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Recent Trends in Heat Power

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Abstract – Energy demands are increasing day by day but human beings are unable to meet these needs. Heat Power has a great potential to overcome these needs. Hence it is necessary to work on the recent trends in heat power to bring a revolutionary change across the globe.

So it is need of time to avoid wasted heat energy using Waste Heat Recovery Unit (WHRU). In IC Engine (ICE) about 20-45% heat energy is used to produce mechanical energy. Remaining 55-80% is wasted. So; it's time to recover heat energy by using Thermoelectric Generators (TEGs) & heat pipes.

The low temperature level of the waste heat in cement plants (200 – 400 °C) limits the efficiency to a maximum of 20 – 25%. However, 25 to 30% of plant's power demand can be met through generating power from waste heat.

Keywords:- Heat Power, waste heat, WHRU, TEGs, Heat pipes.

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INTRODUCTION

Energy supply is a vast industry, powering the world economy. More than 10% of the world expenditure is used for energy purposes. Most of the energy get's produced & whereit is consumed, distinguishing fossil, nuclear & renewable energy. Worldwide energy supply refers to the global production & preparation of Fuel, generation of Electricity & Energy Transport. Many countries cannot produce sufficient energy to satisfy their uses & energy demands adding day by day. So; it's time to look after in RECENT TRENDS IN HEAT POWER to fulfil those needs. Likewise- Waste Heat Recovery Units (WHRU), Thermoelectric Cooling etc.

Waste heat recovery unit is an energy recovery heat exchanger that recovers heat from hot streams with high potential energy content. Such as, hot flue gases from a diesel generator, steam from cooling towers , even waste water from different cooling processes, hot gases in a cement factory & in IC ENGINE (ICE) by Thermoelectric Generator's (TEGs) & heat pipes. Thermoelectric cooling uses a principle called the "PELTIER" effect to pump heat electronically.

OBJECTIVES:-

- To introduce about Waste Heat Recovery Unit among Industries.
- To increase the efficiency of any system by using WHRU.

Thermoelectric Coolers are require for heat removal ranging from mill watts to several thousand watts.

WASTE HEAT :-

Industrial waste heat refers to energy that is generated in industrial processes without being put to practical use. Sources of waste heat include hot combustion gases discharge to the atmosphere, heated products exiting industrial processes, &heat transfer from heat equipment surfaces. Exact quantity of industrial waste heat is poorly quantified, but various studies have estimated that as much as 20 to 50% of industrial energy consumption is ultimately discharged as WASTE HEAT.

WASTE HEAT SOURCES:-

• Combustion exhaust
• Process of Gases
• Cooling water from furnaces, IC Engine etc.
• Conductive, Convective & Radiative losses
• Conductive, Convective & Radiative losses from

heated products

WASTE HEAT RECOVERY:-

Waste heat losses arise both from equipment inefficiencies & from thermodynamic limitations on equipment design and processes. Recovering industrial waste heat can be achieved via numerous methods. The heat can either be reused within the same process or transferred to another process. Ways of reusing heat locally include using combustion exhaust gases to preheat combustion air or feed water in industrial boilers.

Uses of Waste Heat:-
• Combustion air preheating
• Boiler feedwater preheating
• Power Generation
• Water Preheating

WASTE HEAT RECOVERY UNITS:-

Waste Heat Recovery Unit is an energy recovery heat exchanger that recovers heat from hot stream with high potential energy content. Waste heat found in the exhaust gas of various processes or even from the exhaust stream of a conditioning unit can be used to preheat the incoming gas. This is one of the basic methods for recovery of waste heat. Some waste heat recovery units are **Recuperators, Regenerators, Heat Pipe Exchanger, Thermal Wheel, Economiser** etc.

Such various WASTE HEAT RECOVERY UNITS being used in practical applications are as follows:

1. Power Generation in Cement Factory

2. Waste heat recovery in IC ENGINE

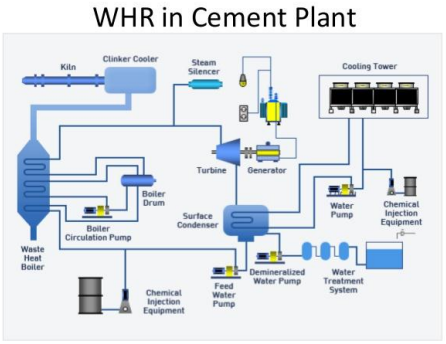
3. Thermoelectric Cooling

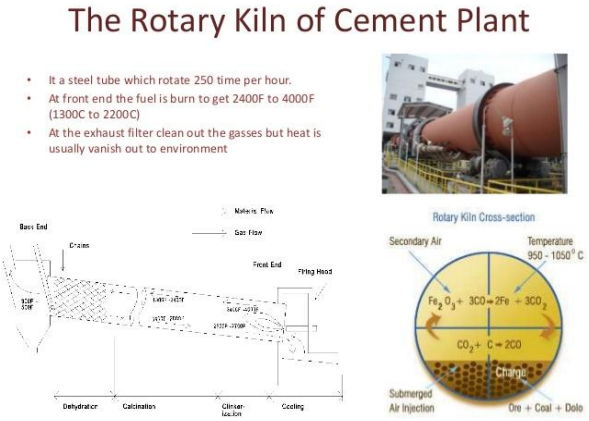
Power Generation in Cement Factory:-

Waste heat from cement kilns is usually used for drying of raw materials and fuel. Depending on the humidity of the raw materials and the cooler technology, additional waste heat is available from the kiln gases (preheater exit gas) and cooler exhaust air. This heat can be used for electricity production. Power can be produced by using a steam cycle, an organic rankine cycle, or the KALINA process. The low temperature level of the waste heat in cement plants (200 – 400 °C) limits the efficiency to a maximum of 20 – 25%. However, 25 to 30% of plant's power demand can be met through generating power from waste heat.

Heat recovery for power is most economical for long dry kilns but long dry kilns with preheaters in China and Europe have power production installations. Heat recovery for power production may not be feasible in plants where the waste heat is used in raw mills to extensively dry the raw material - which offers a more efficient and economic option (US EPA, 2010. p22).

It has been reported that there are at least 33 cogeneration units in various cement plants with total capacity about 200 MW in Japan. In China about 24 kilns having capacity of 2000 ton per day and above have cogeneration units with supplementary fired boilers to meet about 22 — 36 kWh/t clinker





Waste heat recovery can provide up to 30 percent of a cement plant's overall electricity needs and offers the following advantages (LBNL 2008, EPA 2010):

- Reduces purchased power consumption (or reduces reliance on captive power plants), which in turn reduces operating costs
- Mitigates the impact of future electric price increases
- Enhances plant power reliability
- Improves plant competitive position in the market
- Lowers plant specific energy consumption, reducing greenhouse gas emissions (based on credit for reduced central station power

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generation or reduced fossil-fired captive power generation at the cement plant)

Recoverable Waste Heat and the Potential for Power Generation the amount of recoverable waste heat from an NSP kiln depends on several factors including the following:

- Moisture content of the raw material feed (i.e., determines heat requirement for the kiln and the amount of preheater exhaust needed for drying)
- Amount of excess air in the kiln
- Amount of air infiltration
- Number and efficiency of preheater/precalciner stages
- Configuration of the clinker cooler system

WASTE HEAT RECOVERY IN IC ENGINE:-

The increasingly worldwide problem regarding rapid economy development and a relative shortage of energy, the internal combustion engine exhaust waste heat and environmental pollution has been more emphasized heavily recently. Out of the total heat supplied to the engine in the form of fuel, approximately, 30 to 40% is converted into useful mechanical work; the remaining heat is expelled to the environment through exhaust gases and engine cooling systems, resulting in to entropy rise and serious environmental pollution, so it is required to utilized waste heat into useful work. The recovery and utilization of waste heat not only conserves fuel (fossil fuel) but also reduces the amount of waste heat and greenhouse gases damped to environment. The study shows the availability and possibility of waste heat from internal combustion engine, also describe loss of exhaust gas energy of an internal combustion engine. Possible methods to recover the waste heat from internal combustion engine and performance and emissions of the internal combustion engine. Waste heat recovery system is the best way to recover waste heat and saving the fuel.

POSSIBILITY OF HEAT RECOVERY And AVAILABILITY FROM I.C. ENGINE:-

Waste heat is heat, which is generated in a process by way of fuel combustion or chemical reaction, and then "dumped" into the environment even though it could still be reused for some useful and economic purpose. This heat depends in part on the temperature of the waste heat gases and mass flow rate of exhaust gas. Waste heat losses arise both from equipment inefficiencies and from thermodynamic limitations on equipment and processes. For example, consider internal combustion engine approximately 30 to 40% is converted into useful mechanical work. The remaining heat is expelled to the environment through exhaust gases and engine cooling systems. It means approximately 60 to 70% energy lossesas a waste heat through exhaust (30% as engine cooling system and 30 to 40% as environment through exhaust gas). Exhaust gases immediately leaving the engine can have temperatures as high as 842-1112°F [450-600°C]. Consequently, these gases have high heat content, carrying away as exhaust emission. Efforts can be made to design more energy efficient reverberatory engine with better heat transfer and lower exhaust temperatures; however, the laws of thermodynamics place a lower limit on the temperature of exhaust gases.

Availability of Waste Heat from I.C. Engine The quantity of waste heat contained in a exhaust gas is a function of both the temperature and the mass flow rate of the exhaust gas:-

The heat loss (kJ/min); is the exhaust gas mass flow rate (kg/min); is the specific heat of exhaust gas (kJ/kg°K); and is temperature gradient in °K. In order to enable heat transfer and recovery, it is necessary that the waste heat source temperature is higher than the heat sink temperature. Moreover, the magnitude of the temperature difference between the heat source and sink is an important determinant of waste heat"s utility or "quality". The source and sink temperature difference influences the rate at which heat is transferred per unit surface area of recovery system, and the maximum theoretical efficiency of converting thermal from the heat source to another form of energy (i.e., mechanical or electrical). Finally, the temperature range has important function for the selection of waste heat recovery system designs.

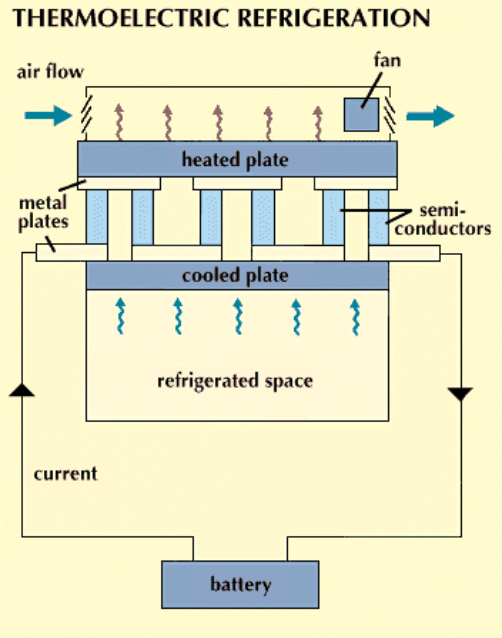
Solution:-

It is estimated that globally, only one third of all energy usages were utilized while the remaining is rejected as waste heat. A large part of global energy usage is consumed in the form of thermal energy. This has triggered off an intriguing challenge for scientists and engineers to utilize the waste heat from the industry. Thermo-electric generator (TEG) is a solid state device capable of converting thermal energy to electrical energy. There are no moving parts in TEG and therefore no maintenance is required for long operation. The use of heat pipe can transfer a large amount of heat over a relatively long distance due to its high thermal conductivity. It is very effective and simple device because of its uncomplicated configuration, no power input requirement, no moving parts, passive heat transferring, compactness and lightweight. There are many ongoing researches on thermoelectric power generation undertaken in many countries such as U.K., the U.S., Ukraine, Australia, Korea and Japan. This study will provide a continuous research on

thermoelectric power generation that will not only lead to an improvement in its feasible performance solutions, but also to the future prospect of promising energy conservation technology.

THERMOELECTRIC COOLING:-

Thermoelectric cooling is a way to remove thermal energy from a medium, device or component by applying a voltage of constant polarity to a junction between dissimilar electrical conductors or semiconductors. Thermoelectric cooling uses the Peltier effect to create a heat flux between the junctions of two different types of materials. A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC). It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools.



Operating principle:-

Peltier element schematic. Thermoelectric legs are thermally in parallel and electrically in series.

Free convection thermoelectric cooler (Peltier cooler) with heat sink surface temperature contours, and rising warmer air and falling cooler air flow trajectories, predicted using a CFD analysis package, courtesy of NCI.

Construction:-

Two unique semiconductors, one n-type and one p-type, are used because they need to have different electron densities. The semiconductors are placed thermally in parallel to each other and electrically in series and then joined with a thermally conducting plate on each side. When a voltage is applied to the free ends of the two semiconductors there is a flow of DC current across the junction of the semiconductors causing a temperature difference. The side with the cooling plate absorbs heat which is then moved to the other side of the device where the heat sink is. TECs are typically connected side by side and sandwiched between two ceramic plates. The cooling ability of the total unit is then proportional to the number of TECs in it.

ADVANTAGES OF THERMOELECTRIC COOLING:-

COMPACT SIZE: Very little space is required by the cooling system. The thermoelectric module is the size of a matchbook.

LIGHTWEIGHT:A 36 qt. capacity unit weighs only 17 lbs. PORTABLE: Carries with one hand and is unaffected by motion or tilting.

LOWER PRICED: 20% to 40% less expensive than compressor or absorption units.

LOW BATTERY: Averages approximately 4.5 amps - less than your cars headlights.

ACKNOWLEDGEMENT:-

This whole paper is a recent innovation in Engineering just to bring a revolutionary change across the globe by using waste heat so that efficiency will increase. The complete idea belongs to us.

CONCLUSION:-

By this paper everybody may learn about the new innovations in HEAT POWER as well as the utilisation of waste heat power by WHRU.

REFERENCES:-

Kajikawa T. Thermoelectric power generation system recovering industrial waste heat. Thermoelectrics handbook: macro to nano. CRC/Taylor & Francis; 2006: 50-1.

Snyder GJ. Small thermoelectric generators. The Electrochemical Society Interface 2008; 17(3): 54.

Lee HS . Thermal design: heat sinks, thermoelectrics, heat pipes, compact heat exchangers, and solar cells. John Wiley & Sons; 2010.

Remeli MF, Date A, Baljit S, Lippong T, Randeep S, Akbarzadeh A. Combined Thermosyphon Thermoelectric Model (TTM) for Waste Heat Recovery and Power Generation. Proc.of

11th International Heat Pipe Symposium (11th IHPS) 2013**.**

Bhardwaj, S., 2010, Future Trends in Waste Heat recovery in Cement Plants, Green Cemtech, Hyderabad, 2010

International Energy Agency (IEA), "Key World Energy Statistics 2012", free publications, http://www.iea.org, 2012.

International Energy Agency (IEA), "Key World Energy Statistics 2012", free publications, http://www.iea.org, 2012.

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