Experimental Investigation of the Refrigerator Condenser By Varying the Fins Spacing of the Condenser

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***Abstract* – This article presents the experimental analysis of domestic refrigeration system by using wire-on-tube condenser with different spacing of wire, operating parameters like heat transfer rate , condenser pressure and condenser temperature , refrigerating effect is increased by using wire-on-tube condenser comparatively power consumption remain same as with air cooled condenser in a domestic refrigeration system. Therefore wire-on-tube condenser can replace the ordinary air cooled condenser in a domestic refrigeration system**

Keywords – Household refrigerator, wire-on-tube condenser, heat transfer.

I. INTRODUCTION

Condensers and evaporators are basically heat exchangers in which the refrigerant undergoes a phase change. Next to compressors, proper design and selection of condensers and evaporators is very important for satisfactory performance of any refrigeration system. Since both condensers and evaporators are essentially heat exchangers, they have many things in common as far as the design of these components is concerned. However, differences exist as far as the heat transfer phenomena are concerned. In condensers the refrigerant vapour condenses by rejecting heat to an external fluid, which acts as a heat sink. Normally, the external fluid does not undergo any phase change, except in some special cases such as in cascade condensers, where the external fluid (another refrigerant) evaporates. In evaporators, the liquid refrigerant evaporates by extracting heat from an external fluid (low temperature heat source). The external fluid may not undergo phase change, for example if the system is used for sensibly cooling water, air or some other fluid.

Earlier different types of condenser slides air cooled condenser, water cooled condenser is been used in a domestic refrigeration system. Air cooled condenser is most popular condenser for a refrigerator. Many researches done in a past ion the condenser, one of them wire-on-tube condenser where main tube is used in a spiral form with vertical wire (fines) with different spacing. Heat transfer rate increased by using this condenser.

Fig. 1. Finned tube condenser used for experimental study

II. TYPES OF CONDENSERS

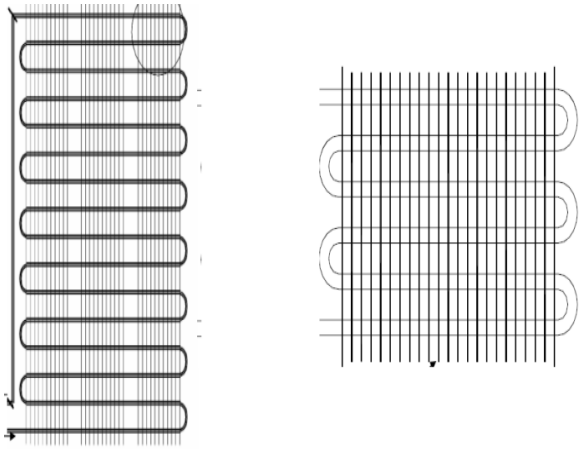


Fig. 2 Schematic of a wire-and-tube type & plate fin type condenser r used in small refrigeration systems

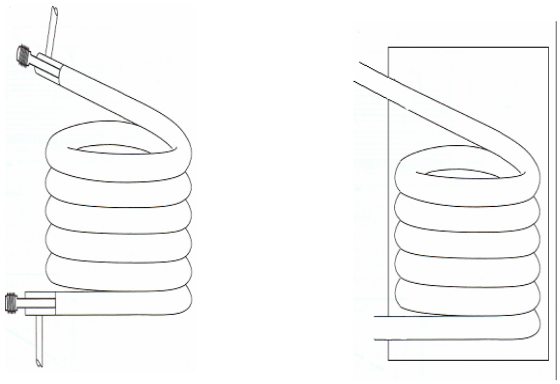
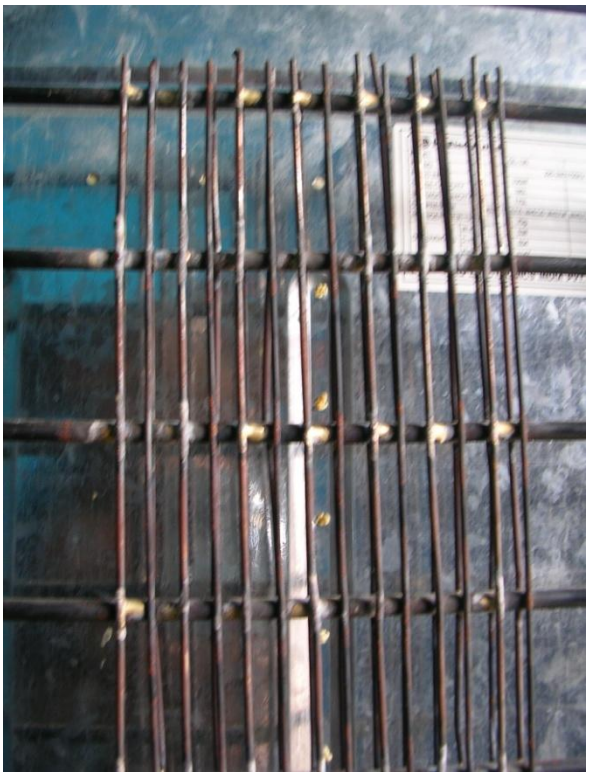


Fig. 3 Schematic of a Double pipe (tube-in-tube) type condenser & shell & coil type condenser used in small refrigeration systems.

6mm spacing

3mm spacing

9mm spacing



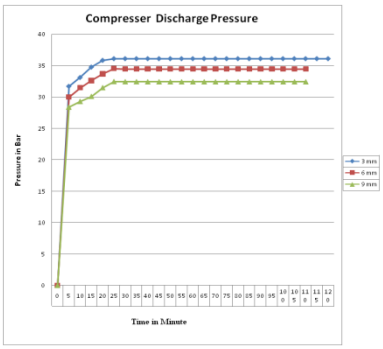
III. LITERATURE REVIEW

1. **Bansal et al-**experimental analysis is done by using wire-on-tube condenser in a refrigerator with different operating parameters and compare these results with a simulation modeling finally they optimized the condenser performance.
2. **Looza et al-**evaluated the performance of wire-on-tube condenser with the help of basic operating parameters and compare with different fin design of condenser.
3. **Hoke et al-**they have performed with seven different spacing with wire-on-tube condenser for increasing the air heat transfer rate during operating this experiment new type of coil and heat exchanger is usded.
4. **Tanda et al-**they investigated a Nusselt number and operating parameters for predicting the free convections heat transfer from a wire-on-tube condenser.
5. **Reeves et al-**the demonstrated the domestic refrigerator performance under of conditions , by using different instrumentations with different range of room temperature.
6. **Lee et al-** he developed heat transfer coefficient for wire-on-tube condenser using single layers.

IV. OPTIMIZATION OF CONDENSER

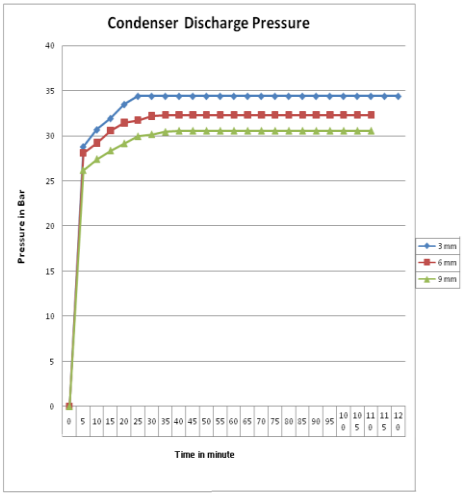
In the past single coil air cooled condenser was used by the refrigerator companies, as the time progressed many changes is done by the researchers to enhance the performance of the condenser, different types of fines and coils with different shapes is now been used to increased the heat transfer rate by the air cooled condenser. Coils having different diameter also been used to increased then over all COP of the vapour compression refrigeration system.

Results & discussion:



Graph 1.1: Variation of discharge pressure with time for condenser spacing of 3mm, 6mm & 9 mm

Fig. 1.1 shows the variation of discharge pressure with time for Different condenser spacing. As shown in the figure, the maximum short-time discharge pressure within the first 20 min of starting the Compressor runs up to, after which the pressure reduced and stabilized. At steady-state conditions the discharge pressures for 3 mm, 6 mm, 9 mm were 36.12, 34.42 and 32.43 bar, respectively.



Graph 1.2. Variation of discharge pressure with time for condenser spacing of 3mm, 6mm & 9 mm

Fig.1.2 shows the variation of discharge pressure with time for Different condenser spacing. As shown in the figure, the maximum short-time discharge pressure within the first 20 min of starting the Compressor runs up to, after which the pressure reduced and stabilized. At steady-state conditions the discharge pressures for 3 mm, 6 mm, 9 mm were 36.12, 34.42 and 32.43 bar, respectively.

V. CONCLUSION

1. Discharge pressure of 9mm fins spacing is about the same with that of 6mm fins spacing with average percentage reduction of 5.7%. The discharge pressure of 3mm fins spacing was the highest with average value of 4.7% and 10.2% higher than those of 6mm fins spacing and 9mm fins spacing respectively.
2. At steady-state conditions the discharge pressures for 3 mm, 6 mm, 9 mm were 34.41, 32.00 and 30.56 bar, respectively.

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