No pinch of salt

The world's first osmotic power station has just opened in Norway.

IT was one small movement for a royal finger—but it started a power station of a sort that has never been tried before. On November 24th, when Princess Mette-Marit of Norway pressed the red button, pumps started to hum, pressing freshwater from a river and saltwater from the nearby Skagerrak through an array of white steel cylinders. Then a turbine began to run inside a small, redbrick hall at Tofte, a few kilometres south-west of Oslo, and electric current emerged.

The power in question was generated by osmosis. This is the tendency for water to pass through a membrane separating a weak solution from a strong one. This causes a build-up of pressure on one side of the membrane.

The Tofte experimental power station exploits this pressure. According to Statkraft, the company that owns the station, the pressure generated by water passing across the membrane from the fresh stream to the salty one is equivalent to a head of 120 metres of water—a sizeable hydroelectric plant. The membrane that can withstand such force is made of polyester, polysulfone and polyamide and is held within the white steel cylinders. Some of the resulting pressure is used to keep the pumps running. The rest turns a turbine.

Devising a suitable membrane—tough enough to withstand the pressure while remaining permeable to water but not to salt—is harder than it sounds. It took researchers at the GKSS Institute, near Hamburg, a decade to do it. At the moment the membranes at Tofte put out one watt per square metre. For the technology to be commercially viable, that would have to be increased to five. According to Anja Car, the project's manager at GKSS, that will be possible in the laboratory but not, yet, in applications the size of a power station.

Nevertheless Statkraft hopes to build a commercial osmotic plant by 2015, and to follow it with others. The firm thinks that up to 10% of Norway's electricity could be generated this way. Nor is Statkraft alone in its line of thinking. Since 2001 a Dutch company called KEMA has been working on an osmotic power plant that uses a different approach, reverse electrodialysis. In this case it is not water that passes through the membrane, but the sodium and chloride ions of which salt is composed.

This actually requires two different sorts of membrane, one for each ion, which make the process more complicated than Statkraft's. Nevertheless Kees van den Ende, the reverse-electrodialysis project manager at KEMA, thinks his process has some advantages over the Norwegian way (which is known, technically, as pressure-retarded osmosis). For one thing, it operates at lower pressure. For another, the actual passage of the ions (which are electrically charged atoms) creates the current, so no turbine is required. The disadvantage is that reverse electrodialysis produces direct current, whereas the world runs mostly on alternating current. Transforming one into the other wastes energy.

KEMA has two possible sites for its first electrodialysis plant. One is the Closure Dyke in the Netherlands and the other is between the Dead Sea and the Red Sea. Tofte is, at least, up and running—although it does, perhaps, need to become a little more powerful. At the moment the world's first osmotic plant produces just enough power to make a cup of tea.

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