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Prospectus of Waste Heat Recovery Power Plant in Lafarge Surma Cement Ltd

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Abstract: ***In the current world Bangladesh isthe biggest importer of Clinker, as the raw materials for clinker calcination is a foreign product to this country. Every year the government spends 125 million USD to import clinker. But the scenario is expected to change in the near future as limestone ore, the main ingredient for clinker has been discovered in the country.Thus there will be an increase in the number of local calcination plants and a certain rise in emission of Green House Gas. In such industries about 90% of the energy is used as heat energy and out of which 35% of is released tothe atmosphere as waste. This paper proposes a methodology to utilize the waste heat released from Pre-heater and Air Quenching Cooler of the plant for the effective generation of electricity. Electricity crisis has always been an issue in Bangladesh. Even today the per capita electricity consumption of Bangladesh is*** $1/60$ ***thof that of USA.With the fast depletion of Natural gas in the country, Waste Heat Recovery Power Plant (WHRPP) can be a strong armament to fight this crisis. "Lafarge Surma Cement" owns the only clinker calcination plant of Bangladesh. If a WHRPP project is being implemented in this site the annual electricity generation is expected to be 64,800 MW.hr which will reduce the*** CO_2 ***emission by*** $41,286.88$ ***tons.***

Keywords: WHRPP, Green House Gas, Electricity Generation, Heat loss, Clinker

1. Introduction

Bangladesh has no source of cement clinker which makes it one of the largest importers of clinker and limestone in the world [1]. The country annually imports an estimated amount of 10-15 million tons of clinker from India, Thailand, Indonesia, Philippines and China [1].But this scenario is expected to change within the next few decadesas limestone mine has been discovered in Nogaon of Rajshahiwith a deposit of about 50-100 billion tons over an area of 50 sq-km [2]. The proper utilization of these resources with the construction of clinker calcination plants will eliminate the annual clinker imports and will reduce the import cost of nearly 125 million BDT[2].

Company	Production (t/d)	Power (kW.hr)
Sumitmo Osaka Cement	5,700	2,640
Hachinto Cement	4,400	2,200
Taiheiyo Cement	12,000	15,000
Mitsui Kozan	7,000	9,000
Mitsubishi Materials	4,500	7,300
Toh Soh	9,000	9,000
Hitachi Cement	4,000	15,00
Taiwan Cement	13,000	15,100
Jaxin Cement	7,000	9,650

But with the increase of clinker calcination plants, the emission of Green House Gas will induce. The only clinker calcination plant of Bangladesh is owned by "Lafarge Surma Cement" whichemits 608.4 thousand tons of CO_2annually.With the increase in the number of clinker plants the emission might increase to 60.84 million tons, if the entire National demand of clinker is met from the National resources. So it needs the solution if the flourishment of this industry leads to Global Warming.The main aim of this paper is to give suggestion to utilize the waste heat released from the plants to generate electricity. This project will not only generate electricity following Waste Heat Recovery technology but will also reduce the emission of CO_2

2. Background

Waste Heat Recovery Power Plant(WHRPP) projects are available all over the world in numerous cement factories. Various research papers were written on the established WHRPP projects and in many of them projects were proposed based on the available data. In this regard it noteworthy to mention about the papers written on Quzhai Cement plant of China, Bestway Cement Plant of Pakistan and many more."Kawasaki Cement Plant" has been successful in establishing such projects since 1980. Electricity generation depends on the quantity of calcined clinker. In the following table some of the projects established by the company are being mentioned [3].

The mainreason of developingsuch projects in energy affluent countries like China and Japanwas to reduce the emission of CO_2. But in Bangladesh the approach should be different as the country is yet to fulfill the National demand of electricity. Currently, such projects are being developed throughout the world in wide scale; thus it is the peak time for Bangladeshto take proper initiatives to establish such projects and improve the electricity generation capacity.

3. Proposal

In cement plant about 90% of total energy is used as heat energy in the clinker calcination process [4], 35%ofthis heat is discharged as waste heat to the surroundings without being utilized [4].Waste Heat Recovery (WHR) system is being proposed to effectively utilize the low temperature waste heat which exit from Suspension Preheater (SP) and Air Quenching Chamber (AQC) [5]. The generated steam is being fed to the steam turbine generatorsto produce power.

When gas is being transmittedfrom a high pressure zone to a low pressure zone rotation of turbine is initiated thus electricity is generated as the armature of the generator is coupled with the steam turbine. Atmospheric pressure of 1.63 MPa and temperature of $321 - 380^0 C$ are to be maintained both in SP and AQC regionsfor the maximization of production [5]. In the conventional methods,burning of Natural gas and Crude oil for the generation of electricity associates the production of CO_2. But the installation of this WHRPP will reduce the emission of Green House Gas as natural resources is not burnt for the generation of electricity in the process [4].

4. Feasibility and Impact Analysis

"Lafarge Surma Cement Ltd." is a joint venture of Lafarge and "Cementos Molins", a Spanish Company with strong global presence [6]. Lafarge Surma Cement Ltd. was incorporated on 11th November 1997 as a private limited company in Bangladesh under the Companies Act 1994 [6]. The plant located in Chhatak Sunamganj is the only cement plant in Bangladesh which produces high premium quality clinker [1]. Lafarge Surma Cement sources its primary raw material limestone from its own quarry in Meghalaya, India, which has one of the best quality limestone deposits in the world [1]. This limestone is brought to the Plant using a 17 km long conveyer belt.

Usually for a single production line 2 WHR boilers, 1 steam turbine and 1 Generator are required [4].Generally, 0.216 tons of steam is generated during the manufacture of 1 ton clinker [5]. Thus the production of 4000 tons of clinker will generate =4000×0.216 = 864 tons of steam. As 4 tons of steam generates 1 MW.hr of electricity [5],it is expected to generate 216 MW.hr of electricity every day once this project is implemented.

The project will also reduce the emission of CO_2 effectively; the electricity generated in this process does not release any Green House Gas as fossil fuel is not burnt during generation. The reduction of emitted gas per year is calculated using the following equation [4].

$$ER_y = BE_y - PE_y$$

Where,

- ER_y=Emissions reduction of the project activity during the year y (tCO_2)
- BE_y= Baseline emission during the year y (tCO_2)
- PE_y=Project emissions during the year y (tCO_2)

The baseline emission is the heat released to atmosphere utilizing the conventional method for electricity generation. To calculate the baseline emission, the following equation is used [4]

$$BE_y = E_{y.net} * EF_y$$

Where,

- $E_{y.net}$ =Net electricity generation
- EF_y= emission factor of the grid

For Bangladesh $EF_y = 0.63714323$ [7] and the annual generated electricity from the project is expected to be 64,800 MW.hr.

Thus, $BE_y = 0.63714323 \quad 64{,}800 = 41{,}286.88$ tons of CO_2

Again $PE_y = 0$ as fossil fuel was not burnt during the generation of electricity.

Thus, $ER_y = BE_y = 41{,}286.88$ tons of CO_2

As limestone core has been discovered in Bangladesh it is expected that within the next few decades Bangladesh will own numerous numbers of clinker calcination plants. Then the necessity of such projects will be inevitable; because with the rise in the number of plants the production of CO_2 gas will be indulged. In the following graphs the clinker production vs. Electricity Generation and Electricity Generation vs. reduction of the emission of tons of CO_2has been highlighted.

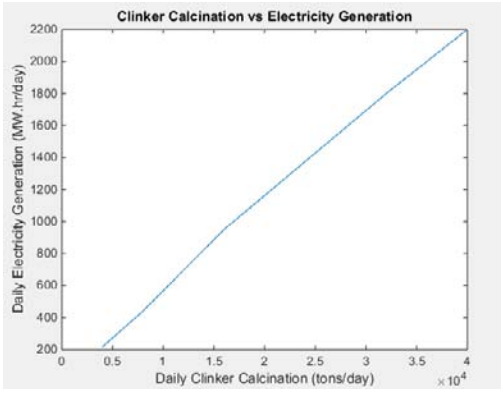

Figure 1: Clinker production vs. Electricity Generation

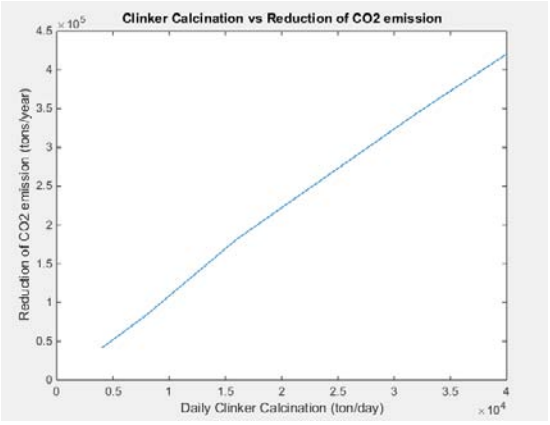

Figure 2: Electricity Generation vs. CO_2 reduction

The graphs shows if the National clinker demand of 12.5 million tons [1] can be met from local plants, then 2200 MW.hr of electricity generated daily provided that WHRPP projects are being established in all the clinker calcination plants

5. Conclusion

In this paper the prospectus of WHRPP project in "Lafarge Surma Cement" has been explained. In various countries such projects are functional; but it is yet to be established in Bangladesh. Many papers are written on this theory but no paper was written in this technology in the prospectus of this country. The main aim of this paper is to draw the attention of the concerned authority focusing on the benefits of this

project. Once implemented, the project will generate 64,800 MW.hr which will reduce the CO_2 emission by 41,286.88 tons annually. Therefore, such projects should be developed in wider scale for the betterment of future.

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Author Profile

KM Samaun Reza is a final year undergraduate student of Islamic University of Technology (IUT) with the department of Electrical and Electronic Engineering (EEE). He intends to pursue his MSc in the field of Renewable Energy. He has much interest on the topics like- Hydroelectricity, Wind Energy, Solar Energy, Waste Heat Recovery Power Plant, Biogas plant, Microbial fuel cell, CO_2 utilization, Hydrogen cell and solar thermal power plants. He was awarded the 1st prize in poster presentation competition in esonance, annual fest organized by EEE department of IUT.

Professor Dr. Mohammad Mehedi Hasan Khan completed his PhD from Newcastle University, UK in 2010. He was rewarded First prize in Environment YES (Young Entrepreneurs Scheme) 2009 competition organized by Natural Environment Research Council, UK. He was also awarded Sir Kenneth Blaxter Scholarship from British Society of Animal Science. He is now working as the dean, Faculty of Biotechnology and Genetic Engineering, Sylhet Agricultural University, Sylhet-3100, Bangladesh