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K. Samonchyk, A. Mankevich, T. Lapitskaya

Osmotic Energy

Belarusian National Technical University
Minsk, Belarus

It goes without saying that energy consumption has increased immensely in the last decades. Almost all of the energy we use comes from nonrenewable sources. We haven't enough fossil fuels to satisfy our needs. Besides that most scientists believe that fossil fuels an important contributor to global warming. That's why we are highly interested in developing alternative sources of energy. There are many alternative sources of energies that harness natural forces and resources such as solar power, wind power, and geothermal energy. Scientists all over the world continue to research new sources of energy.

Water is a renewable predictable source of energy. The mixing of freshwater and seawater where rivers flows into the salty ocean releases large amounts of energy. This energy can be harvested and made into electricity using pressure retarded osmosis (PRO).

Osmosis means passage of water from a region of high water concentration (often freshwater) through a semipermeable membrane to a region of low water concentration (often NaCl). The membrane only lets water molecules pass. Salt molecules, sand, silt and other contaminants are prevented to do so.

There are two primary methodologies for osmotic power:
A) natural occurrence's globally where river water meets the sea;

B) bringing together two man made water sources from processing plants

Both methods are viable but one produces more power than the other method. Method A: Seawater averages 40 grams of salt/ liter + River Water provides less power than Method B: Brine (from desalination) averages 60 grams of salt/ liter + treated water. The higher the salinity, the more power can be generated.

For example, we have two compartments. (pict. 1) Both compartments contain water, but the one on the left also contains a solute whose molecules are too large to pass through the membrane. If the cell is set up so that the liquid level is initially the same in both compartments, you will soon notice that the liquid rises in the left compartment and falls in the right side, indicating that water molecules from the right compartment are migrating through the semipermeable membrane and into the left compartment. This hydraulic pressure can be used to drive a turbine that produces electrical energy. This migration of the solvent is known as osmotic flow, or simply osmosis.

What is the force that drives the molecules through the membrane? This is a misleading question, because there is no real “force” in the physical sense other than the thermal energies all molecules possess. Osmosis is a consequence of simple statistics: the randomly directed motions of a collection of molecules will cause more to leave a region of high concentration than return to it; the escaping tendency of a substance from a phase increases with its concentration in the phase.

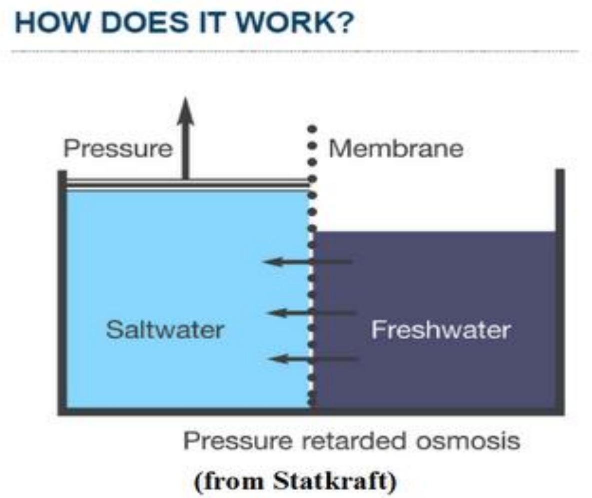

Fig.1- Principle of the process

The main advantages of Pressure Retarded Osmosis are:

1. This type of power generation is very reliable,
2. It is very quiet when operating and requires minimal supervision.
3. In addition, it is quickly fed to the hydroelectric turbine to generate electricity. Expected the plant could respond very quickly, using the membranes to 'store' power ready in the form of high pressure water.
4. The expected lifetime of this plant is large; with almost no moving parts, there will be little wear occurring.

But it has some disadvantages:

1. This plant is very expensive to install.
2. The permeable membrane is currently an expensive resource.

3. The plant could reach a power output of 4 kW in ideal conditions. By comparison, an open cycle gas turbine a fraction of the size could easily produce greater than 15MW .

Osmotic power came into sharper focus when the world's first osmotic facility opened in the village of Tofte in Norway in November 2009. A proof-of-principle facility set up by Norwegian power company Statkraft, the plant takes in freshwater and saltwater and converts it to brackish water and energy as the outputs.

At Tofte, freshwater crosses a membrane to the seawater side, an influx that builds up pressure and drives turbines. Water begets energy and water. Unlike solar and wind, the energy output is predictable. Such power plants could be situated anywhere there is abundant seawater and freshwater, such as the mouth of a river. The Totfe facility produces less than 1 watt/m2 , which is well below Statkraft's target of 5W/m2 for commercialization. "We are able to produce membranes in our labs producing 3W/m2 "says Stein Eric Skilhagen, head of osmotic power at Statkraft. Skilhagen says that the next step is to build a pilot plant and they hope to be in this position within two to three years, which would generate 1 or 2MW. Ultimately, a good average size plant would be a 25MW installation, producing about 150 to 200GWh/year of electricity. And you could locate this plant close to a village, town or city, since there are no noise or pollution issues. It could make a big splash on the energy market: Statkraft estimates that there is a potential of producing 180TWh/year in Europe.

Osmotic power has great potential, but it's only economically feasible if you reduce the cost of creating it. Energy Recovery's PX devices reduce energy use, allowing osmotic power plants to produce renewable energy.