Rice U. parlays sun's saving grace into autoclave (w/ video)

May 3 2011

(PhysOrg.com) -- Rice University senior engineering students are using the sun to power an autoclave that sterilizes medical instruments and help solve a long-standing health issue for developing countries.

The student's used Capteur Soleil, a device created decades ago by French inventor Jean Boubour to capture the energy of the sun in places where electricity -- or fuel of any kind -- is hard to get. In attaching an insulated box containing the autoclave, the students transform the device

into a potential lifesaver.

The Capteur Soleil, which sits outside Rice's Oshman Engineering Design Kitchen, looks something like an ultramodern lawn swing. Its spine is a steel A-frame, and a bed of curved mirrors beneath the frame produces steam by focusing sunlight along a steel tube at the frame's apex. Rather than pump steam directly into the autoclave, the Rice team's big idea was to use the steam to heat a custom-designed conductive hotplate.

"It basically becomes a stovetop, and you can heat anything you need to," said Sam Major, a member of the team with seniors Daniel Rist, David Luker and William Dunk, all mechanical engineering students. "As long as the autoclave reaches 121 Celsius for 30 minutes (the standard set by the Centers for Disease Control and Prevention), everything should be sterile, and we've found we're able to do that pretty easily."

He said one person could easily adjust the Capteur Soleil by ratcheting up the back leg to align the mirrors with the sun. Within half an hour of receiving strong sunlight, the Capteur Soleil will begin to produce steam, which will in turn heat the patterned hotplate and then the standard-issue, FDA-approved autoclave. With good midday sun, Major said, it takes 40 minutes to an hour to begin significant heating of the autoclave.

The autoclave, which looks like a tricked-out pressure cooker, has a steamer basket inside. "We put about an inch of water inside, followed by the basket with the tools and syringes," Major said. "We've used some biological spores from a test kit, steamed them, and then incubated them for 24 hours and they came back negative for biological growth. That means we killed whatever was in there."

The autoclave, tucked inside a plywood frame, is wrapped in silicon-based Thermablok insulation, which has the highest R-value of any

known material and is a spinoff from NASA research into thermal protection for the space shuttle. "This thin layer does most of the work," Major said. "We used standard pink insulation around the inside just to make the box stronger."

"This is really the latest iteration of a much larger project," said Doug Schuler, the team's faculty adviser and an associate professor of business and public policy at Rice's Jones Graduate School of Business. "We already have a version of the Capteur Soleil being used in Haiti for cooking, but we felt it could do more."

Provided by Rice University