**Experimental and Numerical Study of Steam/Water Cavity Receiver**

**in Solar Thermal Power Tower System**

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***Abstract***

Solar energy is clean without pollution, rich and free, so solar thermal power has the huge potential for future energy utilization. Tower type concentrating technology can be used for large-scale solar power generation. In the power tower system, the heat receiver is the key equipment for sunlight-heat conversion. The thermal performance of the receiver will affect the efficiency of the entire power plant. There is no rich experience on the design of receiver, which is mainly based on the coal-fired boiler. Due to the nonuniform and instantaneous characteristics of sunlight, the receiver should differ greatly from the conventional coal-fired boiler. So it is necessary to study the receiver according to the sunlight characteristics. An experiment platform for testing the thermal performance of a water/steam cavity receiver was firstly designed and built. The start-up curves under different operating pressures were obtained and the receiver has low thermal efficiency of only about 55-70%. The low thermal efficiency is attributed to the low mass flow rate. A combined method was proposed to evaluate the thermal performance of the cavity receiver for startup and operation. The numerical results are in good agreement with the experiments. The results suggested that an appropriate mass flow rate of 200kg/h should be chosen for the design and operation of the experiment platform. The thermal performance of a solar cavity receiver under windy conditions was numerically studied. The heat flux and temperature distributions on boiling tubes in the cavity were obtained. The convective and radiative heat losses were analyzed in detail. Changing the wind flow angle or velocity can obviously affect the air velocity inside the cavity, which reaches the maximum value for side on wind, resulting in a large convective heat loss. The nonuniform heat flux distribution on the cavity wall was analyzed and the effective methods were proposed to increase heat flux uniformity and thermal performance of the cavity receiver. Based on the experimental and numerical studies, a water/steam cavity receiver was designed and manufactured. The receiver is now being used in 1MW power tower plant in China with a very good thermal performance and reliability.