Development of a Solar Energy Refrigeration Cycle Laboratory

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Abstract

Solar energy is one alternative of great importance to the Southwestern United States as we develop plans to continue to meet increasing energy needs. In order for students to understand the basics of solar energy, an undergraduate laboratory experiment was developed. The Solar collector consists of 3 parabolic mirrors that transfer solar energy to a heat transfer fluid. The system is equipped with a 30 gallon thermal storage tank, radiator, circulating pump and ammonia refrigerator. The circulating pump is a 12 volt pump powered by a 40 watt photo voltaic array. In principle the hot thermal fluid (up to 115C) circulates through the refrigerator where it separates ammonia from water in the evaporation tube. The ammonia is then cooled via external finned heat exchanger. The negative heat of mixing between ammonia and water is used to cool the contents of the refrigerator. The preliminary experimental protocol and the Labview-based control system to regulate both the operation of the radiator cooling fan and the flow of heating fluid through the refrigerator were developed. Furthermore, the software interface and the hardware necessary for remote operation of the experiment were installed. Remote operation not only increases student safety by reducing the time students are on the roof, but also allows for distance learning activities. Future plans include exploring if students from other universities could record data and control the device.