

PIRAT Systems – Energy and resource-efficient wastewater treatment processes for China

Client II – International partnerships for sustainable innovation

In many regions of the world, the wastewater sector consumes huge amounts of energy and resources. Innovative process technologies can be used to reduce the energy consumption of wastewater treatment systems and improve their sewage cleaning efficiency. Furthermore, new approaches make it possible to use by-products as secondary raw materials, such as the use of organic residues from sewage sludge for biogas production. The German-Chinese research project “PIRAT Systems” develops concepts for energy-efficient wastewater treatment and for recovering phosphorus from wastewater.

Resource-efficient wastewater treatment

China is driving the expansion of wastewater treatment plants forward in order to treat a large part of the population’s wastewater in the future. On top of this, many existing Chinese wastewater treatment plants urgently need to be expanded and upgraded in order to comply with more stringent limits for the maximum permissible amount of nitrogen, ammonium nitrogen, and phosphorus in the wastewater. In addition to eliminating nutrients, it is becoming increasingly important to increase the energy efficiency of the clarification processes and to recover phosphorus from the wastewater.

The research project “PIRAT Systems” develops innovative wastewater treatment processes in China. One area that the project focusses on is developing a combined process for phosphorus elimination and recovery. The project will carry out systematic investigations into phosphorus recovery using precipitation and crystallization processes with the aim of adapting procedures that have been researched in Europe and North America to the conditions in China.

Energy efficiency with high cleaning requirements

The construction and expansion of wastewater treatment plants and the associated improvement of the water supply have led to an increased energy demand within the Chinese wastewater sector. Chinese wastewater treatment plants are to be made more energy efficient by switching to anaerobic sludge treatment and using co-substrates. These changes can also significantly reduce the overall amount of sewage sludge.

In order to achieve the goal of energy-neutral operation while simultaneously satisfying increasing requirements

for nitrogen elimination, it will also be necessary to reduce the energy consumption of power units. New, energy-efficient technologies and strategies for nitrogen elimination must also be developed and implemented. Measurement, control, and regulation strategies will be developed to optimize individual process steps and synchronize the entire process chain.



Digestion towers at a Chinese municipal wastewater treatment plant.

Testing of process technologies in China

Due to the different framework conditions in Germany and China, such as the composition of wastewater, cleaning requirements, and the technical processes that are used, developments and experiences from Germany cannot simply be transferred to China without making any adjustments. “PIRAT Systems”, therefore, aims to work with an interdisciplinary team of German and Chinese stakeholders to develop selected technologies for the Chinese market. With the help of simulation models, the German-Chinese team will cooperate very closely on developing concepts for two treatment plants in China. These models will also be used to test process technologies for increasing the energy efficiency of the plants, improving the quality

of nitrogen and phosphorus elimination processes, and recovering phosphorus. Measurement methods and planning tools tailored to Chinese conditions will be developed in order to ensure transferability to other wastewater treatment plants.

Furthermore, the project also aims to integrate wastewater treatment plants with other infrastructure more closely. This will involve looking at the quality, handling, and marketing of recycling products, as well as the processing of biogas for injection into the natural gas network. Support and acceptance by the general public will play an important role in this process.

Overall, “PIRAT Systems” will make an important contribution to improving the environmental situation in the areas of water protection, climate protection, and sustainable resource management.



Biofiltration plant at a Chinese municipal wastewater treatment plant.

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