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A Review on Experimental Investigation of Modified U-Tube Heat Exchanger

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ABSTRACT

A Modify U-tube heat exchanger with the different type of tube is designed, fabricated and tested. The experimental investigation for the proposed model and the original single tube u-tube heat exchanger are conducted. The operation performances of the two heat exchangers are also compared. The results suggest that, under the same conditions, the overall performance of the new result is 20–30% more efficient than that of the single tube heat exchanger. U-tube heat exchanger is generally used in industry. In u-tube heat exchanger tube shape is u type and it is counter flow type heat exchanger. U-tube heat exchanger main part is shell, shell cover, u-tubes, tube bundle, baffles. In u-tube heat exchanger shell side fluid is cold water as cold fluid is used and tube side fluid is hot water as hot fluid is used.

In this experiment we will measure different characteristic parameter like efficiency, effectiveness, pressure drop.

Keywords: U-tube heat exchanger, Thermo-hydraulic Performance, TEMA, Baffles.

I. INTRODUCTION

A Heat exchanger is a equipment which transfer internal energy (enthalpy) between two or different fluid at different temperature with or without contact with each other at minimum investment and running costs and maximum rate. One can realize their usage that any process which involve cooling, heating, condensation, boiling or evaporation will require a [HE $_x$] for these purpose. Process fluids, usually are heated or cooled before the process or undergo a phase change.

The shell and tube heat exchanger has relatively simple manufacture and multipurpose possibilities for liquid and gaseous media in a large pressure and temperature range. So they are widely used in a food industry, chemical industries, power production, waste heat recovery, environmental engineering, refrigeration, air conditioning and oil refinery industry.

Shell and tube heat exchanger consist bundle of tube enclosed with in cylindrical shell one fluid pass to the tube and the other fluid is forced through the shell and it flows over the outside surface of the tube , such as employed were reliability and heat transfer effectiveness are important.

The common components of shell and tube heat exchangers are shell, shell cover, shell flange, Tubes (U-type). Tie rods and spacers, Transverse (or cross) baffles or support plates, Shell nozzle or branch, Floating head support, Floating head cover, Vent connection, Floating head gland, Drain connection, Floating head backing ring, Instrument connection, Stationary tube sheet, Expansion bellows, Channel or stationary head , Support saddles, Channel cover, Lifting lugs, Channel nozzle or branch.

1.1 Application of U-tube heat exchanger :

- ✓ Intercoolers and pre-heaters;
- ✓ Condenser and boilers in steam power plant;
- ✓ Condenser and evaporator in refrigeration
- ✓ Regenerator;
- ✓ Automobile radiators;

1.2 Construction of U-tube heat exchanger :

U-tube heat exchanger is classified based on construction of heat exchanger. U-tube heat exchanger is designed by Tubular Exchange Manufactures Association [TEMA] standards.

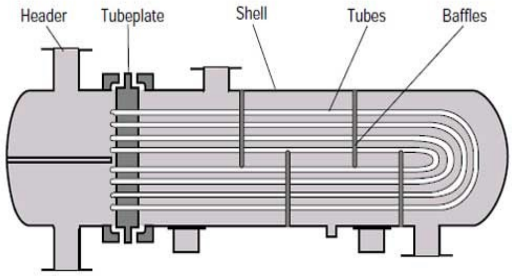

Fig 1- U tube heat exchanger

II. LITERATURE REVIEW

J.J Liu, Z.C Liu, W. Liu [1] (2015)

This paper is present the shell side flow in rod-baffle [HE $_x$] with spirally corrugated tubes. They compared with those in rod baffle [HE $_x$] with plain tubes. They obtain Thermo-hydraulic performance like heat transfer rate, effectiveness, efficiency.

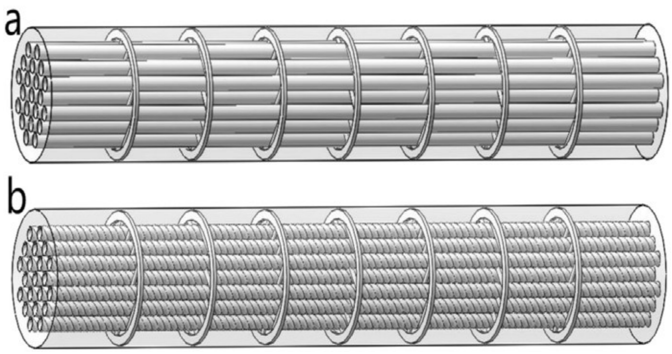

Fig. 2. (a) Rod-baffle heat exchanger with plain tubes. (b) Rod-baffle heat exchanger with spirally corrugated tubes.

Pooja. J. Pawar, Rupesh. J. Yadav [2] (2016)

This paper focus on the experimental investigation of shell and tube [HE $_x$] with different type of baffle. The shell and tube heat exchanger with segmental baffles and flower baffles are designed and tested. They analysis flower baffle give more segmental baffles also pressure drop reduced in flower baffle.

Fig 3. Photo of Experimental set up of STHX

Alok Vyas, Prashant Sharma [3] (2013)

Tubular [HE $_x$] is conducted to study the effect of baffle and its different orientations. They calculate the heat transfer coefficient at different fluid velocities. Use of helical baffles in [HE $_x$] reduce shell side pressure drop, pumping cost, size, weight, fouling etc as compare to segmental baffle.

Dhaval kumar A Maheshwari, Kartik M Trevedi [4] (2016)

This paper is present work is to design and develop a properties model of u-tube type counter flow [HE $_x$]. They use different types of tube like plain tube and corrugated tube. They found heat transfer rate and heat transfer coefficient of corrugated tube is higher then plain tube.

Andre L H Costa, Eduardo M Quiroz [5] (2008)

This paper present a study about the design optimization of shell and tube [HE $_x$]. The formulation of the problem seen the minimum of the thermal surface of the equipment for certain minimum excess area and maximum pressure drop are considering decision variable.

Darshan patel , Prexa parika [6] (2015)

They do thermal designing and analysis of [HE $_x$] due to problem of large pressure drop, less heat transfer rate, and also they analysis of corrugated tube and compare with plane tube. They show efficiency and effectiveness is increase for corrugated tube compare to plain tube.

***Jiuyi liu, Caifu qian* [7]**

They use different types of baffles and tubes experiment one by one .They analysis large and small hole baffles corrugated tubes have best comprehensive properties like decreased pressure drop, increase heat transfer co-efficient, and reduced tube vibration.

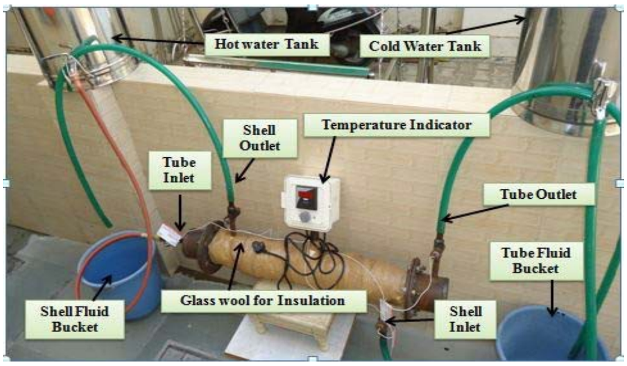

Fig 4. Photo of Experimental set up of STHX

Dr. Ajeet Rai, Faisal Naseer [8]

They are studies carried on a three chamber one-one pass corrugated plate type [HE $_x$] in parallel flow arrangement. They use AL2O3 micro particles and it mix with hot fluid. They observed improve the effectiveness of the [HE $_x$] by 50%.

III. CONCLUSION

From literature review it could be concluded that, entire U-Tube heat exchanger design by TEMA standards, LMTD method also include, we get clear idea about each and every parts design and we easily compare with standard data. After studying various configuration of Heat Exchanger using plain tubes and corrugated tubes it could be found that

A. Heat transfer rate and heat transfer coefficient of corrugated tube heat exchanger is higher than straight tube heat exchanger.

B. In corrugated tube heat exchanger pressure drop is higher than straight tube heat exchanger.

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