Energy supply and decentralized drinking water treatment by Photovoltaic

Students

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Definition of Task: This project aims to plan, design, construct and commission a stand-alone water treatment plant. The plant will filter surface or groundwater, providing clean water with the quality of drinking water using gravity driven membrane (GDM) technology. In addition, the plant should be mobile, compact, and inexpensive. The plant shall provide drinking water to a community (about 100 people) in South Africa to prevent diseases caused by contaminated water and improve their quality of life.

Approach: By carrying out literature research, knowledge was acquired, which is needed to understand the particular topics and interrelationships. With the help of a morphological box, different PV and GDM system variants were created, and compared in a matrix. The dimensioning of the components was done by applying different formulas. To check the flux, an analog flow sensor was installed in the connecting hose. This sensor sends the data directly to a computer. To determine if the plant can provide water with drinking quality, an integrity test was made. For this purpose, E. coli, which count as an indicator of diseases, were added to the raw water tank. Whether the plant can be operated autarkic was determined with the data received directly from the plant via Bluetooth. The PV yield, consumption, and battery status were recorded while performing.

Result: The plant was designed as a tower, which is constructed from two 1000 litre IBC tanks. A DC pump pumps lake water from Lake Zurich into the upper of the two tanks, the raw water tank. In this tank is a membrane module integrated with a surface of 10 m2. This membrane module filters the water, which enters the permeate tank through a connecting hose. On the two IBC tanks, a PV module was installed with the help of a self-made construction, which supplies the system with energy. The measured flux of the membrane module was below the expected value of 5 l/(m2×h), therefore a fault analysis was conducted. This showed that the flux could be improved by changing the position of the connecting hose, angling the hand valve to 45°, and cleaning the membrane surface. The results of the integrity test showed that no E. coli could be detected in the permeate tank. The system could be operated autarkically with the help of the battery. A risk that should be accounted for is not to exceed the calculated amount of AC. Otherwise, an autarkic operation cannot be assured.

Picture of the whole plant
Own presentment

Picture of the electrical box
Own presentment

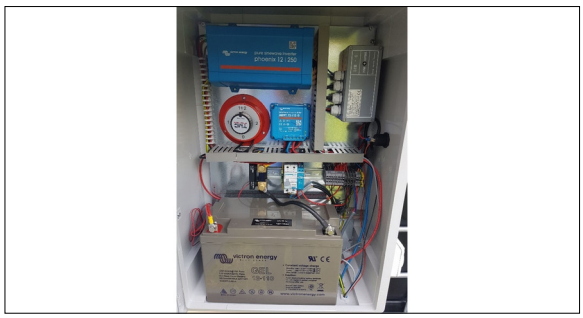
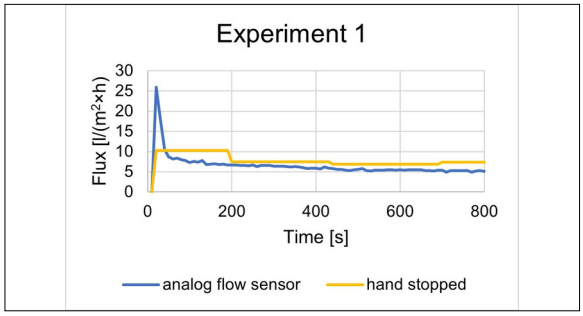


Diagram of an experiment for flux optimization
Own presentment



Examiners

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Subject Area

Electric solar technology, Water treatment, Plant design and project management, Control engineering