Solardriven Membrane distillation

A Combination of a Membrane distillation technique and the Kjaerboe Pump

Abstract

In the area between the Indian West Bengal and Bangladesh one of the history's largest poison catastrophes is going on. Under the 70's and 80's thousands of wells were drilled, often with help from international aid. These wells have shown to contain a large amount of arsenic. Bangladesh is the country that has been most affected, and millions of people are drinking contaminated water every day.

The company Xzero AB works with the method Membrane Distillation witch is a reliable way to provide people with clean water. Xzero's existing system wishes to be reconstructed into a system that works on biofuel and doesn't contain any moving parts. This to reduce the maintenance so that they can be placed all around the world.

The amount of water that can be cleaned stands in direct proportional to the temperature difference between the membranes hot and cold side. This means that the incoming water has to be heated up as much as possible, but not up to 100°C, and afterwards be cooled down to the lowest temperature possible.

To heat the water a careful comparison between different methods have been done, which shows that the biogas is the best alternative.

A number of nature circulation systems with different ways of working have been analyzed. The systems need of energy has been of the utmost importance. A system, which is driven by density difference needs much less energy then a steam driven one, and is therefore considered to be the best.

Pressure losses over the membrane need to be reduced so that the construction can be build in reasonable size. This can we see by analyzing the graph from MATLAB.

Water purification

An Analysis using biofuel as power

Abstract

During this project it has been investigated if it is possible to combine the membrane destillation technique developed by Xzero AB with a solar powered pump. The purpose of this system is to be able to run it without access to electricity and to minimize the number of moving parts.

During the project an experimental system has been built.

A simplified theoretical model has also been constructed, that makes use of well known relations from thermodynamics and flow mechanics, this to be able to make relations between the flow and the size of solar panels.

The main purpose with the experimental system that was built, was to be able to compare the results given from the theoretical models and make observations that can be of use for the construction of a finished product.

Propositions have also been given for rough dimensions of a system that is able to produce about 50 litres clean water in a period of 12 hours.

Clean water from recovered heat

Wärtsilä 6L20s potential for the membrane distillation (MD) technology

Abstract

The principle that any form of heat (energy) can be used for the Xzero MD-system gives it a great potential with many technical applications.
In this report an easier analysis of the capacity from the Wärtsilä 6L20s combustion engine applied on the MD-technology is made, where the heat from the engines cooling system is used. The temperature difference at 55 °C between the in- and output and the energy content for 922 kW in the hot water that flows out from the engine was the base for this study.
Wärtsilä has shown to be a company that is very aware of the environment and the company puts heavy focus on trying to extend as high efficiency as possible from their constructions. This lead to that they had good access to detailed information about their products which made it easy to work with.

To make this analyse, some assumptions of some quantities had to be made. The temperature difference for 5°C for each exchangers and 10°C drop in temperature after every step are those who were of most importance.

The mathematical models that were used led to that 922 kW energy were enough to build a MD-system with five steps and nine 20 membrane modules in parallel with each other for every step. This as a minimum scenario with a production of 26,5 m^3 ultra pure water per day. The system has however a capacity of producing 64,2 m^3 ultra pure water per day if the cooling water is used for every module.
The production of clean water as a secondary product using just recovered heat is a good alternative for Wärtsilä electricity- and heat constructions.