Thermal characteristics of plate-type large heat exchanger for waste heat recovery of tenter machine

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1. Introduction

Industrial heat exchanger for waste heat recovery has been used in various fields, and research is continuously underway in the tentering process, which is a process of preventing deformation of the fiber fabric and fixing the width of the fabric uniformly.

Recently, air pollution is on the rise due to the emission of fine dust and harmful substances. In the field of textiles, research has been conducted to purify harmful substances after the tentering process through catalysts and filters heated to a high temperature of 400 ° C or higher.

It is a waste of energy to discharge high temperature fluid above 400 ℃ as it is, and tentering process requires high temperature gas below 200 ℃. Therefore, it exchanges heat with the atmosphere through the waste heat recovery machine and supplies hot fluid below 200 ℃ to tentering machine.

The waste heat recovery machine used in this study is a plate type heat exchanger. A study on the efficiency according to the plate shape using the fluid of water to carrol mixture [1]. Study on plate heat exchanger performance using air to air fluid and operating conditions [2]. Various studies are being conducted on the heat exchanger [3] regarding the two-phase flow of plate-fin heat exchanger.

The study on the heat exchanger for the waste heat recovery applied to the large-scale tentering machine of more than 5m has not been conducted yet, and the research is needed for the design and manufacture of the heat exchanger for waste heat recovery.

In this study, we studied the heat exchange efficiency of heat exchanger for waste heat recovery according to the operating conditions using experimental analysis on plate type heat exchanger applied to waste heat recovery machine for large-scale tentering machine.

2. Subjects and Conditions

The entire heat exchanger is composed of four chambers, and each one has the same shape. The first chamber exchanges heat between exhaust gas and purge gas, and the second, third and fourth chambers exchange heat with purge gas and air. The detailed picture is as follows.

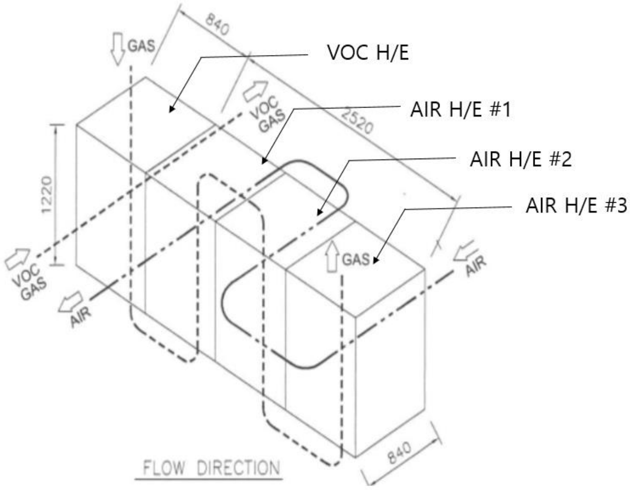

Fig.1 Flow direction of plate heat exchanger

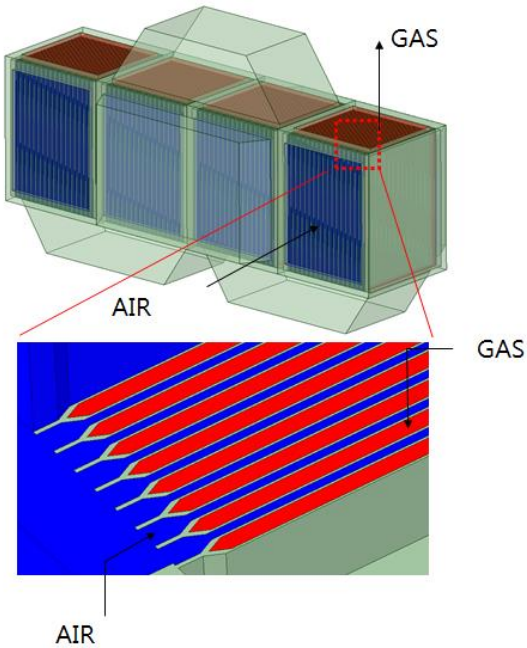

Fig.2 Full heat exchanger and detailed flow diagram

The experiment type is three cases in total, and the operating conditions are shown in the table below.

Tabel1. Experiment Case

		Case1	Case2	Case3
mass flow rate(m^3/h)	Exhaust gas	6,000	6,000	7,444
	Air	4,644	4,644	5,730
Catalytic Reaction Temperature(℃)		250	300	300
LNG usage(m^3/h)		23.6	25.0	29.4

3. Result

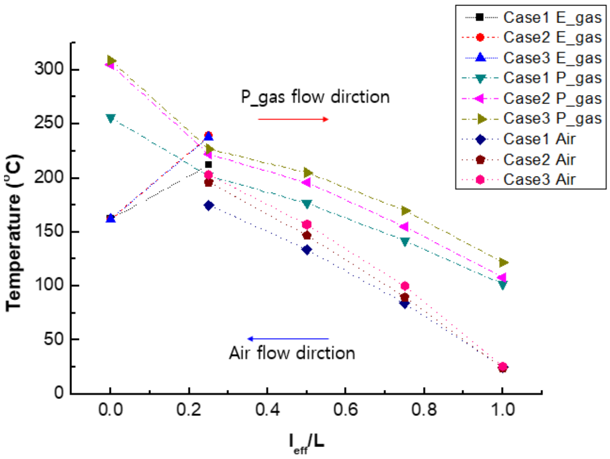

Fig.3 Temperature distribution for each case

The temperature distribution for each case is shown in Fig. 3, where E_gas represents exhaust gas, P_gas represents purge gas, and Air represents external inlet air.

In the graph above, l_{eff} represents the effective length of heat exchange and L represents the total heat exchange length.

After heat exchange in all chambers, the temperature of the exhaust gas decreased and the temperature of the air increased. In case 1, heat exchange efficiency was about 50%, case 2 was 47% and Case 3 was the highest compared to 48%. Further analysis of efficiency is needed for structural and shape changes.

Acknowledgment

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