# WASTE HEAT RECOVERY FROM AIR CONDITIONERS BY USE OF HEAT ABSORPTION PUMP

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**ABSTRACT:** In this paper I have considered the waste heat recovery from an air conditioning system. Air Conditioners often reject heat directly into the air or water circulating from a cooling tower. Normally waste heat rejected from air conditioners are used to provide hot water for domestic purposes. But based on my research it can be shown that the waste heat rejected by ACs can supply enough heat energy to provide hot water to boilers for heating and washing purposes. Using absorption heat pump, we will be able to convert the low grade waste heat into high temperature heat which is used for industrial purposes.

**KEYWORD:** absorption pump, air conditioners, conservation,domestic, energy, recovery, waste heat

## I. INTRODUCTION

"Today's wastage is tomorrow's shortage"

This statement clearly represents the energy crisis that the world is facing today. Man has constantly depleted the limited energy resources .The improper utilisation of the resources has often led its wastage. Hence there is an urgent need for reduction of this wastage. A substantial amount of heat energy is lost to the surrounding during thermal processes, which is known as waste heat. This concept of waste heat liberated by machines is explained by the first law of thermodynamics.

If steps are taken to reduce this wastage heat using methods of heat recovery then this waste heat can be converted to any other useful form of energy. This may further help in enhancing the efficiency of thermal processes and reduce their energy consumption.

## II. PROBLEM DEFINITION:

According to a report made by Energetic Inc.for the DOE titled 'Technology Roadmap' and several others done by the European Commission, a majority of energy production is lost to the environment due to various losses. It has been evaluated that the total energy loss sums around 66% loss in electric value. Waste heat of certain degree could be found in the final processes such as cooling by air conditioners. So these energy losses can be minimised by channelizing the waste heat to some useful form of energy

Air conditioners are widely used in offices, buildings, malls, etc. The air conditioner absorbs heat from living spaces and replaces it by cool air. Large scale cooling processes of air conditioning takes place in cooling towers. The heat energy that the air conditioner absorbs rooms is expelled into the atmosphere. This heat energy is completely wasted which can be otherwise used in more effective and efficient way.

Recently, this waste heat rejected by ACs was used to provide hot water. But, this heat is of 'low grade variety' and so it cannot be used for industrial purposes. Hence the hot water is used only for domestic purposes.

Hence, there is a need to implement such a heat recovery system where the waste heat obtained can be utilised not only for domestic purposes but for also various other industrial uses such as providing steam or hot water to boilers, used for the production of the bio-fuel by growing algae farms. In short, we must devise a device by which we can convert the low grade waste heat into high temperature heat so that it can be utilised in various purpose

## III.SOLUTION OF THE PROBLEM DEFINED:

Absorption heat pumps are systems to transfer heat from waste heat sources to their output hot water or steam, with the rise in temperature. We utilise the

absorption heat pump in our solution in order to fulfil our needs as we require a high temperature output heat. This system is also utilised because these systems can also be driven by thermal energy, consuming very little electricity. The low waste heat from air conditioners is used to produce higher temperature hot water or steam which can be put into several uses. An absorption heat amplifier consists mainly of four parts:

1. Evaporator(E)
2. Absorber(A)
3. Condenser(C)
4. Generator(G)

Aqua ammonia is used as the working fluid in this system. Aqua ammonia has a boiling point of 37.7 degree Celsius at 25% concentration by mass and 24.7 degree Celsius at 32% concentration by mass

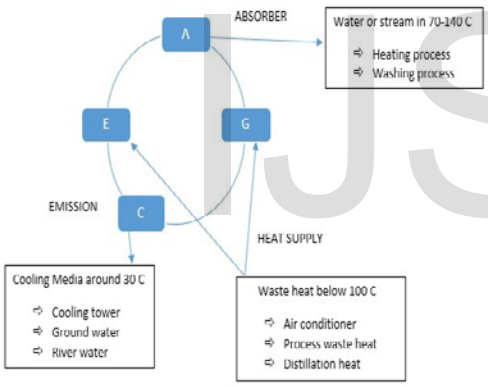


Figure 1: Heat absorption process

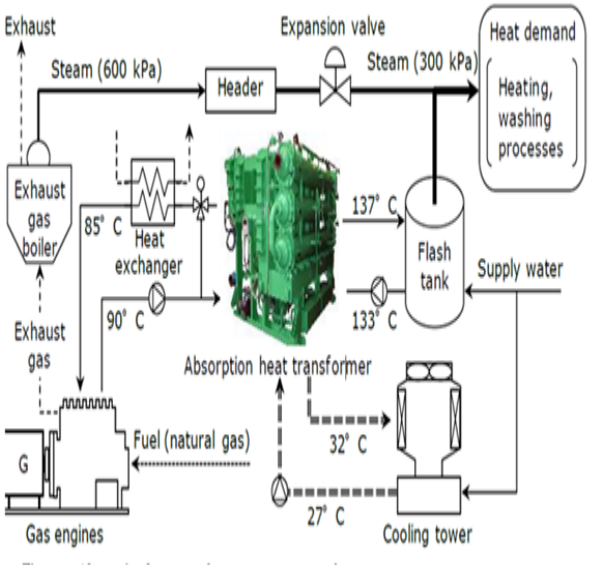


Figure 2: Absorption heat transformer

An energy conservation concept including an absorption heat transfer is shown in figure 1. Here the waste water, that is obtained from the outlet of the air conditioners and other similar sources, is fed into the Generator as heat supply. The output temperature can be utilised for various heating, drying and industrial purposes. Waste heat at a relatively low temperature is supplied to the generator for water and aqua ammonia separation. Now the liquid refrigerant which is aqua ammonia from the condenser is supplied to the evaporator at elevated pressure. In the evaporator, it is vaporised by using the same low temperature, which is supplied to drive the Generator (these heat transformers are usually operated so that generator and the evaporator temperatures are equal). The vapour refrigerant which is aqua ammonia is then absorbed into the solution in the absorber which rejects the high temperature heat into the required outlet.

This cycle heats up the low temperature heat from way below 100 degree Celsius to about over 130 degree Celsius. The co-efficient of performance(COP) of this cycle is given by: $COP= Q_a/(Q_g+Q_e)$

Where $Q_a$, $Q_g$, $Q_e$ are heat quantities in the absorber, generator and evaporator respectively.

## IV.RESULTS AND DISCUSSION:

Based on a sample problem where the air conditioner is working between a temperature difference of 10°C at 1 bar pressure, certain values are obtained. Let the outdoor temperature be 30 °C and indoor temperature be 20 °C ( which is required). We found out that the air conditioner a total of 196 MJ of heat energy is rejected out. Now as the refrigerant is aqua ammonia, having specific heat of vaporisation is 1166.75 kJ/kg, we calculated the amount of heat that is required by this refrigerant to get vaporised. Out of the available 196MJ,19MJ is utilised for the vaporisation process, leaving us with a great deal of waste heat to be utilised. Hence we can obtain high energy from this waste heat.

It is relatively simple to modify the air conditioning system so that the waste heat is recovered and used to heat water.

This has a number of benefits:

- Efficiency is improved
- Life of compressor is extended
- Cooling effect of air conditioner occurs more rapidly
- Air conditioning system generates free hot water when in operation and replaces the use of electricity or fuels. Hence in a manner it saves use of electricity and reduces fuel consumption and thus saves energy.

Extra cost associated with the water heating are relatively small

The waste heat recovery process has no visible disadvantages on the ecology and economy. On the contrary, these systems have many benefits which could be direct or indirect.

## V. PRACTICAL APPLICATION:

Waste Heat is one of the most cost effective source of heat energy. The waste heat recovery process has no visible disadvantage on the ecology and economy. On the other hand, it is increases efficiency of the air conditioning system. The fact that it replaces electricity and fuel finds its use in various practical applications as it requires very negligible amount of electricity. The few applications are enlisted below where the industrial purpose is the focus of our paper.

Domestic Purpose: The waste heat rejected by a standard air conditioner can produce hot water for domestic use such as bathing, boiling water etc. A particular of SEER 18 1.5ton can produce 100 gallons of hot water.

Industrial Purpose: Waste Heat from an air conditioner can also be used for pre-heating of combustion air for boilers, ovens, furnaces. It is also utilised for hot water generation and to provide feed water to boilers because the outlet temperature of the hot water or steam is well above 140 degree Celsius. This high temperature steam or even heat of this outlet source can be put into various uses for various industrial purposes. This would in turn reduce the expenses of these industrial processes. Hence this paper emphasises the use of this type of system to make various processes eco-friendly and more efficient

Algae Farms: Waste Heat recovered from ACs are also used to produce bio fuels by growing of Algae Farms. This is also another useful purpose to which this outlet heat can be put into use.

Miscellaneous: The waste heat generated can also be used for various other purposes such as

- Eco-Industrial Parks
- Greenhouses
- Drying
- Space heating

## VI. CONCLUSION

The world today is grasped by acute shortage of energy due to mismanagement and overuse, A part of total energy is utilised in useful work and the rest is lost as waste energy. We have tried to enlist the various fields were heat is wasted and tried to find a permanent solution to recover it by using the absorption heat pump where the temperature of waste heat is increased to make it more useful. This recovered heat can be utilised to perform additional useful work that will reduce the total energy consumption and shall contribute to the efficiency of the system. We have concentrated on air conditioners and cooling towers whose amount of

waste heat is considerable and have tried to use it to perform additional work. The waste heat generated can be used for preheating air and water for various thermal process, space heating, drying, maintaining the temperature of the system, which reduces additional fuel and energy requirements thereby making the system more efficient and keeping the environment clean and green.

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