EVALUATION OF POTENTIAL WASTE HEAT RECOVERY OPPORTUNITIES FROM THE BOILER CONTINUOUS BLOWDOWN SYSTEM IN LAKVIJAYA POWER STATION

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Degree of Master of Engineering

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DECLARATION

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Prof. R.A Attalage

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Dr. J.G.A.S. Jayasekara

ABSTRACT

An evaluation of potential waste heat recovery opportunities from boiler continuous blowdown system in Lakvijaya coal power station was carried out to assess the waste heat availability, recovery methods and introduced a mathematical model for energy extraction per unit capital cost for the proposed energy recovery system. Calculated total waste heat availability from all three boilers in the power station varies from 3,950 kW to 11,851 kW, when boiler continues blowdown rate changes from 10,250 kg/h to 30,750 kg/h. Two possible opportunities to recover waste heat have been identified. They are considered for working as a heating fluid for heat exchanger to heat up condensate water and the other as a heat source for vapour absorption chiller for partially or fully replace currently use electrically driven vapour compression air conditioning chillers having total cooling capacity of 2,500 kW. Proposed new layout for boiler blowdown system with new components include a heat exchanger and an absorption chiller. The consequently analysed energy system is in terms of energy extraction and energy extraction per unit capital cost by varying heat exchanger outlet waste heat fluid temperature and boiler continues blowdown rate. A regression model was developed to heat exchanger capital cost by using Minitab statistical software and required cost data to build a model was taken from CAPCOST ver2 software. From the results it is observed that energy extraction per unit capital cost is optimum at heat exchanger outlet temperature in between 120 ^{0}C to 95 ^{0}C, where affect from absorption chiller was insignificant and result was similar in both single stage and two stage chiller machines. Two regression models were developed for energy extraction for unit capital cost with four variables and R-sq values were 86.66% and 76.86% for two stage chiller and single stage chiller system respectively. This model can be used to find optimal points in similar applications.

Key Words: boiler waste heat recovery, continuous blowdown, condensate water preheating, vapour absorption chiller, capital cost estimation, energy extraction per unit capital cost, mathematical modelling, thermodynamic analysis, sensitivity analysis.

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LIST OF ABBREVIATIONS

BMCR	Boiler Maximum Continues Rating
CBD	Continues Blowdown
CEB	Ceylon Electricity Board
COP	Coefficient of Performance
ETS	Emergency Trip System
FDF	Forced Draft Fan
HP	High Pressure
IBD	Intermittent Blowdown
IDF	Induced Draft Fan
IP	Intermediate Pressure
LP	Low Pressure
LVPS	Lakvijaya Power Station
PAF	Primary Air Fan
PVC	Pressure Variable Control
TDS	Total Dissolved Solids
TSI	Turbine Supervisory Instrumentation
UK	United Kingdom
USA	United States of America