INCREASING THE EFFICIENCY OF REFRIGERATOR BY REDUCES THE LOSSES IN EVAPORATOR, COMPRESSOR AND CONDENSER

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Abstract

Domestic Refrigerator consumes significant energy in percentage of total energy used in India. Aim of this paper is to improve coefficient of performance of system. To improve the coefficient of performance, it is to require that compressor work should decrease and refrigerating effect should increase. Modifications in condenser are meant to increase degree of sub-cooling of refrigerant which increased refrigerating effect or more cooling water is required in condenser. The purpose of a compressor in vapour compression system is to elevate the pressure of the refrigerant, but refrigerant leaves the compressor with comparatively high velocity which may cause splashing of liquid refrigerant in the condenser tube, liquid hump and damage to condenser by erosion. It is consumption is less for same refrigerating effect so performance is improved . In this paper we describes the different ways to reduce the losses in evaporator, condenser and compressor. Finally, we note that future efforts to reduce losses in evaporator, condenser and compressor should be accompanied by a corresponding effort to improve evaporator, condenser and compressor thermodynamic performance.

INTRODUCTION

Vapour compression refrigeration system is based on vapour compression cycle. Vapour compression refrigeration system is used in domestic refrigeration, food processing and cold storage, industrial refrigeration system, transport refrigeration and electronic cooling. So improvement of performance of system is too important for higher refrigerating effect or reduced power consumption for same refrigerating effect. Many efforts have to be done to improve the performance of VC refrigeration system. A vapor refrigeration cycle is composed of several componenets below. These components are the evaporator, compressor, condenser and throttling valve. The figure 1 shows the simplified stages at which the cycle occurs. At the stage one the compressor increases the pressure in the refrigerant which is accompanied also by the compressor increases the pressure. Ideally this compression is isentropic; this heated fluid is then passed to the condenser in order to reject heat to the surroundings. Here at stage two the temperature is lowered and then is passed to the stage three. This stage is where a sudden change in pressure takes the saturated liquid and is further cooled this cooling ideally occurs as an isenthalpic process. The loop is closed at stage four where the cooled refrigerant is then returned to evaporator.

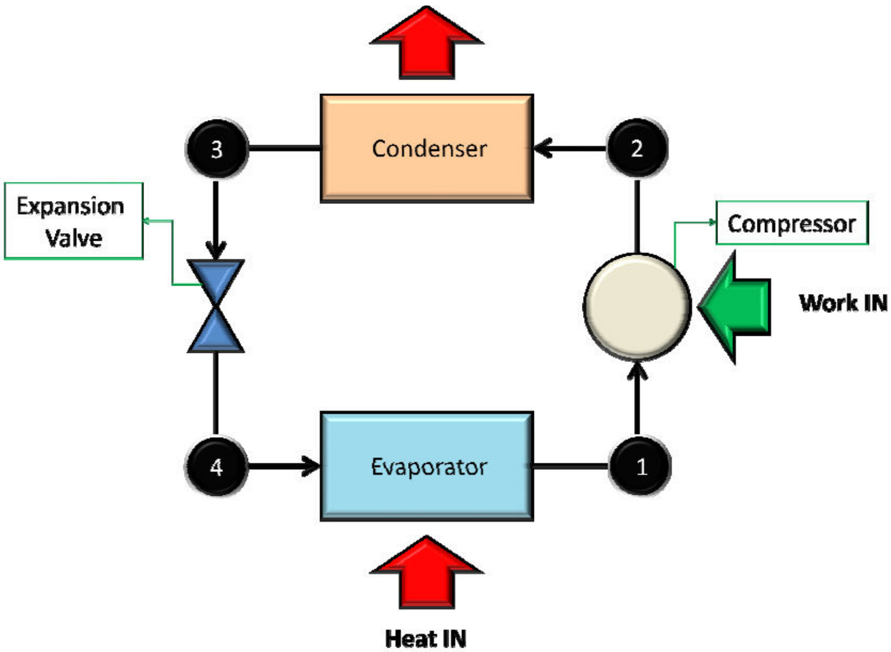
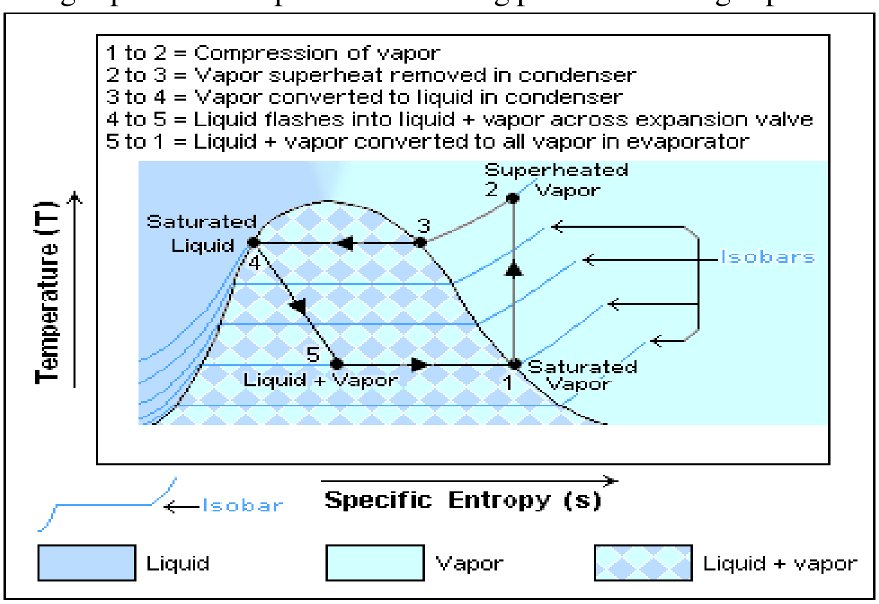


Fig 1. Schematic for vapor compression cycle

THEORETICAL ANALYSIS

Simple vapour compression cycle

Dry saturated vapour coming from evapourator is compressed in compressor so pressure increases superheated vapour is passed through condenser where vapour is condensed by flowing the cooling water in condenser. Dry saturated liquid is passed through expansion valve where expansion takes place so pressure decrease by expansion after expansion liquid is passed in evapourator where it absorbs the heat of storage space and evapourate so cooling process in storage space is achieved, thus cycle is complete.



Factors which reduces the losses in evaporator, condenser and compressor

1. REDUCES EVAPORATOR LOSSES

Evaporator losses can be increasing the evaporator pressure or temperature. A high evaporation pressure/temperature indicates the system is drawing heat from the product without expending too much energy.

1(a). Thermostat setting

Setting thermostats only as low as necessary will keep the evapourating temperature as high as possible, absorbing less heat energy into the refrigerant and therefore reducing the load on the compressor.

1(b). Correctly sized evaporator

Size the evapourator to suit the load. A small evapourator may have a low capital cost but may require a larger compressor to cope with the load and so have higher operating costs.

1(c). Clean and defrost evaporator coils

When necessary, clean and defrost evapourator coils to prevent the build up of ice and subsequent reduction of heat transfer efficiency. If water is used for defrosting, investigate opportunities to reduce or reuse the water elsewhere in the plant. Good ventilation can also assist in defrosting.

1(d). Hot gas defrost

Hot discharge gas from the compressor can be used to defrost evaporators and offers an excellent alternative to water or air defrosting, saving energy and added into the cooling space. Defrost cycles can be set automatically to occur at the end of production shifts or breaks, helping to extend production run times.

2. REDUCES CONDENSER LOSSES

2(a). Correctly size condensers

Size condensers to suit the load. If the condenser is too small the condensing temperature will increase or if it is too large, it will cause sub-cooling and vaporisation of the refrigerant.

2(b). Clean condenser

Keeping condensers clean and in good condition, e.g. not blocked or corroded, promotes efficient energy transfer.

2(c). Locate condenser to allow good airflow

Providing fresh air and unrestricted air flow (e.g. not against a wall or condenser housing) to condensers that reject heat into the outside air will prevent air recirculating back into the condenser inlet.

2(d). Variables speed drives on condenser fans

Installing variables speed drives on condenser fans can reduce operating costs by two to three per cent, especially on systems with fixed-head pressures.

2(e). Purging

Air entering the system through seals and valve packing when systems are open (for repair, coil-cleaning or when oil or refrigerant is added) can create an insulating barrier.This barrier reduces the effective size of the condenser and heat transfer efficiency. By purging the system of air this barrier can be minimised. Purging can be manual or automatic manual purging does not totally eliminate the air and can be dangerous as refrigerants may be flammable and are discharged to the atmosphere.

3. **REDUCES COMPRESSOR LOSSES**

Compressor of the refrigerator system consumes work 80 to 100% of the total energy used.

3(a). COMPRESSOR SELECTION

The efficiency of the system is measured by the co-efficient of performance (COP). This is the ratio of cooling output (kilowatt) compared with energy input (kilowatt), thus the higher the COP, the more efficient the system.

3(b). COMPRESSOR LOAD

The most widely used compressor for refrigeration is the screw compressor; its efficiency decreases for partial loads. Compressor capacity should be matched with cooling load as operating it at partial loads will cause the compressor to stop and start frequently, reducing efficiency. Multiple compressors with a sequencing or capability control can be used to match the load. Compressors operating in sequence should be reviewed to ensure the time intervals at which individual machines operate at part load ratios is less than 70 %.

3(c). COMPRESSOR LOCATION

Compressor should be located in cool and well-ventilated areas as they generate large amounts of waste heat and where possible waste heat should be recovered for reuse.

3(d). INSULATION ON SUCTION LINES

Insulating the suction lines reduces energy loss as compressor efficiency is improved with lower suction gas temperature.

RESULT AND DISCUSSION

By considering all los ses with reduces its effect, which result refrigerating effect are increases thus COP increases. By using different methods to reduces the losses in evaporator, condenser and compressor , the ability to increase the efficiency increases and some amount of pressure increases in compressor so compressor work is decreases or power consumption is decreases. Thus performance or COP is increases. In evaporator losses we consider some important points such as size of evaporator, defrost and other thermostat setting. Similarly in condenser and compressor such important points are purging, cleaning condenser, speed drives in condenser fans, compressor load, insulation of suction and selection of compressor.

CONCLUSION

COP of Vapour Compression Cycle is increased by lowering the power consumption /work input or increasing the refrigerating effect. By reduces the losses in condenser, compressor and evaporator inlet refrigerating effect increases and power consumption or work input decreases. Thus performance of cycle is improved. This paper presents reason of the decreasing efficiency due to some different types of losses in evaporator, condenser and compressor. Due to these losses different problems be associated which is solved by above solutions.

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