OPTIONS FOR RE-BURNING BOTTOM ASH AT "LAKVIJAYA" COAL POWER STATION

Nahitiya Arachchilage Nadeera Madumal Wimalasiri

(09/8679)

Degree of Master of Science

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DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Abstract

This thesis discusses about the options for re-burning of bottom ash which is currently discarded as a waste from Lakvijaya power station that has got the largest pulverized coal fired boilers in Sri Lanka. This study has been conducted to evaluate the contents of the bottom ash and the possibilities of re-burning the bottom ash to recover the energy of the bottom ash before sending to the dumping yard. Thereafter the advantages in terms of economy are evaluated.

The results illustrate that re-burning of the bottom ash will recover the loss of chemical energy due to the unburned carbon content of the bottom ash, loss of ash enthalpy due to the sensible heat of the bottom ash and loss of radiation through boiler throat in spite of the opening area of the boiler throat to the submerged scrapper conveyer, recovering of these energy sectors will increase the boiler efficiency while other operational costs such as unscheduled outage of the boiler, ash disposal costs, chemical costs, maintenance costs including spare parts are also discussed. To achieve the above process of re-burning the bottom ash will require some process modification to the existing system which is also proposed. Finally the investigation is extended to evaluate and implementing of such a project to find out the project IRR.

The results shows that the potential recoverable energy of the bottom ash is expected to be 1,369kW which will lead to 0.18% increase of efficiency in the boiler. This will result in 1,699 MT of annual total coal saving which has a monetary value of 29.6 million rupees. The introduction of this re-burning process will make an effect on the fly ash output which has a remarkable monetary value due to the demand of cement and roofing manufacturers in Sri Lanka. The increase of the fly ash production will generate further 2.22 million rupees per year. Anyway this revenue is expected to be enhanced after the introduction of new price strategies for the bidders by competitive basis.

The introduction of new process has some challenges to overcome specially the incombustible contents in the bottom ash specially the SiO_2. The percentage increase of the SiO_2 in the fuel is discussed and this will result in decrease of boiler efficiency in the degree of 0.01% which is negligible according to the Harbin boiler manufacturer. Finally a supplier was found who manufactures such systems which have a compatibility with vast range of boiler manufacturers' including Harbin and feasibility study has been done accordingly which gives a result of 20.6% IRR for 240.1 million rupees of investment during a 30 year period.

Key words: Submerged scrapper conveyer, Recovery, Boiler efficiency, Bottom ash, Fly ash, Coal, Re-burning

Acknowledgement

An interesting postgraduate research title like “Options for re-burning bottom ash at Lakvijaya power Station” would not be a reality if it had not been a thorough investigation of environment impact of the burned ash and the interest to come up with a practical solution. Hence the research title was planted accordingly and my heartiest thanks should go the following all the people who have been mentioned below unless plead for the forgiveness.

First of all I would like to express my sincere gratitude to Prof H.Y.R Perera, of the Department of Electrical Engineering for his guidance, support and encouragement given throughout the time. I must thankful to him for giving me the permission to proceed with one of my own idea related to my working environment Lakvijaya power station. After doing a literature survey and suitability of this sort of project to the Lakvijaya power plant he gave me the title “Options for re-burning bottom ash at Lakvijaya power station” with the green flag.

Again my heartiest thankfulness should go to Prof H.Y.R Perera in the Electrical department, who was my Project Supervisor. If not his guidance I would not have chosen a project like this and would not go for a success like this. He was always there to guide me and encourage me throughout the time. His experience and knowledge on supervising such an interesting topic related to the energy conservation which was his expertise was the light for me when I got lost in between the practical circumstances. Sometimes I felt that he has also taken a part of my project and carried me through each and every critical time period of the discussion.

One who I can never forget is the Mr. Vincenzo Quattrucci who gave me detail knowledge of their bottom ash recycling process and how the system can be adopted to the Lakvijaya Power Station. Further he kept me in line with their systems used throughout the world and enhanced my belief regarding such a process by giving me examples which can be introduced to the Lakvijaya power station.

Also my appreciation goes out to all the members of my staff who supported me in various ways in accomplishing several phases of my project.

My special thanks go to Mr. Buddika who is the chemist in Lakvijaya Power Station for giving me immense support to do the laboratory tests in finding the compositions of the samples. His knowledge in the chemical environment was strength for me to hold on to the outcome.

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A – Ash

ASTM –American Society of Testing and Material

BA – Bottom Ash

BMCR – Boiler Maximum Continuous Rating

CEB – Ceylon Electricity Board

CMEC – China Machinery Engineering Corporation

DCS – Distributed Control System

ESP – Electro Static Precipitator

FC – fixed Carbon

FT –Fluid Temperature

HEC – High Efficiency Concentrator

HEC – Harbin Electric machinery Company

HHV – High Heating Value

HPCC – Henan No 1 Thermal Power Construction Company

HT – Hemispherical Temperature

IDT - Initial deformation Temperature

ITI – Industrial Technology Institute

IRR – Internal Rate of Return

LHV – Low Heating Value

LOI – Loss of Ignition

MGEA – Minimum Guaranteed Energy Amount

MT – Metric Ton

PAC - Poly Aluminum Chloride

PE – Poly Electrolyte

SCC – Submerged Scrapper Conveyer

ST – Softening Temperature

VM – Volatile Matter