Paper ID: ET-17

Use of Less Oil Ignition Technology (LOIT) to reduce oil consumption in a coal fired power plant.

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Abstract:

Oil-saving ignition technology has been extensively studied for the large consumption of oil during boiler start-up and pulverized coal combustion stabilization in a thermal power plant with the conventional coal burning method. In the case of conventional pulverized coal combustion boiler, oil which is delivered by the oil-gun (OG) is primarily used to pre-heat the furnace. For this, many of the liquid fuel are consumed in these processes. In order to achieve certain savings of liquid fuel, a great number of experiments have been made and develop the technology of oil-saving ignition such as, plasma-aided ignition technology, laser-heated ignition technology, high-temperature air ignition technology and induction-heating ignition technology. In this paper, a new upgraded system has been proposed titled as 'Less-oil ignition technology' (LOIT), which have the advantages of low operating costs, high oil-saving rates, maintenance-free, low unburnt particle and good performance in stability. By the LOIT system the oil consumption is reduced up to about 58 kg/hour where this consumption amount is about 3512 kg/hour in a conventional system. So, a huge amount of costing of oil about 16,19,166.12 *taka has been reduced per start up. This statistical data and the total procedure have been completed based on the filed survey in the 3rd unit of 'Barapukuria coal fired powerplant, Dinajpur' which is the latest edition of that power plant has the capacity about 300 MW.*

Keywords*:* Less oil ignition technology (LOIT), Oil burner, Less oil burner (LOB), Less oil gun (LOG).

1.Introduction:

A conventional oil burner is a heating device by which burns heating oils, diesel fuel or other similar type fuel. This type of burner is a part which is attached to an oil furnace, boiler or water heater [1]. It provides the ignition of heating oil or biodiesel fuel used to produce heat either air or water via a heat exchanger. At present scenario, mainly due to domestic fuel prices rising and the international energy shortage, in the power plant boiler oil ignition system cost increases unceasingly, which brings to the enterprise under a great pressure. By development and promotion of a new technology needs badly in ignition system with the current situation of the energy shortage and state environmental protection policy. Thus, it helps enterprises to create notable economic benefit by reducing the fuel oil in ignition system greatly effective for thermal power plants, so that enterprises can reach energy saving purpose [2]. For this purpose, a new technology has been introduced titled as 'LOIT' (Less oil ignition technology). In this process, there has been occurred a huge amount of economical benefits compared with conventional oil burning process in a coal based thermal power plant. This process achieves oil saving about 98% with boiler ignition start up, stop and low load stable combustion. This LOIT system has enhanced combustion oil gun adopts simple mechanical atomization method. Beside this, LOIT system has used very low amount of diesel, that's why the possibility of unburnt particles also very low during the system. The total procedure has been completed based on the filed survey in the 3rd unit of 'Barapukuria coal fired powerplant, Dinajpur' which is the latest edition of that power plant has the capacity about 300 MW. In

Reviewing some previous papers, some invention has been introduced between the term of previous some era for creating a reasonable and effective ignition system in a steam boiler. Such of these processes are Plasma energy

technology, Laser heated ignition system, Tiny oil ignition system etc. In the case of plasma energy technology, plasma torch in added in a reactor to ignite the air fuel mixture. By this process, can reduce the oil cost approximately 85-90% [3]. But in LOIT system the integer will be about 98%. Beside this, by using plasma torch a precious spark leaking on the ground is occurred which is a big drawback of this process [4] For the plasma-aided ignition technology, methods of both numerical simulation and the full-scaled trials had been employed to study the plasma supported coal combustion. Plasma energy technology also uses high temperature plasma for the thermo chemical preparation for the coal air mixture for combustion and also needs cooling water for cooling of plasma torch [5]. In the case of laser heated ignition system, the method is based on laser ignition devices that produce short but powerful flashes regardless of the pressure in the combustion chamber. Usually, high voltage spark plugs are good enough for automotive use [6]. In the laser heated ignition system, extra amount of hot air need to supply. Because, cold air can't carry coal. But, in LOIT technology design, a duct is introduced by which auxiliary air is introduced automatically in the system. On the other hand, at the case of tiny oil ignition system, realize fuel sufficient atomization, active combustion after intense burning wind, bigger combustion flame plumpness and stronger rigidity in low pressure and less flow conditions with unique mechanical atomizing oil gun and burners [7]. By this process, the oil cost approximately 92% is reduced which is more economical in the case of LOIT technology. Tiny-oil ignition system includes fuel mains and purging steam header, respectively by manual valve, filter, fast valve, non-return valve, pressure gauge components and metal hose to micro oil gun. This technology adopts a complicated design criteria which is much simpler in the case of LOIT technology.

2.Methodology:

The experimental setup is designed by the author in Microsoft word by experimenting the latest ignition system used in 3rd unit of 'Barapukuria coal fired powerplant, Dinajpur'. During the boiler start-up and combustion stabilization, the boiler was retrofitted with the LOIT (Less oil ignition technology) and Less oil burner (LOB) replaced four primary air nozzles for oil saving. In the duct of the LOB, primary air with the pulverized coal mixed, which flows through the concentrator installed near the wall of the burner and centrally be concentrated, then ignites and after that combusts intensively during the first-stage firing chamber with a high-intensity of oil flame of the less-oil gun (LOG). Firstly, in the Less oil gun (LOG) the oil which is for igniting the pulverized coal is then atomized and combusted in an adiabatic chamber. The pulverized coal is ignited in the first-stage firing chamber and high-temperature flue gas is then directed into the second-stage firing chamber to ignite pulverized coal in it. Finally, as the principle of energy amplification, all of the pulverized coal in the duct of the LOB is ignited. Thus, the purpose of oil-saving is achieved.

The exit of the LOB is similar to the original burner before the retrofit in area. Output of each LOG equipped in the LOB is 60kg/h and resistance of the LOB is 600Pa on the condition that the primary air-coal mixture flow velocity is 25m/s according to the calculation. The type of oil atomization employed a mechanical method that has a good adaptability and stable atomization performance at variation of oil pressure over a wide range from 0.5MPa to 2.0MPa. During the boiler start up with the LOIT, the parameters of operation is recorded at intervals of 30 minutes such as temperature and pressure of primary steam, wall temperature of heat exchange surfaces and LOBs.To detect the combustion status, fly-ash is be taken every 60 minutes before electrostatic precipitator by isokinetic sampling system. The rectangular flue gas duct will be divided into 36 uniform sections and the sampling point is located at the center of each uniform section.

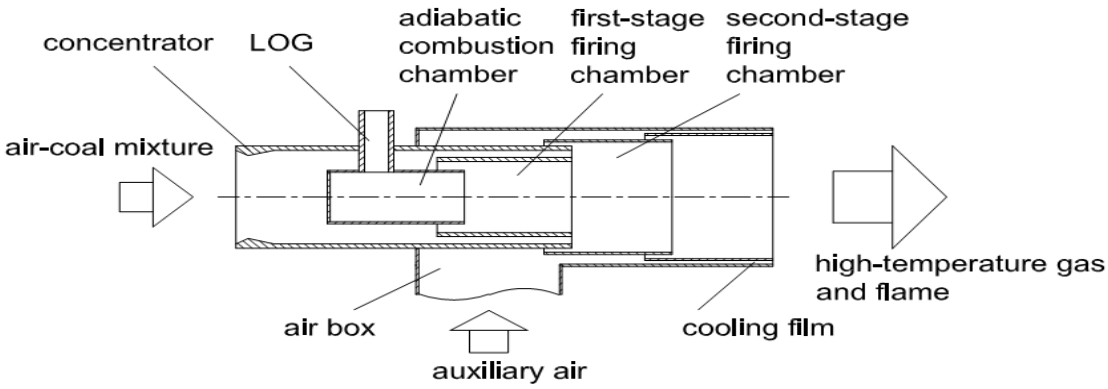


Fig.1. Experimental setup of LOIT technology

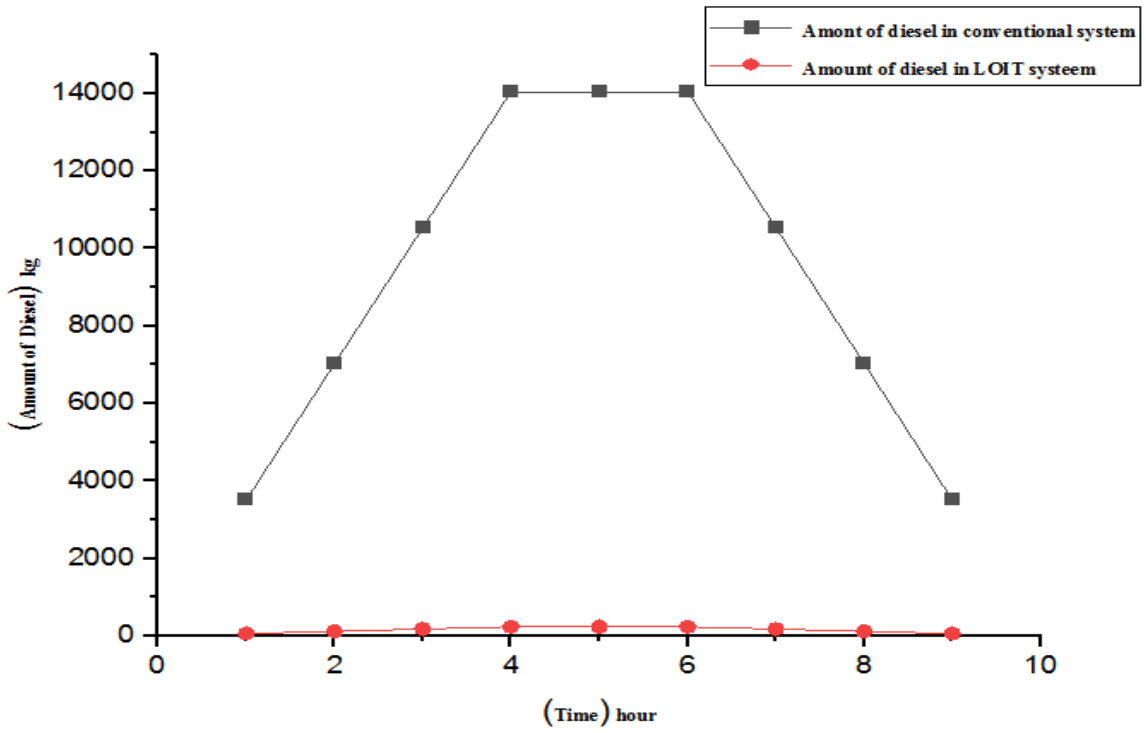
3.Results and Discussion:

By experimenting some conventional coal fired thermal power plant like 'Barapukuria coal fired power plant' situated in Dinajpur, it is resulted that about 3512 kg of diesel per hour is ignited for starting up the main generation process. Here, the rate of the ignition is increased in a proportion rate sequentially by four burners. But in the case of 'LOIT' system the amount of diesel is less. In this process, about only 58 kg per hour of diesel is ignited for starting up the process according to the survey on oil burning system in the 3rd unit of Barapukuria coal fired power plant.

Table.1: Table on amount of diesel respect to time and number of burners

Time (hour)	Number of active burners	Amount of diesel in conventional system (kg)	Amount of diesel in LOIT system (kg)
1	1	3512	58
2	2	7024	116
3	3	10536	174
4	4	14048	232
5	4	14048	232
6	4	14048	232
7	3	10536	174
8	2	7024	116
9	1	3512	58

Graph.1: Amount of diesel (kg) vs Time (hour)

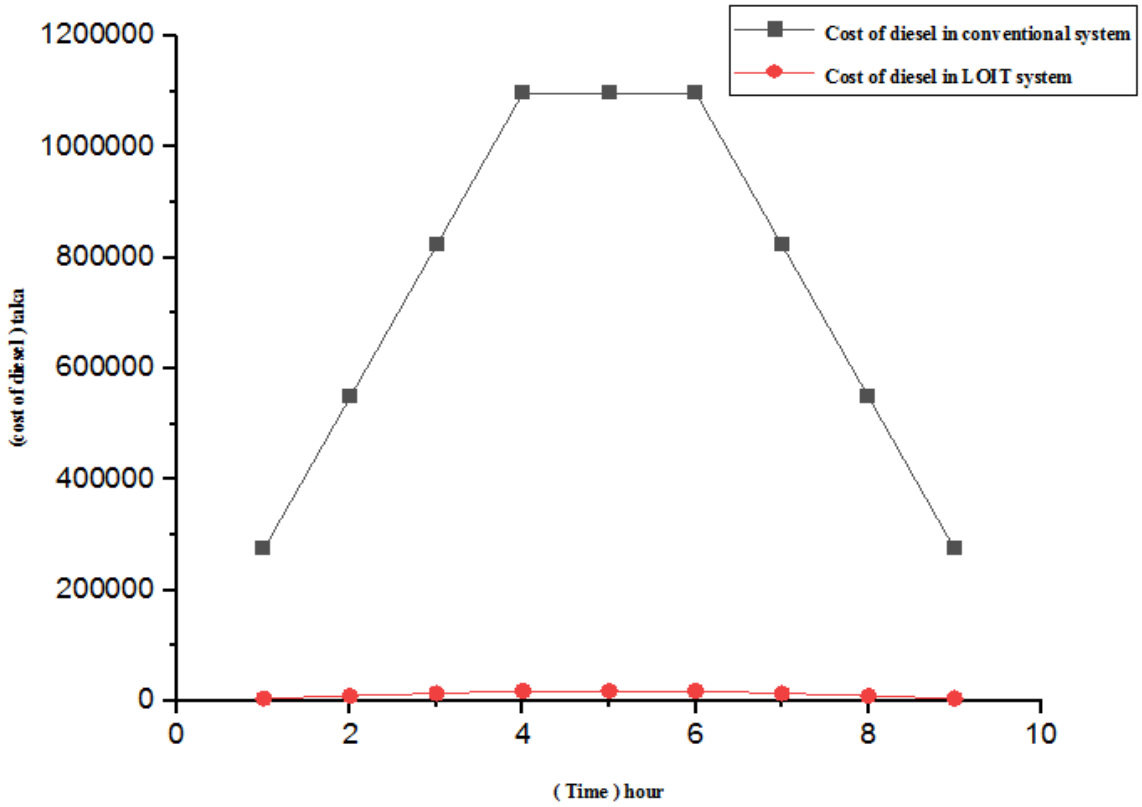


According to the statistical data of 2019, the rate of diesel in Bangladesh market is 78.13 tk per kg and it is multiplied with amount of diesel in both conventional and LOIT system given in the previous table. That's mean a lot of amount of money can be saved by LOIT system in one start up and it is discussed in the below table and graph:

Table.2: Table on costing of diesel respect to time and number of burners

Graph. 2: Cost of diesel (taka) vs Time (hour)

Time (hour)	Number of active burners	Cost of diesel (Taka) in conventional system	Cost of diesel (Taka) in LOIT system
1	1	274375	4531.54
2	2	548750	9062.5
3	3	823125	13593.75
4	4	1097500	18125
5	4	1097500	18125
6	4	1097500	18125
7	3	823125	13593.75
8	2	548750	9062.5
9	1	274375	4531.54



Saving of diesel = Rate of diesel ignition in conventional system – Rate of diesel ignition in LOIT system

= (3512 – 58) kg/hour

= 3454 kg/hour

The start up time was about 6 hours. Therefore, the burners were activated sequentially from 1 to 4 during 6 hours. After that, the number of the burner was decreased sequentially and the process was off.

Up to start up condition, the amount of saved diesel = 3454 kg/hour * 6 hours

= 20724 kg

From the statistical report of 2019, in Bangladesh diesel cost is about 78.13 taka per kg.

The total amount of money can be saved by LOIT system in every start up = (20724 * 78.13) taka

= 16,19,166.12 taka

Therefore, it is clearly seen that, a large amount of money can be saved by using LOIT system to reduce oil consumption in coal fired power plant.This data and calculations are done on the basis of the field surveying in the 3rd unit of 'Barapukuria coal fired power plant, Dinajpur' which capacity is 300 MW where the tiny oil ignition system is installed.

4.Conclusion:

Electricity plays as a vital ingredient to upgrade the socio-economic condition as well as to alleviate poverty.The supply of electricity has a great impact on the national economy. Enough and proper reliable electricity supply have created a great positive impact on our GDP which is one of the key measures to understand the economy of a country. The generation of massive electricity in modern era highly dependent on coal based thermal power plant. Therefore, it is more beneficial to reduce the costing of production as well as there is a huge crisis of liquid fuel all over the world. The use of LOB might save the amount of liquid fuel up to 98% as well as low amount of unburnt particles have been produced during the system. The basic advantage of LOIT system is that by the LOIT system the oil consumption is reduced up to about 58 kg/hour where this consumption amount is about 3512 kg/hour in a conventional system. So, a huge amount of costing of oil about 16,19,166.12 taka has been reduced per start up. So, LOIT system is much environment friendly. The LOB might be used in Sub – Critical Boiler. Using LOB the wall temperature gain, steam pressure gain, steam temperature gain is hoped to be within the region of safe and healthy operation.

5.References:

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