

**Effect of surfactant and surface treatment of micro-hatched tubes on the absorption performance**

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**ABSTRACT:**

The absorber is one of the most critical components in the thermal driven absorption systems from the viewpoint of size and performance. It is one of the largest components and has a complicated heat and mass transfer mechanism which influences the system performance significantly. Generally, the absorber has a falling film mode as a heat transfer mechanism due to its high heat transfer coefficient on the liquid film region and an easy manufacturing process. However, the falling film heat transfer mode has wettability problem and need good liquid distributors at the inlet of the liquid flow. A low wettability on the heat transfer surface directly deteriorates the heat and mass transfer performance during the absorption process. There are two ways to improve the wettability; surfactant addition and surface treatment. First, by adding small amount of the surfactant into the working fluid, the surface tension reduces significantly leading to a higher wettability. Absorption rate is improved by the Marangoni convection that results from the imbalance of the surface tension. Second, mechanical surface treatment by adding adequate surface roughness makes the liquid even distributed on the surface. The mechanical surface treatment can be categorized into two groups: shape treatment and roughness treatment. The shape treatment falls on the macro-scale treatment while the roughness treatment does on the micro-scale treatment.

In this paper, three different micro-scale hatched tubes and a bare tube are tested to quantify the effect of the surface roughness on the absorption performance. The roughness of the micro-scale hatched tubes ranges 0.386 to 11.359  $\mu\text{m}$ . The working fluid is H<sub>2</sub>O/LiBr

solution with inlet concentration of 55, 58 and 61 weight % of LiBr. The experimental setup consists of the absorber test section, liquid distributor, a heat exchanger, coolant circuit, circulation pump and a vapor generation heater. The absorber heat exchanger consists of 24 horizontal tubes in a column, liquid distributor at the liquid inlet and the liquid reservoir at the bottom of the absorber. The liquid solution flows down on the surface of the micro-scale hatched tubes counter to the coolant flow. The weak solution (low concentration of the refrigerant, H<sub>2</sub>O) flows into the heat exchanger by the circulation pump (Magnetic gear pump). The inlet temperature of the weak solution is controlled by the heat exchanger at the top of the test section. The mass flow rate of the liquid is measured by a mass flow meter before entering the liquid distributor. The liquid solution liquid is distributed at the top of the absorber test section and flows down on the horizontal tube bank. The water vapor is generated by a heater installed within the reservoir at the bottom of the test section, and is absorbed into the liquid solution flowing down on the micro-scale hatched tube. The coolant (Ethylene Glycol 35%) flows inside the tube from the bottom to the top of the test section. Therefore there is a counter-cross flow between the solution and the coolant flows.

In summary, the objective of this paper is to investigate the effects of roughness of micro-hatching tubes and heat transfer additive on the absorption performance in H<sub>2</sub>O/LiBr systems. Normal octanol is used as the heat transfer additive. Three different micro-hatching tubes and a bare tube are tested in the present experiment. It was found that absorption performance of micro-hatching tubes without and with additive was improved to 2.5 and 4.5 times of the bare tube, respectively. The absorption performance of bare tube was improved to 3.76 times by adding the heat transfer additive.