



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

| | |
|--|---------------------------------------|
| Name(s) John Chapman A. Caddell | Project Number S0305 |
| Project Title The Leidenpump: A Non-Mechanical Means of Fluid Delivery | |
| <p style="text-align: center;">Abstract</p> <p>Objectives/Goals The main purpose of this project was to determine the viability of a pump utilizing the Leidenfrost Effect. Non-mechanical, this proposed method of coolant delivery only requires a unique, asymmetrical ratchet pattern and a significant temperature differential between the substance being "pumped" and the surface along which it is moving.</p> <p>Methods/Materials Two models of brass modules of a length of one inch with an internal concentrically grooved ratchet pattern were placed end-to-end in both a two-foot and a four-foot electrically heated hose. The temperature was adjusted with a controller using degrees Fahrenheit. Distilled water was dispensed directly into the pipe through a hole in the surface by a thin metal nozzle. Measuring change in mass and the average speed of droplets through the tube allowed ideal conditions to be determined.</p> <p>Results Droplets consistently traveled in the same direction through the tube, against the ratchets, at the Leidenfrost point. Average droplet velocity decreased as droplet mass and the slope of the tube increased. Changing the temperature also affected average droplet velocity. After reaching the Leidenfrost point, average droplet velocity rapidly increased before decreasing slowly. Unexpectedly, droplet mass increased as the droplets passed through the tube. A smaller mass gain was found when moisture was evacuated from the tube.</p> <p>Conclusions/Discussion A tube with a ratcheted internal surface is a viable method for the non-mechanical delivery of a coolant. This technology could be used for a number of applications, particularly for cooling nuclear reactors by delivering essential coolant without the use of any energy beyond the thermal energy of the reactor itself. It was also found that hot water vapor in the tubular environment condensed on the relatively cool droplets, an unexpected finding without precedent in the relevant scientific literature.</p> | |
| Summary Statement This project is concerned with the construction of a non-mechanical means of delivering a fluid, a pump, using only thermal energy. | |
| Help Received Grandfather helped procure and explain the operation of testing equipment; Dispensing system donated by Nordson/EFD; Heated hoses donated by Universal Heated Hoses; Machining assistance from Sunshine Products USA | |