Optimization of reverse osmosis performance

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The ability to purify water is of great importance in the world today. The most commonly used method to purify water is called reverse osmosis and is used in applications ranging from desalination of seawater to creating ultra clean water to be used in medical applications. Reverse osmosis however is not free from costs. The process needs pressurized water which costs energy and to be able to produce clean water some water needs to carry the removed “dirty” particles out of the system and is thereby wasted. The purpose of this thesis was to optimize this process so that no more water or energy than necessary is wasted and designing a system that could automatically adjust itself and remain efficient even when the inlet water quality changed. The goal was to design a system that could be used to deliver high quality water to dialysis machines in any operating condition.

Dialysis is one of those applications were water purification is of great importance and is crucial to ensure the safety of the patient. During a treatment, the patient’s blood comes directly in contact with a dialysate, a mixture of highly purified water, salts and other particles, and this fluid is used to purify the blood of the patient. Any contaminants in the water can therefore make its way into the patient’s bloodstream and cause harm.

The main method of water purification in dialysis applications is reverse osmosis. This process is highly sensitive to changes in water quality and temperature and therefore a system that doesn’t use any control algorithm will have very different efficiency due to seasonal changes and depending on where in the world the system operates. For instance, a water purification system in operation in Delhi will have very different working conditions than a system that operates in Lund. The only way to handle this problem is to design a system that can measure the quality of the inlet water and adapt itself in order to always stay as efficient as possible. By using this adaptive system, it is possible to design a machine that can operate anywhere in the world and be as cheap and environmentally friendly as possible.

The thesis work resulted in a prototype water purification system that was able to deliver high quality water while reducing both noise, energy and waste water. The algorithm used in the system was design to adapt to variations in temperature and water quality and to remain efficient in a wide working area.