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LOW GRADE HEAT RECOVERY FROM COOLING TOWER

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***Abstract*—**Energy and utility are the major heads in industries. Use of energy and utility in industries is huge. There are lots of work done to save utility and conservation of energy previously. Still there is scope to do work for these.
Cooling towers are major equipment for utility in various industries like chemical, petroleum, power plant etc. cooling tower absorbs low/high grade energy from process plant and emits it into the environment in the form of low-grade energy. Low-grade energy is difficult to recover and utilize in industries. sometime recovery and utilization are possible but cost of recovery is higher.
Here we work to recovery of low-grade energy from cooling tower water and utilize for the evaporation of liquid to gas like chlorine, Sulphur dioxide, ammonia etc. which are store in liquid condition in cylinder and requires in gas form and higher flow rate. This arrangement will give advantage over conventional evaporation utilities like steam, hot water, electrical/thermal tracing etc., also gives advantages in cooling tower performance.
***Keywords*— low- & high-grade energy, heat pump, cooling tower, vapour pressure**

I. INTRODUCTION

The chemical sector is immersed in a movement towards more sustainable manufacturing processes. However, this is extra challenging when operating in the strictly controlled and highly regulated chemical industry, because corners cannot be cut to make savings. Production of many chemicals produces significant quantities of carbon dioxide and other greenhouse gases, often this is unavoidable – and chemical companies are still required to maintain production and seek growth – the world still needs those chemical products.
Cooling tower is constantly using equipment in industries with large capacities. This is one of the largest sources of low-grade energy which is continuously dumping energy into environment. This operation in industries loss the huge amount of energy and quantity of utility. Cooling tower always require the treatment and blowdown as the energy is release from the system.[2] Energy saving has become one of the most important subjects as energy shortage is getting worse and the demand for energy is rising rapidly worldwide in recent decades.
Water consumption in cooling tower is very high, as per the previous record water is major crisis in past years. Water availability is down drastically. water stress is a broader concept.it would include aspects of water availability, water quality and the accessibility of water. The latter is related to existing infrastructure and whether customers can afford to pay for the water. This is termed by others as "economic water scarcity". Sources of water are reduced their capacity due to increased uses, contamination of sources, salinity increased due to evaporation rate increase etc.

What are the grades of energy?

1)high grade energy
2)low grade energy

High-Grade Energy Electrical and chemical energy are high-grade energy, because the energy is concentrated in a small space. Even a small amount of electrical and chemical energy can do a great amount of work. The molecules or particles that store these forms of energy are highly ordered and compact and thus considered as high-grade energy. High-grade energy like electricity is better used for high grade applications like melting of metals rather than simply heating of water. Low-Grade Energy Heat is low-grade energy. Heat can still be used to do work (example of a heater boiling

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water), but it rapidly dissipates. The molecules, in which this kind of energy is stored (air and water molecules), are more randomly distributed than the molecules of carbon in a coal. This disordered state of the molecules and the dissipated energy are classified as low-grade energy.

One of the method and technique available for recovery of low grade is heat pump. a heat pump uses technology similar to that found in a refrigerator or an air conditioner. It extracts heat from a source, such as the surrounding air, geothermal energy stored in the ground, or nearby sources of water or waste heat from a factory. It then amplifies and transfers the heat to where it is needed. Because most of the heat is transferred rather than generated. The output of energy in the form of heat is normally several times greater than that required to power the heat pump, normally in the form of electricity. The heat pump itself consists of a compressor, which moves a refrigerant through a refrigeration cycle, and a heat exchanger, which extracts heat from the source. The heat is then passed on to a heat sink through another heat exchanger. A heat pump is a device that uses work to transfer heat from a cool space to a warm space by transferring thermal energy using a refrigeration cycle, cooling the cool space and warming the warm space. In cold weather a heat pump can move heat from the cool outdoors to warm a house; the pump may also be designed to move heat from the house to the warmer outdoors in warm weather. As they transfer heat rather than generating heat, they are more energy-efficient than other ways of heating a home.[4]

Chemical industries use many gases like chlorine, Sulphur dioxide, ammonia etc., the consumption of these gases is huge in numbers. These gases are supply in cylinder in liquid form where ever consumption is at higher rate these gases are evaporated by using steam, hot water, heat tracing (thermal or electricity) etc. which leads to emission of greenhouse gases, utility cost, increase in operational activity etc.in this works we do use cooling tower return water which normally at 32-35deg. C to evaporate these gases Chlorine (BP: -34Deg C), Sulphur dioxide (BP: -10Deg.C), ammonia (Bp: -33.34Deg C).[1] gases are extracting the energy from cooling tower return water.

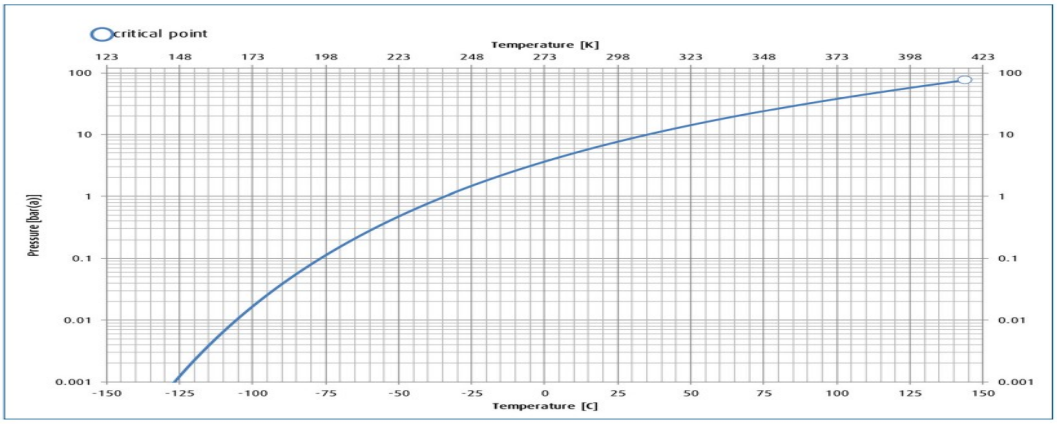

FIGURE 1 TEMPERATURE VS. VAPOUR PRESSURE OF CHLORINE [6]

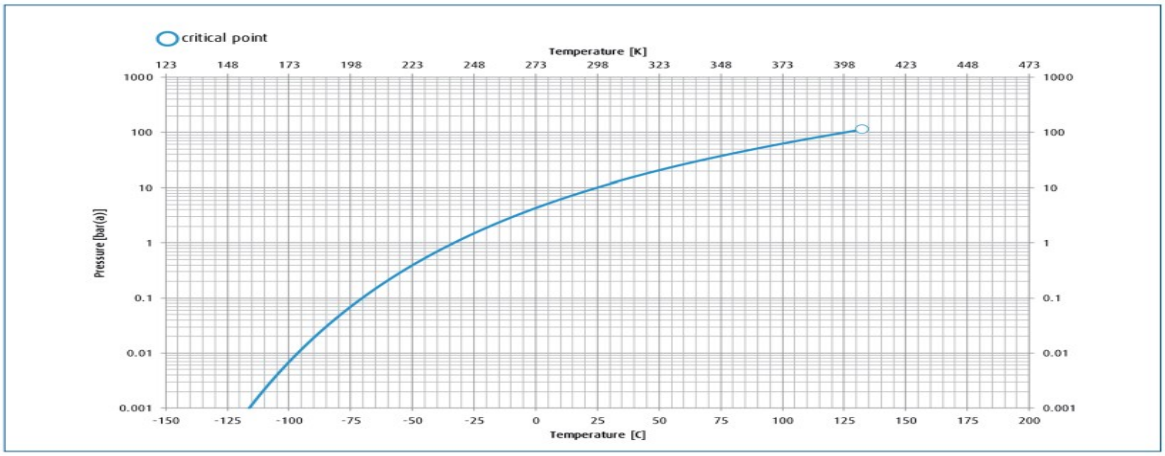

FIGURE 2 TEMPERATURE VS VAPOUR PRESSURE OF AMMONIA [5]

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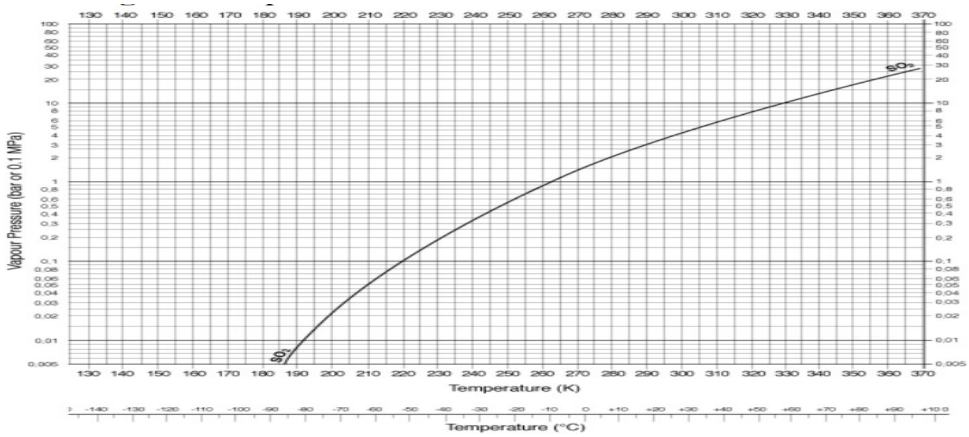

FIGURE 3 TEMEPRATURE VS VAPOUR PRESSURE OF SULPHUR DIOXIDE [4]

recovery is depending on the cooling tower capacity and water requirement for evaporation, quantity of chlorine gas consumption. cooling return water from process plant and recycle the low-grade energy. As shown in figure 4. Remove one stream from cooling water return line and pump the water to the heat exchanger i.e., gas evaporator and return is reconnected in cooling tower return near to the cooling tower. Cooling tower return is at temperature 35deg.C that we are passing to the evaporator, where low grade heat is extracted and Chlorine, Sulphur dioxide, Ammonia etc. evaporated and supply to the process plant.

a) Example-1 14kmol/hrs of liquid chlorine required 100Mcal/hrs heat is supply by cooling tower return water leads to reduce evaporation of water 12-15%. This recovery is depending on the cooling tower capacity and water requirement for evaporation, quantity of chlorine gas consumption.

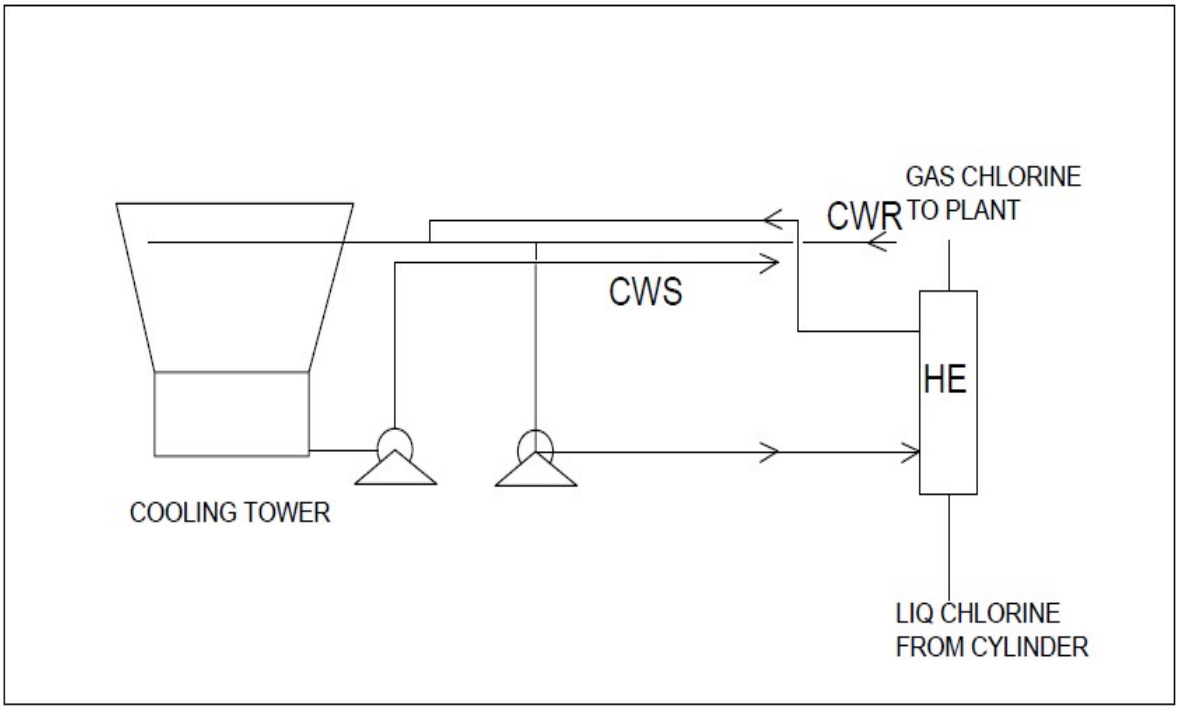

FIGURE 4. HEAT RECOVERY ARRANGEMENT

b) Example-2 58kmol/hrs of liquid ammonia required 300Mcal/hrs heat is supply by cooling tower return water leads to reduce evaporation of water 20-25%.

c) Example-3 16kmol/hrs of liquid Sulphur oxide required 80Mcal/hrs heat is supply by cooling tower return water leads to reduce evaporation of water 10-12%.

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II. Conclusion:

According to this arrangement low grade heat which is directly dump into the environment, we were recovered partially or completely as per requirement of gases in process plants. This arrangement claims the benefits over conventional arrangements of gas evaporation:

1) It leads to the fuel saving due to elimination of uses of steam, electricity etc. up to 80-90%, reduction in greenhouse gases emission.
2) Cooling tower water evaporation loss reduction up to 10-20%.
3) Reduction in evaporation loss leads to reduction of cooling tower blow down and blowdown water treatment cost.
4) Make up water consumption reduction.
5) Reduce water treatment chemical consumption.
6) Increase cooling tower capacity by 10-20%.

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