Prototype demonstrates success of advanced new energy technology

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This prototype of a "thermal activated cooling system" has been developed by engineers at Oregon State University, and promises important new advances in energy efficiency by using wasted heat. (Photo courtesy of Oregon State University)

With the completion of a successful prototype, engineers at Oregon State University have made a major step toward addressing one of the leading problems in energy use around the world today – the waste of half or more of the energy produced by cars, factories and power plants.

New technology is being developed at OSU to capture and use the low-to-medium grade waste heat that's now going out the exhaust pipe of millions of automobiles, diesel generators, or being wasted by factories and electrical utilities.

The potential cost savings, improved energy efficiency and broad application of such technology is enormous, experts say. The new systems now being perfected at OSU should be able to use much of that waste heat either in cooling or the production of electricity.

A prototype device has been finished to demonstrate the efficacy of this technology, and the findings just published in *Applied Thermal Engineering*, a professional journal.

"This could become a very important new energy source and way to improve energy efficiency," said Hailei Wang, a research associate in the School of Mechanical, Industrial and Manufacturing Engineering at OSU. "The prototype shows that these systems work as well as we expected they would."

More than half of the heat generated by industrial activities is now wasted, Wang said, and even very advanced electrical power plants only convert about 40 percent of the energy produced into electricity. The internal combustion engines of automobiles are even worse – they generally operate around 25-40 percent conversion efficiency. The very function of an automobile radiator is to dissipate wasted heat.

Various approaches have been attempted, and are sometimes used, to capture and use at least some of that waste heat to produce cooling. The new system being developed at OSU may do that as, or more efficiently than past approaches, be more portable, and also have one major advantage – the ability to also produce electricity.

It's called a "thermally activated cooling system" that gains much of its efficiency by using extraordinarily small microchannels which help to better meet the performance, size and weight challenges. It effectively combines a vapor compression cycle with an "organic Rankine cycle," an existing energy conversion technology.

The new prototype completed at OSU succeeded in turning 80 percent of every kilowatt of waste heat into a kilowatt of cooling capability. Researchers say the conversion efficiency wouldn't be nearly as high if the goal is to produce electricity – about 15-20 percent – but it's still much better than the current approach, which is to waste the energy potential of all of the heat.

"This technology would be especially useful if there's a need to have cooling systems where heat is being wasted," Wang said. "That's one reason the research has been supported by the Department of Defense, because they see it being used to provide needed air conditioning for electronics and other purposes when they are using generators in the field."

However, the OSU scientists said that may be just the beginning. Factories often produce enormous amounts of wasted heat in their operations. The systems could also be incorporated into alternative energy technologies such as solar or geothermal, scientists say, in addition to fossil fuel use.

Conceptually, it should also be possible for such systems to be used in hybrid automotive technology, taking waste heat from the gasoline engine and using it not only for air conditioning but also to help recharge the battery that powers the vehicle, Wang said.

Continued research will be needed to perfect the technology and adapt it to different uses, the scientists said.

The work takes advantage of OSU's advanced programs in microchannel technology, a key focus of the Microproducts Breakthrough Institute operated by OSU and the Pacific Northwest National Laboratory. This study was co-authored by Rich Peterson, an OSU professor of mechanical engineering, expert in thermal sciences and energy systems,

and associate director of the Microproducts Breakthrough Institute.

"There continues to be significant potential for reducing energy consumption and greenhouse gas emission by improving overall energy efficiency for various energy systems," the scientists said in their study. "One route toward satisfying both paths is to develop technology able to recover waste heat that would be otherwise rejected to the atmosphere without usage."

More information:
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