Common Mistakes in Boiler Operation & Maintenance (Perspective Bangladesh)

Pranab Kumar Sarker
Inspector of Boilers
Office of The Chief Inspector of Boilers
91, Motijheel C/A, Dhaka
engrpranab.04ruet@yahoo.com

Md Hanif Hossan
Inspector of Boilers
Office of the Chief Inspector of Boilers
91, Motijheel C/A, Dhaka
hanif.kuet@gmail.com, hanif@boiler.gov.bd

Abstract

Recently Bangladesh has been graduated least development country (LDC) to developing country. Bangladesh has already established eight export processing zones (EPZ). Bangladesh Economic Zones Authority (BEZA) has till August 2019 got approval to establish 88 economic zones countrywide. For attracting foreign investors it is big challenge for government to create congenial environment in industrial sector as well as ensure proper industrial safety. Boiler is a most common risky technical pressure vessel usually used in textile sector, Powerplant, Fertilizer company, Sugar factory, Auto rice mill, Feed Mill, Medicine factory, lather industry, hotel, hospitals etc. Improper operation & maintenance of boiler is responsible for accident. Many users do not know how to operate boiler safely & efficiently. They do not maintain Standard operating & maintenance procedure of Boiler. Due to lacking of knowledge & experience boiler accident occurs with loss of live & property. As a result, industrial safety hampers and we loss country image to foreign investors. This research has identified the common mistakes & take necessary action to overcome such mistakes in Boiler operation & maintenance after analyzing base line data collected from approximate five hundreds (500) boilers inspection which are located different districts in Bangladesh.

Keywords
Boiler faults, Boiler Operation, Boiler Maintenance, Boiler Inspection, Industrial safety

1. Introduction

Bangladesh's economy continues to grow at an impressive rate. In recent decade, Bangladesh has been largely driven by its exports of readymade garments, leather products, pharmaceuticals, food processing, steel processing, domestic agricultural sector, remittance etc. Economy of Bangladesh has maintained a sustainable growth and achieved GDP growth at more than 6 percent on an average during the last decade. According to Bangladesh Bureau of Statistics (BBS) provisional data (May-2019), the GDP growth stood at 8.13 percent in Fiscal Year 2018-19. In order to become an upper middle-income country by 2031 and achieve high-income country status by 2041, Bangladesh will require huge investments in Power & industrial sector as well as increase power generation capacity, readymade garments, leather products, pharmaceuticals, food processing etc. To achieve this ambitious vision, Bangladesh will be requiring more Boilers to produce 60,000 MW electricity & capable of export various products to foreign countries after fulfilling demand within 2041. Moreover Rooppur 2,400MW nuclear power plant, Matarbari 1200 MW coal power project, Rampal 1320 Power projects are under construction. So demand of boilers are increasing day by day. Now a days it is a big challenge for boiler safety. It is directly associated with public life & property. Even a small boiler faults may be create a dangerous accident. Office of the chief inspector of boilers is responsible authority to ensure safe & efficient operation of standard boilers by applying

Boiler Act 1923, Bangladesh Boiler regulation 1951. This research paper briefly express common mistakes in boiler & maintenance which always ignore boiler owners.

2. Common mistakes in Boiler operation:

2.1. Boiler operate in above permitted pressure:

According to the boiler Law 1923, 6(d), No owner of boiler shall used the boiler or permit it to be used at a pressure higher than the maximum pressure recorded in such certificate or provisional order. But many operatoroperate boiler above permitted pressure. They cannot set the safety valve in permitted pressure. Due to over pressure after some year, boiler faults occur. Boiler internal structure & pressure parts damage due to extra load. After some years, Boiler internal structure & pressure parts required to replace. Boiler lifetime decrease day by day.

2.2. Boiler rooms are insufficient:

According to the BNBC 2006(3,4) room containing boiler or heating plant shall be effectively separated from the main building by a separated wall. Boiler room shall be situated on the periphery of the basement and shall have a 4 hour fire resistance wall. Boiler door shall have a minimum 2 hour fire resistance wall. Boiler rooms are not enough for doing maintenance activities. Many owners (specially non compliance factory) do not install boiler in separated room. Fresh air required for combustion do not enter to the boiler room properly. Sometime we found no any exhaust fan in boiler room or exhaust fan is very small according to room size or no of exhaust fan are less in number. Due to lacking of exhaust fan, boiler room becomes very hot. If furnace oil, gas or flammable products contacts with this hot temperature fire will produce. As a result, Accident may create. Many feed mills, Auto rice mills, Leather industries & non compliance garments are the example for this topics.

Fig-a No Boiler rooms.

Fig-b Boiler is installed close adjacent to wall

2.3 Missing insulation & packing :

Many operators do not maintain proper insulation in steam line, chimney line, steam header & feed tanks etc and gland packing in different valves. In running time, heat loss occurs due to missing insulations & packings. In this circumstances, Boiler rooms becomes very hot and boiler run inefficiently.

2.4 Uncertified Boiler attendant

According to the Bangladesh boiler rule 1953(amended 1986), (2), Boiler must be operate by certified Boiler attendant. Many operators in specially auto rice mill, feed mills have not any primary knowledge of boiler operation. But, Incase of textile & garment sectors, maximum owners recruit certified operator. In Auto rice mill & feed mills operators are familiar with only on-off switch. Owners do not invest to recruit certified boiler operator. As a result, Many boilers are running in risky conditions .Although it an offence to run boiler without certified boiler operator according to the boiler law 1923. In our country, there is a very few number of standard boiler training centres. As a result, operator do not get any proper training of boiler.

Fig-c Missing insulation in Steam receiver

Fig-d Missing insulation in Chimney line

2.5 Not attentive to log book use:

Logs are tools. They contain information that allows the operator to make better decisions. The wise operator knows the value of his log. By maintaining an adequate log the operator is demonstrating his skills , protecting the interest of his employer and developing a database as a resources for evaluating the performance of his plant which allows him to improve on the plant performance. But it is a matter of sorrow that, Many operator are not present in boiler room during operation time. They do not use log book. In that case management are not attentive to boiler and boiler operator.

2.6 Ignore safety procedure Testing:

According to Bangladesh boiler regulations 1951 (381)e, Each boiler shall be equipped with two safety valves in series for relieving the steam pressure. The diameter of the valve shall not be less than 19 mm. In many case we found one safety valve. Some time safety valve becomes block due to scale formation. Many operator do not blow off steam through safety valve in running time by hand lever. Operators do not test the effectiveness of pressure limit switch which are dangerous activities.

2.7 One gauge glass:

According to Bangladesh boiler regulations 1951 (381)C, Every boiler other than a coil type or a once through boiler shall be fitted with two gauge glass not less than 150 m long for determining the water level. But in most case we found one gauge glass. Sometime one gauge glass shows false water level which is dangerous for boiler. One gauge glass may break or leakage in any time.

2.8 Dirty & leakage gauge glass:

Dirty & leakage gauge glass is not acceptable for proper boiler operation. Dirty & leakage gauge glass prevails in boiler room. Water level can not measure through dirty gauge glass.

2.9 Manual Blow down system:

Proper blowdown will prevent scale formation and the life of boiler will increase. Maximum operators operate boiler with manual blowdown system. Operator blowdown boiler in their own times not depends on Boiler Water TDS. But automatic blowdown system depends on Boiler Water TDS.

2.10. No water treatment Plants**:**

Many operators specially auto rice mill, feed mill do not maintain feed water treatment procedure. Due to bad water quality, there will be scale accumulated in boiler tube. Scale create tube leakage and hampers heat transfer. As a result operation cost increase & efficiency of boiler decrease. Some operators uses water softener. But they do not change resin, stone in proper time.

2.11 Non Standard local made boiler**:**

According to Bangladesh boiler regulations 1951, 3(3) where no provision is made in these regulations for design or manufacture of any pressure parts of the boiler, the inspection authority may permit the design, manufacture, stage inspections and certification of such pressure parts including the valve, mounting & fittings conforming to the international standards & foreign codes like B.S, ASME Boiler and pressure vessel code, tubular exchanger manufacturers association (TEMA), technical regulation for steam boilers (TRD), Russian standards (GOST), German Standards (DIN), Japanese industrial standard (JIS) and ISO Boiler code ISO/R-831, which are known to be commonly used in industrially advance countries. In many case we found non standard local made boiler which is very harmful. This boiler are made of normal plate and do not follow any international standard & foreign codes. this kinds of boilers are very risky.

Fig-e Non standard Feed mill boiler

Fig-f Non standard auto rice mill boiler

2.12 No Stack temperature Meter:

Stack Temperature meter is very important for investigate boiler efficient operation. High stack temperature indicates boiler cleaning time. It also indicates incomplete & excess air combustion. If stack temperature is high, then boiler must be clean immediately. In many boiler room (as specially feed mills & Auto rice mill), we do not found any stack temperature meter due to owner inattention.

2.13 Unregistered Boilers:

In Bangladesh, there are many unregistered boiler running in different areas. Owners are not attentive to communicate with boiler office for registration. As a result Government do not get proper revenue from them. In Boiler law 1923, it is offence to run boiler without registration.

3. Common mistakes in Boiler Maintenance:

3.1 Do not renew gasket & packing timely**:**

Gasket used in manhole, mudhole, hand hole gets damage over some period of operations and need replacement. If any leakage found in valves, packing must be replace as quickly as possible. Many operators do not renew old gasket and packing. As a result in operation time, due to weak gasket and packing heat losses occurs & decrease boiler efficiency.

3.2 Refractory materials are poor:

Poor refractory materials is not acceptable. Good refractory material contain heat generated by burning of the fuel in the furnace and to minimize heat losses from the furnace. Sometimes we found slag buildup in refractory materials which are not acceptable.

3.3 Descaling materials are poor:

Descaling materials must be good in quality in case of boiler maintenance. Otherwise boiler will not be clean. As a result scale will accumulated. It is mandatory to descale boiler minimum once in a year before hydraulic test. Many operators do not know about descaling system & materials.

Fig-g Rusting in Manhole cover & Gasket need replacement

3.4 Do not clean the flow gas path**:**
Heat transfer will be affected in case of soot deposits. Sometimes it desirable to clean soot in every six month. Many operator do not clean flow gas path timely. Chimney temperature indicates when flow gas path will clean.

Fig-h Fly ash corrosion

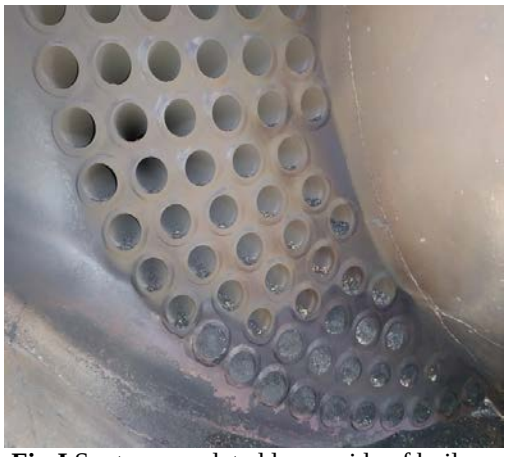

Fig-I Soot accumulated lower side of boilers

3.5 Blanking of tubes in case of failures**:**
Some time when boiler tube fail, many operator blanks the tubes. However more than 5% tube should not be blanked at any conditions. It is good practice to replace all tube set even a single tube leakage. But many operators do not follow this because of costing. Many owners do not invest money in this case.

3.6 Crack in fire drum**:**
Many boilers has plain furnace. After some years, crack in fire drum occurs due to differential expansion in boiler. To solve these problems, corrugated furnace must be used. Many operator cut a small portion of fire drum and do patch work in case of drum leakage.

3.7 No Preventive maintenance:
Many operator run boilers without preventive maintenance. Many operator do not add oil or grease in Feed pump Motor bearing, ID Fan, FD Fan checking. They do not clean steam trap, Gas strainer, ignition electrode etc. before operation. Calibration of pressure gauge must be done. Incorrect reading of pressure gauge is very risky.

3.8 Do not hydraulically test the boiler yearly:
Boiler must be hydraulically test once in a year. This test is very suitable for measuring boiler strength. Proper hydraulic test indicates boiler fitness. Many operator do not test the boiler hydraulically once in a year. They do not know proper procedure of hydraulic test.

3.9 Incorrect boiler preservation in idle conditions**:**
The boiler is particularly susceptible to corrosion when left idle for a period of time. Many operators do not know how to preserve boiler in idle conditions. As a result boiler internal structure becomes corrosive because of moisture.

3.10 Do not replace the boiler in proper time:
Many owners do not replace the boiler if boiler becomes old, inefficient & costly firing. They want profit and do not interest to any investment.

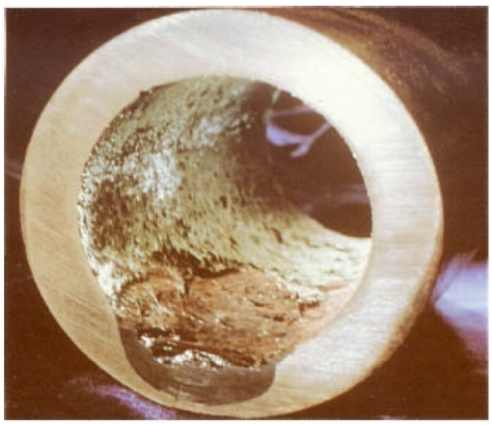

Fig-J Water side corrosion

Fig-k Old Boiler

4. Boiler Accident & common faults data in Bangladesh:

According to the boiler Act,1923, 2(A)accident means an explosion of boilers or steam pipe or any damage to a boiler or steam pipe which is calculated to weaken the strength there of so as to render it liable to explode. It wil not be an exaggeration to state that power liberated by the explosion of Lancashire boiler (7.5 inch Dia x 30 inch) length , working at 7 kg/sqcm is sufficient to project it to a height 3.29 km/s. Moreover, destruction hazard of 28.3 liters of water at 4.2 kg/sqcm & saturation temperature in a steam boiler is equivalent to 0.45 kg of gun powder. So hazard of boiler explosion is very devastating. Every year many people die in boiler accident. It happens mostly due to lack of training, awareness and negligence of the industry owners, operators and management team. There are some specific reason of boiler accidents are following.

- Over Steam Pressure
- Low water level
- Failure of tube
- Faulty design, erection & operation
- Faulty welding Joint
- Failure of safety device(pressure limit switch, safety valve, water level controller, Flame safeguard system)
- Combustion failure
- Improper feed water treatment & dosing chemical.
- Faulty preservation in idle condition
- Clogged Flue gas passages
- Over heating
- Water & fire side corrosion
- Oxidation & erosion etc.

Fig-l Boiler Accident at Jumuna Auto Rice mill, Dinajpur.

Fig-m Boiler Accident at Multifabs ltd, Gazipur

4.1 Boiler Accident data in Bangladesh

Table 1. Last five years registered boiler explosion data in Bangladesh

Boiler Registration no	Name of owners & address	Death counts & injury	Date of accident
Ba.Bo 2339	M/S Gausia Auto Rice mill, Narayanganj	02 Death, 5 injury	03/06/2015
Ba.Bo 1532	Ram Auto Rice Mill, Nagoan	02 Death, 3 injury	16/07/2016
Ba.Bo 3868	M/S Nazrul Auto Rice Mill, Chapainawabganj	01 Death	31/03/2017
Ba.Bo 2027	M/S Jamuna Auto Rice Mill, Dinajpur	19 Death, 8 injury	19/04/2017
Ba.Bo 2899	Multifabs ltd, Gazipur	13 Death, 16 injury	03/07/2017

Table 2. Recent unregistered boiler explosion data in Bangladesh

Name of owners & address	Death counts & injury	Date of accident
Hafiz Jute Mill	03 injury	08/02/2017
KNB agro Industries, Kustia	01 Death, 1 injury	16/05/2018
M/S Keya Auto Rice mill, Jamalpur	02 Death	15/07/2018
Khalaque Auto Rice mill, Mymensingh	01 Death, 2 injury	09/04/2019

4.2 Boiler Common Faults data in Bangladesh**:**

Table 3. Some common Boiler faults data In Bangladesh

Type of Industry	Common Faults	Percentage (%)	location
Auto Rice Mill Boilers	No certified boiler operator	80	Maximum Auto Rice mill located in Rajshahi Division, Rangpur division, Mymensingh division, Noyakhali districts etc
	No Separate Boiler Room	90	
	Do not hydraulically test the boiler yearly	95	
	Dirty & leakage gauge glass	30	
	Improper feed water treatment & dosing chemical.	60	
Feed Mill Boilers	No certified boiler operator	90	Maximum feed mills located Mymensingh division Rajshahi Division, Rangpur Division, Khulna division, Manikganj district
	Non Standard local made boiler	85	
	Un registered Boiler	85	
	Improper feed water treatment & dosing chemical.	95	

	Do not hydraulically test the boiler yearly	90	etc
Boilers in Garment & textile Factory	No certified boiler operator	20	Maximum Garments & textile industries located in Dhaka Districts, Chittagong Districts, Gazipur Districts, Narayanganj Districts, Comilla Districts, Mymensingh Districts etc.
	Non Standard local made boiler	01	
	Un registered Boiler	05	
	Improper feed water treatment & dosing chemical	05	
	Boiler rooms are insufficient	15	
	Do not hydraulically test the boiler yearly	20	
Boilers In lather industry	No certified boiler operator	70	leather industries located in Hemayetpur, Savar, Dhaka
	Boiler rooms are insufficient	30	
	Improper feed water treatment & dosing chemical	40	

5. Recommendations and Suggestions:

- Boiler must be operated in permitted pressure by certified boiler operator.
- Boiler room must be large enough to allow for boiler maintenance, retubing, remaining & replacing the boiler. The boiler room must be kept clean and free from dust & dripping chemicals. Good ventilation must be provided. The boiler room air supply opening must be kept clear at all times. Install reguired no of exhaust fan for flow gas exit. Boiler door must be minimum 2 hour fire resistance wall & boiler wall must be 4 hour fire resistance wall.
- Missing insulation & gland packing is not acceptable in boiler operation & maintenance. Insulation & packing must be replace yearly operation.
- Descaling & refractory materials should be good quality.
- Log book must be maintain for every boiler by operator.
- Must be keep minimum two safety valves.
- Must be keep minimum two feed pumps.
- Never operate boiler with one gauge glass except a coil type or a once through boiler. Dirty gauge glass is not acceptable. Always keeps spare of gauge glass.
- Automatic blowdown system must be keep.
- Water treatment plant / softner is mandatory for every boiler. Resin & stone in a softener must be change in one year operation. Resin must be backwash by salt timely. Dosing chemical must be supply in running time.
- Non standard local made boiler must be prohibited. Keep penalty who use those boilers.
- Stack temperature meter must be attached to chimney.
- Cleaning of flow gas path & boiler internals timely. Cleaning of gas trainer, steam strap, valves timely.
- Monthly Test the effectiveness of safety valves & pressure limit switch by raising boiler pressure.
- Weekly test low water fuel cut-off.
- It is good practice to remove all tubes and replace new tubes in tube failure. Otherwise one tube failure indicates that other tubes are also weak and similar failure will soon be repeated. This is increase risk of boiler operation and downtime will also increase.
- Corrugated furnace is preferable to plain furnace. Otherwise fire drum damage after some years operations. It is always advisable to replace fire drum in case of any damage. Do not cut a small portion of the fired rum and do patch work.
- Replace the boiler if boiler becomes old, inefficient & costly firing.
- Common Preventive maintenance (add oil, grease to bearing, clean Steam trap, gas strainer, NDT testing in welding joints) must be done.
- Descaling & Hydraulic test must be done once in a year.

6. Conclusion

This paper is briefly described about common mistakes in boiler operation & maintenance in Bangladesh. Boiler Act & regulations are very old. Penalty is very limited to owners if they brake boiler Act & regulations .It is very necessary to update boiler rules & regulations. Office of the chief inspector of boilers has taken active initiative for increasing awareness, give suggestions to owners, operators & company management. Updating Boiler Act &

Regulations are under processing. But it is matter of pleasure Now a days many owners are concerned about boilers Safety. Presently, more than twenty local boiler companies are manufacturing almost 75% of small industrial boiler and 5% medium capacity horizontal fire tube boilers. These boilers are very standard. In future, Bangladesh will be capable of export boilers to foreign countries. We hope that all mistakes in boiler operation & maintenance should be solve as early as possible which accelerate industrial development. As a result, employment will increase & poverty will decrease.

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Biographies

Mr. Pranab Kumar Sarker is an Inspector of Boiler working in Office Of the Chief Inspector of Boilers under Ministry of Industries, Bangladesh. He earned Bsc in Mechanical Engineering from Rajshahi University of Engineering & Technology (RUET) in 2009. He has 10 years experience about Boiler Operation, Maintenance, & Manufacturing in Government & Private organization. He served as a Assistant Engineer in a renowned Boiler Manufacturing Company Modern Erection ltd, Bangladesh (2009-2012), as an Assistant Manager (Mechanical) in Bangladesh Sugar & Food Industries Corporation (2012-2016), as an Assistant Engineer (Mechanical) Bangladesh Chemical Industries Corporation (2016). He is a Resources Person in Boiler operation, Maintenance & Safety training Program organized by Directorate of Continuing Education(DCE), BUET. Mr Pranab Kumar Sarker has attended many workshops, seminars, training programs about Boiler Operation, Maintenance & safety in Bangladesh & abroad.

Md Hanif Hossan is an Inspector of Boilers in Office of the Chief Inspector of Boilers in Bangladesh. He earned B.S. in Mechanical Engineering from Khulna University of Engineering and Technology (KUET), Bangladesh in 2011. Mr. Hanif served as Assistant Manager (Mechanical) in Carew and Company (Bangladesh) Ltd. an organization under Bangladesh Sugar and food industries Corporation (2012-2016), Assistant Engineer (Mechanical) in Eastern Cables Ltd. Under Bangladesh Steel and Engineering Corporation (BSEC), Assistant Engineer (Mechanical) in Shahajalal Fertilizer Company Ltd. an enterprise of Bangladesh Chemical Industrial Corporation (2016).