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Integrated Wastewater Concept for Industrial Zones



Tra Noc IZ
Can Tho City

Project coordination



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Short description of the project



The AKIZ project

Over the past years the economic growth in Vietnam has risen significantly. As a result, Vietnam has an increasing number of more than 200 registered industrial zones without sustainable wastewater treatment. To approach this challenge, a "Flagship Project" is planned for Tra Noc Industrial Zone in Can Tho City, located in the Mekong-Delta. Accomplishing activities for the central sewage treatment plant of the industrial zone, the German-Vietnamese joint research project develops an integrated wastewater concept for industrial zones ("AKIZ" = "Integriertes Abwasserkonzept für Industriezonen") to secure the efficiency and sustainable operation of the whole wastewater system including all its technical components. In addition to the combination of centralised and decentralised wastewater treatment solutions, the close connection of technical auf financial planning is an important part of the integrative approach. This also includes adequate structures for wastewater tariffing and cost allocation.

Objectives and tasks

Using containerized pilot plants in different branches of Tra Noc Industrial Zone, high-tech solutions for pre-treatment of wastewaters, generation of energy from wastewater and recuperation of valuable substances are adapted and verified by on-site pilot systems, taking into consideration the local conditions. Concepts for the management of sewage sludge are investigated. Monitoring surveys will create the database for control mechanisms especially in terms of toxic wastewaters. Furthermore, sociological and ecological aspects are

researched. The sustainable implementation of AKIZ is supported by capacity building of stakeholders and local partners.

Applied science and close co-operation

Within the frame of six sub-projects, German and Vietnamese research and industrial partners jointly perform the research work and practical application of the pilot systems in Tra Noc together with relevant local authorities. Furthermore, the project is conducted in cooperation with ODA partners like GIZ and ADB.

Best practice guides

The results of the project will be condensed into two guidelines:

- "Guideline on integrated wastewater concepts for industrial zones" as decision support tool for the implementation of wastewater disposal infrastructure"
- "Financial modelling of wastewater solutions for industrial zones as pre-condition of sustainable investments and operations"

Support by research ministries and industry

The joint project is sponsored by the German Federal Ministry of Education and Research (BMBF) and the Ministry of Science and Technology of the Socialist Republic of Vietnam (MOST) as well as the participating German industrial partners.



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Four main project phases

The project is implemented in four main phases between 2010 and 2015: basic and conceptual studies, adaption to local situation and set-up, optimisation and evaluation, and, finally, verification and transfer of results.

General timeline of AKIZ project sponsored by the BMBF

Work phase	2009	2010	2011	2012	2013	2014	2015
Project initialisation							
Basic and conceptual studies							
Set-up and adaption							
Optimisation and evaluation							
Verification and transfer							
Wrap-up							
Evaluation Milestones			MS 1		MS 2		
Project Conferences							

Milestones:

Two intermediate assessments of the project have been conducted by BMBF, including the analyses of the technical, financial and organisational feasibility of the work schedule for the pilot plants and other investigations as well as the general viability of the overall AKIZ management concept.

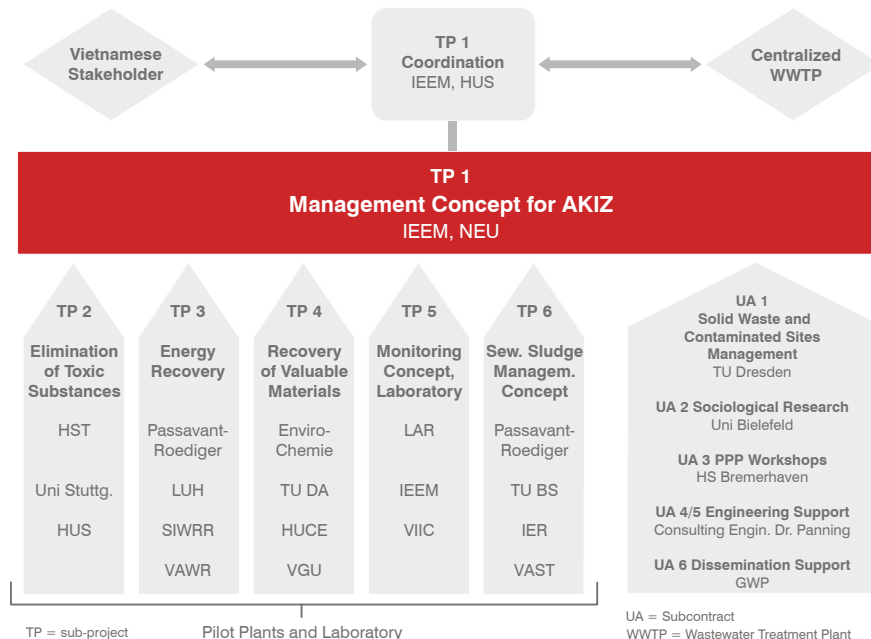
Six sub-projects

The joint project consists of six main sub projects (TPs), each executed together by both Vietnamese and German partners:

- TP 1:** Coordination of the joint research project and development of an integrated management concept
- TP 2:** Elimination of toxic substances by chemical and physical treatment
- TP 3:** Anaerobic industrial wastewater treatment with energy recovery
- TP 4:** Recovery of valuable materials by membrane filtration
- TP 5:** Development and operation of a containerized laboratory and monitoring concept
- TP 6:** Sewage sludge management concept

Additionally, contiguous research fields like sociological and ecological aspects as well as the implementation of capacity building measures are conducted by sub-contracts within the co-ordination activities of TP 1.

Including the sub-contractors, eight universities and four industrial partners are involved on the German side, sponsored by BMBF. On the Vietnamese side, nine academic institutions take part in the joint project, supported by MOST.





Coordination of the joint research project and development of an Integrated Management Concept

- IEEM - Institute of Environmental Engineering and Management at the Witten/Herdecke University gGmbH
- VNU - Hanoi University of Science (HUS)
- National Economics University (NEU)

Need for wastewater concepts of industrial zones

Wastewater treatment in Vietnamese industrial zones has often suffered from poor governance, management and chronic under-investment. The AKIZ integrated management concept shows the most appropriate technologies and operational measures and explains their successful application by adopted solutions. Especially operators, investors, financing institutions (e.g. donor banks) as well as legislative and supervisory authorities may benefit from the project.

In most cases, any reasonable wastewater concept for industrial zones has to be a combination of centralized and decentralized wastewater treatment systems as well as of technological and economical measures. Centralized wastewater treatment plants will not work without decentralized pre-treatment facilities, wherever toxic or inhibiting contaminants are discharged. The (re)use of water, valuables and energy from wastewater can often be more profitable in decentralized plants, near-to-source at the factories, where the integration for water- and energy-efficient production is possible.

An important part of the integrated management concept is the financial model, which indicates required investments, budgets for operations (incl. sustainable maintenance and monitoring), plus expected cash-flows with debt-repayment potential.

Objectives

In addition to the coordination of the joint research project, TP 1 covers the development and proving of an overall, integrated management concept for wastewater disposal in tropical industrial zones in Vietnam and emerging countries with similar conditions.



Development of the overall, integrated concept

Based on the results of the other sub projects, the AKIZ management concept has to integrate centralised and decentralised, near-to-source solutions for the treatment of industrial wastewater, on the one hand, and technological and economic aspects, on the other hand. The concept shall cover all relevant functions for the sustainable operation of the wastewater infrastructure within the industrial zone, taking into consideration the local conditions.

The concept will be based on a comprehensive monitoring and control system, also taking into consideration reliable quality control of the day-to-day operation, and creating the basis for cost calculation and re-financing of all facilities and organisations within the industrial zone.

Contiguous aspects and capacity building

To complete the management concept, contiguous fields with relevance for the AKIZ application, like waste, contaminated sites and as well as sociological and ecological aspects, have to be investigated. The sustainable implementation of AKIZ is supported through capacity building measures for stakeholders and local partners.

For these issues additional partners are involved through sub-contracts:

- Technical University of Dresden, Institute for Waste Management and Contaminated Sites
- Bremerhaven University of Applied Sciences, Chair for Public-Private-Partnership (PPP)
- German Water Partnership (GWP)

Additional funding and cooperation for joint training and workshops is provided through GIZ and ADB.





Universität



Stuttgart



Elimination of toxic substances by chemical and physical treatment

- HST Systemtechnik GmbH & Co. KG
- Stuttgart University, Institute of Sanitary Engineering, Water Quality and Solid Waste Management (ISWA)
- VNU - Hanoi University of Science (HUS)



Objectives

Toxic wastewaters are a danger to humans and the environment. Within TP 2, approved chemical and physical treatment technologies for decentralised, near-to-source detoxification of industrial wastewater are adopted to the specific constraints in Vietnam and demonstrated by a containerised pilot system. In addition, the test of some innovative approaches under local circumstances is planned.



Several treatment options

The variation of substances in industrial wastewaters allows no general decision for only one or two treatment methods; in most cases, different methods have to be combined. Within the project, the most efficient combination of technologies and methods has to be found out. The following state of the art treatment methods for detoxification have been taken into consideration: mechanical separation, precipitation and flocculation, adsorption with activated carbon, filtration with e. g. membrane, biological treatment (e.g. SBR or moving carriers), chemical and advanced oxidation with H_2O_2 etc.

Pilot system for detoxification

Based on the identification of relevant industries and toxic wastewater flows, a concept for an adopted pilot system is developed and designed. Constructed by industrial partner HST, the pilot system is installed and operated on site of a pesticide processing company. By optimisation and evaluation, general concepts with focus on chemical and physical treatment methods for the detoxification of highly loaded industrial wastewater are elaborated.



Anaerobic industrial wastewater treatment with energy recovery

- Passavant-Roediger GmbH
- Leibniz University of Hanover, Institute for Water Quality and Waste Management (ISAH)
- Southern Institute of Water Resources Research (SIWRR)

PASSAVANT ROEDIGER



Leibniz
Universität
Hannover



High organic loads in tropical regions are suitable for anaerobic treatment

Recent research and applications show that decentralised anaerobic systems are suitable for industrial and domestic wastewater treatment in tropical regions due to high temperatures. Especially for wastewater containing a high concentration of organic compounds, these treatment systems are relevant, like in fish and seafood processing industries.

The anaerobic treatment offers additional advantages by producing biogas which can be used for energy production, making the process ecologically as well as economically interesting. Moreover, excess sludge production of anaerobic treatment is very low, while the dewatering characteristics of the sludge are excellent.

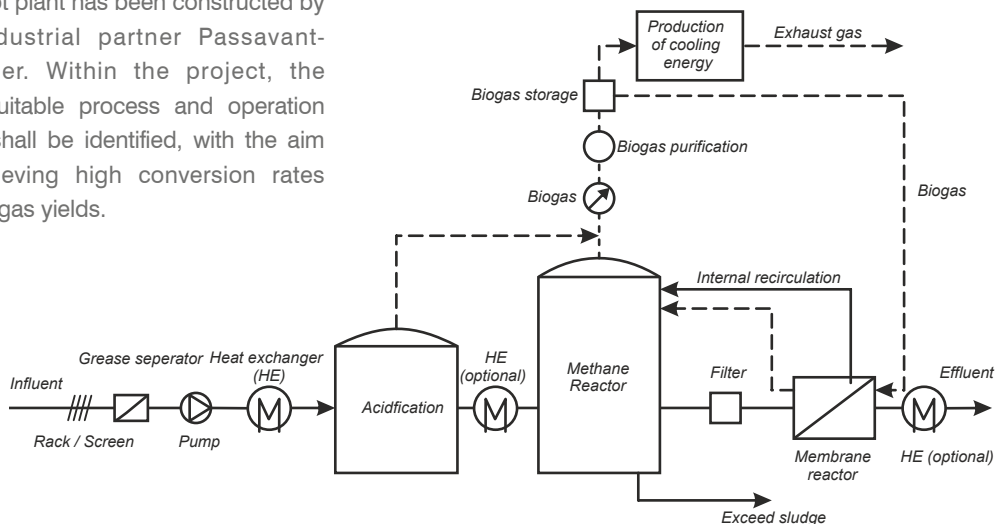
Objectives

In order to show the applicability under real conditions, within TP 3 an anaerobic wastewater treatment system with energy recovery is adopted and applied at pilot scale at a fish and seafood processing factory with highly organic loaded wastewater.

Pilot system

The pilot plant consists of anaerobic reactors, optionally equipped with a membrane module, biogas collecting and purification system, sampling and control units. The biogas will be used as an energy source for cooling systems.

The pilot plant has been constructed by the industrial partner Passavant-Roediger. Within the project, the most suitable process and operation mode shall be identified, with the aim of achieving high conversion rates and biogas yields.





Recovery of valuable materials by membrane filtration

- EnviroChemie GmbH
- Technische Universität Darmstadt, Institute IWAR
- Hanoi University of Civil Engineering (HUCE)



Objectives

Based on the identification and assessment of relevant industries in Tra Noc Industrial Zone, which allow economically reasonable recovery of valuable materials, an adopted process-integrated recovery system using membrane technology is developed and demonstrated.

Application of membrane technology

Polluted process water from industrial production processes often contains high concentrations of valuable materials that could still be (re)used. Membrane filtration technology can be used as a treatment step to recover these valuable materials by separating them from other impurities or by increasing their concentration. Membrane technology is based on physical separation leading to unchanged properties of substances. Therefore, the reuse of separated materials is possible with only limited post-treatment.

The recovery of wastewater constituents by membrane technology may result in positive economic outcomes through reduced consumption of resources and operating costs for the plant operators on the one hand, and through reduction of investment and operating costs for the downstream central wastewater treatment plant on the other hand.

Nevertheless, different membrane materials and their differences in selectivity and application ranges make a detailed pre-investigation necessary to reduce possible drawbacks. Because economic benefits are usually the main criteria for using these techniques, a careful pre-selection and investigation of capabilities is needed before installing membrane technology plants.



Pilot system

By means of preparatory laboratory tests in Germany and Tra Noc, suitable membrane processes have been selected. Based on these results a pilot system has been designed and constructed by industrial partner EnviroChemie and installed at a brewery and a chitin production site in Tra Noc.

During the operation of the pilot plant different settings are tested in order to achieve the optimum performance. Investigations on site cover relevant aspects like fouling and scaling potential under consideration of local climate conditions, quality and stability of recovered materials, integration of re-use concepts for valuable materials (recyclables) as well as reduction of operating costs.

Dissemination of results

In addition to the transfer and dissemination of the elaborated project results by TP 4 partners, the Vietnamese-German University (VGU) is involved in the project for further support related to know-ledge transfer measures.



Monitoring concept and development and operation of a containerised laboratory

- LAR Process Analysers AG
- IEEM - Institute of Environmental Engineering and Management at the University of Witten/Herdecke gGmbH
- Vietnam Institute of Industrial Chemistry (VIIC)



Monitoring concept

For technological and economical planning of wastewater treatment solutions a reliable database of wastewater analyses is necessary. So far this database and regular measurement programmes are of only limited scope and size for Tra Noc and other similar industrial zones. Therefore an adopted monitoring and control concept for industrial zones under the specific conditions in Vietnam and similar emerging countries is elaborated.

The monitoring concept has to take into consideration the local and regional situation in terms of environmental, organisational and institutional as well economic circumstances with regard to monitoring tasks.

Sampling programmes

Starting with the identification of relevant monitoring points and parameters, sampling programmes are defined and practically conducted in Tra Noc. Main focus is on toxic contaminants and constituents which are able to inhibit or even stop the biological treatment process of wastewater treatment plants.

Development and operation of a containerised laboratory

A containerised laboratory unit, adopted to the specific working and climate conditions, have been implemented in Tra Noc. The project tasks include the definition und evaluation of analytical concepts for the laboratory in terms of monitoring tasks as well as the practical operation and optimisation of the laboratory unit. The laboratory also has to offer analysis capacities for measurement programmes of the other sub-projects within the AKIZ joint project.

Two Mobile Units for Monitoring Toxicity

By end of 2012, IEEM has received additional grant from BMBF to equip AKIZ TP 5 with two novel mobile units for real-time and on-line analysis of industrial wastewater toxicity.





Sewage sludge management concept

- Braunschweig Institute of Technology, Institute of Sanitary and Environmental Engineering (ISWW)
- Passavant-Roediger GmbH
- Vietnam National University, Institute for Environment and Resources (IER)
- Vietnamese Academy of Science and Technology (VAST)



PASSAVANT ROEDIGER



Concepts for sewage sludge management

Since then number of wastewater treatment plants in Vietnam has increased rapidly during the last years, a need for sustainable solutions in sewage sludge management has occurred.

Objectives

An adequate sewage sludge management concept which particularly considers the interaction between wastewater (pre-)treatment and sludge quality is developed for industrial zones in tropical climates. For that purpose, Tra Noc Industrial Zone in Can Tho is used as an example. Recommendations on sludge treatment, reuse and disposal are determined not only for sludge produced at the central wastewater treatment plant but also for sludge produced by decentralised wastewater pre-treatment at selected industries (see TP 2–4).

Survey on sludge situation and practical sludge treatment tests

No data is available about sludge qualities and quantities produced from industries in Tra Noc Industrial Zone. In the first phase of the project, basic data about wastewater quality and corresponding sludge production has to be collected.

Using laboratory scale sedimentation and biological treatment experiments, primary and secondary sludge is generated from different wastewaters, representing the wastewater characteristics of different industries and of mixed inflow to the central wastewater treatment plant. This enables to make a prognosis of sludge amounts and qualities taking into account different sources of industrial wastewater.

For laboratory and pilot plant scale examinations in Tra Noc, industrial partner Passavant Roediger supplies the specific test equipment.

Relevant sludge treatment technologies

The following treatment technologies are chosen as relevant for the project:

- Anaerobic digestion with and without chemical disintegration
- Sewage sludge composting
- Solar sludge treatment
- Humification in reed beds and
- Vermicomposting.

The determination of the sludge management concept includes experiments regarding adequate treatment technologies on site in Tra Noc. Among others, the effect of possible inhibiting wastewater and sludge substances, which can be hazard to biological sludge treatment, is investigated.



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Sewage sludge management concept

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