CHAPTER 4

Exergy Analysis of a Coal-Fired Open Cycle MHD Power Plant

4.1. Introduction

Modern-day economies have been largely dependent on the use of thermal systems in many day-to-day applications. These systems ought to be cost-effective and also very efficient in their operations. The effectiveness of any thermal system can be evaluated when it is investigated using suitable analyzing tools or methods. The selected tools or methods when applied can evaluate the performance of the thermal system. In general, the fact that no thermal system is fully efficient due to the presence of various losses often resulted in lower output from such systems.

It is thereby necessitated to undertake certain analyses in order to estimate the cause and location of these losses and consider suitable preventive measures to minimize the deficiencies. Analysis that is based on the first law of thermodynamics which is also called the energy analysis approach is not carried out alone due to its inability to rightly predict the correct scenario of energy utilization as has been mentioned in various literature on thermodynamics [1, 2]. On the other hand, the exergy analysis as reported in the literature is a better approach to finding the quality of energy by rightly pointing to the amount, causes, and location of losses within a system or in system components [3]. Besides the conventional exergy method of system analysis, there are also methods that use advanced processes for exergy analysis through the splitting of exergy destruction [4, 5] and thermo-economic analysis [2] which also takes into account the related cost. Contributions to understanding the basics of exergy and exergy analysis of thermal systems are elaborately described in the works given if Refs. [1-3]. Exergy or availability is the maximum theoretical work that can be extracted from an energy system when a system or its components are brought to equilibrium with its environment while considering only heat transfer as the mode of interaction with the environment. Exergy analysis measures both the physical and chemical components of exergy taking into account the restricted dead state and the dead state [2] and accordingly termed them as thermo-mechanical and chemical exergies. While considering exergy, the chemical exergy of elements and the effects of preheating is well illustrated in Refs. [6, 7]. In the study on the effects of the preheating of reactants taking part in a combustion reaction, it was found that the use of chemical energy was greatly reduced due to the preheating and it also improves the scope for increasing lean fuel in gaseous fuel mixture [6].

Apart from the existing conventional and non-conventional systems, a potential non-conventional system in the area of electrical power generation is the Magnetohydrodynamics or the MHD power generation system. In MHD electrical power generation system, the desired power is a result of the direct conversion of energy from fossil fuel combustion products or high-temperature noble gases or heated liquid metals when they pass through the generator of MHD. The first type where the flow of combustions products is used mainly operates in an open cycle whereas using the other two as working fluids the operation usually takes place in a closed cycle [8, 9].

The history of MHD power generation capability begins with the experiment of Faraday in 1832. In his experiment, Faraday demonstrated the possibility of electrical power extraction when fluid flows under the influence of the earth’s strong magnetic field [10]. From the study of Ref. [10] it is seen that in order to realize the power of MHD, there has been a long quest both theoretical as well as experimental development of MHD worldwide. The research interest in MHD power can also be attributed to the advantages that it would bring along. Advantages included a reduction in wear and tear because of the non-availability of moving energy conversion equipment, attainment of higher working temperature, a reduction in the environmental degradation when it is operated especially in a closed cycle [9].

Combined power generation systems having an MHD system as one of their parts were reported to deliver more performance in terms of enhanced efficiency when they were operated using syngas [11]. In analyzing MHD power generation systems, it was found that the use of supersonic type inlet in the MHD generator results in more power generation with the critical interaction parameters remaining passive at the exit of the MHD generator [12].

The different processes involved in the analysis of the MHD power system were also discussed in the study given in Ref. [13]. Moreover, the use of MHD power generation system along with other existing thermal power-producing systems was reported to have an improved overall power output and efficiency [14]. Setting the unit volume power output criterion, it was found that by keeping the gas speed to the MHD generator unchanged the efficiency of the MHD cycle can be improved under the condition of the highest power per unit volume [15]. Investigation of the performance and stability of MHD generator under the effect of ionized seed plasma considering varied seed fractions showed that using seed material in a completely ionized state but with a lower proportion improves MHD power output [16].

As seen from Ref. [12] the type of generator inlet also played an important role in the performance of the MHD power plant. In another study, it was found that the nozzle and the plant efficiencies were almost independent of either the area ratio or Mach number at the nozzle exit section. In the same study, it was also shown that the maximum voltage and maximum power density were increased with an increase in the nozzle exit section area ratio.

From the available literature, related to the development of MHD power generation technology, it was found that the primary focus of most of these investigations was on the improvement of the different aspects of MHD technology. As such, detailed exergy analysis of an open-cycle MHD power generation plant was never been attempted earlier. So, in this study, a coal-fired open cycle MHD power plant is investigated for evaluating its performance using the energy-exergy approach of thermodynamics.

4.2 Description of the MHD system

The MHD power generation system in the present study, consists of 8 different components and is shown in Fig. 4.1. The MHD system in Fig. 4.1 is an extended version of Fig. 3.1 with the inclusion of additional components for an overall study of exergetic performance of the MHD system. Compressed air (stream 2) is heated by the exhaust gases (stream 8) of the MHD generator in an air preheater, and the mixture of fuel (pulverized coal, stream 4) and air is fed to the combustion chamber of MHD. A small fraction of a seed material (potassium carbonate) is added to this mixture of fuel and air. The addition of seed material in a low fraction improves the electrical conductivity of gases at a lower temperature and reduces instability, besides improving the performance of MHD [16]. The combustion products are then accelerated to a high-velocity stream (stream 7) and enter the MHD generator to generate electrical power. The electrical energy is extracted through the electrodes that are in contact with the walls of the generator.

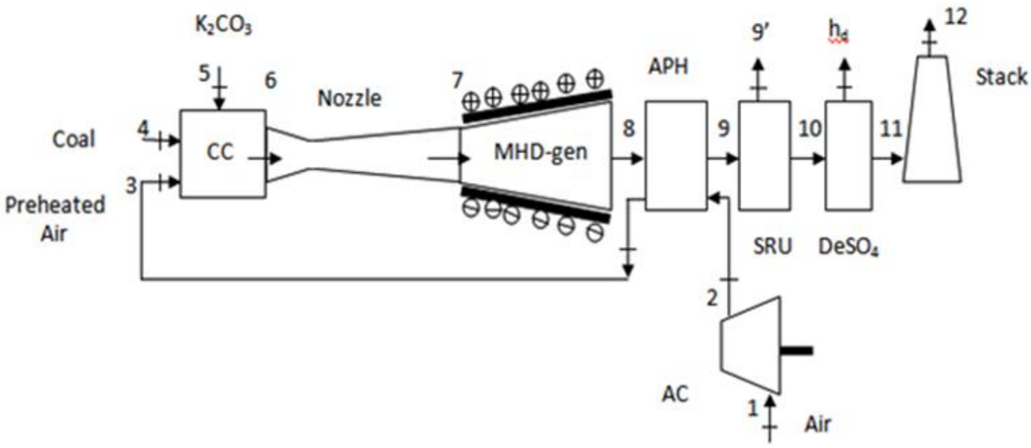

Fig.4.1. Schematic of the MHD power generation system

The exhaust gases of the MHD generator after heat recovery in the air preheater passes through the seed recovery unit (SRU) meant for seed regeneration purpose thereby reducing the operating costs to some extent [17]. The desulphurization equipment (DSU) removes most of the remaining sulphur compounds entering it (stream 10) present in the gases. Finally, the seed is recovered and desulphurized gases are released into the environment through the stack.

4.3 Mathematical formulation

The MHD system uses the products of fuel and air combustion, together with a fractional amount of seeding for the power generation in the generator. The pulverized coal considered for combustion in the present analysis is from the Dilli-Jaipore coalfields of Assam with the average % wt. composition, C- 75.59, H-5.8, S-2.825, O-14.89, N-1.47, A-6.8; M=6.0, VM = 47% on an as-received basis [18].

Assuming the air constituents from the air molar analysis (% basis) [2] with $N_2 = 77.48$, $O_2 = 20.59, CO_2 = 0.03$, $H_2O = 1.9$, the combustion reaction of coal and air is expressed by equation (4.1)

$$f(aC + bH + cO + dN + eS) + (0.7748N_2 + 0.2059O_2 + 0.0003CO_2 + 0.019H_2O \rightarrow (1 + f)[x_1N_2 + x_2O_2 + x_3CO_2 + x_4H_2O + x_5SO_2] \quad (4.1)$$

in equation (4.1), $x_1, x_{2,} x_{3,} x_4, x_5$ are the mole fractions of nitrogen, oxygen, carbon dioxide, water, and sulphur dioxide in the gas phase respectively obtained accordingly from balancing the elements. The coefficients *f, a, b, c, d, e* are the fuel to air ratio and mass fractions of the composition of coal respectively.

The chemical exergy of dry coal can be expressed by the equations (4.2) and (4.3), using the correlations of Ref. [1].

$$\xi^{0,ch} = [NCV + wh_{fg}] \times \emptyset + 9417s \left(\frac{kJ}{kg}\right) \quad (4.2)$$

$$\emptyset_{dry} = 1.0437 + \frac{0.1882h + 0.0610(o) + 0.0404n}{c} \quad (4.3)$$

In equation (4.2) above, $\xi^{0,ch}$ is the standard chemical exergy of fuel, w is the mass fraction of moisture in fuel and h_{fg} is the enthalpy of evaporation of water at standard temperature, NCV is the net calorific value of fuel and *s* is the mass fraction of sulphur. In equation (4.3), $\emptyset_{dry}$ is the ratio of $\xi^{0,ch}$ to NCV and *h, o, c, n* are the mass fractions of hydrogen, oxygen, carbon and nitrogen present in the fuel [1].

The heating values of coal are estimated using the correlations of Refs. [1, 19] and are expressed by the equations (4.4) and (4.5) respectively.

$$HHV = 0.3491C + 1.1783H + 0.1005S - 0.1034O - 0.0211A - 0.015N \quad (4.4)$$

$$LHV = HHV - 2.442m_w \quad (4.5)$$

In equation (4.4), HHV is the higher heating value of fuel coal, *H, C, O, S, A, N* are the percentage composition of elements resent in coal with their usual meaning. In equation (4.5), m_w is the mass fraction of water vapour in the fuel.

Assuming, the reference environment at a temperature of 298.15 K and 1 bar pressure, the specific enthalpies and entropies on a molar basis are computed for the flow streams at all the state points using the relations given in Ref. [2]. The evaluated values are then applied to obtain the thermo-mechanical exergies of the various streams.

The molar specific enthalpies of the air, fuel and the combustion products are obtained using the equations (4.6), (4.7) and (4.8) respectively given as:

$$\bar{h}_{air} = 0.7748\bar{h}_{N_2}(T) + 0.2059\bar{h}_{O_2}(T) + 0.0003\bar{h}_{CO_2}(T) + 0.019\bar{h}_{H_2O}(T) \quad (4.6)$$

$$\bar{h}_{coal} = 0.7559\bar{h}^0_{f,C} + 0.058\bar{h}^0_{f,H} + 0.1489\bar{h}^0_{f,O} + 0.0147\bar{h}^0_{N} + 0.02825\bar{h}^0_{f,S} \quad (4.7)$$

$$\bar{h}_{product} = 0.7234\bar{h}^0_{N_2} + 0.1971\bar{h}^0_{O_2} + 0.051\bar{h}^0_{CO_2} + 0.031867\bar{h}^0_{H_2O} + 0.001867\bar{h}^0_{SO_2} \quad (4.8)$$

The absolute specific entropy on a molar basis at a given state, $\bar{s}_i$ is evaluated knowing the molar-specific entropy of the individual elements. For any state *i*, the molar-specific entropy of a stream can be obtained using the equations (4.9) and (4.10), as given by Ref. [2].

$$\bar{s}_i = \sum_k x_k \bar{s}_k \quad (4.9)$$

$$\bar{s}_k = \bar{s}^0_k - Rln\frac{p_k}{p_0} \quad (4.10)$$

In equation (4.9), x_k is the mole fraction of stream constituent *k*, and $\bar{s}_k$ is the molar specific entropy of the constituent *k* of the stream. In equation (4.10), $\bar{s}^0_k$ is the standard molar specific entropy of the *k*th stream constituent, R is the gas constant, p_0 and p_k are the standard and actual pressures of the *k*th stream.

4.3.1. Energy and exergy modeling of the MHD system components

In the present analysis, equipments related to the MHD system are shown in Fig. 4.1 and are evaluated separately using the energy and exergy tools of thermodynamics. The mathematical expressions for individual equipments based on the first (energy) and second laws (exergy) of thermodynamics are given in the following sub-sections. The exergy model for the MHD plant constitutes both energy and exergy balances for the sub-components.

Assuming a steady-state- steady-flow (SSSF) process for the component control volume, the mass and energy balances can be expressed with reference to [1, 2] and are given by equations (4.11) and (4.12) as:

$$\sum_{in} \dot{m}_{in} = \sum_{out} \dot{m}_{out} \tag{4.11}$$

$$\dot{Q}_{cv} + \sum_{in} \dot{m}_{in}\bar{h}_{in} = \dot{W}_{cv} + \sum_{out} \dot{m}_{out}\bar{h}_{out} \tag{4.12}$$

The exergy balance for the same SSSF process for the control volume is given equation (4.13):

$$\sum_{z}(1 - \frac{T_0}{T_z})\dot{Q}_z + \sum_{in} \dot{m}_{in}\dot{\varepsilon}_{in} = \dot{W}_{cv} + \sum_{out} \dot{m}_{out}\dot{\varepsilon}_{out} + \dot{\xi}_D \tag{4.13}$$

In equation (4.13), $\dot{\varepsilon}_{in}$ and $\dot{\varepsilon}_{out}$ are the rate of specific exergies at the inlet and exits of the control volume, $\dot{W}_{cv}$ is the rate of work transfer, $\dot{Q}_z$is the rate of instantaneous heat transfer, $\dot{\xi}_D$ is the rate of exergy destruction and T_0 and T_z are the reference and instantaneous temperatures.

4.3.1.1. Air compressor

Energy balance*:* $-\dot{w}_{AC} = \dot{m}_1(\bar{h}_1 - \bar{h}_2)$
Exergy balance*:* $-\dot{w}_{cv} = (\dot{\xi}_1 - \dot{\xi}_2)$

4.3.1.2. Combustion chamber

Energy balance: $\dot{m}_6\bar{h}_6 - \dot{m}_3\bar{h}_3 - \dot{m}_4\bar{h}_4 - \dot{m}_5\bar{h}_5 = \dot{Q}_{CC,\ MHD}$
Exergy balance: $\dot{\xi}_6 - \dot{\xi}_3 - \dot{\xi}_4 - \dot{\xi}_5 = \dot{\xi}_D$

4.3.1.3. *Nozzle*

Energy balance: $\dot{m}_6(\bar{h}_6 - \bar{h}_7) = \dot{m}_6 \frac{v_7^2}{2}$
Exergy balance: $(\dot{\xi}_6 - \dot{\xi}_7) - \dot{\xi}_D = 0$

4.3.1.4. Generator

Energy balance: $\dot{w}_e = \dot{m}_7(\bar{h}_7 - \bar{h}_8)$
Exergy balance: $\dot{w}_e = (\dot{\xi}_7 - \dot{\xi}_8) - \dot{\xi}_D$

4.3.1.5. Air preheater

Energy balance: $\dot{m}_8(\bar{h}_8 - \bar{h}_9) - \dot{m}_2(\bar{h}_3 - \bar{h}_2)$=0

Exergy balance: $(\dot{\xi}_8 - \dot{\xi}_9) - (\dot{\xi}_3 - \dot{\xi}_2) = \dot{\xi}_D$

4.3.1.6. Seed recovery unit

Energy balance: $\dot{Q}_{SRU} - \left[\dot{m}_9\bar{h}_9 - \dot{m}_{9'}\bar{h}_{9'} - \dot{m}_{10}\bar{h}_{10}\right] = 0$

Exergy balance: $\dot{\xi}_9 - \dot{\xi}_{9'} - \dot{\xi}_{10} = \dot{\xi}_D$

4.3.1.7. Desulphurization unit

Energy balance: $\dot{Q}_{DeSO_4} = \left[\dot{m}_{10}\bar{h}_{10} - \dot{m}_{h_d}\bar{h}_{h_d} - \dot{m}_{11}\bar{h}_{11}\right]$

Exergy balance: $\dot{\xi}_{10} - \dot{\xi}_{11} - \dot{\xi}_{h_d} = \dot{\xi}_D$

4.3.1.8. Stack

Energy balance: $\dot{m}_{11}\left(\bar{h}_{11} - \bar{h}_{12}\right) = \dot{m}_{11}\frac{v_{11}^2}{2}$

Exergy balance: $\dot{\xi}_{11} - \dot{\xi}_{12} - \frac{v_{11}^2}{2} = \dot{\xi}_D$

4.4 Determination of energy and exergy parameters of the proposed MHD plant

Considering the reference environment mentioned above, the constant-pressure adiabatic flame temperature has been computed. For the present study, certain parameters are assumed for the convenience of analyses and these assumed values are close to the ones given in the Refs. [21-26]. The assumptions are listed in the following:

(a) compressor pressure ratio: 10.0 [21]

(b) air preheat temperature: 1900 K [22]

(c) air-side efficiency and pressure drop: 0.95 and 0.04 [24, 25]

(d) gas-side efficiency and pressure drop: 0.71 and 0.04 [24, 25]

(e) air-side pressure drop: 0.04

(f) flow through nozzle and generator is isentropic

(g) combustion efficiency: 0.97 [23]

4.4.1. Determination of fuel-air ratio, heating values, chemical exergy and chemical exergy ratio

The fuel-air ratio is evaluated by taking the fuel composition and the basis adjustment factor of 0.872. The heating values are obtained using the relations given in equations (4.4) and (4.5) respectively. The chemical exergy, and the ratio of chemical exergy (standard) to the net calorific value are obtained from the equations

(4.2) and (4.3) respectively. The values of all the above parameters are determined and are listed in Table 4.1.

Table 4.1. Fuel-air ratio, HHV, LHV, chemical exergy and chemical exergy ratio

f	HHV(MJ/kg)	LHV(MJ/kg)	ξ^{ch}(MJ/kg)	ϕ_{dry}
0.072	31.803	24.721	26.897	1.071

4.4.2. Estimation of mass flow rate, pressure and temperature at the state points in the MHD plant

Using the assumptions, the pressure and temperature are suitably estimated at all state points. The mass flow rate of fuel is evaluated using computed overall conversion efficiency of 0.295, the heating value of the coal, and heat rate. Subsequently, the mass flow rates of air and combustion products are determined. The temperatures at the combustor exit is obtained considering the constant volume process while that at the nozzle exit is evaluated assuming the nozzle flow to be isentropic. At other state points, the pressures (p), temperature (T) are evaluated assuming necessary pressure drop and temperature relations in the evaluated components. The values of the mass flow rates, p, T are useful in the determination of the rates of energy and exergy by obtaining the values of specific enthalpies and entropies at the given state points. Table 4.2 illustrates the evaluated values for mass flow rates, pressure, and temperatures at various state points.

Table 4.2. Mass flow rates, temperature and pressure of flow streams for the MHD plant

Variables	State points						
	1	2	3	4	5	6	7
$\dot{m}$(kg/s)	50.61	50.61	50.61	3.634	0.542	54.236	54.236
T(K)	298.15	621	1900	298.15	298.15	5000	3147
p(bar)	1	10.0	9.5	1.0	2.0	20	2.613

Variables	State points						
	8	9	9′	10	h_d	11	12
$\dot{m}$(kg/s)	54.236	54.236	0.542	54.236	54.236	54.236	54.236
T(K)	1967	1011	1011	991	991	971	874.2
p(bar)	2.509	2.408	2.408	2.360	2.360	2.313	2.197

4.4.3. Calculation of energy and exergy rates of flow streams of the MHD plant

The energy and exergy rates of the various streams of the MHD plant, were evaluated by considering the estimated mass flow rate, specific enthalpy, and entropy at the given pressure and temperature and that of the reference state using the relations given by equations (4.6 - 4.10). The determination of the exergy rates involved the evaluation of the thermo-mechanical and chemical exergies of the flow streams, their mass flow rates and the molecular weights of the streams. The energy and the exergy rates at the different state points help to determine the energy loss and exergy destructions in various components of the MHD system. The streamwise rates of energy and exergy are shown in Table 4.3.

Table 4.3. Energy and exergy rates of the flow streams of the MHD plant

State	$\dot{E}_i$ (MW)	$\dot{\xi}_i^t$ (MW)	State	$\dot{E}_i$ (MW)	$\dot{\xi}_i^t$ (MW)
1	8.237	0.000	8	40.894	85.660
2	8.157	14.621	9	14.089	28.260
3	82.522	69.048	9′	$2.356*10^{-8}$	0.216
4	16.324	115.529	10	11.691	26.776
5	0.134	0.346	h_d	1.157	0.906
6	233.689	252.594	11	11.571	24.300
7	114.600	134.457	12	11.041	23.089

4.4.4. Component-wise evaluation of energy loss and exergy destruction

In the MHD plant, the presence of irreversibilities had led to a reduction in the output in energy and exergy rates of the various MHD equipments. The losses in energy rate and in the rate of exergy destruction for individual equipment of the MHD plant are evaluated component wise for the MHD system using the energy and exergy balances given in the sections 4.3.1.1 – 4.3.1.8 and their values are listed in Table 4.4. From Table 4.4, it is seen that the energy loss and exergy destruction rate is the highest for the nozzle followed by the MHD generator. It is also seen that, from the energy loss and exergy destruction rate point of view, the nozzle, the MHD generator and the combustor are the components of interest requiring attention for performance improvement. Moreover, it was seen that the trend in the rate of energy losses and those of the rate of exegy destructions in the MHD components are not similar when these values are arranged in a particular order. These are certain outcomes which are obvious because certain qualitative aspects of energy conversion which are not possible to find through energy analysis are predicted by the exergy analysis. For example, in case of the combustor where the energy loss rate was not so significant. However, the exergy destruction rate was found to be quite high. The cause of highest losses in the nozzle may be attributed to the consideration of molecularity of the combustion reaction constituents.

Table 4.4. Component-wise energy loss and exergy destruction rates of the MHD plant

Component	$\dot{E}_{loss}$(MW)	$\dot{\xi}_D$ (MW)
Air compressor	6.576	1.935
Combustor	17.662	47.899
Nozzle	118.410	117.46
MHD generator	43.706	48.796
Air-preheater	20.216	2.973
Seed recovery unit (SRU)	4.815	1.268
Desulphurization unit (DSU)	1.241	1.569
Stack	0.650	1.211
Total	213.276	223.112

4.4.5. Determination of thermal and exergetic efficiencies of the MHD plant

In the MHD plant, energy is to be supplied for the air-compressor operation. Assuming the power required by the compressor to be supplied from MHD generated power, the net power output of the MHD plant is reduced. Knowing the fuel flow rate and the heating value of the fuel, the energy supplied to the MHD plant is determined with 115.571 MW. The thermal efficiency, η_{th}, of the MHD plant, is then calculated. For the exergetic efficiency, η_{ex}, the total exergy values of the input and the output flow streams are evaluated. The evaluated data of the compressor power requirement, MHD generator power output, net power output and thermal and exergetic efficiencies are given in Table 4.5.

Table 4.5. Compressor power, generator power. net power output, thermal efficiency and exergetic efficiency of the MHD plant

P_{AC} (MW)	P_{MHD} (MW)	$P_{net}(MW)$	η_{th} (%)	η_{ex} (%)
16.394	73.706	57.312	49.59	87.80

4.5 Energy and exergy based performance analyses of the MHD plant

The thermal or first law efficiency of energy systems or related equipment cannot evaluate the energy savings and cannot provide a correct measure of the quality of the processes during energy transfer [20]. According to Ref. [20], the best way to correlate the transfer of energy amount and the quality and use of energy is to apply both energy and exergy analysis using the second law of thermodynamics.

4.5.1. Energy efficiency of the MHD system components

The first law efficiency or the thermal efficiency is not a suitable parameter for measuring system efficiency, rather it indicates the losses due to irreversibilities in the systems [20]. Higher thermal efficiency of equipment indicated lower loss in energy supplied or reduction in the specific energy consumption and vice-versa. The mutual effects of the energy loss rate and thermal efficiency of the individual components of the MHD plant are shown in Fig. 4.2. As seen in Table 4.5, the overall thermal efficiency of the present MHD plant is only an average value. Thus, the overall MHD plant has an average performance in terms of energy.

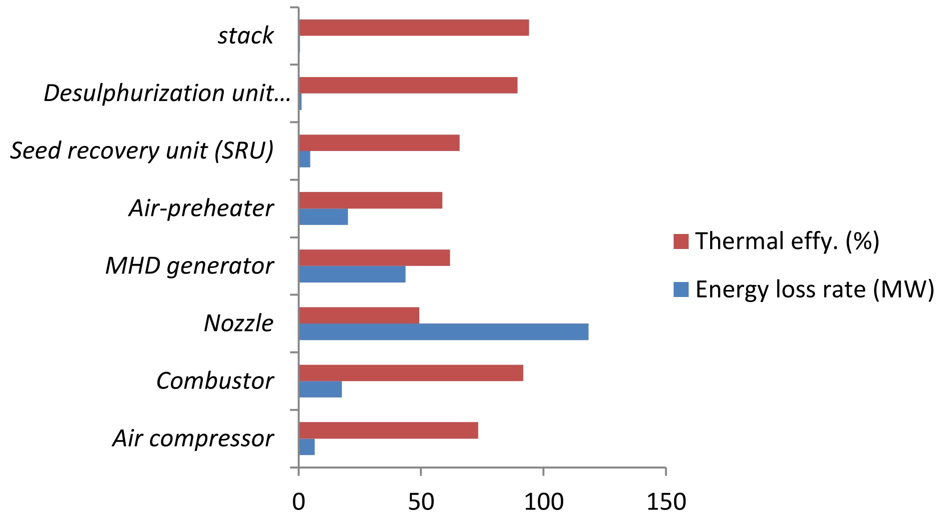

Fig. 4.2. Equipment's thermal efficiency vs rate of energy loss of the MHD plant

4.5.2. Exergy efficiency of the MHD system components

In the determination of the overall exergetic efficiency of the MHD plant, the total rate of exergy inputs of the flow streams is estimated at 751.593 MW whereas the total rates of exergy of the flow streams are evaluated at 659.929 MW.

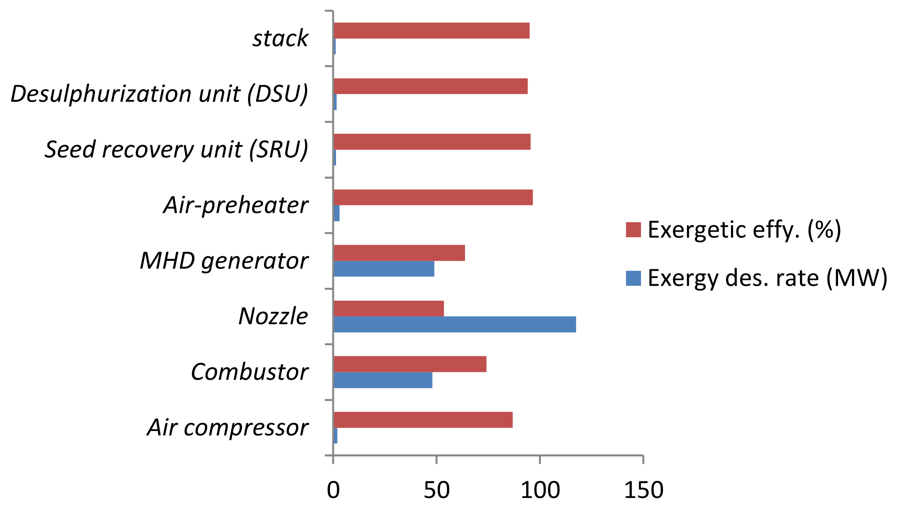

Fig. 4.3. Equipment's exergy efficiency vs rate of exergy destruction of the MHD plant

In fig.4.3, it was observed that the exergetic efficiency of an individual component of the MHD plant is affected by their rates of exergy destructions. Maximum exergetic efficiency is found to be for the air preheater with the least exergy destruction whereas maximum destruction in exergy rate occurs in the nozzle of the MHD plant.

4.5.3. Overall power output of the MHD system

When no power diversion is assumed, such as supplying MHD-generated power to run the air compressor, the electrical power output of the MHD is found to be higher. In the present study, the electrical power generated before diversion is about 73.706 MW. The work input to the air compressor is evaluated with 16.394 MW. When this power requirement of the compressor is to be supplied from the generated MHD power, the net electrical power obtained is at 57.312 MW.

4.6 Summary

The performance of a coal-fired MHD power generation plant is studied using the exergy analysis tool. The combustion of the fuel, preheated air with the addition of the calculated amount of seed produces the gaseous combustion products. The products of combustion are accelerated in a nozzle and the flow stream passes through a power-producing channel called the generator. The MHD generator is capable of producing electrical energy under the influence of an applied strong magnetic field and induced electric field. At the generator of MHD electrical energy is extracted at the electrodes attached to the generator channel. From the analysis, it was found that the component with maximum energy loss and exergy destruction is the nozzle. The generator of the MHD plant is the next component where further improvement is sought based on the results obtained in terms of energy loss and exergy destruction. Moreover, the trend in the rate of energy losses and those of the rate of exergy destructions in the MHD components are not similar when these values are arranged in a particular order. This is because certain qualitative aspects of energy conversion which are not possible to find through energy analysis are predicted by the exergy analysis. The air compressor, air preheater and the seed recovery unit have lower exergetic destruction values when compared to the corresponding energy losses.

Thus, a further analysis combining MHD with other systems will be able to provide a better picture of the use of MHD and its real potential as a power generation system.

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