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NEW DESALINATION TECHNOLOGY TAPS WASTE HEAT FROM POWER PLANTS

GAINESVILLE, Fla. --- Desalination is often touted as one solution to the world's water woes, but current desalination plants tend to hog energy.

Now University of Florida researchers have developed a technology that can tap waste heat from electrical power plants as its main source of energy, an advance that could significantly reduce the cost of desalination in some parts of the world.

"In the future, we have to go to desalination, because the freshwater supply at the moment can just barely meet the demands of our growing population," said James Klausner, a UF professor of mechanical and aerospace engineering, whose research was funded by the U.S. Department of Energy.

"We think this technology could run off excess heat from utility plants and produce millions of gallons each day," said Klausner, lead author of an article on the system that appears in the current issue of the Journal of Energy Resources Technology. He co-invented the technology with fellow UF mechanical engineering professor Renwei Mei

More than 7,500 desalination plants operate worldwide, with two-thirds of them in the Middle East, where there often is no other alternative for fresh water, Klausner said.

The technology is less common in North America, with plants located mostly in Florida and the Caribbean producing only about 12 percent of the world's total volume of desalinated water, he said. US residents get less than 1 percent of their water from desalination plants, he said.

The need for desalination is likely to grow, however, as the population increases and residents consume more fresh water. In Florida, for example, desalination has been touted as one solution for metropolitan areas where freshwater resources are becoming ever more scarce. With more than 97% of the Earth's water supply composed of salt water, desalination is even more urgent in developing nations, such as China, Klausner said.

"China has a large and growing demand, Japan has a large demand, the Middle East, Sub-Saharan Africa – I look at it as a worldwide problem," he said.

Most commercial desalination plants now use either distillation or reverse osmosis, Klausner said. Distillation involves boiling and evaporating salt water and then condensing the vapor to produce fresh water. In reverse osmosis, high pressure pumps force salt water through fine filters that trap and remove waterborne salts and minerals.

Boiling the vast amounts of water needed for the distillation process requires large amounts of energy. Reverse osmosis uses less energy but has other problems, including mineral buildup clogging the filters. That's the main technical issue plaguing the largest desalination plant in the United States, Tampa Bay Water's $108 million plant in Apollo Beach. Although it was supposed to produce 25 million gallons of freshwater each day, the plant, beset by technical and financial problems since opening in 1999, currently is shut down.

Employing a major modification to distillation, Klausner's technology relies on a physical process known as mass diffusion, rather than heat, to evaporate salt water.

In a nutshell, pumps move salt water through a heater and spray it into the top of a diffusion tower – a column packed with a polyethylene matrix that creates a large surface area for the water to flow across as it falls. Other pumps at the bottom of the tower blow warm, dry air up the column in the opposite direction of the flowing water. As the trickling salt water meets the warm dry air, evaporation occurs. Blowers push the now-saturated air into a condenser, the first stage in a process that forces the moisture to condense as fresh water.

Klausner said the key feature of his system is that it can tap warmed water plants have used to cool their machines to heat the salt water intended for desalination, turning a waste product into a useful one.

He has successfully tested a small experimental prototype in his lab, producing about 500 gallons of fresh water daily. His calculations show that a larger version, tapping the waste coolant water from a typically sized 100-megawatt power plant, has the potential to produce 1.5 million gallons daily. The cost is projected at $2.50 per 1,000 gallons, compared with $10 per thousand gallons for conventional distillation and $3 per thousand gallons for reverse osmosis.

Because the equipment would have to extract as much heat as possible from the coolant water, it would need to be installed when a

plant is built, he said. Another potential caveat is that a full-scale version of the mechanism would require a football field-sized plot on land, likely to be expensive in coastal areas where power plants are located, Klausner said. Presumably a utility would sell the fresh water it produces, recouping and then profiting from its investment, he said.

Klausner said a miniature version of the full-scale system could be run using solar or other forms of heat, which might be useful for small towns or villages. UF has applied for a patent on the technology. Klausner's research was funded by a $200,000 grant from the Department of Energy.