

Project Title: ONAMI Heat Actuated Heat Pump Development

Project Funding: \$2,250,000 grant from Defense Advanced Research Programs Agency (DARPA)

Project Description: Program Description: ONAMI at OSU is developing a microtechnology-based compact light weight cooling system that uses heat as the primary energy source. Most coolers use electricity or power from an engine as the primary energy source. This can be a serious problem for portable applications where it can be difficult to provide electric power.

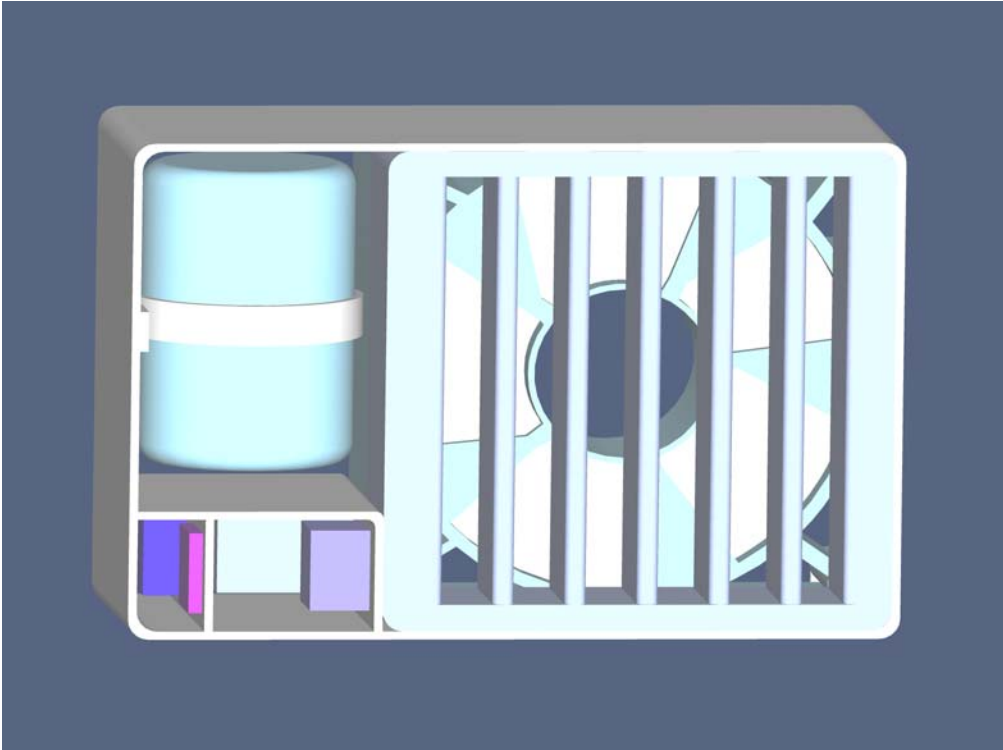
Providing cooling for soldiers in hot climates, such as Iraq, is critical for maintaining the soldier's performance. This is particularly true for soldiers wearing body armor or chemical and biological warfare clothing. However, a soldier with a conventional electric powered cooler will need to carry 10 to 20 pounds of batteries for a one day mission. This is clearly not acceptable, particularly when a soldier is often carrying 75 to 100 pounds of other equipment. However there is an alternative. Fuels such as diesel contain 100 times more energy per pound than an equivalent battery. The key is to develop a system that can combust fuel and use the resulting heat to provide cooling.

We are developing an alternative class of portable cooling systems that do not require electricity. This class of devices will use thermal energy to provide cooling. Recent developments at OSU suggest that the performance of heat-actuated cooling systems can be significantly enhanced by the use of ONAMI technology. The use of very small flow channels (approximately the size of a human hair) improve heat and mass transfer, thereby reducing size and weight and improving performance. All of the pieces of the heat actuated cooling system have been developed and have been integrated into a complete functioning system. The results of suggest that this approach can lead to a portable cooling system that is independent of electric power and that weighs approximately 50% of the next lightest cooling system.

Student Involvement: Nine graduate students are involved in this research project.

Innovations, new companies and jobs: While portable heat actuated cooling is initially being developed for military applications, the same technology will have many applications in the commercial sector. The market for person portable cooling has been estimated to be between \$500 million and \$1 billion per year. However the same technology can be used to cool automobiles using the waste heat from the engine rather than requiring the engine to provide power for cooling. This improves gas mileage by approximately 10% when the automobiles air conditioner is operating and eliminates the drag on the engine that occurs when cooling the car. The market for automotive cooling is between \$1 and \$10 billion per year. We are within 1 to 3 years of commercializing this technology which may lead to one or more new companies in Oregon with substantial business volume.

Graphic: Schematic of a soldier portable cooling system.



Cooling System Dimensions:

Length = 18.2 cm

Height = 12.4 cm

Depth = 7.5 cm

Cooling System Weight: 1.70 kg

Conventional System Weight: 3:2 kg