical know-how and regional experts. Beside the professional development in Germany and abroad, monthly allowance and accommodation, among others, are provided during the project stay.

Requirements:

Some requirements to become a part of the organization are as follows:

- Interest in working on projects abroad in the long term
- Motivation and commitment
- Autonomous and a team player
- Open-minded and cosmopolitan
- Master or Diploma degree in civil / environmental engineering
- Master or Diploma degree in electrical or mechanical engineering
- Fluency in English and good knowledge of either French, Spanish or Portuguese

**3. Working for a Research Organisation, Mr Maximilian Grau, EAWAG -
Swiss federal institute for science and technology**

In the first part of the presentation there was an overview of the main structure of the way any research works. The identification of scientific questions in water sector has to begin right after identification and analysis of all the large scale problems. There are many of those in the Water sector: Water quality treatment, water supply, water resource management, etc.

A good example of a large scale problem is the fact that 1,1 billion people have absolutely no access to protected and clean water. In this field the group of EAWAG have the task to develop a simple and easy to maintain device which can assure water appropriate for domestic needs. The device works as a part of decentralized purifying system and needs only gravity. Such a device can be called purifying membrane.

It is interesting to mention that after developing the prototype a difference between the expectation and the results regarding changing of flow capacity during the time of operation has occurred.

A particular problem that the presenter has been researching is the structure of cake /layer which is created by waste in the feed water/ above the membrane itself. It is interesting to compare the difference models of formation of the cake and the real macro pictures made by microscope.

The structure of cake impacts on flow capacity and quality of purified water. Some of the factors that influence the type of cake are pressure, temperature, TOC, etc.

It is very important to publish the results of the research. It is better to publish it in a referenced magazine, for example the issues of IWA.

Of course the main result of this example of a research is the information and knowledge, needed by industry to develop a prototype and to produce a device. The presenter has used amusing way to describe one typical day of the researcher – checking experiments and from time to time developing new ideas.

It was also presented some ways how to get in research organization as well as duration of different steps in different paths in the research carrier was mentioned. Furthermore some advantages of the researchers' carrier were elaborated.

4. Working for a technology supplier - Sr. Application Development Engineer Katariina Majamaa, Dow Water & Process Solutions

Dow Water & Process Solutions is a purification and separation technology supplier leader, offering advance ion exchange and membrane technology, which is used to improve human health and enables success and well-being to both the customers and the millions of people they serve.

The main activities of the company are:

- Markets and applications
- Industrial process water
- Chemical processing
- Food and beverage
- Waste and water reuse

The commercial roles and the R&D roles are the two typical career paths that are applying for the technology suppliers.

The most important advice given by Ms Katariina Majamaa is that the young water professionals should think what they really want to do, and after that, step by step, the right direction is going to be found.

III. Opportunities for developing the YWP's career

1. UN-Water Decade Program on Capacity Development, Dr. Hani Sewilam

The presentation has showed the dependency of the achievement of the MDG's with relevance to the water resources. From the presenter's point of view, not only the 7th goal of the MDG's, which refers to the insurances of the environmental sustainability, depends on the protection of the water resources. What's more, the eight goals which range from halving the poverty to halting the spread of HIV/AIDS and providing universal primary education by the year 2015 depends on water. A new calculation of the percentage of the water's impact, both in quantity and quality, on the MDG's has been presented. For example, water affects around 50% the achievement of ensuring sustainable environment, around 30% the eradicating poverty and hunger, and 2.5% on combating HIV/ AIDS and other diseases. In total, one third of the MDG's found to depend on water. Therefore, if the water problems are solved, one third of the MDG's will be achieved by the year 2015.

In 2003 the UN-Water was established as an inter-agency mechanism to strengthen the coordination coherence among UN entities and none-UN partners dealing with issues relating to all aspects of freshwater and sanitation. It consists of over two dozens of members. The main task of this No- single leading agency is to support the achievement of the MDG's. The UNW-DPC strategy is to offer a long term capacity development concept through workshops, meetings, training and seminars, etc. The first phase (2007-2010) was concluded, where 45 bi- and multilateral workshops and seminars and 4 multilateral activities for UN-Water were accomplished. The activities in 2009-2010 included, among others, the publications of series of regional drinking water loss reduction workshops and the MDG's report for the year 2010. The report shows the

proportion of the population that has been using improved water resources in the years 1990 and 2008. The Oceania and Sub-Saharan Africa still needs more efforts to have enough drinking water and sanitation improvement.

The UNW-DPC has undertaken different types of capacity development activities to disseminate the importance of improving and preserving the water resources. The percentage of these activities undertaken by the UN-Water members and partners showed that e-learning has very low percentage when compared to other activities. Organizing training is the one with the highest percentage. Thus, enhancing the e-learning activity will increase the other activities. The internet is said to be the best option to disseminate the information for its simplicity, quickness, and cheapness. This option assures an immense number of viewers of the technical videos. Those videos could be loaded into the web. Even shifting from you-tube to you-water one day can be possible.

2. Getting Involved in Associations: A Way to Develop Your Career, Adrian Puigarnau, IWP

As an introduction it has been mentioned that International Water Association (IWA) is the global network for water professionals. Furthermore it has been explained that associations can be worked by group of people that share knowledge, people coming together and form groups, members formed groups and committees, and members decide the future of the association.

It was also elaborated about offers associations have for professionals such as networks of professionals working in specific field, knowledge related to specific work area and interdisciplinary projects. Therefore Young Water Professionals will benefit from associations by expanding their network, recognition of expertise and visibility in the water sector.

The organizational structure of International Water Association (IWA) mainly where different committees and groups found was explained. The Specialist Groups (SG) of

IWA works to create platforms where their topic of interest can be discussed and moved forward.

It was indicated that in the SG a person can develop its own knowledge by participating different activities - conferences, publications, newsletters, tool boxes and young water professional activities.

As it has been mentioned that a person may get involved in SG through the following ways: by being part of the management teams of SGs, by helping with the submissions' reviews sent to the conferences, by getting involved with the organization of conferences, engaging himself to the development of products and by developing a Young Water Profession (YWP) Sections. It was mentioned that being part of Task Groups, which are sub group of SG that are working to develop a product such as benchmark, charter and reports, is important to develop knowledge.

It was also announced that there is an offer to people interested in IWA Task Group on green house gas emissions from water systems.

It was mentioned that as being Governing Member of an association, a person can represent its own country and develop national activities such as national meetings, national YWP chapters, newsletters, and help to organize IWA Days.

By getting involved with IWA publishing, everybody can become a paper reviewer for journals, and can submit articles to Water Wiki.

Finally it was re-reminded that 'the more you get involved, the more you will get back'

3. The Global Water Platform: Building on the IWA Water Wiki to Support Young Water Professionals

Water Wiki is constructed by the International Water Association (IWA), the objective is to provide a platform for the global water community to interact and share knowledge online. Like Wikipedia, Water Wiki is a new freely accessible website which is growing rapidly and becoming an essential information source for water professionals. The quality control is maintained through a community manager and volunteer editorial group, and every internet user can read, create and edit pages.

There are different sections in Water Wiki: Articles, Article Discussion Zone, User Profiles, Forum, Wiki Blog, RSS Feeds, Organization Space, Group Spaces, and Events

Extra. It provides networking features enabling water professionals to discuss their work and interact with colleagues and peers from around the world.

In order to make Water Wiki a broad based water information and collaboration website in the world, we young water professionals from different countries, different fields should take full advantage of this global platform to work together, exchange our ideas and improve the design and usability of this website.

Conclusion:

Considering the presentations in this career event workshop, it is necessary to understand the need of YWP and the wide range of opportunities which are opening in front of us. In a global and mobile world such as we live in, we encounter the chance to discover the proper area in which we aim to develop from research to exploitation. Having chosen the most interesting field for us, we can begin to utilize the information – *‘the more you get involved, the more you will get back’*. This is the way to face the challenges of a new time and we will be able to solve problems, connected with environment and water.





REPORT OF GROUP II



EXCURSION TO:

**MUNICH WATER WORKS
AND
CHANNEL BUILDING SITES**

13TH AND 16TH SEPTEMBER
MUNICH

Presented by: Md.Tohidul Islam, Bangladesh
Kalina Kalcheva, Bulgaria
Marcela Krenkova, Czech Republic
Radu Pop, Romania
Eszter Toth, Hungary
Mohammad Salah Uddin, Bangladesh
Razvan Vaida, Romania
Magdalina Zaharieva, Bulgaria – Guide

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Introduction

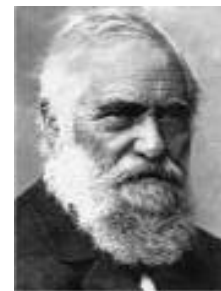
As a part of the Young Water Professionals program organized by DWA, during the event of IFAT ENTSORGA 2010 in Munich, two field trips were held. The aim was to learn more about the quality of the water and the system for supplying Munich and also to see how some of the projects are being realized on site.

I. Field Trip to Munich Water Works

On the 13th of September we visited the Munich Water Works or “Stadwerke München”. SWM works to assure the best possible services, considering water quality and quantity. Governed by the Municipality of Munich it controls approximately 3200 km of pipelines and has about 7000 workers.

1. History

The water was first found by Max von Pettenkofer in 1880. Soon after his discovery the construction of water works started (1902-1913)



2. Some facts and Figures



The catchment area “Mangfall” is the most important in Bavaria. It is situated in a beautiful forest region, about 55 km away from Munich. Per day the average consumption of water is about 130 l/day/person. SWM supplies water to 1.5 million citizens of Munich and per day this makes approximately 320 million liters of water that has to be transported. The water cost is 1.5 € per m³.

3. Hydrogeology of the area

There are four valleys at the region:

- Mangfall (supplies 80% of the water, biggest well in the world, 2500 l/s)
- Schlierach
- Muhtal
- Gotzing

The Annual rainfall is around 1400 mm. The impermeable layer forms a funnel-shaped bottleneck, in which the groundwater is collected. Aquifer material consists of fine sand with gravel.

4. Collection and distribution system

Quite interesting is the fact, that water flows by gravity and no pumping is needed. It is being collected in a collection chamber. The chamber consists of 4 collection pipes and 2 distribution pipes. The total length of pipe system is 1.8 km. Pipes are made of steel and concrete and they are laid at approximately 9 m depth with 2m diameter. The “Thalham-Nord” spiral shaft is the most important and interesting construction. It has been built during 1993-1998 and is about 20 m deep.

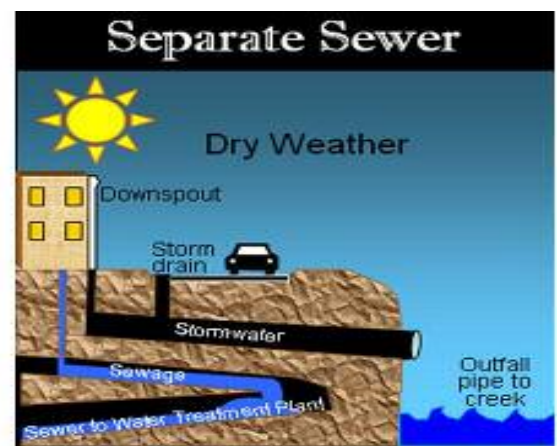


5. Maintenance and quality assurance

One of the interesting facts, concerning the water quality is that no treatment is required. The rain water has to retain 50 days under ground before it is considered as safe drinking water. Since 1992 the City Water Works department uses financial instruments to help for the cooperation of 80% of the farmers in the region to use natural fertilizers and avoid application of pesticides etc. The SWM drinking water is being regularly checked and monitored, to reveal undesirable contamination in the distribution pipe systems. Tests of quality are proved also by sensitive fish- trout. The total technical water losses are below 10%.

II. Field trip to Channel Building Site

During our second excursion, we visited two sites – the construction of a new channel nearby Karlsfeld and the rehabilitation of the 130 years old part of a channel on “Thierstraße” in Munich. The sewer system in Munich has total length of 2000 km. Its newer parts consist of separate system for sewage and rainwater, while the older are combined.



1. Construction of a new channel at North-West Main Sewer

The purpose of the site that we visited is to be finished the last missing part of the biggest channel in Munich. The total length, that has to be built is 1,6 km for 18 months and the pipes' diameter is 3,20m. The projected cost is 10 000 €/m. Till our visit, 350m were finished. Most of the works are carried out under the ground so that minimal disturbance of the people living nearby is assured.



2. Method of construction

→ A tunnel boring machine is being used on the site. The advantage is that it cuts out the ground and transports it out simultaneously with speed: 8-12 m/day. The bore's

diameter has to be 2cm bigger than the pipe itself. The maximum flow capacity of the new sewer system is 14 m³/sec.

- The concrete pipes are constructed on site. The advantages include more cost effectiveness and less noise and no traffic increase as there is no need for transporting machines (otherwise 440 trucks would have been needed).



- Another machine, that has being used on that site is ground separator. It increases the cost efficiency. Works to separate the ground, the water and the bentonite and afterwards the separated materials are either recycled in the process or sold as building materials.



3. Rehabilitation of a 130 years old channel section



The purpose here is the rehabilitation of an old, damaged channel section and also an environmental protection measure. On this site, the projected shape of the channel is irregular (egg-shaped) and the capacity is 200 l/sec. The part that has to be renewed is 160 m long and the duration of works lasts approximately 2 weeks. The method used is Japanese. The Spiral Pipe Renewal (SPR) method allows the new inner plastic layer of the channel to be formed by PVC

stripe (spirally). 8-10m stripe is used per minute and 1m channel is covered for 4 minutes. The gap between old channel wall and new PVC layer is filled up by concrete. The advantages of Spiral Pipe Renewal (SPR) method are that by that method there is no digging at all. It is suitable for a wide range of channel sizes and irregular cross-sections (eg egg-shaped) or bends. The application of the method requires small space above the ground and can be carried out even if there is some water in the channel (eg if rainwater enters the channel).

EWA – SYMPOSIUM

SESSION 3: SEWER REHABILITATION AND INDUSTRIAL WASTEWATER TREATMENT

SESSION 4: WET WEATHER PROBLEMS AND SOLUTIONS



14TH AND 15TH SEPTEMBER

MUNICH

Presented by:

Venera Asenova, Bulgaria

Tanya Igneva-Danova, Bulgaria

Shyamal Karmakar, Bangladesh

Marius Marcu, Romania

Cristina-Maria Medrea, Romania

Megenagna Tadesse Minalu, Ethiopia

Stefan Musat, Romania

Santosh Nepal, Nepal

Anna Pakuluk, Poland

Joanna Sieradocha, Poland

Nadejda Taneva, Bulgaria - Guide

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Picture 1. Group 3 at Munich Water Works

Introduction:

On the 9th Young Water Professionals' Programme at the International DWA Symposium on Water, Wastewater and Waste on the International Trade Fair and Congress IFAT Entsorga our working group of the Young Water Professionals attended several presentations concerning the topics: Sewer rehabilitation, Industrial wastewater treatment and Wet Weather Problems and Solutions. In the following paragraphs we would like to give a brief summary of the congress lectures and the gained overall information dealing with these topics.

I. Sewer Rehabilitation

The process of sewer rehabilitation includes several steps: Physical Evaluation of Sewer System, Manhole Inspection, Physical Assessment of Sewer Systems, Hydraulic Evaluation of Sewers and can be done by different methods.

1. Physical Evaluation of Sewer System

Rehabilitation for sewer systems involves investigation of both the physical condition and the hydraulic performance of the system. Sewers are evaluated to identify segments vulnerable to collapse, soil intrusion, groundwater infiltration and storm water inflow. Collapse of a sewer main could result in spilled sewage and potential damage to surface structures



Picture 2. Physical evaluation of sewer systems



Picture 3. Hydraulic evaluation of sewer system

2. Smoke Testing

Smoke testing is a method of detecting source of infiltration and inflow in sewer systems. During a smoke test, a smoke generating flare is placed in the sewer section. Smoke testing detects inflow problems such as storm sewer cross connections, direct connections of drain area.

3. Manhole Inspection

Manhole inspections give information about structural problems such as missing bricks, cracks, breaks and leaks.

4. Sewer Television Inspection

Closed-circuit television inspections (CCTV) provide information about structural problems such as cracks, breaks, displaced joints, missing pipe pieces, roots and corrosion.

5. Physical Assessment of Sewer Systems

Physical assessment of the sewer system includes classifying the degree of deterioration. The physical conditions of sewers are ranged from fair to badly damaged.

6. Hydraulic Evaluation of Sewers

Assessing sewer system hydraulics involves estimating flows in a sewer system, including base wastewater flow, infiltration from groundwater or rainfall and inflow from storm water sources that enter the systems through cracks, displaced joints and illegal connections.

7. Sewer Rehabilitation methods

Numerous methods of sewer rehabilitation are available on the market today. Rehabilitation and replacement methods are possible to be classified into three basic categories:

- Pipe lining
- Pipe bursting
- Open-trench replacement

Trenchless techniques are often recommended due to their economical feasibility.

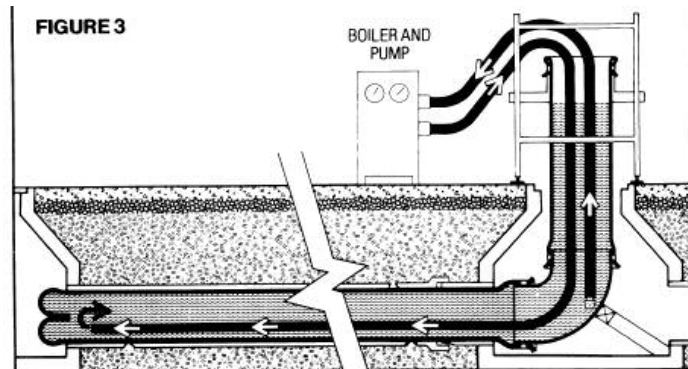


Figure 1. Pipe lining

8. Pipe lining

Pipe lining generally consists of new pipe inserted into existing pipe. There are numerous lining systems available including sliplining, cured-in-place pipe and formed-in-place pipe.

Sliplining typically consist of a high density polyethylene (HDPE) pipe which is inserted into the host pipe. Sliplining fits loosely in the host pipe. The small open or annular space between the host pipe and liner pipe should be sealed at connecting manholes.

Cured-in-place and formed-in-place pipe lining techniques use a relatively soft liner which is inserted into the host pipe. Cured-in-place typically uses an inverted “sock” which is pushed into the pipe by steam or hot water. The steam or hot water activates thermosetting resins in the sock material, which then cure to set up as a rigid liner.

Formed-in-place pipe uses a thermoplastic liner such as HDPE or PVC.

9. Pipe Bursting

Pipe bursting involves inserting a new pipe of equal or larger diameter into existing pipeline by fragmenting the existing pipe and forcing the fragmented material into the surrounding soil. The main advantage of this method over pipelining is that it allows more capacity in the pipe. The sewer is the same size or larger than the original pipe and generally has less flow friction than the original material.

Open Trench Replacement

Open trench replacement has been the traditional way to replace defective sewer pipe. This method involves excavating an open trench, removing the existing sewer and installation of new pipe.

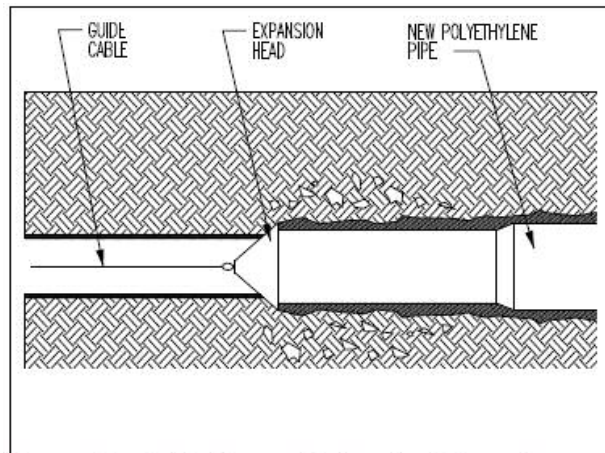


Figure 2. Pipe Bursting

10. Manhole rehabilitation

The condition of the manholes in the sewer system impacts the capacity of the sewers. Debris accumulated in the manholes diminishes the flow carrying capability. Deteriorated manholes can allow infiltration into the collection system. Such manholes can be rehabilitated with grout and corrosion protective epoxies.

An example of rehabilitated sewer system is this of Munich.

Munich is a fairly old town. It's first sewer dates back until 1811. With a precipitation volume of 1000mm/year, Munich's sewer is fast flowing, so the preventive maintenance loses it's main purpose. Over time, Munich's sewer developed several types of problems in the old masonry due to water corrosion and upper structure pressure. Cracks and lose joints also appeared in the case of the pipes. A rehabilitation programme became necessary. The first phase was the inspection. After 85% inspected sewers, resulted an estimated cost of 17€/m (around 14 millions total). The next phase was in-depth inspection of major damages. Rehabilitation itself can be seen as preventive and corrective at the same time. The main operations conducted were

corroded reinforcements repairs and joint sealing with cements and epoxy. In extreme cases, total reconstruction was necessary. Watertightness, stability and operational safety were the goals achieved through the rehabilitation.

II. Industrial wastewater treatment

In many parts of the world, economic, social and political problems have arisen following rapid industrial development and urbanization, resulting in adverse effects on the quality of life. Urbanization in general initially places pressure on and overstrains public amenities. However, long-term and wider issues would eventually also be encountered as industrialization and urbanization exert pressure on the larger resource base that supports the community. This larger resource base includes forestry, freshwater and marine resources, as well as space suitable for further development. The difficulties associated with environmental degradation often originate from industrial development. They are amplified by rapid urbanization that is responsible for the growth of many major cities. Rapid industrialization and its concentration in or near urban centers have placed very high pressures on the carrying capacity of the environment at specific locations. At these locations waterbodies such as rivers, lakes, and coastal waters have typically been severely affected. Freshwater is a vital natural resource that will continue to be renewable as long as it is well managed. Preventing pollution from domestic, industrial, and agro-industrial activities is important to ensure the sustainability of the locale's development. Undoubtedly the water pollution control efforts which have been underway in many countries have already achieved some success. Disposal of industrial wastewater has always been a major environmental issue. Pollutants in industrial wastewater are almost invariably so toxic that wastewater has to be treated before its reuse or disposal in water bodies. Maximum allowed limits for contaminants in "treated" wastewater are enforced in developed and many developing countries. Treatment methods that use simple techniques and make use of locally available treatment materials will result in reducing the cost of treatment to the point that polluting industries will not find it inhibitive or discouraging. Previous investigations on the removal of heavy metals from wastewater suggest that systems containing calcium in the form CaO or CaCO_3 and carbonates in general, are particularly effective in the removal of heavy metals from wastewater. Thus, natural

soils of high calcium and carbonate contents may prove to be useful in this respect. The industrial activities that contaminate water are:

- Pharmaceuticals
- Vegetable Preservation
- Paints Manufacturing
- Organic Fertilizers
- Iron and Steel Processing
- Soaps and Detergents Manufacturing
- Cardboard Manufacturing.

Industrial wastewaters (including agro-industrial wastewaters) are effluents that result from human activities which are associated with raw-material processing and manufacturing. These wastewater streams arise from washing, cooking, cooling, heating, extraction, reaction by-products, separation, conveyance, and quality control resulting in product rejection. Water pollution occurs when potential pollutants in these streams reach certain amounts causing undesired alterations to a receiving waterbody. While industrial wastewaters from such processing or manufacturing sites may include some domestic sewage, the latter is not the major component. Domestic sewage may be present because of washrooms and hostels provided for workers at the processing or manufacturing facility. Examples of industrial wastewaters include those arising from chemical, pharmaceutical, electrochemical, electronics, petrochemical, and food processing industries. Examples of agro-industrial wastewaters include those arising from industrial-scale animal husbandry, slaughterhouses, fisheries, and seed oil processing. Agro-industrial wastewaters can be very strong in terms of pollutant concentrations and hence can contribute significantly to the overall pollution load imposed on the environment. It is perhaps ironic that the very resources which promoted industrial development and urbanization in the first place can subsequently come under threat from such development and urbanization because of over and inappropriate exploitation. Industrial wastewaters (including agro-industrial wastewaters) are effluents from raw- material processing and manufacturing such as washing, cooking, cooling, heating, extraction, reaction by-products, separation, conveyance, and quality resulting in product rejection in the industry. An example of riverine pollution are the rivers flowing through urban and industrial areas such as Hanoi and Ho Chi Minh City in Vietnam picking up pollutants such as heavy metals and organochlorine pesticides and herbicides. These pollutants reach the sea eventually and therein threaten the

fisheries (Nguyen *et al.*, 1995). On Hainan Island (Southern China), for example, industries such as sugar refineries, paper mills, shipyards, and fertilizer plants accounted for about half the total wastewater generated and reaching the sea. This had resulted in incidences of the red tide in Houshui Bay and an area northwest of the island (Du, 1995). The effects pollutants have on the water environment can be summarized in the following broad categories:

Physical effects — These include impact on clarity of the water and interference to oxygen dissolution in it. Water clarity is affected by turbidity which may be caused by inorganic (Fixed Suspended Solids or FSS) and/or organic particulates suspended in the water (Volatile Suspended Solids or VSS). The latter may undergo biodegradation and thereby also have oxidation effects. Very fine particulates may also clog the gill surfaces of fishes and thereby affecting respiration and eventually killing them. As the sludge layers accumulate, they may eventually become sludge banks and if the material in these is organic then its decomposition would give rise to malodours.. In contrast to the settleable material, particulates lighter than water eventually float to the surface and form a scum layer. Many industrial wastewaters contain oil and grease (O&G). Their organic or mineral nature, both types cause interference at the air-water interface and inhibit the transfer of oxygen.

(a) Oxidation and residual dissolved oxygen - biological or chemical processes induced by the presence of organic or inorganic substances which exert an oxygen demand (i.e. as indicated by the BOD or COD), exceeded this capacity then the dissolved oxygen (DO) levels would decline.

(b) Inhibition or toxicity and persistence - Many industrial wastewaters do contain such potentially inhibitory or toxic substances. For example small quantities of residual phenol in water can react with chlorine during the potable water treatment process giving rise to chlorophenols which can cause objectionable tastes and odors in the treated water. Apart from the organic pollutants which are potentially inhibitory or toxic, there are those which are resistant to biological degradation.

(c) Eutrophication - The discharge of nitrogenous and phosphorous compounds into receiving waterbodies may alter their fertility. Enhanced fertility can lead to excessive algal growth. Treatment of industrial wastewater (or domestic sewage for that matter) can then target the removal of either phosphorous or nitrogen, depending on the receiving waterbody, to ensure that the nutrient limiting condition is maintained. In

terms of BOD:N:P, the optimal ratio for biotreatment is often taken as 100:5:1 while the minimum acceptable condition can be 150:5:1;

Pathogenic effects — The exception to this is wastewaters associated with the sectors in the agro-industry dealing with animals. With the above effects in view, industrial wastewater treatment would typically be required to address at least the following parameters:

- (a) Suspended solids (SS);
- (b) Temperature;
- (c) Oil and grease (O&G);
- (d) Organic content in terms of biochemical oxygen demand (BOD) or chemical oxygen demand (COD);
- (e) pH;
- (f) Specific metals and/or specific organic compounds;
- (g) Nitrogen and/or phosphorus;
- (h) Indicator micro-organisms (e.g. *E. Coli*) or specific micro-organisms.

Treatment of Industrial wastewater.

Filtration

Iron and Manganese removal

Severn Trent Services designs and provides Omni SORB™ Filter Systems for iron and manganese removal applications, for combined arsenic/iron/manganese removal where iron levels are high enough to effect arsenic removal and as pretreatment with SORB 33® arsenic “Polishing.”

The Omni-SORB™ granular filter media from Severn Trent Services was specifically designed to provide removal of iron and manganese compounds from water and wastewater supplies. Unlike other iron (Fe) and manganese (Mn) removal media, Omni-SORB is not a processed mineral. It is an engineered product using refined manganese that has high catalytic activity for oxidation and adsorption of these metals. These catalytic properties allow the media to be efficiently used without the addition of potassium permanganate (K_2MnO_4), a strong oxidant required for Fe and Mn removal with greensand and other media.

Severn Trent Services offers the Higgin's Loop, a continuous countercurrent ion exchange system contactor for liquid phase separations of ionic components using solid ion exchange system resins.

The TETRA® Higgin's Loop™ (CCIX) is a Continuous Countercurrent Ion Exchange contactor for liquid phase separations of ionic components using solid exchange (I-X) resins. The Higgin's Loop contactor is a vertical cylindrical loop, containing a packed bed of I-X resin that is separated into four operating zones by butterfly, or "loop" valves. These operating zones - Adsorption, Regeneration, Backwashing and Pulsing - function like four separate vessels. The Higgin's Loop treats liquids in the adsorption zone with resin while the ions are being removed from loaded resin in the regeneration zone simultaneously. Intermittently, a small portion of resin is removed from the respective zone and replaced with regenerated or loaded resin at the opposite end of that zone. This is accomplished hydraulically by pulsing the resin through the loop. The result is continuous and counter current contacting of liquid and resin.

III. Wet Weather Problems and Solutions

The session is about the wet weather problems and solution with specific focus on Pluvial flooding in Europe. The presentations were mainly based on the outcomes of the specific projects carried out in Pluvial flooding. Pluvial flooding is a flooding which results from rainfall generated overland flow before the runoff enters any watercourse or sewer. In general it occurs when rainfall intensity is higher than the infiltration capacity of the land and can happen everywhere.

Dr. Ronnie Falconer, presented the general overview of Pluvial and surface flooding across the Europe. Dr. Falconer shared the outcomes from the European Water Association Expert Meeting on Pluvial Flooding in Europe held in Brussels in October 2009. The meeting had drafted the questionnaire to assess the extend of the pluvial flooding problem across Europe. Dr. Ronnie also shared the outcomes of the questionnaire and the important findings are as follows:

- All Member States appear to have implemented some form of flood monitoring/early warning system.

- All the states consider that there is a potential problem from these flooding and likely to exacerbate by the Climate Change.
- There are many members which gather records of pluvial flooding for significant events.
- Regarding the protection measures, some member states already have national guidance and for some it is under preparation.



Picture 4. Aerial view of the Pluvial flood in urban areas

Dr. Ad de Roo presented ‘Wet weather problems and solutions: Pluvial flood risk and climate change’ with specific examples from Europe. Dr. Roo shared the result of the analysis of future pluvial flooding in different parts of the world. The preventive and corrective measures to control the floods are also discussed during the presentation. Some of the highlights of the presentation include: from the outcome of different Regional climate models (RCMs) based on the current available scenarios for the period of 2071 to 2100, it is likely to increase that pluvial flooding will increase under the climate change scenarios. For example, 5-day accumulated rainfall is expected to increase in almost all scenarios (Fig. 2). The other different analysis including river discharge, expected annual damage from the flood in general indicate that the whole continent will be impacted by Pluvial flooding at different magnitude and space.

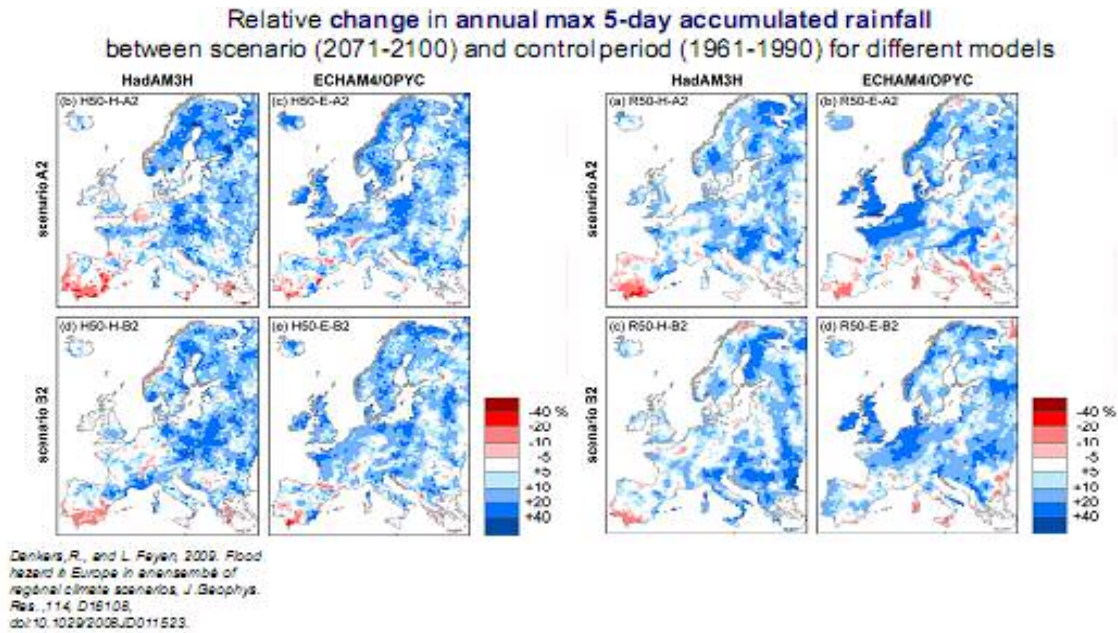


Figure 3. Relative change in annual max 5 day accumulated rainfall

Dr. Roo also shared the result about how such flooding can be prevented. Local measures (eg. increasing retention capacity) and Policy measures such as developing flood risk map, plan could be effective tool. In addition, European Flood Alert System has been set up which is able to model the weather forecast and thereby the flood related information in advance. Such critical information are relayed to the concerned authority to take necessary action to deal with the forthcoming flood. In summary, pluvial flooding is an increasing problem in Europe and can occur in every single EU country.

Mr. Tom Leahy, UK presented about the Flood Resilience City Project. The main aim of the project is the development of the improved flood risk management practices. The project has adopted the approach of 4 A's:

- Awareness
- Avoidance
- Alleviation
- Assistance

with the aim of increased flood resilience in partners cities which are addressed by different project partners. However, Mr. Tom presentation was from the experience of Dublin flood initiative. Dublin has developed frameworks to address coastal,

infrastructural dam and river flood risk management. The initial focus is in pluvial and surface water floods in the Dublin city.

Dr. Péter Kozák made a presentation on ‘Managing Excess Water and Pluvial Flooding in Hungary in connection with forecasts, prevention and mitigation. In connection with forecasts, the assessment of the water balance was developed which can give general information about current and forecasted status of water balance based on continuous water balance index. Regarding prevention, the task includes continuous maintenance activities of structural tools and continuous cooperation on the relevant infrastructural investments in the basins. Whereas, mitigation related task includes cutting sludge and vegetation, repairing the sluices and canal gates and efforts to reduce surface runoff from the upstream areas.

Conclusion

The reported topics present different aspects of human activities concerning water. Almost every country in the world suffers flooding or dry periods. That is why it is essential between the nations and governments to exist mutual understanding in order the countries to support each other in a bad situation. The sources of drinking water in the world become less and less, so it is very important to use water wisely and to apply new methods and technologies for treatment of domestic and industrial waste water.

EWA – SYMPOSIUM

SESSION 1: EMERGING ISSUES IN WASTEWATER TECHNOLOGIES

SESSION 2: MANAGEMENT OF BIOSOLIDS



14TH SEPTMBER
MUNICH

Presented by:

- Vera Asenova, Bulgaria - Guide**
- Ana Borisavljevic, Serbia
- Mihai Grozavescu, Romania
- Mariana Koleva, Bulgaria
- Daniel Mihai, Romania
- Dejan Peric, Serbia
- Vanesa Rodriguez, Bolivia
- Ruth Schaldach, Germany
- Adrian Stan, Romania
- Marina Stoykova, Bulgaria
- Dorothea Weingärtner, Germany

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- IV. Reduction of Excess Sludge Production in a Conventional Activated
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- III. Design of the SHAFDAN Digestion and Cogeneration Facility,
David Perry, Bellvue (US).....54*
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Marcel Büchler, Dübendorf (CH).....55*

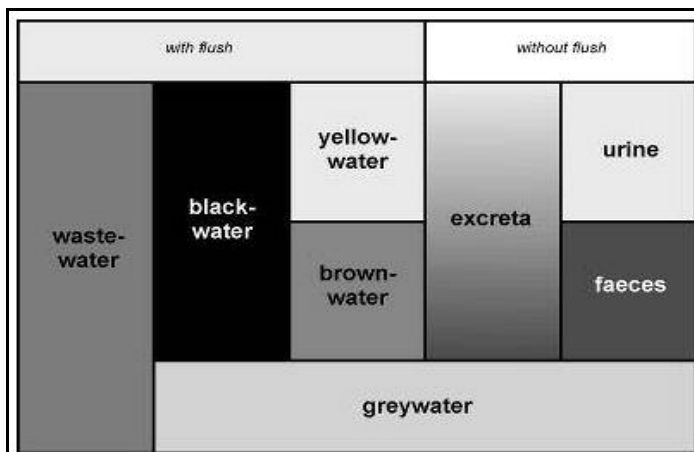
Emerging Issues in Water and Wastewater Technologies, Chairman Prof. Dr.-Ing. Jörg Londong, Weimar (DE)

I. Opening Address and Keynote Speech, Prof. Dr.-Ing. Jörg Londong, Weimar (DE)

II. Resource Oriented Sanitation. Potentials, Options, Experience. Report of a Large German Working Group, Prof. Dr.-Ing. Martin Oldenburg, Höxter (DE)

Prof. Dr.-Ing. Martin Oldenburg gave the presentation “Resource Oriented Sanitation - Potentials, Options, and Experience - report of a large German working group”.

The current European practice is based on centralized sewage systems and wastewater treatment that have a low flexibility and are in need of high (re-)investment costs. Resource oriented sanitation systems are more flexible and use wastewater as source of water and nutrients. (Scheme 1)



Scheme 1. Different wastewater streams

To get a further understanding of the options offered by resource oriented sanitation, a large working group was found in Germany.

Using a systematic approach, six different systems to separate and reuse the streams of wastewater were identified and described. The results were published 2008 by DWA in the handbook "Neuartige Sanitärsysteme" (innovative sanitation systems).

The discussion that followed Prof. Oldenburgs presentation showed two major concerns regarding the implementation of resource oriented sanitation. First, difficulties to introduce a source separating system to an already existing conventional system were mentioned. Second, the cost recovery of source separating systems was doubted. Prof. Oldenburg emphasized that the particular circumstances of each project have to be considered to evaluate economic benefits. While in Central Europe, the implementation of innovative sanitation systems is seen as a minor issue, it is of higher relevance in other countries, especially where water and nutrients are limited.

III. Aeration - Key Issue for Energy Saving, Dipl.-Ing. Peter Jagemann, Essen (DE)

Mr. Jagemanns presentation was based on research conducted by one of Germanys biggest waste water service providers, which maintains 54 plants. Especially, in times of "hot" climate change debates, fossil resource shortage and Germanys politically loaded energy debate parallel to the IFAT 2010 ways to save energy in waste water treatment processes gain more and more importance, this apart from an anyway obvious monetary advantage of using less energy in the treatment process.

In these 54 treatment plants of the Emmscher Genossenschaft-Lippeverband, actually, 25% of the running costs are due to energy consumption.

This part of the running costs is to 35-45% (variability between plants) due to energy running costs of aerators as part of the activated sludge process, particularly, in the running phase of the system. Installation costs are more so a factor to be considered tackling the question of switching to a more energy saving system and are not included in the evaluation of different types of aerators energy consumption. Disk aerators

domineer in the Emmscher Genossenschaft-Lippe Verband, which reflects that disk aerators are the most installed aerators worldwide.

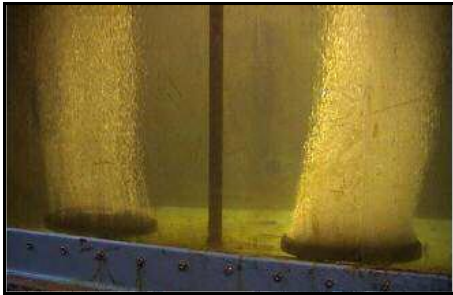


Figure 1. Disk Aerators



Figure 2. Experimental Station

The system comparison considers energy reports and an analysis of technical aspects in order to compare efficiency variations in generating fine bubble pressure aeration.

Four main influential factors on efficiency and energy consumptions were explored:

- Pressure losses
- Grade of efficiency
- Oxygen saturation factor in the exhaust air
- Surplus oxygen

Aerator analysis: As older they get as higher are the pressure losses.

Solutions to avoid losses:

- Frequent air flushing cycles
- Adding formic acid
- Mechanical cleaning (but most costly)

How to choose the right aerator?

According to Mr. Jagemann in an after presentation interview he recommends, if a system is newly constructed it should be constructed flexible. A flexible system which would be able to switch to the most innovated and therefore energy efficient system on the market. Existing systems have often the problem that the costs to switch to a more

efficient system are often too high and then cost reduction can be reached only through more frequent maintenance.

IV. Reduction of Excess Sludge Production in a Conventional Activated Sludge System by a New Electromagnetic Treatment, Eric Valette, Sierre (CH)

Mr. Erik Valette was representing Planet Horizons Technologies, a Swiss company who developed an innovative treatment using electromagnetism. The goal of the study was the reduction of excess sludge production. The experiment was conducted both in the laboratory and in a full-scale treatment plant. The procedure has a very small energy consumption and is using a weak magnetic field lower than 10 micro Tesla (μT).

Two parallel lines were used; one as a reference and the other one using electromagnetic treatment. Removal efficiencies of organic substrate and excess sludge production were measured in the two lines. The result was significant sludge reduction and good pollutants removal.

Currently the cost of treatment and elimination of sludge is estimated to be half of the cost of waste water treatment thus there are a lot of studies to develop new ways of dealing with sludge.

An alternative way to the regular technology is the application of an electromagnetic treatment consuming very low energy. The procedure has very low operating costs and energy consumption and did not reveal any significant disadvantage.

The laboratory scale test installation works with a weak load and is composed by two parallel and identical lines including an aeration tank and a clarifier.

Electromagnetic treatment was applied to the aeration tank of the EM line and it consisted of an electronic command which transmits the electronic signal to a cable antenna wrapped around the aeration tank. The lab results showed similar results for removal efficiency of organic substrate in both lines but the excess sludge production reduction was from 0 to 30% for the electromagnetic treatment.

The full scale plant installation is located in Penthaz (Switzerland). The treatment plant has a capacity of 7000 person equivalent and is composed of two identical parallel lines.

The same principal was used in the full scale installation as in the laboratory, but the 5 antennas used were rectangular shaped. The total power consumption was never above 50 W. The results for the full scale installation, as in the lab, were almost the same efficiency for the removal of organic substrate but the reduction of excess sludge production increased to 55% in some cases.

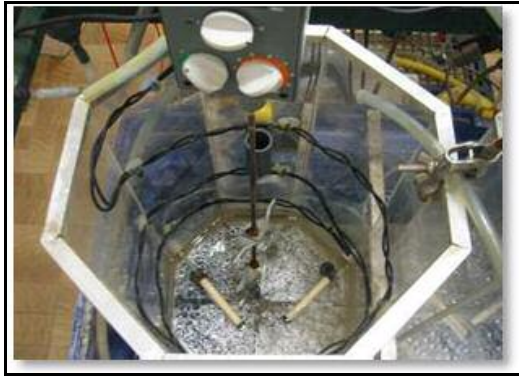


Figure 3. Laboratory scale with antenna **Figure 4.** Full-scale installation with antenna

However, the presentation also stirred up some discussion on the topic summarized by the chairman's (Prof. Dr.-Ing. Jörg Londong) comment: **"But, where is the sludge? Is it magic?"**

V. Long Lasting Experience with Water Reuse in Braunschweig. Prospects and Risks, Dipl.-Ing. Andreas Hartmann, Braunschweig (DE)

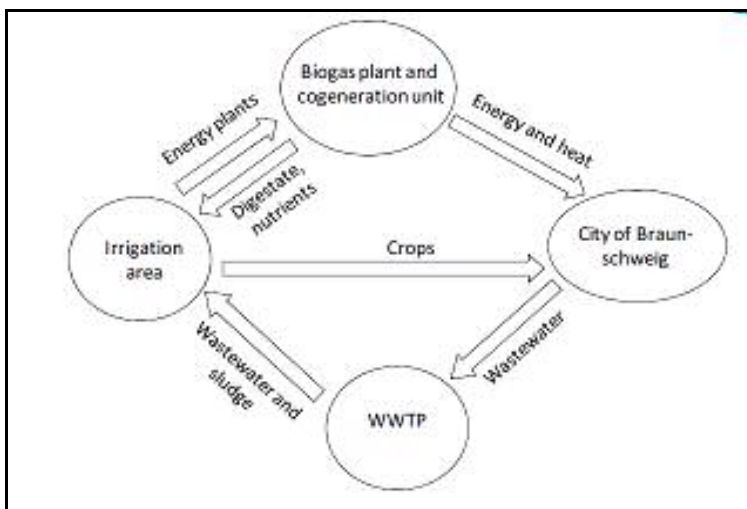
Wastewater used for agricultural irrigation has a 50 years old history in Braunschweig. At the moment there is an area of 3000 ha (1/3 used for energy production and 2/3 for food production), which is irrigated with pre-treated wastewater from the Wastewater Treatment Plant (WWTP).



Figure 5. Wastewater Treatment Plant Braunschweig

Since 1970 discharge control and pre-treatment of industrial wastewater is being carried out in order to reduce heavy metals and other pollutants in wastewater and sludge at the source. These measures contribute to the safe reuse of sludge. In 2006 a biogas plant was built. It supplies energy for 3 800 households and heat for 1 000 households.

One of the most important advantages of this process is the repeated utilization of nutrients like Phosphorus and Nitrogen. Around 200 t/year, which is almost complete reuse of Phosphorus, is achieved. In summer, this amount is used in form of digested sludge for irrigation, while in winter the sludge is dewatered, stored and used as dry fertilizer. In the case of Nitrogen, 40-45% losses are registered mainly due to denitrification. Therefore, around 50% can be used for fertilization. However, this content is scarcely stored in soils and rapidly degraded when not used by plants. There is a need of optimization of the Nitrogen application in order to reduce its degradation.



Scheme 2. Overview of nutrient, water and energy cycles

The main elements of wastewater reuse are related to management and include several aspects: contractual obligations between water/nutrient supplier (WWTP) and user, efficient infrastructure, acceptance and monitoring of sludge, water, soil and groundwater.

Wastewater and sludge irrigation has many advantages:

- The operators of WWTP are avoiding sludge disposal issues and they eliminate the costs related to post-treatment of the water.
- The farmers are benefiting from nutrient and C-applications.
- The environment gains in form of the protection of N- and P-resources and the recipient river, energy savings, production of renewable energy and groundwater recharge.

There is a proposal for a project called “CoDiGreen”. It deals with the optimization of the energy cycles by co-digestion of the grass from the sewage fields and its thermal disintegration together with the sludges. Nevertheless, there are still discussions about the economical and ecological aspects of this project.

Management of Biosolids, Chairman Dr.-Ing. Fabio Tatàno, Urbanio (IT)

I. A Sustainable Integrated Approach to Sludge Management, K. Richard Tsang, Raleigh (US)



Scheme 3. Integrated Sustainable Sludge Management

The project is based on making sustainable plan development for the Hickory Regional Sludge Consortium formed in the later 1980’s with the membership of the cities of

Hickory, Newton and Conover, in Catawba County (North Carolina). A regional sludge composting facility was constructed and became operational in 1990. The facility had odour problems from the beginning, which forced the shutdown of the plant and reconstruction of an odour control system. The plant was reopened in 1991 and currently operated by Veolia Water. Most compost products are sold. However, a capacity analysis study in 2000 identified some problematic areas, such as: operation costs continue to be high, remaining capacity is not adequate to meet long-term needs, location of composting facility is not ideal for local development and the aging infrastructure requires significant upkeep costs.

These are drivers for thinking of alternative solutions. Thermal drying is a popular alternative being implemented in the U.S. in recent years with the advantage to reduce the moisture content of sludge to less than 10 %. The increased temperature of this process also kills pathogens effectively. The thermal drying process, however, requires considerable energy input (3000-3500 KJ is required to evaporate 1 kg of water).

The benefits of biosolids management planning working together with solid waste management, industries and research facilities are: the protection of public health and environment, energy efficient, product market assurance, net overall economic and environmental benefits. Therefore, product utilization of nutrients (on-site application for biofuel crops, turf production and off-site land application) and energy (fuel for bioenergy plant) is provided. Comparison of CO₂ emissions between drying and composting facility clearly points out the advantage of the drying solution.

Overall benefits are: sustainable biosolids management in Catawba County, beneficial use of landfill gas and biogas for green energy, economic development, employment through new industries, turf production and research facility, co-operative research, environment education and awareness.

II. Capacity Evaluation and Optimisation of a Co-Digester Plant, Prof. h.c. Dipl.-Ing. Erhard Hoffmann, Karlsruhe (DE)



Figure 6. Wastewater Treatment Plant Baden Baden Sinzheim

On waste water treatment plant Baden Baden Sinzheim digesters were installed in 1983.

They were put into operation in 1994 with 5000 t/a Bio-waste. Today, the plant has an input of 30000 t/a of Bio-waste and 3200 t/a of kitchen-waste.

One of today's challenges is that the digester volume got halved due to the rehabilitation of one fermenter.

How to cope with the unchanged amount of substrate?

Possibilities are the pre-treatment of the substrates and/or inclusion of an existing biomass reactor.

Used material and methods were:

- Sludge disintegration (batch experiments) with ultra sonic generator (SONOTRONIC Nagel GmbH, 1000 W, >6m³/d). Exposure time was 10 min. Energy input was between 0 and 17 kWh/kgDM)
- Hydrolysis (batch experiments) with double-walled tempered hydrolysis reactors. Temperature range was between 36° and 52° C. Hydraulic retention time was between 24 h and 72 h.

- Continuous one-stage flow experiments. Digestion temperature was 36°C. HRT was 20 d. Volumetric loading was 3.5 kg COD_{tot}/(m³·d).
- Continuous flow two-stage experiments. Hydrolysis (1st-stage): Temperature was 42°C, HRT was 24h and Volumetric loading was 68.8 kg COD_{tot}/(m³·d). Digestion (2nd-stage): Digestion temperature was 36°C, HRT was 11 - 16 d and volumetric loading was 4.6 - 7.1 kg COD_{tot}/(m³·d).

Results for sludge disintegration show that the energy input decreases according to the dry matter concentration increase and also that disintegration efficiency achieves up to 50 % based on COD_{tot}.

Results for the hydrolysis step show that the optimal temperature for the hydrolysis process was about 42 °C and the optimal HRT about 24h. Degree of disintegration was about 20 % based on COD_{tot}. Increase of organic acid concentration was from 1320 to 5200 mg/L.

An ultrasonic pre-treatment of the co-substrate bio-waste suspension and excess sludge leads to disintegration efficiencies up to 51%. However, treating kitchen-waste or primary sludge in the same manner is not promising as the disintegration yields are rather low.

Out of the hydrolysis temperatures of 37, 42 and 52°C which have been investigated, a process temperature of 42°C turned out to be optimal. The results indicated that the hydrolysis step is almost completed after 24h (batch tests) and leads to an average disintegration degree of 18.5%. Thus, only a minor increase of the solubilization/disintegration degree during hydrolysis could be expected at prolonged HRTs.

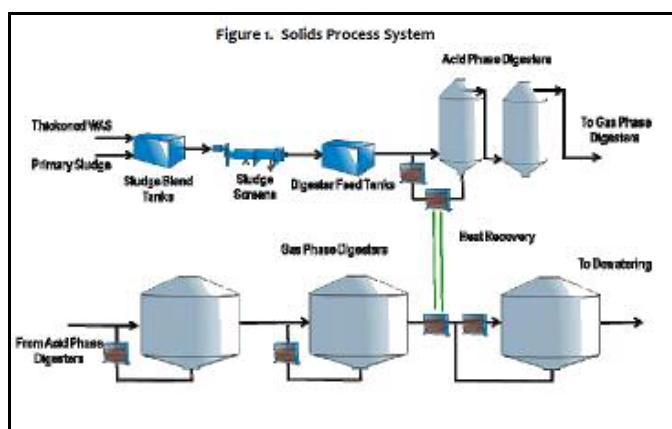
Compared to the one-stage operation a two-step technology with an upstream, separated hydrolysis allows to reduce the total HRT to about 25% and leads to an increase of the specific biogas production [L Biogas/kg COD_{tot,in}] by 12.8% at the same time and also allows an increase of the daily COD input from 22.2 to 42.3 tons leading to a biogas production of 12495 m³/d compared to a former daily amount of 5772 m³/d.

III. Design of the SHAFDAN Digestion and Cogeneration Facility, David Perry, Bellvue (US)

The wastewater treatment plant of SHAFDAN is designed for 1.8 million people equivalent. Annual average flow rate of the plant is estimated with 340 000 m³/d. In order to discharge sludge in the Mediterranean Sea a three stage anaerobic sludge digestion was built to produce Class A digested biosolids and to ensure pathogen reduction.

The primary and waste activated sludge is first screened and afterwards pumped to eight acid phase sludge digesters, where the sludge is hydrolyzed to basic acid compounds. In this phase the facility is operated at low pH which creates an environment suitable for the microorganisms that are responsible for a rapid breakdown of the solids into organic acids. The final step of the sludge stabilization process is the methane phase. After sludge hydrolyzation, the gas-phase follows with eight anaerobic digesters. To ensure pathogen reduction and shorter sludge retention time the temperature range in the tank was kept around 55°C. Plant effluent wastewater is used to cool down the sludge to a mesophilic temperature. After dewatering processes the sludge is utilized in agriculture.

A large amount of methane gas is produced during the sludge degradation. For gas utilization a co-generation engine is used to provide heat and power to run the anaerobic digester facilities.



Scheme 4. Solids Process System

IV. New Development of the Highly Efficient Sludge Drying Process, Marcel Böhler, Dübendorf (CH)

INNODRY 2E is a patented drying process which has a 2-step drying process:

- Conduction (Thin Film Evaporator, TFE);
- Convection (Belt Dryer, BD).

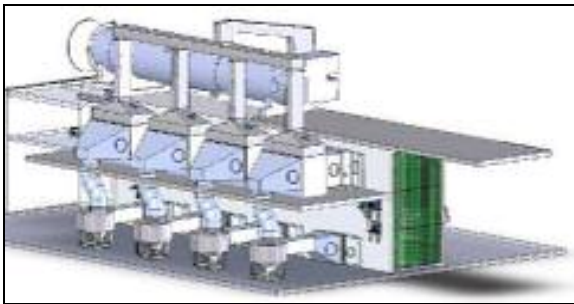


Figure 7. Full-scale installation



Figure 8. Dried Sludge

Other important characteristics for INNODRY 2E are:

- Internal Heat Recovery;
- Intermediary Granule Formation;
- Closed Air Loop.

The main advantages of this method are:

1. Low energy consumption - it is an important fact that the energy consumption will be an important decision point in the near future under the condition that the sources of fossil energy are limited to less than 30-40 years;
2. Vapour reuse;
3. Waste heat recovery: another important issue in a more ecological planet.

The fact that we are living in a century of speed and innovation makes INNODRY 2E to be “on the wave” and according with the latest standards in this sector through the following facts:

■ Easy to Operate:

- Short Start-up / Shutdown
- Fully Automated
- Reliable and Proven Technology

■ Expertise

- Fully Automated Thermal and Mechanical Processes - Patented Technology
- Engineering and Project Management - ISO 9001 / TÜV - WHG
- Erection, Commissioning and Site Supervision - One Company
- Commissioning and Training of Operator's Personnel
- Preventive Maintenance Contracts

■ Higher Capacity: up to 6,000 kg H₂O / Hour

■ New Design:

- Concrete
- Airproof
- Small Footprint
- Less Transport Costs

Last but not least, we would like to extend our gratitude to the sponsors of YWP Programme at IFAT ENTSORGA 2010 in Munich, who made this event possible and especially to the German Association for Water, Wastewater and Waste (DWA), particularly to Mrs. Laura Langel and Mrs. Gabriele Martens.



WASTEWATER TREATMENT PLANT GUT MARIENHOF - MUNICH



13TH SEPTEMBER

MUNICH

Presented by (from left):

Paulius Gutauskas, Lithuania

Milica Jovanova, Macedonia

Igor Bojadjiski, Macedonia

Laura Mähar, Estonia

Vo Thi Yen Phi, Vietnam - Guide

Benjamin Sarfo Okrah, Ghana

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Introduction

I. Background

Munich City has two wastewater treatment plants: The Gut Großlappen and the Gut Marienhof (Photograph 1). These are modern Wastewater Treatment Plants in Europe.



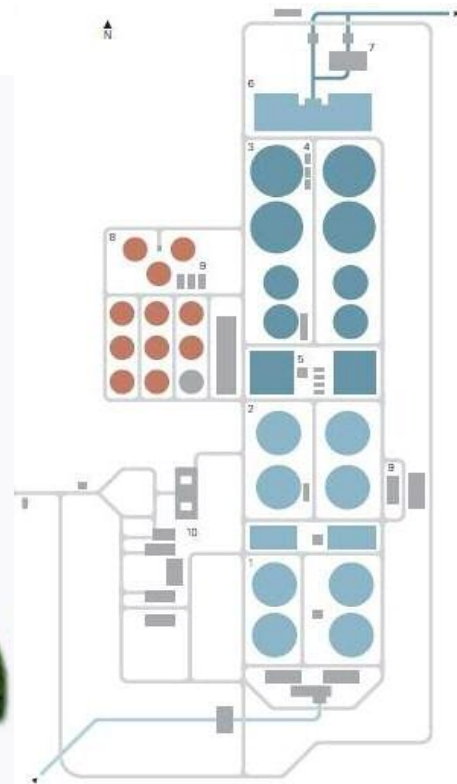
Photograph 1: (Left) -Wastewater Treatment Plant Gut Großlappen;

(Right)- Waste Treatment Plant Gut Marienhof

(Source <http://www.muenchen.de/Rathaus/bau/wir/mse/klw2/148635/>)

The Gut Marienhof plant treats about 40% of the wastewater in Munich. Together with the Gut Großlappen plant they have a treatment capacity of 3 million population equivalents, which accounts for domestic, commercial and industrial wastewater from Munich and 22 neighboring communities. The treatment processes in the plants remove 99 percent of the organic pollutants and a major part of the nutrients nitrogen and phosphorus. This would otherwise enhance eutrophication in the receiving waters. The construction of the Gut Marienhof plant has had historical background. The first plans were made in 1940 but the Second World War had stopped the project. After the Second World War Munich grew leading to an increasing amount of wastewater. In 1972 the project was realised. An investment of 300 million euro brought the Gut Marienhof plant into operation in 1989.

Process and Plant



- | | |
|-----------------------------------------|------------------------------|
| 1: Screening chamber; | 11: Thickener; |
| 2: Inlet elevator | 12: Collection Container; |
| 3: Grit Chamber; | 13: Digester; |
| 4: Primary Clarifier; | 14: Biofilter; |
| 5: Aeration Tank- 1 Stage; | 15: Discharged air; |
| 6: Intermediate clarifier; | 16: Gas Container; |
| 7: Aeration Tank- 2 Stage; | 17: Power house; |
| 8: Secondary settlement tank – 1 Stage; | 18: Operational Building; |
| 9: Secondary settlement tank – 2 Stage; | 19: Wastewater disinfection; |
| 10: Sand Filtration; | 20: Discharge building |

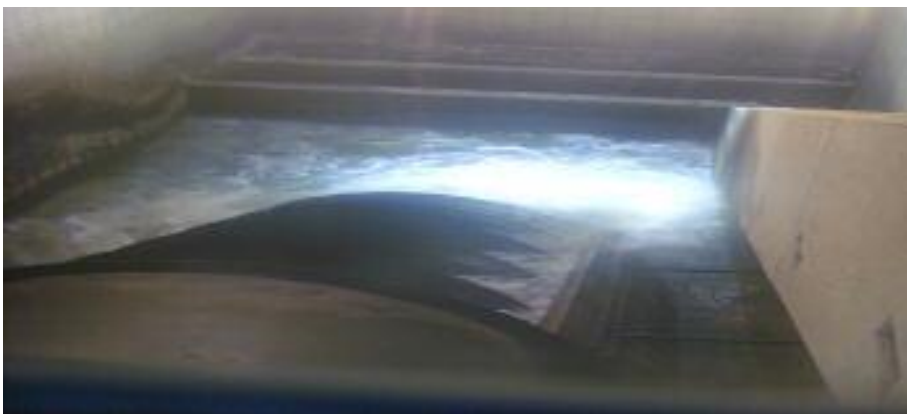
I. Mechanical separation

Photograph 2 shows the first stage of mechanical separation. The wastewater arrives at the plant via two main collectors. Coarse matter is removed in four parallel lines each equipped with a 40 mm and 20 mm spaced bar screen.



Photograph 2: Screening Building.

The second stage is the pumping station. The wastewater will be lifted 2.5 meters with a screw pump (Photograph 3) to the aerated grit chamber (Photograph 4).



Photograph 3: Archimedean screw pump.

The Flow rate is reduced in the grit chambers (Photograph 4) allowing the sand to settle, which would otherwise disturb plant operation and not only that but the greases and oils are also removed. The settled sand is pushed into funnels with scarper shields.



Photograph 4: Aerated Grit Chamber.

Primary Sedimentation Tank

The wastewater is distributed into four tanks (6,000 m³) where most of the organic solids are removed by gravity within one to two hours. A bottom scraper pushes the so-called primary sludge to a center funnel, from where it is pumped to the sludge treatment section. (Photograph 5).



Photograph 5: Primary sedimentation tank

II. Biological Treatment, First Stage

Activated Sludge Tank

The two biological stages are the most important part of the wastewater treatment. Principally it imitates the self-cleaning process of natural waters, only in less time and space. In these tanks bacteria and other microorganisms feed on nonsettling and dissolved organic pollutants. They grow in high concentrations and form small flocs called activated sludge. This process requires a permanent supply of oxygen provided by intense aeration. Special ceramic aeration tubes, which are installed 6 meters deep, provide 40,000 to 150,000 m³ of finely dispersed air per hour. The air supply is constantly controlled by submersed online oxygen meters.

The intermediate settlement is to separate the sludge from the first biological stage and reside in to the aeration tanks (Photograph 6). After this first stage, 85 percent of the wastewater pollutants are removed.



Photograph 6: Intermediate Sedimentation tank

Biological treatment second stage

In the second biological stage, nitrifying bacteria oxidate ammonia to nitrates, which originates from nitrogen containing compounds like urea. Ammonia would be poisonous for fish and other animals in natural waters. The plant's nitrifying process has an efficiency of about 98% and removes the remaining organic compounds at the same time.. To improve this nutrient's removal efficiency, alum-ferric salt solutions are added and react with the phosphorus forming floc compounds, which settle and can then be removed with the waste sludge.

Sand filter

After biological treatment most of the organic substances are converted to biomass, which has settled in the sedimentation tanks. 24 filter cells, each having a 1.5 meter thick sand layer, remove these remaining particles from the treated wastewater. These filter cells are periodically backwashed with water and air to keep the filtering process efficient. With this filtration stage the total removal of pollutants increases to 99 percent.



Photograph 7: Sand Filter

UV Disinfection

This unit ensures that the plant effluent has bathing water quality. The short wave light damages the nuclei of the microorganisms thusly preventing their further growth.



Photograph 8: Ultraviolet lamps for UV disinfection

Depending on the current water flow, up to 1,300 ultraviolet lamps arranged in six lines are in operation. The radiation intensity is controlled continuously to guarantee a continuous disinfection performance.

III. Chemical Treatment

Denitrification Concept with Recirculation and Sand Filter

The Münchner Stadtentwässerung has developed a unique and economic process to reduce effluent nitrates, which act as unwanted nutrients in natural waters. A part of the wastewater stream is recirculated from the end of the second biological stage to the beginning of the first. The nitrates produced in the second stage are reduced in the first stage to gaseous nitrogen and escape into the atmosphere. The other location for this reaction is the sand filter. Here denitrifying bacteria feed on externally added methanol and simultaneously convert nitrates to gaseous nitrogen. This combined denitrification guarantees high process stability while complying with allowed nitrogen effluent concentrations.

IV. Effluent Discharge into the Isar River

The treated effluent enters the Isar River via a specially designed discharge structure. It replaced an existing weir. The interior is hollow with evenly spaced outlets to enable the treated wastewater to be dispersed along the entire river width. This way it is mixed completely with the Isar River and simultaneously enriched with oxygen. A flood water pumping station guarantees the plant discharge even at high water levels.

V. Sludge Treatment and Energy

Sludge Thickener

The final products of the treatment of wastewater are clear water and waste sludge. This sludge comes from the primary sedimentation tanks and the two biological treatment stages. However, the solids content of the sludge is only 0.5 to 1%, the rest being water. To reduce the volume for the following digestion stage, it is again thickened by sedimentation. The thickeners, tanks with a volume of 2,500 m³ each, increase the solids content to 6%, which in turn reduces the volume by 90%. The excess water is recirculated into the biological treatment process.

Digestion Tank

In the digestion tanks thickened waste sludge is anaerobically digested with 24-day hydraulic retention time at 38°C (Photograph 9). During this process specialized bacteria convert organic matter to methane-containing biogas, which is used to run the power plant generators. Approximately 80% of the entire treatment plant's electrical energy demands are met through this source.



Photograph 9: Digestion Tank

Three gas-diesel engines burn the biogas from the digestion process each driving generators which produce up to 1600 kilowatts of electrical power. Two additional gas-diesel engines provide pressurized air for the biological treatment stages via turbo blowers. Next to these aggregates are yet two more turbo blowers driven by electric motors. The waste heat of the engines' cooling system is utilized throughout the entire treatment plant. The systems combined efficiency (thermal and electrical) attains a high efficiency of more than 70%.

Biofilter

A series of installations eliminate the unpleasant odours from the exhaust air in the plant. The air from the encapsulated screening building and the covered aerated grit chambers is blown into the aeration tanks of the first biological stage. These tanks are also covered and their exhaust air is in turn blown through a specially designed biofilter, in which microorganisms feed on the odorous substances. The biofilter can treat up to 90,000 m³ of air flow per hour. At the sludge handling and storage area the exhaust air is treated by a wet scrubber combined with a downstream biofilter.

Waste Sludge Pumping Station and Pressure Pipe

Digested and thickened waste sludge is pumped through a 12 kilometer long pressure pipe to Munich's other wastewater treatment plant Gut Großlappen where it is dewatered, dried and finally incinerated. The pressure pipe is kept free of deposits by periodical "pigging". This "pig" is an elastic body with steel brushes that fits tightly into the pipe and is pumped together with the sludge.

Advantages compared to other typical plants

Compared to other typical wastewater treatment plants, Gut Marienhof has extra facilities to satisfy the needs of the surrounding communities. This includes biofilter, UV treatment and sand filter.

- Biofilter unit has been installed to minimize the odour from the aeration tanks. Thus there is almost no odour outside of the treatment plants.

- Due to the discharge to the Isar River, UV treatment is employed during the bathing season from mid-April to October.
- The suspended organic matter must be removed; hence sand filtration has been used after the biological treatment. There are 24 filter units with 22 of them being in continuing operation. Almost all pollutants are removed at this stage.

Summary and recommendations

The treatment plant has good effluent quality which is monitored continuously for all relevant parameters with online probes. There is no smell in the plant area and its surroundings. The plant effluent is used for cooling and cleaning purposes to prevent wasting valuable ground water.

In order to make it transferable to developing countries, energy recovery should be optimized. For instance, co-fermentation of the sludge with food waste may be used.