Breakthrough made in energy efficiency, use of waste heat

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Engineers at Oregon State University have made a major new advance in taking waste heat and using it to run a cooling system - a technology that can improve the energy efficiency of diesel engines, and perhaps some day will appear in automobiles, homes and industry.

This heat-actuated cooling system, which will probably find its first applications by the U.S. Army, could ultimately be applied to automobiles, factories or other places where waste heat is being generated, and used to provide either air conditioning or electricity.

In its first military application where stationary diesel generator sets are used, researchers say they expect improved efficiencies of 20-30 percent in situations where cooling is needed.

The system is one of the early applications of microchannel technology that is being developed jointly by OSU and the Pacific Northwest National Laboratory, through a joint venture called the Microproducts Breakthrough Institute.

"Our approach will provide a capability that has not yet been achieved for efficiently using waste heat with small-scale systems," said Richard Peterson, a professor of mechanical engineering at OSU. "The technology has been successfully developed and we should have a working prototype ready for demonstration by this summer."

Conceptually, the system works somewhat like existing heat pumps, but it's powered by waste heat, not electricity. What makes the technology unique is the use of microchannel heat transfer components and an efficient "vapor expander" to provide high heat transfer rates and smaller, lighter and more efficient heat exchangers.

"Right now, about 75 percent of the fuel energy in most stationary diesel generators used to produce electricity is lost in the form of waste heat," Peterson said. "And the military often needs these generators to operate air conditioning for advanced electronic equipment and other applications. So we're using that waste exhaust heat to drive an expander-compressor cycle that provides cooling."

The first prototype will be a small five-kilowatt cooling system that's a little larger than an automobile air conditioner in capacity, Peterson said. It's the type of air conditioner, for instance, that could be used in a forward-deployed military command post. The military is particularly interested in the system and has supported its development, he said, to help improve fuel efficiency and economy.

For a complete range of commercial or consumer applications, some further size improvements, component integration and reduced cost will be needed, researchers say. But the potential applications are broad.

The most immediate and obvious, of course, might be automotive air conditioning, where heat energy that's now being blown out the tailpipe might be used to power the car's air conditioning. The integration of a generator into this technology might allow it to also produce electricity instead of air conditioning, depending on what was needed.

Industrial applications to improve energy efficiency are clearly possible - basically, anywhere significant amounts of heat are being produced but not used. While the early applications may be most readily developed with waste heat, it could also be possible to use this technology with heat that's intentionally produced, such as with moderately concentrated solar energy to provide a building's air conditioning on hot, sunny days.

"Since this technology would allow you to produce electricity or cooling whenever something is hot, it might be an ideal complement to a 'smart' energy system that could provide extra power during peak demand periods," Peterson said. "We can now take heat and use it to create either electrical power, heat or cooling. It's not yet clear what all the possible applications will be."

OSU, through the Microproducts Breakthrough Institute, can already produce the microchannel devices needed to make this system operational, but work will continue in order to develop improved manufacturing efficiencies and create less expensive devices at higher production volumes.

Source: Oregon State University (news : web)

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