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Scope of Improving Energy Utilization in Coal Based Co-Generation on Thermal Power Plant -Review

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ABSTRACT: *Effective energy utilization and its management for minimizing irreversibility has made human to look for efficient energy consumption & conversion. Based on several research activity and local power plant experience some key observation has made and is presented in this paper The aim of this paper is to be find out amount and source of irreversibility's generated in boiler of 35 TPH boiler in 6 MW captive power plant so that any process in the system that having largest energy destruction can be identified that help designer to re design the system components.*

Keyword: *First law of thermodynamic, Second law of thermodynamic, Irreversibility.*

I. Introduction

Energy consumption is the most important problem in the today's era. In the present scenario per capita energy consumption determines the level of development of the nation. With the increased awareness that the world's energy resources are limited has caused many countries to reassess their energy policies and take measures for eliminating the waste. It has also ignited the interest in the scientists and researchers to take a close look at the energy conversion devices and to develop new techniques for better utilization of the available resources.

The First Law deals with the amounts of energy of various forms transferred between the system and its surroundings and with the changes in the energy stored in the system. It treats work and heat interactions as equivalent forms of energy in transit and offers no indication about the possibility of a spontaneous process proceeding in a certain direction. The first law places no restriction on the direction of a process, but satisfying the first law does not ensure that the process can actually occur. This inadequacy of the first law to identify whether a process can take place is remedied by introducing another general principle, the second law of thermodynamics

The exergy method of analysis is based on the Second law of thermodynamics and the concept of irreversible production of entropy. The fundamentals of the exergy method were laid down by Carnot in 1824 and Clausius in 1865. The energy-related engineering systems are designed and their performance is evaluated primarily by using the energy balance deduced from the First law of thermodynamics. Engineers and scientists have been traditionally applying the First law of thermodynamics to calculate the enthalpy balances for more than a century to quantify the loss of efficiency in a process due to the loss of energy. The exergy concept has gained considerable interest in the thermodynamic analysis of thermal processes and plant systems since it has been seen that the First law analysis has been insufficient from an energy performance stand point. Keeping in view the facts stated above, it can be expected that performing an analysis based on the same definition of performance criteria will be meaningful for performance comparisons, assessments and improvement for thermal power plants. Additionally, considering both the energetic and exergetic performance criteria together can guide the ways of efficient and effective usage of fuel resources by taking into account the quality and quantity of the energy used in the generation of electric power in thermal power plants. The purpose of this study presented here is to carry out energetic and exergetic performance analyses, at the design conditions, for the existing coal and gas-fired thermal power plants in order to identify the needed improvement. For performing this aim, we summarized thermodynamic models for the considered power plants on the basis of mass, energy and exergy balance equations. The thermodynamic model simulation results are compared. In the direction of the comprehensive analysis results, the requirements for performance improvement are evaluated.

II. Energy and EXERGY Analysis Of Coal Fired Cogeneration Power Plant With Condensate Extraction Turbine

In general coal based thermal plant works on Rankin cycle. Several advancement has made in recent thermal power plant to increase the energy output per unite mass of fuel burnt like reheating, regeneration etc. The design of any power plant is based on location, avaibility of fuel and it effectiveness. Since thermal power plant works on fossile fuel, it has made great interest to research to look for more efficient utilization of this fuel due to it's stock limitation under earth. Which results into no. of analysis based on energy losses and irreversibility, various attempts where made to over come this loss as and hence reheat cycle, regenerative cycle are the some fruitful outcome that came out for improvement.

2.1. Description of Coal fired power plant:

Several observed processes are considered for the analysis of a cumulative coal fixed thermal like lowering condenser pressure, superheating the to high temperatures, increasing the boiler pressure, reheat regenerative Rankin cycle is used.

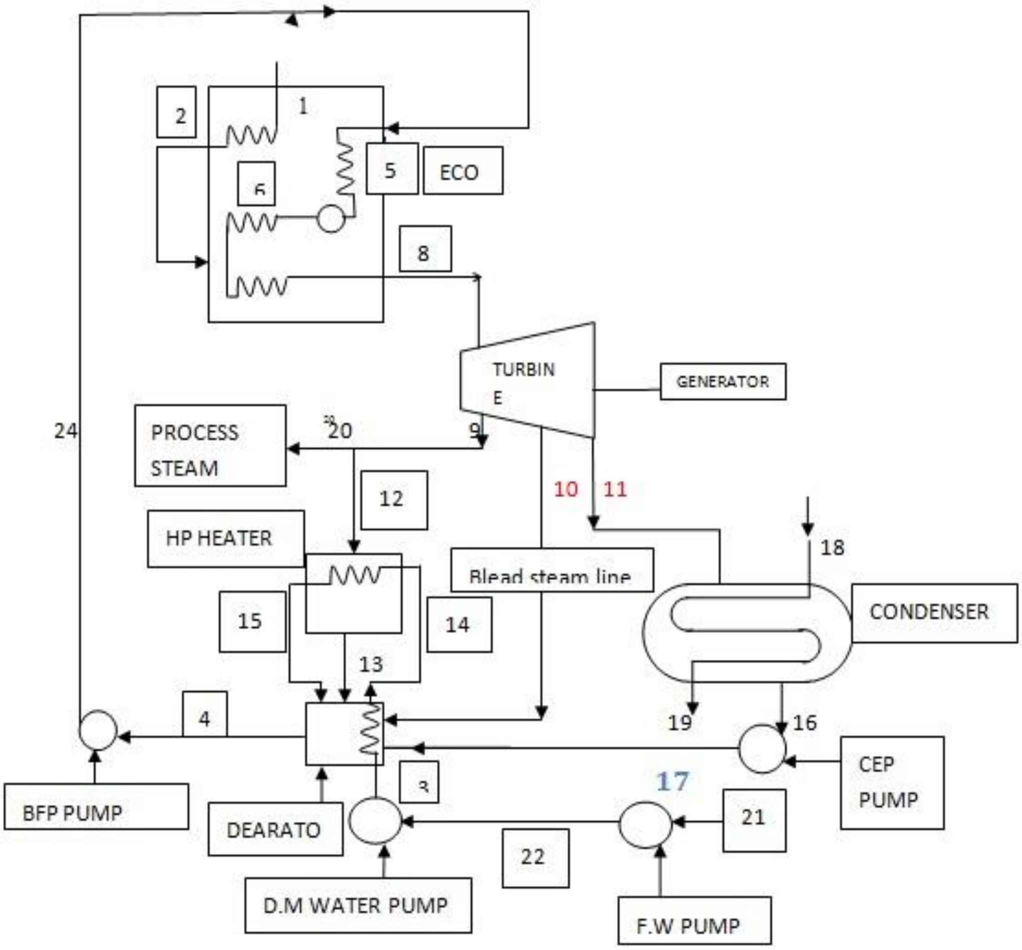

Fig. 1. Flow diagram of cogeneration thermal power plant with condensate extraction turbine

Fig.1 describes the detail part of cogeneration coal based with condensate extraction turbine consists of Boiler (B), Condensate extraction turbine with there stages (T) Pump (P), Decretory (D), a generator (S) , condense (c) high pressure feed water heater (HPH). The thermodynamic models of power plant are based on fundamental mass and energy balances. Using the energy and mass balance equation for each component in the power plant model, it is possible to compute energy and energy contents in terms of turbine power outputs, pump power consumptions boiler heat requirements, energy and exergy flows at each node of the plants, component first and second low efficiencies, component irreversibility in the plant etc.

2.2. Energy Analysis

In an open flow system there are three types of energy transfer across the control surface like work transfer, heat transfer, and energy associated with mass transfer and / or flow. The first law of thermodynamics or energy balance for the steady flow process of an open system is given by

$$\sum Q_k + m\left(hi + \frac{ci^2}{2} + g.z_i\right) = m\left(ho + \frac{co^2}{2} + g.z_o\right) + w$$

$$ή = \frac{desired\ output\ energy}{input\ energy\ supplied}$$

The energy balance for boiler and its component

2.2.1. Energy balance for combustion of boiler

The energy balance for boiler form energy equation can be given as,

$0 = Q_k - m_w(h_8 - h_{24}) - \text{energy loss} - m_a(h_2 - h_1)$

Where m_w is mass flow rate of water , m_a is a mass flow rate of air

Energy loss = $Q_K - m_w(h_8 - h_{24}) - m_a(h_2 - h_1)$Type equation here.

The first law efficiency is given by

$$ή= \frac{desired\ output\ energy}{input\ energy\ supplied}$$

$$= \frac{\text{Energy input – Energy loss}}{\text{Energy input}}$$

=1-(enegy loss)/(energy input)

$$= 1- \frac{Q_k - m_k(h_8-h_{24}) - m_a(h_2-h_1)}{Q_k - m_a(((h_2-h_1)}$$

$ή= (m_w\ (h_8 - h_{24}))/(Q_k - m_a((h_2 - h_1))$ this is efficiency of boiler

since air is heated in a preheated in boiler which would otherwise would have absorb the heat from boiler

2.2.2.Eenergy balance for turbine

From energy balance equation,

$W_T = m_8(h_8 - h_9) + (m_8 - m_9)(h_9 - h_{10}) + (m_8 - m_9 - m_{10})(h_{10} - h_{11})$-energy loss

Energy loss= $ή = 1 - \frac{energy\ loss}{energy\ input}$

$$=1- \frac{m_8(h_8-h_9)+(m_8-m_9)(h_9-h_{10})+(m_8-m_9-m_{10})(h_{10}-h_{11})-WT}{m_8(h_8-h_9)+(m_8-m_9)(h_9-h_{10})+(m_8-m_9-m_{10})(h_{10}-h_{11})}$$

$$= \frac{WT}{m_8(h_8-h_9)+(m_8-m_9)(h_9-h_{10})+(m_8-m_9-m_{10})(h_{10}-h_{11})}$$

2.2.3. Energy balance for condenser

From energy balance equations,

$0=m_{11}(h_{11}-h_{16})- Q_k-$ energy loss

$0= m_{11}(h_{11}-h_{16})- mcw(h_{19}-h_{18})$- energy loss

Energy loss= $m_{11}(h_{11}-h_{16})- mcw(h_{19}-h_{18})$

Efficiency of condenser is given by

$$ή= 1 - \frac{energy\ loss}{energy\ input}$$

$$=1 - \frac{m_{11}(h_{11}-h_{16}) - mcw(h_{19}-h_{18})}{m_{11}(h_{11}-h_{16})}$$

$$= \frac{mcw(h_{19}-h_{18})}{m_{11}(h_{11}-h_{16})}$$

2.2.4.Pump system

(a) Condensate extraction pump ie CEP pump

$W_{cp}=m_{16}(h_{17}-h_{16})$-Energy loss

Energy loss=$W_{cp}+ m_{16}(h_{17}-h_{16})$

$$ή =1 - \frac{energy\ loss}{energy\ input}$$

$$=1-\frac{Wcp+m_{16}(h_{17}-h_{16})}{wcp}$$

$$\eta_{condenser}=\frac{m_{16}(h_{17}-h_{16})}{wcp}$$

(b) Efficiency of DM water pump

Energy loss $=m_{21}(h_{22}-h_{21})+Wfw_p$

$$ή=\frac{m_{21}(h_{22}-h_{21})}{Wfwp}$$

(c)Boiler feed pump

Energy loss $=m_4(h_{24}-h_4)+Wb_pf$

$$ή=\frac{m_4(h_{24}-h_4)+_{16})}{Wb_pf}$$

2.2.5. Energy flow equation for high pressure feed water heater

From fig and steady state energy equation is given by

$0=m_{12}(h_{12}-h_{13})-m_{14}(h_{15}-h_{14})$-energy loss

$$ή\ hph=1-\frac{energy\ loss}{energy\ input}$$

$$=1-\frac{m_{12}(h_{12}-h_{13})-m_{14}(h_{15}-h_{14})}{m_{12}(h_{12}-h_{13})}$$

$$=\frac{m_{14}(h_{15}-h_{14})}{m_{12}(h_{12}-h_{13})}$$

2.2.6. Dearetor sub system

It is well insulated system consider adiabatic one to which hot steam 13 ton from h.p heater and hot feed water from 15 enter into mix together forming mixture as well as D.M is heated from atmospheric condition to some higher level and left to dearator ,the energy supplied is sum of energies of hot steam and water and losing energy to cold water

The energy flow equation for dearetor is given by

$0=m_{13}.h_{13}+m_{15}h_{15}-m_3(h_{13}-h_3)+m_{10}.h_{10}+m_{17}.h_{17}.-m_4.h_4-h_{20}.m_{20}$-energy loss

Energy loss= $m_{13}.h_{13}+m_{15}h_{15}-m_3(h_{13}-h_3)+m_{10}.h_{10}+m_{17}h_{17}..-m_4.h_4-h_{20}.m_{20}$

But $m_3=m_{14}=m_{15}$

$$ή=1-\frac{m_{13}.h_{13}+m_{15}h_{15}-m_3(h_{13}-h_3)+m_{10}.h_{10}+m_{17}.-m_4.h_4-h_{20}.m_{20}}{m_{13}.h_{13}+m_{15}h_{15}-m_3(h_{13}-h_3)+m_{10}.h_{10}+m_{17}h_{17}}$$

$$ή=\frac{m_{15}\ (h_{13}-h_3)+m\ _4.h_4+h_{20}.m_{20}}{m_{13}.h_{13}+m_{15}h_{15}+m_{10}.h_{10}+m_{17}h_{17}}$$

above is the efficiency of dearator

2.2.7. Energy balance for process steam application

The steam supplied to the process is consider as a lost steam from cycle even though it is utilized for some application providing money

Energy utilized in the process $=m_{20}.h_{20}$

Scop energy analysis for particular application not consider in this article.

2.3. Exergy Analysis of Condensate Extraction turbine

Exergy is a generic term for a group of concepts that define the maximum possible work potential of a system, a stream of matter and/or heat interaction, the state of the (conceptual) 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 and/or flow. The work transfer is equivalent to the maximum work which can be obtained from that form of energy. The exergy of heat transfer Q from the control surface at temperature T is determined from maximum rate of conversion of thermal energy to work Wmax is given by. kinetic, potential and physical exergy. The kinetic and potential energy are almost equivalent to exergy. The physical specific exergy and depends on initial state of matter and environmental state. Energy analysis is based on the first law of thermodynamics, which is related to 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. Exergy analysis is useful method, to complement but not to replace energy analysis. The exergy flow for steady flow process of an open system is given by.

$$Wmax=\Psi\varrho=\varrho(1-\frac{To}{T})$$

$$\sum(1-\frac{To}{Tk})+\sum \left[m\Psi i = \Psi w + \Sigma m\Psi o + I_{destroyed}\right.$$

Where

$$\Psi=m^{o}[h^{\circ}\_ho^{\circ}]\_To(s-so)$$

And

$$h^{\circ}=h+\frac{c^2}{2}+gZ$$

Where ψ_i and ψ_o are exergy associated will mass inflow and outflows are respectively, is useful work done on/by system I destroyed is irreversibility of process and h^0 is the enthalpy as summation of enthalpy, KE and PE. The other notations C is the bulk velocity of the working fluid, Z is the altitude of the Steam above the sea level, g is the specific gravitational force. The irreversibility may be due to various losses occurring like to overcome Friction may be surface and steam or between adjacent layers of steam.Exergy analysis is an effective means to pinpoint losses due to irreversibility in a real situation.The second law efficiency is defined as

$$\acute{\eta}=\frac{actual\ thermal\ efficience}{maximu\ m\ possible\ reversible\ thermal}$$

$$=\frac{exergy\ output}{exergy\ input}$$

To analyze the possible realistic performance, a detailed exergy analysis of coal fired cogeneration thermal power plant with condensate extraction turbine has between carried out by ignoring the KE & PE change. For steady State flow the exeran balance for a thermal system is given below.

$$\Psi\omega=\sum_{k=1}^{n}\left(1-\frac{To}{Tk}\right)Q_k+\sum \left[m\Psi i - m\Psi o\right]k - Togen\right]$$

$\Psi\omega$=exergy summation supplied through heat transfer

$\Sigma \left(1-\frac{To}{Tk}\right)Q_k$= exergy summation supplied through heat transfer

$m\Psi i - m\Psi o$= change in exergy summation of working fluid

Where,

Q=heat transfer
M=mass flow rate
Ψ=exergy flow rate per unit mass
Sgen=entropy generation rate
T_0=ambient temp
T_k=temp of source

Component wise exergy balance of the coal fire co generating thermal power plant with condensate extraction turbine

2.3.1. Exergy balance for boiler combustion the exergy balance for the combustion

Exergy balance equation for combustion can be written as,

$$0=\sum_{k=1}^{n}(m\Psi_{)}f+\dot{a}-m\Psi p)-ToSgen$$

m_f = sum of mass of coal
m_g=mass of product after combustion which give

$$(m\Psi)_{(f+a)} - (m\Psi p) = ToSgen$$

second law efficiency is given by

$$ή = \frac{exergy\ output}{exergy\ input}$$

$$= 1 - \frac{exergy\ loss}{exergy\ input}$$

$$= 1 - \frac{T0.Sgen}{(m\Psi)f+a} = \frac{(m\Psi)p}{m\Psi)f+a}$$

2.3.2. Exergy balance for high pressure turbine is given by

For high pressure turbine form fig ure and steady state ewqaution,

$0=m_8(\psi_8-\psi_9)+(m_8-m_9)(\psi_9-\psi_{10})+(m_8-m_9-m_{10})(\psi_{10}-\psi_{11})-T_0.Sgen$

$T_0.Sgen= m_8(\psi_8-\psi_9)+(m_8-m_9)(\psi_9-\psi_{10})+(m_8-m_9-m_{10})(\psi_{10}-\psi_{11})-W_T$

And entropy generation rate is

$Sgen= m_8(s_8-s_9)+(m_8-m_9)(s_9-s_{10})+(m_8-m_9-m_{10})(s_{10}-s_{11})$

Iirreversibility=exergy loss
$I_{destroyed} = T_0.Sgen=T_0(m_8(s_8-s_9)+(m_8-m_9)(s_9-s_{10})+(m_8-m_9-m_{10})(s_{10}-s_{11})$

The second law efficiency is given by

$$ή=1 - \frac{I_{destroyed}}{exergy\ input}$$

$$=1- \frac{T0.Sgen}{T_0.Sgen+W_T}$$

$$=1- \frac{m_8(\psi_8-\psi_9)-(m_8-m_9)(\psi_9-\psi_{10})+(m_8-m_9-m_{10})(\psi_{10}-\psi_{11})-W_T}{m_8(\psi_8-\psi_9)-(m_8-m_9)(\psi_9-\psi_{10})+(m_8-m_9-m_{10})(\psi_{10}-\psi_{11})-T_0.Sgen+T_0.Sgen}$$

$$= \frac{WT}{m_8(s_8-s_9)+(m_8-m_9)(s_9-s_{10})+(m_8-m_9-m_{10})(s_{10}-s_{11})}$$

2.3.3. Exergy balance for condenser is given by

From fig and steady flow energy equation,

$0=m_{11}(\psi_{11}-\psi_{16})-m_{cw}(\psi_{19}-\psi_{18})-T_0.Sgen$

$T_0.Sgen= m_{11}(\psi_{11}-\psi_{16})-mcw(\psi_{19}-\psi_{18})$

Also,

Irreversibility=exergy loss

$I_{destroyed}= T_0.Sgen$

$$ή =1 - \frac{I_{destroyed}}{exergy\ input}$$

$$=1- \frac{T0.Sgen}{m_{11}(\psi_{11}-\psi_{16})}$$

$$=1-(m_{11}(\psi_{11}-\psi_{16})-mc_w(\psi_{19}-\psi_{18}))/(m_{11}(\psi_{11}-\psi_{16}))$$

$$ή_{condenser} = \frac{mc_W(\psi_{19}-\psi_{18})}{m_{11}(\psi_{11}-\psi_{16})}$$

2.3.4. Pump system

(a)Condenser pump

$$-Wc_p = m_{16}((\psi_{17} - \psi_{16}) - T_0 . Sgen)$$

:.

$$I_{destroyed} = T_0 . Sgen$$
$$= m_{16}((\psi_{17} - \psi_{16}) + Wcp$$

$$ή = 1 - \frac{m_{16}((\psi_{17} - \psi_{16}) + Wcp}{Wc_p}$$

$$= \frac{m_{16}((\psi_{17} - \psi_{16})}{Wc_p}$$

(b)DM water feed pump

$$I_{destroyed} = T_0 . Sgen = m_{21}(\psi_{22} - \psi_{21}) + Wcp$$

$$ή = \frac{m_{21}(\psi_{22} - \psi_{21})}{Wc_p}$$

(c)Boiler feed pump

$$T_0 . Sgen = m_4(\psi_{24} - \psi_4) + Wbfp$$

$$ή = \frac{m_4(\psi_{24} - \psi_4)}{Wbfp}$$

2.3.5. Exergy flow equation for high pressure feed water heater

Exrgy equation for high pressure feed water can be given as,

$$0 = m_{12}(\psi_{12} - \psi_{12}) - m_{14}(\psi_{15} - \psi_{14}) - T_0 . Sgen$$

$$I_{destroyed} = T_0 . Sgen = m_{12}(\psi_{12} - \psi_{12}) - m_{14}(\psi_{15} - \psi_{14})$$

$$ή_{hph} = 1 - \frac{I_{destroyed}}{exergy\ input}$$

$$= \frac{m_{14}(\psi_{15} - \psi_{14})}{m_{12}(\psi_{12} - \psi_{12})}$$

2.3.6. Dearetor sub system

The exergy equation from fig can be given as

$$ή = 1 - \frac{I_{destroyed}}{exergy\ input}$$

$$= \frac{m_{13}(\psi_{13} - \psi_3) + m_4\psi_4 + m_{20}.\psi_{20}}{m_{13}\psi_{13} + m_{13}\psi_{13} + m_{20}\psi_{20} + m_{17}\psi_{17}}$$

III. Discussion On Results Of Different EXERGY - Energy Study Of Co-Generation Power Plant

S. C. Kamate et.al. investigated cogeneration power plant in sugar industries for exergy analysis, with back pressure turbine the exergy and energy efficiency is found better over condensate extraction turbine plant with boiler as least efficient component and turbine is the most efficient component of the plant. Kotas [2] has been explained in this work the concept of exergy used to define criteria of performance of thermal plant. [3] Yongping yan studied comprehensive base analysis state of art USE CP plant the boiler has a largest energy destruction . [4] P Regulagada el al studied energy analysis of thermal power plant with measured boiler and turbine losses in 32 MW coal fired boiler he determine power plant energy efficiency 30.21 %for gross generation output as well as exergy efficiency is 25.38 % for gross generator output, the max energy destruction is found to be in the boiler .Ganapathy ***el al.*** [5] studied with an exergy analysis performed on an operating 50 MWe unit of lignite fired steam power plant at Thermal Power Station-I, Ncyveli Lignite Corporation Limited, Neyveli. Tamil Nadu, India. The distribution of the exergy losses in several plant components during the real time plant running conditions has been assessed to locate the process irreversibility. The comparison between the energy losses and the exergy losses of the individual components of the plant shows that the maximum energy losses of 39% occur in the condenser, whereas the maximum exergy losses of 42.73% occur in the combustor.[6] selcuk atas studied comparative energetic and exergetic performance analysis for coal fired nine thermal power plant performance under control govt of turkey he use low quality of coal and boiler was conventional reheat . Kamate and Gangavati [7] studied exergy analysis of a heat-matched bagasse -based cogeneration plant of a typical 2500 tpd sugar factory, using backpressure and extraction condensing steam turbine is presented. In the analysis, exergy methods in addition to the more conventional energy anal) ses are employed to evaluate overall and component efficiencies and to identify and assess the thermodynamic losses. Boiler is the least efficient component and turbine is the most efficient component of the plant. The results show that, at optimal steam inlet conditions of 61 bar and 475 C. the backpressure steam turbine cogeneration plant perform with energy and exergy efficiency of 0.863 and 0.307 and condensing steam turbine plant perform with energy and exergy efficiency of 0.682 and 0.260.Arif hepbasli [8]thermodynamic analysis of a building using exergy analysis method heated by convection boiler in a heating centre ,a convectional boiler in a heating centre and fan coil unit are consider in this analysis tatal exergy input rate is to be 694.5kw while largest exergy loss rate is obtained to be 333kw .exergetic effiency of convectional boiler and fan coil unit are also found to be 13.4% and 37.6%.for future work exergetic analysis is preferred for both the exergetic and economical analysis. as per his experiment installation of well insulated building material support low exergy heating system.

Datta etal [9] was presented work on exergy analysis of a coal-based thermal power plant is done using the design data from a 210 MW thermal power plant under operation in India. The exergy efficiency is calculated using the operating data from the plant at different conditions, viz. at different loads, different condenser pressures, with and without regenerative heaters and with different settings of the turbine governing. The load variation is studied with the data at 100. 75. 60 and 40% of full load. Effects of two different condenser pressures, ***i.e.*** 76 and 89 mmllg (abs.). are studied. It is observed that the major source of irreversibility in the power cycle is the boiler, which contributes to exergy destruction of the order of 60%. Part load operation increases the irreversibility in the cycle and the effect is more pronounced with the reduction of the load. Increase in the condenser back pressure decreases the exergy efficiency. Successive withdrawal of the high pressure heaters shows a gradual increment in the exergy efficiency for the control volume excluding the boiler.M.K Gupta [10] the energy and exergy analysis has been carried out of conceptually proposed direct steam generation solar thermal power plant having only one feed heater the exergy loss are found in condenser followed by collector field ,it shows that main source of energy destruction that was found in collector field,the results of exergy analysis of direct steam generation point out that collector and receiver required improvement for reduced exergy loss the material of collector plays an important role and reduced exergy loss in the receiver inlet temp should be optimum he maximum efficiencies equal to 16.13% be achieved by using two feed water heater without dry pump, it is found that if we use three water heater maximum efficiencies improves was 16.60 and for higher efficiency three feed water heater is use , Aljundi [11] was presented in this study, the energy and exergy analysis of Al-Hus-sein power plant in Jordan is presented. The primary objectives of this paper are to analyze the system components separately and to identify and quantify the sites having largest energy and exergy losses. In addition, the effect of varying the reference environment state on this analysis will also be presented. Energy losses mainly occurred in the condenser where 134 MW is lost to the environment while only 13 MW was lost from the boiler system. The percentage ratio of the exergy destruction to the total exergy destruction was found to be maximum in the boiler system (77%) followed by the turbine (13%), and then the forced draft fan condenser (9%). In addition, the calculated thermal efficiency based on the lower heating value of fuel was 26% while the exergy efficiency of the power cycle was 25%. For a moderate change in the reference environment state temperature, no drastic change was noticed in the performance of major components. Anit patel [12] the energy and exergy analysis of boiler plant Indian coal as fuel ,it seems that energy analysis found all inefficiency to losse is 23.46% ,the first law efficiency of the boiler is 76.64% and second law efficiency is 37% there is large amount of energy degradation ,this degradation of energy reduce exergy of second law efficiency and increase entropy generation, so stack loss are very less it is found major loss are in boiler so increase the efficiency of boiler by 1% for that reduced the temp of flue gas by 22 degree so preheat combustion of a air with a waste heat improvement oxygen control .R Saidur[13] in this paper the useful concept of energy and exergy utilization is analyzed and applied to the boiler system in this paper he was calculate the energy and exergy efficiency 72.46%and 24.89%,according to his concept major contributor of energy destruction is combustors. Dai ***el al.*** [14] was done exergy analysis for each cogeneration system is examined, and a parameter optimization for each cogeneration system is achieved by means of genetic algorithm to reach the maximum exergy efficiency. The cement production is an energy intensive industry with energy typically accounting for 50-60% of the production costs. In order to recover waste heat from the preheated exhaust and clinker cooler exhaust gases in cement plant, single Hash steam cycle, dual-pressure steam cycle, organic Rankine cycle (ORC) and the Kalina cycle are used for cogeneration in cement plant. The optimum performances for different cogeneration systems are compared under the same condition. The results show that the exergy losses in turbine, condenser, and heat recovery vapor generator are relatively large. R jyothu naik et [15]al studied exergy analysis of 120MW of coal base thermal power plant, in this paper he investigate exergy value at all location ,it observed that exergetic efficiency of overall plant is 39.75% and over all thermal effiency is 37% ,now difference of 2.75%is destruction of available energy observed. the exergy analysis of boiler ,turbine is calculated and losses in exergy is calculate ,it can be seem that maximum energy destruction is found in boiler with the value of 89.37% of total exergy destruction. the Rosen [16] reported results were of energy- and exergy-based comparisons of coal-fired and nuclear electrical generating stations. A version of a process-simulation computer code, previously enhanced by the author for exergy analysis, is used. Overall energy and exergy efficiencies, respectively, are 37% and 36% for the coal-fired process, and 30% and 30% for the nuclear process. The losses in both plants exhibit many common characteristics. Energy losses associated with emissions '(mainly with spent cooling water) account for all of the energy losses, while emission-related exergy losses account for approximately 10% of the exergy losses. The remaining exergy losses are associated with internal consumptions. M.k Pal [17] st udied exergy and energy analysis of a coal fired thetmal power plant he calculate the exergy and energy loss. In this paper energy and exergy analysis of reheat and regeration rankine cycle is being carried out ,the energy analysis is done with the help of first law effiency and exergy analysis is done with second law effiency the exergy loss or irreversibilities are maximum at the boiler i.e 61% of total input while maximum exergy loss in low pressure turbine .Dincer and Rosen [18] present effects on the results of energy and exergy analyses of variations in dead-state properties, and involves two main tasks: 1) examination of the sensitivities of energy and exergy values to the choice of the dead-state properties and 2) analysis of the sensitivities of the results of energy and exergy analyses of complex systems to the choice of dead-state properties. A case study of a coal-fired electrical generating station is considered to illustrate the actual influences. The results indicate that the sensitivities of energy and exergy values and the results of energy and exergy analyses to reasonable variations in dead-state properties are sufficiently small. Alpesh mehata el al[19] studied in thermodynamic analysis of gandhinagar thermal power station of 210 MW in this paper seem that boiler efficiency is highest 86.84% and heat losses are only 13.16% out of all boiler losses maximum heat loss occur in the 5.29% in flue gas .Turbine efficiency is very low that is 43.59% and power plant overall efficiency is 37.01%.the effectiveness of HP heater is working good condition 0.85. Erdem ***el al.*** [20] analyzes comparatively the performance of nine thermal power plants under control governmental bodies in Turkey, from energetic and exergetic viewpoint. The considered power plants are mostly conventional reheat steam power plant fed by low quality coal. Firstly, thermodynamic models of the plants are developed based on first and second law of thermodynamics. Secondly, some energetic simulation results of the developed models are compared with the design values of the power plants in order to demonstrate the reliability. Thirdly, design point performance analyses based on energetic and exergetic performance criteria such as thermal efficiency, exergy efficiency, exergy loss, exergetic performance coefficient are performed for all considered plants in order to make comprehensive evaluations, Amir vosough el al [21]improvement of power plant effiency with varying condenser pressure ,the analysis shows that condenser pressure is valuable parameter for power putout.the maximum energy loss found to in condenser where as 60.86 %of input energy was lost to the environment the major loss was found in the boiler is 86.21%of the fuel exergy input to the cycle was destroyed.the percent exergy destruction in the condenser and other components was 13.22%,The calculated thermal and exergy effiency of the ower cycle was found to be 38.89% ,45.85%.

Isam H Aljundi [22] studied energy and exergy analysis of steam power plant in jordan the primary objective of this paper was analysise the system component separately and identify the exergy losses .according to him mainly energy losses are found in condenser where 134MW is lost to the environment while In boiler 13 mw energy lost ,the percentage ratio of exergy destruction to the total exergy destruction was found to be maximum in the boiler system 77%followed by turbine 13% and force draft fan in the condenser 9% the main conclusion of this paper boiler is major source of irreversibility in the boiler . Vidal ***el al.*** [23] analysis exergy method was applied in order to evaluate the new combined cycle proposed by Goswami. using Ilasan-Goswami-Vijayaraghavan parameters. This new combined cycle was proposed to produce both power and cooling simultaneously with only one heat source and using ammonia-water mixture as the working fluid. At the irreversible process two cases were considered, changing the environmental temperature. However, in order to know the performance ol" the new cycle at different conditions of operation, the second irreversible case was analyzed varying the rectification temperatures, the isentropic efficiency of the turbine and the return temperature of the chilled water. Exergy effectiveness values of 53% and 51% were obtained for the irreversible cycles; with heat input requirements at temperatures of 125 and 150*C. Solar collectors or waste heat are suggested as heat sources to operate the cycle.

Arai ***el al.*** [24] presents an exergy analysis on combustion and energy conversion processes, which is based on the above-mentioned concept of exergy and energy supported by temperature level. When we discuss high temperature air combustion in furnace, this process shows a hig**her** performance than that of the ambient air combustion. beacause it will reduced the coal combustion and increase the effiency of the boiler.

3.2. Captive and Combined Cycle Thermal Power Plants

Khaliq and Kaushik [27| presented thermodynamic methodology for the performance evaluation of combustion gas turbine cogeneration system with reheat i.e steam at low stage of turbine again heated in the boiler with the help of reheater and then again use in the turbine inorder to reduced the moisture. The energetic and exergetic efficiencies have been defined. The effects of process steam pressure and pinch point temperature used in the design of heat recover) steam generator, and reheat on energetic and exergetic efficiencies have been investigated. The power to heat ratio and second-law efficiency increases significantly with increase in process steam pressure, but the first-law efficiency decreases with the same. Results also show that inclusion of reheat provides significant improvement in electrical power output, process heat production, fuel-utilization (energetic) efficiency and second-law (exergetic) efficiency.

3.3. Gas Turbine Based Thermal Power Plants

Khaliq and Kaushik [28] were presented theoretical second-law approach for the thermodynamic analysis of the reheat combined Brayton/ Rankine power cycle. Expressions involving the variables for specific power-output, thermal efficiency, exergy destruction in components of the combined cycle, second-law efficiency of each process of the gas-turbine cycle, and second law efficiency of the steam power cycle have been derived. It is found that the exergy destruction in the combustion chamber represents over 50% of the total exergy destruction in the overall cycle. The combined cycle efficiency and its power output were maximized at an intermediate pressure-ratio, and increased sharply up to two reheat-stages and more slowly thereafter. Chen and Tyagi [29] were presented parametric study of an irreversible cycle model of a regenerative-intercooled-reheat Brayton heat engine along with a detailed. The power output and the efficiency are optimized with respect to the cycle temperatures for a typical set of operating conditions. It is found that there arc optimal values of the turbine outlet temperature, inter cooling, reheat and cycle pressure ratios at which the cycle attains the maximum power output and efficiency. But the optimal values of these parameters corresponding to the maximum power output are different from those corresponding to the maximum efficiency for the same set of operating condition. Kaushik and Tyagi [30]

IV. Conclusion

Exergy analysis of cogeneration power plant. Proves useful tool for analyzing various losses occurring in different parts of power plant and possibility for improvement in it. Exergy analysis in different power concluded the maximum losses in boiler which we already tried to minimum by adopting different accessories. Further this plant can be improved by adopting methodology used in big thermal power plant irreversibility generally due to temp, loss to atm and heat lost to exhaust gas which is impossible to remove but can be minimized to optimum naw. The minimum exergy loss occur in turbine generally due to insulation it, which works life adiabatic section with minimum losses. Condensers are important part of condenser which is necessary to create the back pressure and increase the efficiency of power plant. This heat rejected by steam or hot water is the reused by circulating cold feed water to hot water which could other wire be rejected to atmosphere. The demand of power per day per hr. various with situation and the leads to fluctuation of load on to power plant. According to different wading condition the exergy and energy analysis can be the scope of study for optimizing the different values of parameter to act best Performa with varying. This also can be studied with change in operating parameter and then its effect on load which difficult to carry out practical but with aid of new computational it may be possible to work with some ready data calculation.

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