LECTURE NOTES

ON

REFRIGERATION & A/C

ME C461/ CHE C471

CONDENSORS

PART- 7

BY DR.A.M.SURENDRA KUMAR

FUNCTIONS

- This is another important component of the refrigeration system which needs more consideration in Design and construction
- The Condenser removes the heat from refrigerant carried from evaporator and added by compressor and converts the vapour refrigerant into liquid refrigerant.
- It is an Heat Exchanger in which heat transfer takes place from high temperature vapour to a low temperature liquid with help of cooling like air or water.

HEAT REJECTION FACTOR [HRF]

- THE LOADING ON THE CONDENSOR/UNIT OF RFRIGERATION IS CALLED THE HEAT REJECTION RATIO or Heat Rejection Factor.

- HRF = $$\frac{Heat\ gained\ by\ the\ gas\ in\ the\ Condenser}{Heat\ absorbed\ by\ the\ Refrigerant\ in\ the\ Evaporator}$$

This ratio gives the heat rejected in the Condenser per unit load of Refrigeration handled by the Evaporator.

In other words, when we say that HRF is 1.2, it means that for every tonne of refrigeration load handled by the evaporator, the condenser will have to reject heat equivalent to 1.2 tonne.

COOLING MEDIUM

- The cooling mediums provided by nature are air and water.
- Air cooled condensers are designed for condensing temp. of 15^0C to 20^0C above the temp. of the entering air
- 6^0C to 12^0C above if water is used as cooling medium.
- Quantity/ Velocity of Cooling medium :
- Water : 7 to 20 litres/min/TR - 120 to 180 m/min.
- Air : 30 to 35 cu.m/min/TR - 270 to 300 m/min

CLASSIFICATIONS

- The condensers are classified on the basis of the cooling medium used
- 1. Air-Cooled Condenser
- 2. Water cooled condenser
- 3. Evaporative condensers

AIR COOLED CONDENSER

- In air cooled condensers, heat is removed by air using either natural or forced circulation.
- The condensers are made of steel, copper or aluminum tubing provided with fins to improve air-side heat transfer.
- The refrigerant flows inside the tubes and the air outside.
- Air cooled condensers are used only in small capacity machines such as Refrigerators & small water coolers Window type A/C
- This type are seldom made in sizes over 5 TR because of high head pressure, excessive power consumption & objectionable fan noise.

- The circulation of air may be natural or forced convection.
- The area required for natural convection is considerably large compared with forced convection type. Due to its low value of U.
- Natural convection type are used for small capacity purpose like domestic refrigerators, water coolers and Room A/C.
- In the case of forced convection, the air is used though the condenser by the Blower.
- Forced convection type further divided into
- 1. Chassis mounted type
- 2. Remote air cooled type

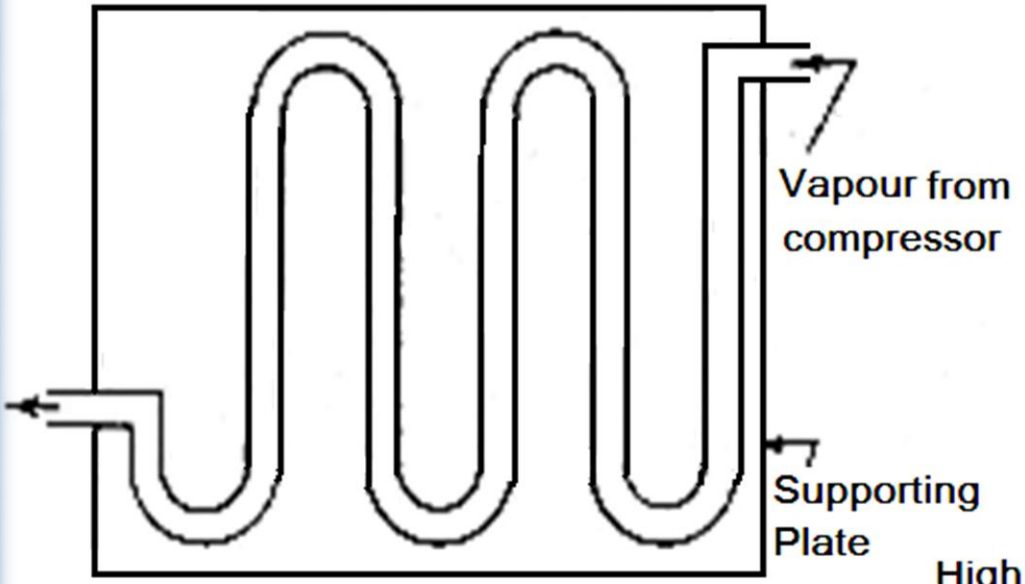


Fig.(A) Natural Convection
Air-Cooled Condenser

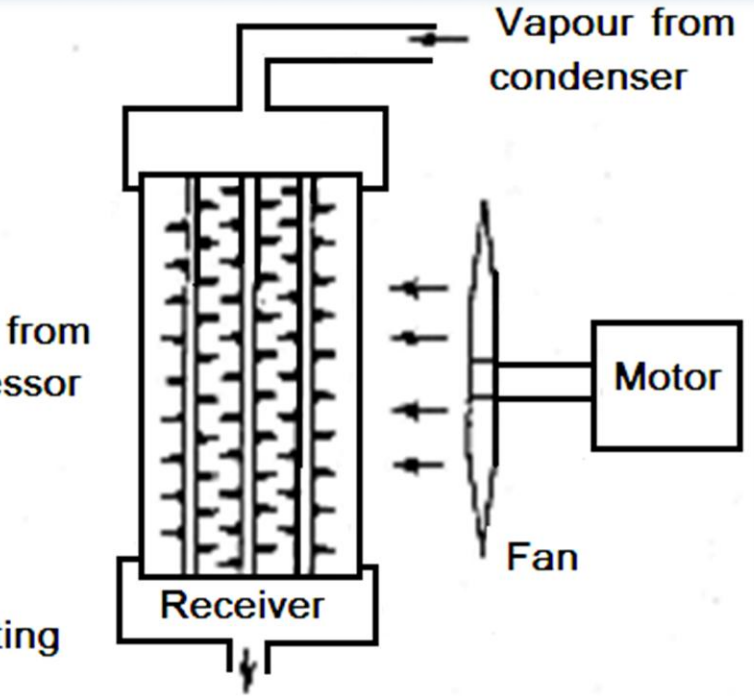


Fig.(B) Forced convection
Air-cooled condenser

Advantages Of Air-Cooled Condensers

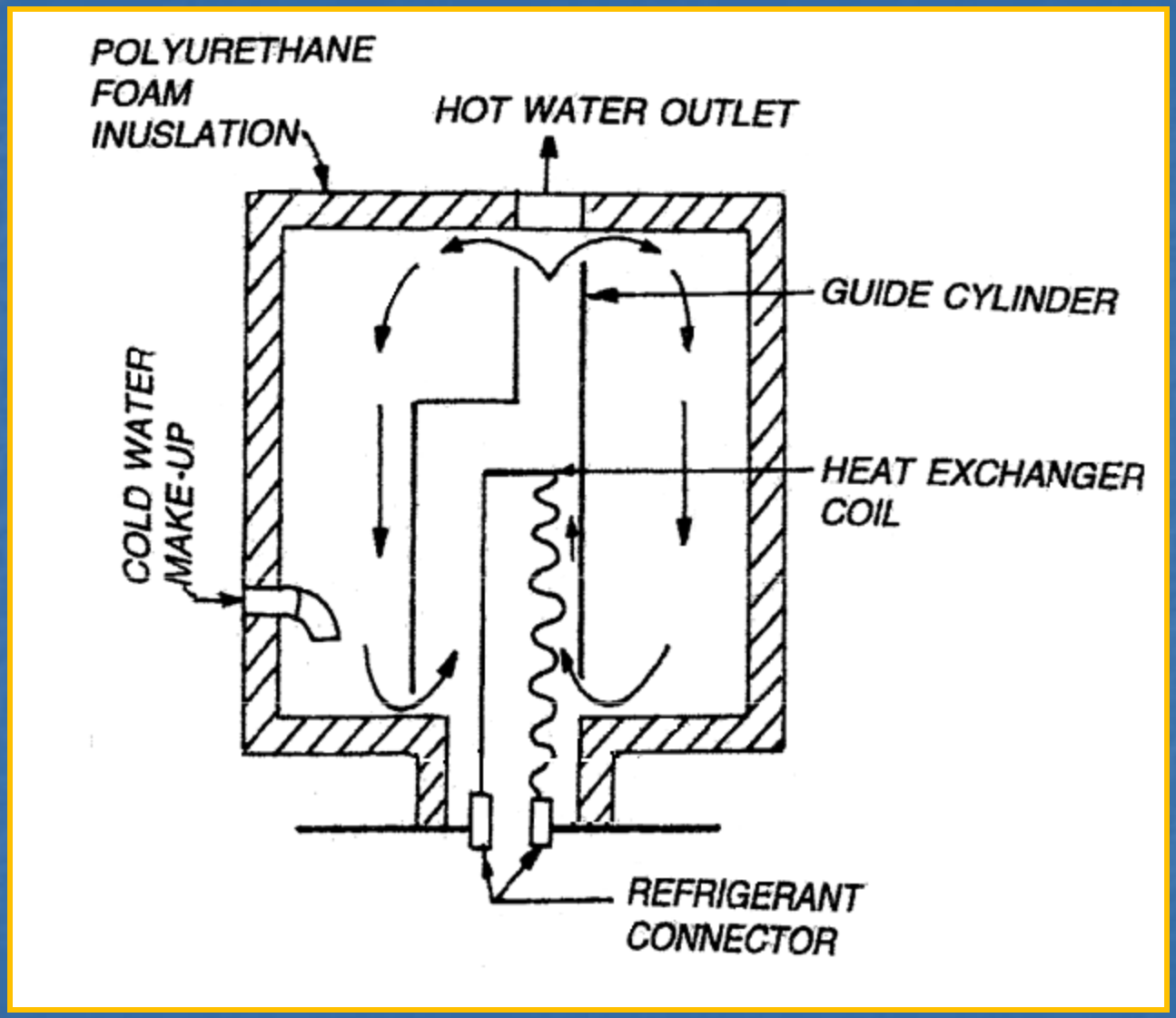
- 1. Simplicity of construction.
- 2. No handling problems.
- 3. Piping arrangement for carrying the air is not required.
- 4. There is no problem of disposal of used air.
- 5. Fouling effects are very less compared with water.
- 6. Installation and maintenance costs are considerably less.
- 7. High flexibility.

- The air-cooled Condensers are preferred under the following circumstances:-

- 1. Minimum corrosion is the major requirement.
- 2. Inadequate supply of cooling water.
- 3. Expensive means of water disposal.

WATER COOLED CONDENSERS

- Three types:
- 1. Shell & Tube
- 2. Shell & coil
- 3. Double tube.
- The shell & tube type, with water flowing through passes inside tubes and the refrigerant condensing in shell is the most commonly used Condenser.
- The Shell is made of Steel.
- Copper tubes are used for Fluro carbons and Steel tubes for ammonia.


POLYURETHANE
FOAM
INUSLATION
HOT WATER OUTLET
GUIDE CYLINDER
HEAT EXCHANGER
COIL
COLD WATER
MAKE-UP
REFRIGERANT
CONNECTOR

In the double tube arrangement, the refrigerant condeses in the outer tube and water flows through the inner tube in the opposite direction.

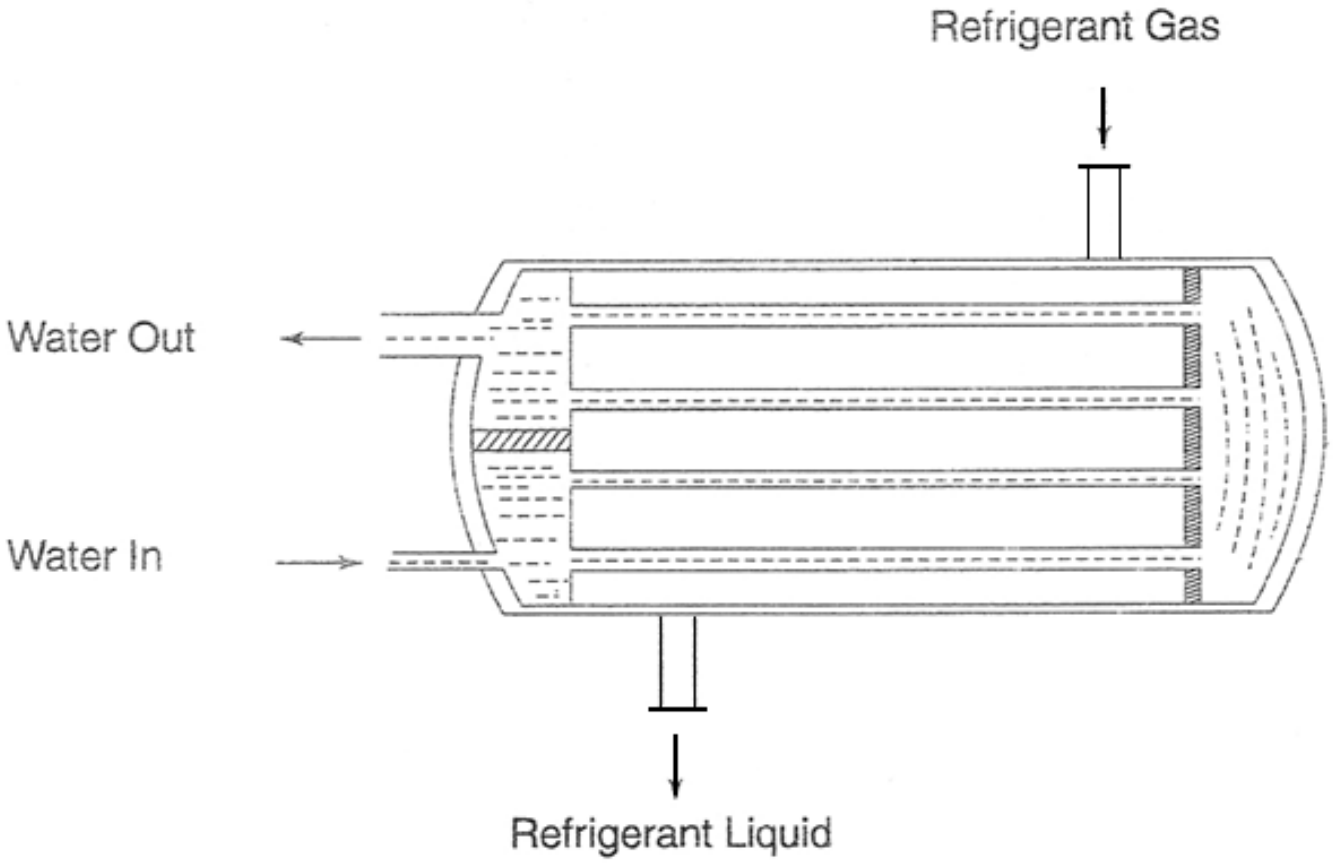


Fig. Schematic Representation of a Two-pass Water-Cooled Shell and Tube Condenser

EVAPORATIVE CONDENSER

- Evaporative condensers are commonly used on large ammonia plants as they are found to be cheaper.
- Such condensers are require a large amount of the refrigerant charge due to the longer length of the refrigerant piping.
- But in the case of ammonia systems this is immaterial since the refrigerant is quite cheap.
- In this, refrigerant first rejects its heat to water and then water rejects its heat to air, mainly in the form of evaporated water.
- Air leave with high humidity as in a cooling tower.
- Thus an evaporative condenser combines the functions of a condenser and cooling tower.

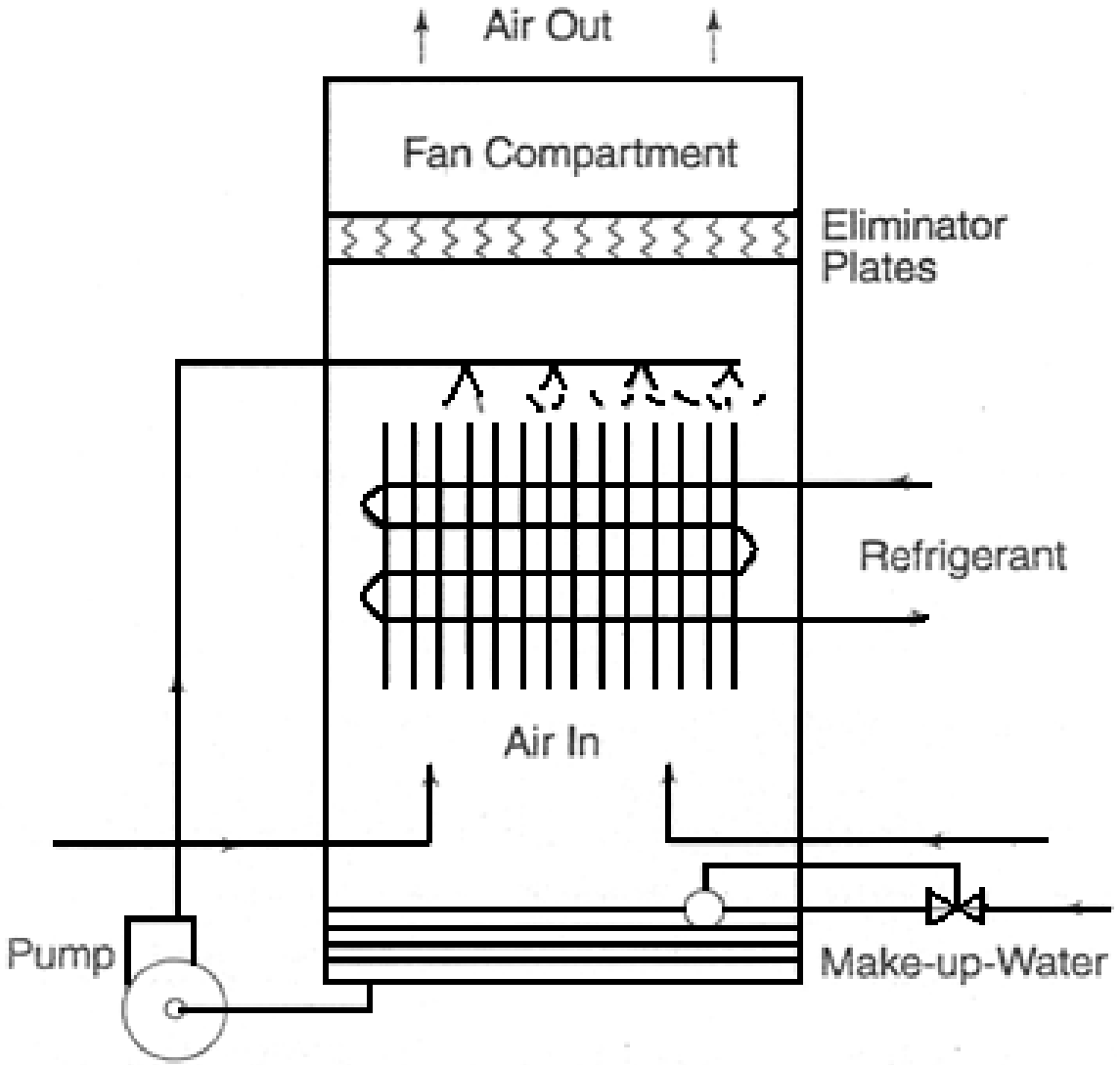


Fig. Evaporative Condenser