A Study on Power Generating Arrangements in Rotary Kiln by using Excessive Heat

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Abstract

According to our project to produce an electrical energy from a rotary kiln heat radiation also a rotary kiln chimney radiation. In a rotary kiln and chimney to out a heavy heat radiation (250ºC-350ºC) from a working condition, so we set a steam power plant by using a that heat radiation. The steam power plant agent as water. So the water as convert into steam. The steam goes to a turbine by using forced draft fan. Turbine is converted in kinetic energy into mechanical energy. The generator is connected to a turbine, so generator also rotating. The generator is converted in mechanical energy into electrical energy. So we get an electrical energy easily from this method. In our project to design a closed cycle. So we set a condenser in our project. The condenser is converted in steam into water, so the water is not waste as well as to supply the plant and the process is recycled.

Keyword: *Electrical energy, Heat radiation, Kinetic energy, Mechanical energy, Closed cycle.*

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1. INTRODUCTION

According to aspect law of our project to produce an electrical energy in rotary kiln heat radiation and also chimney. Our project main parts as rotary kiln, condenser, water storage tank, economiser, chimney, water tube, steam separating drum, super heater, forced draft fan, impulse turbine, generator, feed water pump. Our project agent as water. Those parts all are involved in working condition. Rotary kiln and chimney out a heavy heat radiation in working condition. So that heat radiation we use our project and set a steam power plant. That steam power plant to produce an electrical energy easily. In our project cycle as closed cycle, So we set a condenser on our project. That condenser recycle a steam into water so we get an efficiently. Also no wastage and efficient. So we get an electrical energy in our steam power plant easily.

2. ABBREVIATIONS AND ACRONYMS

A rotary kiln is a large cylinder-formed furnace used in certain hot-process manufacturing industries. It is a slightly inclined, refractory lined steel container which rotates about its axis and where certain chemical and physical reactions take place by the influence of heat. The slope and the rotation make the material inside to move through the kiln from feed to discharge end. The heat is commonly generated by a flame in the discharge end from the combustion of coal, oil, natural gas or waste. The size of a rotary kiln can be as large as 180 m in length and 7.5 m in diameter, while

service temperature can be up to1800ºC. The kiln is commonly resting on two to five pairs of support rollers, depending on its length. Additionally, it is equipped with thick, tightly fitted steel tyres that are riding on the support rollers. There are many industrial users of rotary kilns, however most of them are found in the field of cement, lime and mineral production.1In order to be able to operate at high temperatures, the inner part of a rotary kiln consists of one or several layers of refractory materials. This is required for heat protection of the steel casing of the kiln, surroundings (such as sensible equipment and personnel) and reduction of heat losses (lower drift costs). These materials are usually in form of constables or bricks and have varied chemical composition dependent on service conditions. Refractories are essential for a wide range of hot processes exceeding 1000ºC and the availability of a rotary kiln is highly dependent on the condition state of the refractory lining. Depletion of the refractory lining can lead to significant failures with fall outs of bricks or constables that may require shut-down of the production. Unplanned shut-downs can cause very high production losses and put company in a demanding situation. Refractory products are often used in harsh service environment and therefore are prone to degradation.

Zones	***Temperature Level (celsius)***
Inlet zone	20°C-200°C
Safety zone	200°C-750°C
Upper transition Zone	750°C-1200°C
Sintering zone	1200°C-1450°C
Lower transition zone	1450°C-1300°C

Table. 1 Rotary kiln zones and temperature level

3. NEED AND SCOPE

1. The waste radiation is utilized into produce electrical power supply and radiation is converted into the electrical power.
2. To improved by the power plant system and also increased into the electrical power supply.
3. The heat energy converted into the electrical energy and extra power savings for the plants.
4. The rotary kiln which is used to convert magnesium carbonate into magnesium oxide and is composed of three layers namely.
5. Refractory lining insulation and boiler shell. Air is blown from the blower and oil is mixed in ratio 1:4.
6. Heat generated inside the kiln is used for the conversion of magnesium oxide and the rest of the heat is transformed to inner wall of the refractory lining.
7. This in turn leads to change of water into steam. For system can be used actuating the turbine to produce the A.C electrical power supply.

4. WORKING PRINCIPLE

According to aspect law of our project to produce an electrical energy from a rotary kiln heat radiation by using a steam power plant .Our project agent as water .Now discuss a main parts of our steam power plant .The main parts are collecting tank ,centrifugal pump, economizer, chimney, water tube, steam separator drum, forced draft fan, impulse turbine, generator, jet condenser (parallel type), feed water pump are involved a working .In a working condition rotary kiln and chimney out a heavy heat radiation .So that heat radiation is used our steam power plant .First the water is goes to economizer from water tank by using a centrifugal pump. Now the water temperature is 10ºC.The chimney out a heat radiation for working condition, so the water as convert a wet steam from an economizer .Then the wet steam is goes to water tube .Now the inlet temperature is 90ºC .The water tube is fit an along with rotary kiln .A rotary kiln out a heat radiation from working condition so the wet steam is change a dry and saturated steam by using the heat radiation. Then the dry and saturated steam is goes to steam separating drum. Now the wet steam (some water involved in a steam condition is called wet steam) is out the steam separating drum, so the dry and saturated steam is convert into super heat steam from super heater and the temperature is 250ºC .

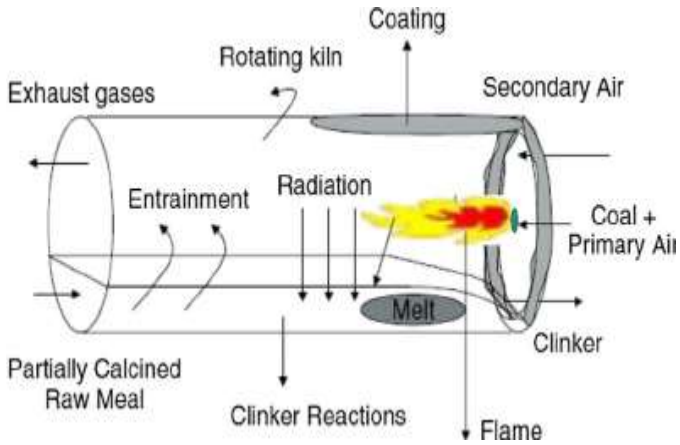

Fig. 1 schematic diagram layout

Then the super heat steam is goes to the nozzle by using the forced draft fan. The nozzle is supplying forced in impulse turbine .So the turbine is rotating then the generator also connected to the turbine, so the generator also rotating then to take an electrical energy from a generator easily. In our project set in closed cycle. So, we set a condenser on our steam power plant .In our project suitable condenser is jet condenser. So excess steam goes to the jet condenser from an impulse turbine .So the steam is convert into water on jet condenser. Then water is goes to the water tank by using the feed water pump and process running is continuously .This is our main working principle of our project.

Energy is a generic term for a group of concepts that define the maximum possible work potential of a system, of matter or heat interaction; the state of the environment being used as the datum state. In an open flow system there are three types of energy transfer across the control surface namely working transfer, heat transfer, and energy associated with mass transfer or flow. The work transfer is equivalent to the maximum work, which can be obtained from that form of energy (Nag et al, 2006).

Energy analysis is based on the first law of thermodynamics, which is related to the conservation of energy. Second law analysis is a method that uses the conservation of mass and degradation of the quality of energy along with the entropy generation in the analysis, design and improvement of energy systems. Energy analysis is a useful method; to complement but not to replace energy analysis,Brad Bucker (2002).

Normally an external fuel is used in Boilers for producing flue gas with temperature about 850° C. This flue gas is the one which is used to generate steam, which in turn produces power [Rajput, 2004; Nag, 2006].

It is proposed in this project to effectively utilize the waste flue gas generated from rotary kilns to produce electricity, because this waste flue gas generated from producing iron will already be of temperature 700° C thus eliminating the need for an external fuel. The irreversibility maybe due to heat transfer, through finite temperature difference, mixing of fluids at different temperature and mechanical friction. Energy analysis is an effective means, to pinpoint losses due to irreversibility in a real situation (Rajput ,2004).

To optimize the operation of a boiler plant, it is necessary to identify where energy wastage is likely to occur. A significant amount of energy is lost through flue gases as all the heat produced by the burning fuel cannot be transferred to water or steam in the boiler. Since most of the heat losses from the boiler appear as heat in the flue gas, the recovery of this heat can result in substantial energy savings. This indicates that there are huge savings potentials of a boiler energy savings by minimizing its losses.

Combustion chamber is the most important part of the boiler. The combustor in a boiler is usually well insulated that causes heat dissipation to the surrounding almost zero. It also has no involvement to do any kind of work. In addition, the kinetic and potential energies of the fluid streams are usually negligible. Then only total energies of the incoming streams and the outgoing mixture remained same for analysis. The conservation of energy principle requires that these two equal each other ’s that is shown in the figure

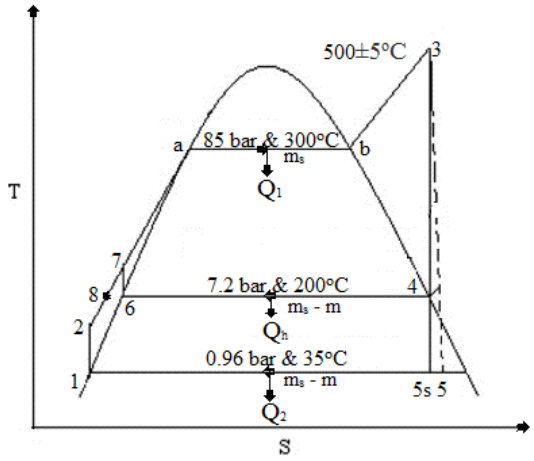

Fig.2 Cogeneration Plant with a Pass – Out Turbine

5. DESIGN METHODOLOGY

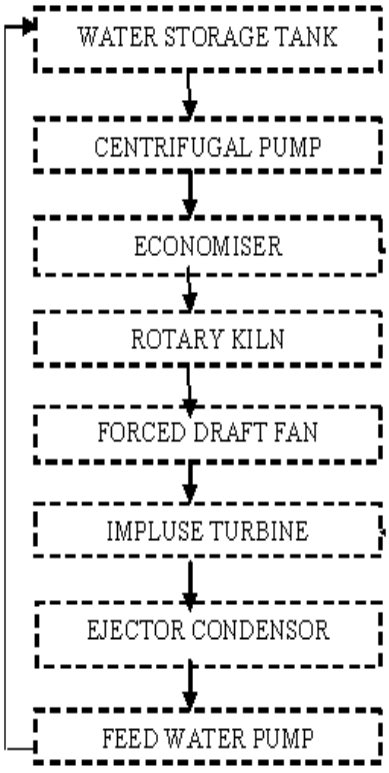

Fig. 3 Design methodology

6. ROTARY KILN MAIN COMPONENTS

1. Water storage tank
2. Centrifugal pump
3. Economiser
4. Chimney

5. Rotary kiln
6. Forced draft fan
7. Impulse turbine
8. Generator
9. Ejector condenser
10. Feed water pump

7. DISCUSSION OF RESULTS

From the energy analysis, the overall plant energy loss is calculated as 81.72%. The comparison of energy losses between different components is given in Figure 4. It is observed that the maximum energy loss (47.79%) occurred in the condenser, this is due to the reason of heat energy expulsion from the condenser. Thus the energy analysis diverts our attention towards the condenser for the plant

performance improvement. Approximately half of the total plant energy losses occur in the condenser only and these losses are practically useless for the generation of electric power. Thus the analysis of the plant based only on the First law principles may mislead to the point that the chances of improving the electric power output of the plant is greater in the condenser by means of reducing its huge energy losses, which is almost impracticable.

Hence the First law analysis (energy analysis) cannot be used to pinpoint prospective areas for improving the efficiency of the electric power generation. However, the Second law analysis serves to identify the true power generation inefficiencies occurring throughout the power station.

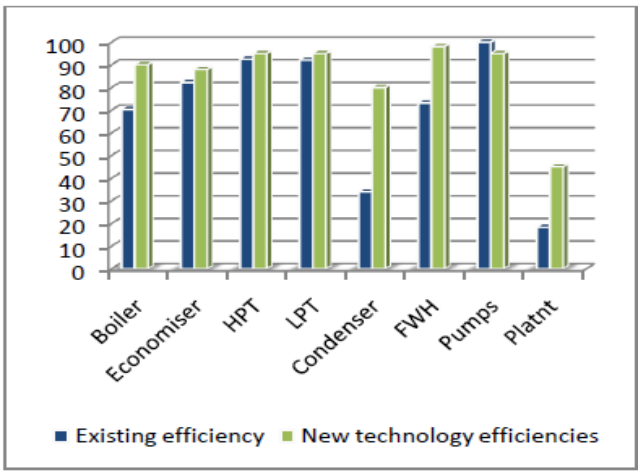

Fig. 4 First law efficiencies of components and plants

8. CONCLUSION

Steam power plants are industrial goods that produce electricity. Moreover, these plants are important to give a higher efficiency and advance technical development of steam producing by the rotary kiln with in exhaust heat. It might be generate the power effectively used in the industries.

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