

Research project

1. Title of the project	Development of integrated wastewater treatment systems with algae for small communities	
2. Project partners/supervisors	Germany	
	Prof. Dr. Renatus Widmann Dr. Thorsten Mietzel Dr.-Ing. Sebastian Schmuck (UDE)	
3. Profile of the master student	Knowledge of waste water treatment processes and biogas production processes. Lab-Experience in waste water analysis (standard parameters).	
4. Duration of the project	4,5 months in Germany (short-time research project)	
5. Work summary	Nutrient removal in waste water treatment plants is very energy consuming using conventional biological techniques. A new, energy efficient approach is the nutrient removal using algae, especially in waste waters with low organic carbon concentrations. The student will set up a Plexiglas reactor for growing the algae and the treatment of artificial and real waste waters. Nutrient removal is monitored over different periods of time and removal rates are derived using different kinds of algae. Illumination is conducted using different artificial light sources and sunlight. A literature research on the elimination of other pollutants (e.g. trace pollutants) is conducted and possibly some lab tests are carried out. In a second step, biogas tests using the algae biomass as a co-substrate are conducted. In standardized batch tests, different pre-treatments will be compared and different substrates (sludge) are digested together with the algae. Biogas production tests in a larger reactor will be conducted. Finally different techniques for algae harvesting will be compared theoretically and some preliminary tests using micro flotation will be conducted.	
6. Funding and resources available to complete the project	Equipment and chemicals for waste water analysis	Algae reactors, different algae species, equipment and chemicals for waste water analysis and biogas tests
7. General impact of the project	<ul style="list-style-type: none"> • Nutrient removal with a significantly lower energy consumption compared to treatment techniques used today • Organics contained in waste water are fermented into methane instead of CO₂ • No additional carbon source required for the removal of nitrate and nitrite • No chemicals required for the precipitation of phosphorus • CO₂ emitted from combustion can be bound • Algae as a new source of co-substrate for digestion of sludge • A new tertiary step for WWTPs 	
8. Outlook of the project	The only energy required for the nutrient removal using algae is light for the illumination (besides pumps etc.). In Egypt the boundary conditions are even more favorable than in Germany and waste water treatment facility are usually optimized for the elimination of carbon sources. In a future project, a large scale reactor could be implemented on a waste water treatment plant in Egypt, improving the nutrient removal without an increase of energy demand.	