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# "Recovery of waste heat energy & it's utilisation in utility plant."

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***Abstract :*** *This paper presents an improved recovery of wasted heat generated by several industrial processes. Heat energy saving is one of the key matters from the viewpoint of fuel consumption and for the protection of the global environment. So, a significant and concrete effort must be made for conserving energy through waste heat recovery too. The main objective here is to study the «Waste Heat recovery system of air compressor. Waste heat can be recovered in a number of ways such as from a vapor absorption system, by preheating boiler feed water, preheating boiler air, operation of vapor absorption-type chillers, hot water generation for a processor, etc. The study is done to determine waste heat recovery generated by air compressors for utilization in the reduction of fuel consumption.*

***Keywords –*** *vapour,absorption system, air compressors, fuel, recovery system*

## I. INTRODUCTION

The growing trend of increases in fuel prices over the past decades as well the rising concern regarding global warming, engineering industries are challenged with the task of reducing green-house gas emissions and improving the efficiency of their sites. In this regard, the use of waste heat recovery systems in industrial processes has been key as one of the major areas of research to reduce fuel consumption, lower harmful emissions and improve production efficiency.

Waste heat recovery is essential for increasing energy efficiency in the chemical process industries (CPI). Presently, there are many WHR methods and technologies at various stages of implementation in petroleum refineries, petrochemical, chemical and other industry sectors. Increasing energy costs and environmental concerns provide strong motivation for implementing more and newer methods and technologies for WHR. Most of the literature on this topic is based on individual methods and techniques, but there is a need for an integrated approach. Waste heat is energy that is rejected to the environment. It arises from equipment and operating inefficiencies, as well as from thermodynamic limitations on equipment and processes. Often, part of waste heat could potentially be used for some useful purpose. At present, about 20 to 50% of energy used in industry is rejected as waste heat

## II. LITERATURE REVIEW

Opoku, R., Sekyere, C. K., Ackumey, S., Abotsi, O. Y., & Kizito, J. P., 2020[1] established that, the maximum heat recovered rate was obtained when the temperature difference between the outlet of the hot and cold fluid of the STC-HX was minimum. The heat recovery part compressor to about 54% & the total 163Kw power consume & two compressor and their blowers. This implies energy saving of 710mh. Per year for compressor runtime & 8000h, annually. The effectiveness of the HRU was determined to be 57%. The analysis further share that the implementation of the heat recovery System yields a benefit to - cast ratio of 3.5 which is US $33,800 for annual energy cost saving for the company.

K. Roth et. al, 2020[2] studied promising technique to improve the peak load capability of such power plants is to integrate transient external waste heat sources into the cycle. Feed-water pre-heaters are one favorable location to integrate the external heat into the water steam cycle. Since the addition of the external energy causes less steam consumption in the high-pressure and low-pressure pre-heaters, one or more steam extraction lines can be closed. By doing this, the steam can be used for additional power generation in the steam turbine. The analysis of the occurring time-dependent processes are studied on a numerical basis, using the dynamic process simulation software APROS from VTT.

Jouhara, H. et, al, 2018[3] High temperature WHR consists of recovering waste heat at temperatures greater than 400 °C, the medium temperature range is100–400 °C and the low temperature range is for temperatures less than100 °C. Usually most of the waste heat in the high temperature range comes from direct combustion processes, in the medium range from the exhaust of combustion units and in the low temperature range from parts, products and the equipment of process units

Pachaiyappan, R., & Dasa Prakash, J. (2015).[4] stated that Air pre-heater and economizer are heat transfer surfaces in which air temperature and water temperature are raised by transferring heat from other media such as flue gas. Hot air is necessary for rapid combustion in the furnace and also for drying coal in milling plants. So, an essential boiler accessory which serves this purpose is air pre-heater. This paper deals with the different ways to obtain the maximum heat from the flue gas travelling through the air preheater and the economizer zone to improve the boiler efficiency (10)

## III. PROBLEM STATEMENT

The heat energy dissipated from numerous operations, such as the formation of compressed air for process requirements. This energy is finally discharged into the atmosphere via cooling towers. However, waste heat in the industries may be saved from different heat recovery units, such as heat exchangers, and then used in the plant according to process requirements, reducing the consumption of fuel and making the plant more cost efficient and productive.

Objective of the paper are as following:

To save fuel consumption.

To collect waste heat from the air compressor.

To design a system to collect the waste heat and pass on to the feed water and pre heat the boiler feed water.

To reduce cooling water pumping power.

## IV. METHODOLOGY

Heat recovery units in air compressors are specifically built coolers that recover more than 70% of available thermal energy and repurpose it for beneficial activity such as heating air or water.

Recycled heat is commonly used for supplemental space heating, industrial process heating, water heating, makeup air heating, and boiler makeup water preheating.

Recovered hot water can be utilised in central heating or boiler systems, industrial cleaning, plating activities, heat pumps, laundries, or any other application that requires hot water. Initially, atmospheric air is extracted by the air compressor, then compressed air with dissipated heat enters the heat recovery unit / intercooler, which consists of ambient temperature water that absorbs heat and is subsequently provided to wherever it is utilised.

The cycle begins with the first stage, then moves on to the second step to obtain more compressed air. The water from the first stage is carried again to the second stage for additional heat absorption, then the after cooler/hru absorbs heat and the heat recovered may be used for further industrial uses.

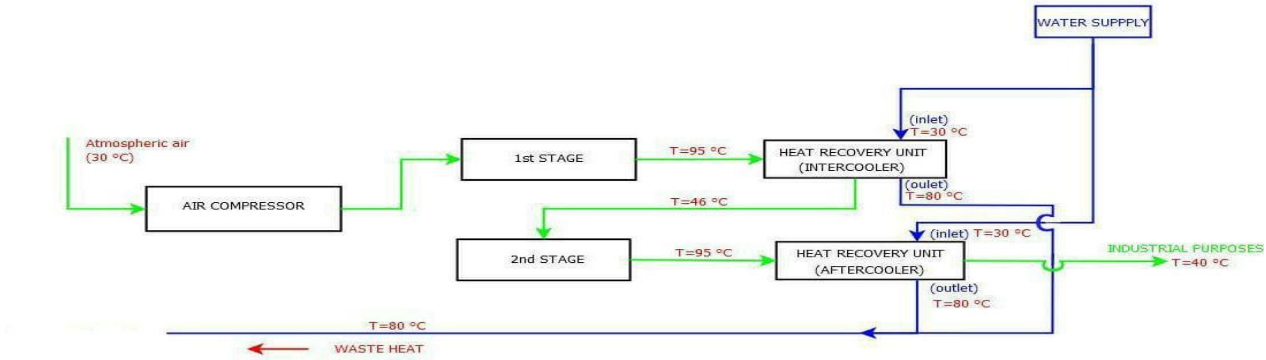
Heat recovery could be carried out by various means according to the requirement and plant layout , one of such way of utilising dissipated heat is by application of heat recovery treatment to a compressor. The procedure for using excess heat for energy consumption in a plant

1.The compressor (1st stage) draws in atmospheric air, which is then compressed, causing pressure to rise, resulting in the generation of heat, which then enters the H.R.U. (intercooler), which is made up of water tubes that absorb the heat from the compressed air, and the temperature of the compressed air drops while the temperature of the water rises because heat is absorbed.

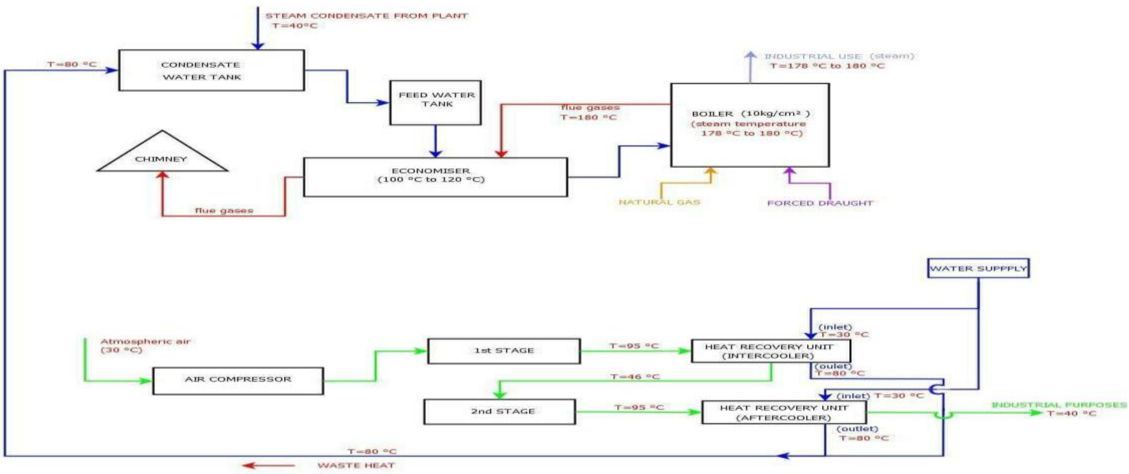
2.After the air is cooled in the intercooler, it enters the second stage compressor, where it is compressed again due to demand, resulting in an increase in heat due to the increase in pressure. This air (with a certain amount of heat) then enters the H.R.U. (aftercooler), where the same process as in the intercooler is repeated, and the compressed air is used in the fermentation process.

3.The water (from both H.R.U.s) is transferred to the feed water tank after entering the condensate tank, and this warmed water enters the economizer, which creates heat from the hot flue gases emitted by the fire tube boiler

4.Which will add more heat to the water and then it enters the boiler, now the boiler requires less fuel to convert the water into steam because the water is preheated, then the flue gases generated are again taken to the economizer and the cycle continues, and the rest of the remaining unused flue gases are exerted through a chimney that is located at a certain height.




4.1 Flowchart of existing process




4.2 Flowchart of Proposed Methodology

The calculation of the total fuel save are as follows:
Compressor motor rating = 550 kw
(The above data is accurate and obtained through company and pre observed by engineering department)
Energy converted to heat = 80% × 550=440 kw = 440 kJ/sec=1584000 kJ/hr.

## V. CONCLUSION

This paper presents the literature review of all the methods to utilize waste heat energy is being presented.
The report proposes a system by which industrial waste heat given out in the atmosphere is being recovered and reused for the industrial processes
This recovery and utilization of energy saves a significant amount of fuel therefor is cost efficient for the industry
Such waste heat recovery methods and techniques are applicable for process industry especially chemical industry.
Heat recovery is limited for large-scale industries compared to small-scale industries since installation is expensive and recovered heat is insufficient for use.
Waste heat recovered from compressed air system.
Lower capital cost, lower operational cost, lower energy cost
Heavy energy savings thereby savings on cost of energy
Premium on compressors
Faster payback as low as <1 year.

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