



Research Article

# HEAT TRANSFER AND PRESSURE LOSS IN DOUBLE-TUBE TYPE HEAT EXCHANGER WITH ROTATING BLADES<sup>†</sup>

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## ABSTRACT:

*In order to enhance the heat transfer to heat and cool the process fluids of high viscosity or high heat sensitivity such as food, the axis with blades to agitate and mix the process fluid is rotated by force in the inner tube of double-tube type heat exchanger. In the experiment, the corn syrup water solution as a test process fluid is used, and the data of overall heat transfer coefficient and pressure drop were obtained by varying the flow rate, the rotational speed of axis with blades and the viscosity of test fluid. From these data, the heat transfer coefficient and the pipe friction coefficient of the test fluid flowing in the inner tube with rotating axis were calculated. The effects of axial Reynolds number, rotational Reynolds number, Prandtl number and viscosity gradient on Nusselt number and pipe friction coefficient were examined, and the characteristics of heat transfer performance and pressure loss were clarified. As a result, the correlations of Nusselt number and pipe friction coefficient were made in the case with rotation and without rotation respectively. The value calculated from these correlations can reproduce the experimental values by the accuracy within  $\pm 25\%$  and  $\pm 30\%$  respectively. In addition, the present correlation of Nusselt number was compared with the correlations of Nusselt Number obtained previously in the scraped surface heat exchanger and the triple pipe heat exchanger with smooth inner tube or finned inner tube respectively, and the range of application of the double-tube type heat exchanger was clarified in the heat transfer performance as not the contact surface heat exchanger like the scraped surface heat exchanger but the non-contact surface heat exchanger.*

**Keywords:** Heat Transfer; Pressure Loss; Double-tube; Heat Exchanger; Rotating Blade

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## 1. INTRODUCTION

In the manufacturing process of food, the heat exchangers of the different types are in use of heating and cooling required in the process of sterilization. The double-tube type heat exchanger is one of the typical heat exchanger. However, it is necessary to attempt the heat transfer enhancement to heat and cool the process fluids of high viscosity or high heat sensitivity such as food. So we have tried to perform the experiments for double-tube type heat exchanger which has the axis with blades rotated by force to agitate and mix the process fluid in the inner tube. The overall heat transfer coefficients and the pressure drop were measured by varying the flow rate, the rotational speed of blades and the viscosity of the test fluid.

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