
**Pollution Control Guidelines
for
Conversion of Boilers/ Utilities
from
Natural Gas to Solid Fuels
(Coal, Lignite, Agro Fuels etc)**

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*Clean Gujarat Green Gujarat
ISO-9001-2008 & ISO-14001-2004 Certified Organisation*

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Foreword

Combustion of Fossil fuel/Bio-fuel in Boilers is one of the proven methods for production of steam, required for the process in various types of industry. The running of Boiler with fuels of proper specification at a higher efficiency is the key to reduce the SO_x, NO_x& the PM levels in the stack which are the key air pollutants.

With increase in the price of natural gas, the Board is getting proposals/ applications for the fuel conversion from natural gas to Solid fuels like coal, lignite, agro-waste, briquettes, imported coal etc. from industries of various regions of Gujarat.

Simultaneous conversion of the large numbers of industries may result in to the impetus in the ambient pollution load if not taken care appropriately right from planning stage to execution & operation phases.

This has resulted in to need to frame a guideline for the design & operation of the solid fuel based utilities & their Air Pollution Control Devices (APCD).

Principles followed to frame this guideline were:

- i. Optimization of the fuel to be used
- ii. Optimization of the combustion
- iii. Application of suitable BAT for the Air Pollution Control Devices (APCD) and operations thereof.

Vigorous consultation was carried out with experts from academia, Retd. Officers from Chief Boiler Inspectorate, boiler manufactures, APCD manufacture & various officers of GPCB at head office and regional offices for their valuable inputs to make this guideline effective.

We hope, this will be useful to all the stakeholders to control the air pollution especially flue gas emission from the industries & will prove to be effective decision making tool. It is however, made explicitly clear that prior permission of the GPCB under the Air Act,1981 is a must for change of fuel in boilers/ utilities.

(Hardik Shah)
Member Secretary

Abbreviations

Apcd	Air pollution control devices
Apcm	Air pollution control measures
Bat	Best available technology
C	Carbon
Cems	Continuous emission monitoring system
Cepi	Comprehensive environmental pollution index
CO ₂	Carbon dioxide
Cv	Calorific value
Daf	Dry ash free
Fc	Fixed carbon
Gcv	Gross calorific value
Gpcb	Gujarat pollution control board
H ₂	Hydrogen
Msw	Municipal solid waste
N ₂	Nitrogen
Ncv	Net calorific value
No _x	Nitrogen oxides
Npc	National productivity council
O ₂	Oxygen
Plc	Programmable logic controller
Pm	Particulate matter
Rav	Reduced air volume
S	Sulphur
So _x ,	Sulphur oxides
Tfh	Thermic fluid heater
Vm	Volatile matter

1.0 Background

Most of the industries in the state of Gujarat, using fossil fuel as their energy input, are located in urban areas with deteriorating ambient air quality in the urban areas, due to various factors such as industrialization, traffic density, burning of MSW etc., it is becomes all the more important to restrict new sources of air pollution. This is the very basic of promoting cleaner fuels. However, with increase in price of cleaner fuel like natural gas in unreasonable proportion, the industries have found it inevitable to turn back to using cheaper fuel like Coal, lignite & other solid fuels for their survival. With increase in the price of natural gas the Board is getting applications for the fuel conversion from natural gas to Solid fuel like coal, lignite, agro-waste, briquettes, imported coal etc. from industries of various regions of Gujarat.

As some of the regions of Gujarat State are covered under critically polluted areas and also for the economical scale of operation there is a need to form a committee and make a policy for the conversion of Natural Gas based Boiler/Utility to Solid fuel based Boiler/Utility, which would at the same time address the issues related to Air pollution in both, the areas covered under the CEPI and rest of the areas without CEPI. This has lead to formation of a committee that would prepare guideline for this purpose. For the said purpose, the Gujarat Pollution Control Board (GPCB) has constituted a Committee vide letter No: GPCB/ANKLESHWAR-C-992/167193, dated 05/12/2013 (Annexure - I), which also had consultative meetings with industries and academia to have their inputs.

2.0 Deliberations of the Committee:

Committee held three meetings with the experts consisting of persons from academia, boiler manufacturers, professionals associated with the operations of boilers and institutes like the National Productivity Council (NPC). The meetings of the committee were held on 09/12/2013, 18/12/2013, 31/12/13, 06/01/2014, 26/03/2014 and 15/04/2014 at GPCB, Gandhinagar. The committee discussed at length the information with regard to fuel type, fuel consumption, boiler capacity and related required APCM and came out with this guideline.

3.0 Boiler System

The heating surface is any part of the boiler metal that has hot gases of combustion on one side and water on the other. Any part of the boiler metal that actually contributes to making steam is heating surface. The amount of heating surface of a boiler is expressed in square meters. The larger the heating surface a boiler has, the more efficient it becomes. The quantity of the steam produced is indicated in tons of water evaporated to steam per hour. Maximum continuous rating is the hourly evaporation that can be maintained for 24 hours.

The boiler system comprises of: feed water system, steam system and fuel system. The **feed water system** provides water to the boiler and regulates it automatically to meet the steam demand. Various valves provide access for maintenance and repair. The **steam system** collects and controls the steam produced in the boiler. Steam is directed through a piping system to the point of use. Throughout the system, steam pressure is regulated using valves and checked with steam pressure gauges. The **fuel system** includes all equipment used to provide fuel to generate the necessary heat. The equipment required in the fuel system depends on the type of fuel used in the system.

The water supplied to the boiler that is converted into steam is called **feed water**. The two sources of feed water are: (1) **Condensate** or condensed steam returned from the processes and (2) **Makeup water** (treated raw water) which must come from outside the boiler room and plant processes. For higher boiler efficiencies, the feed water is preheated by economizer, using the waste heat in the flue gas.

4.0 BOILER TYPES AND CLASSIFICATIONS:

There are virtually infinite numbers of boiler designs but generally they fit into one of two categories:

Fire tube or "fire in tube" boilers; contain long steel tubes through which the hot gasses from a furnace pass and around which the water to be converted to steam circulates. Fire tube boilers, typically have a lower initial cost, are more fuel efficient

and easier to operate, but they are limited generally to capacities of 25 tons/hr and pressures of 17.5 kg/cm².

Water tube or "water in tube" boilers in which the conditions are reversed with the water passing through the tubes and the hot gasses passing outside the tubes. These boilers can be of single- or multiple-drum type. These boilers can be built to any steam capacities and pressures, and have higher efficiencies than fire tube boilers.

Packaged Boiler: The packaged boiler is so called because it comes as a complete package. Once delivered to site, it requires only the steam, water pipe work, fuel supply and electrical connections to be made for it to become operational. Package boilers are generally of shell type with fire tube design so as to achieve high heat transfer rates by both radiation and convection.

5.0 CLASSIFICATION OF COMBUSTION TECHNOLOGY

I. GRATE FIRING TECHNOLOGY

A. Stationary Grate

Manual feeding

Mechanical feeding

B. Dumping Grate

Pneumatic spreading

C. Inclined water cooled Grate

Stationary water cooled grate

Vibrating water cooled grate

D. Travelling Grate (TG)

Pneumatic spreader stocker

Mechanical spreader stocker

E. Moving Grate (MG)

Gravity feed

F. Reciprocating Grate (RG) / Pulsating Grate (PG) – Air

Cooled / Water cooled

Drop feed with Multiple screw feeders

II. FLUIDIZED BED COMBUSTION

Over Bed Feeding

Under Bed Feeding

6.0 Types & properties of Fuels:

6.1 Coal:

Coal is classified into three major types namely anthracite, bituminous, and lignite. However, there is no clear demarcation between them. Coal is further classified as semi-anthracite, semi-bituminous, and sub-bituminous. Anthracite is the oldest coal from a geological perspective. It is a hard coal composed mainly of carbon with little volatile content and practically no moisture. Lignite is the youngest coal from a geological perspective. It is a soft coal composed mainly of volatile matter and moisture content with low fixed carbon. Fixed carbon refers to carbon in its free state, not combined with other elements. Volatile matter refers to those combustible constituents of coal that vaporize when coal is heated. The common coals used in for example Indian industry are bituminous and sub-bituminous coal. The gradation of Indian coal based on its calorific value is as follows:

Grade	Calorific Value Range (in kCal/kg)
A	Exceeding 6200
B	5600 – 6200
C	4940 – 5600
D	4200 – 4940
E	3360 – 4200
F	2400 – 3360
G	1300 – 2400

Normally D, E and F coal grades are available to Indian industry.

- The chemical composition of coal has a strong influence on its combustibility.
- Physical properties of coal include the heating value, moisture content, volatile matter and ash. The heating value of coal varies from coal field to coal field.
- The typical GCVs for various coals are given in the Table below.

GCV for various coal types:

Parameter	Lignite (Dry Basis)	Indian Coal	Indonesian coal	South African coal
GCV (kCal/kg)	4,500	* 4,000	5,500	6,000

*GCV of lignite on 'as received basis' is 2500 –3000

6.2 Bagasse:

Bagasse is the waste product left after crushing of cane and extraction of juice in cane sugar mills. It is a seasonal product, as the crushing campaign lasts from 6 to 10 months in a year; the plant is longer near the equator and gets progressively shorter away from it. Cane is a tropical crop that extends across the globe. Bagasse forms 24–30% of the cane weight. Bagasse burning has been an integral part of the sugar cycle from the beginning. Steam and power requirements of these widespread rural factories have been adequately met with bagasse-based cogeneration and off-season purchase of grid power. Traditionally the bagasse burning has been carried on inefficiently in sugar mills as there was always excess bagasse left with no great market value, and it is too bulky to transport or store. Burning was a way of disposal of this bulk. In the last couple of decades, there has been a sea change in this scenario with the enhanced possibilities of production of paper, certain value-added chemicals, and cogenerated power. Encouragement of its use for distributed power and green power even in small quantities has helped in adopting cogeneration in sugar factories in a big way. Bagasse has now attained its rightful place as a good, consistent and bulk waste fuel in tropical countries that provides good market value. Bagasse burning is also environmentally friendly as combustion temperature is low due to the quenching effect of the fuel moisture and no fuel sulphur to pollute with sulphurous gases. It is now burnt efficiently in vastly improved boilers at increasingly higher pressures and temperatures at low NO_x and SO_x.

Properties of Bagasse

C	47.0 (%)
H ₂	6.5 (%)
N ₂	44.0 (%)
O ₂	2.5 (%)
S	Traces

6.3 Rice Husk:

Rice husk is very uniform in size usually <3 mm, requiring no particular fuel preparation. Together with its CV of ~3500 kcal/kg, rice husk is an attractive fuel except for its seasonality. It requires a lot of space for storage. It is normal, therefore, to adopt multi fuel firing to take care of off-season. Captive power plants of 5–20 MW, attached to the rice mills, have been erected in a number of locations instead of transporting husk over longer distances. Rice husk has ~15 to 20% ash and is highly abrasive, as the ash contains silica to the extent of 90%. It is very dry, containing only ~7 to 9% moisture and not compressible for baling purposes. It has ~20% FC and 80% VM, requiring a normal furnace volume and adequate surface area. Husk demands a high ignition temperature and adequate time for combustion either on grate or on bed. VM leaves the fuel at ~500°C. Stoker firing is a good and simple firing system for rice husk. Its low fan power, simple operation, and seamless 1:4 turndown make it ideally suited for husk. Bubbling fluidized bed combustion is also an alternative, as husk has a good 15–20% ash to create its bed material and is sufficiently heavy to stay in the bed, unlike a light material such as bagasse. The higher fan power is offset by better combustion efficiency of 2–4%. Silica in ash is mostly in crystalline form. Only ~20% is in the amorphous form, and recovering silica in amorphous form has several high-end uses, which can be achieved only on controlled combustion of rice husk, limiting the firing temperatures to ~860°C. For this reason, the husk is pulverized in special mills and burnt in suspension to obtain ash with the desired properties. Analyses and properties of rice husk are given in following Tables.

Properties of Rice Husk and Ash:

Husk bulk density	100–300
Husk particle density (kg/m ³)	600–600
Bulk density (kg/m ³)	1250–1500
Particle density (kg/m ³)	2300–2800
Ash softening temperature (°C)	>1400
Ash fusion temperature (°C)	>1600
Theoretical air (kg/kg or lb/lb)	2.85
Theoretical CO ₂ (%)	20.6
H ₂ O in flue gas (kg/kg or lb/lb)	0.77
H ₂ in fuel (%)	3.0
Bulk density with 48% M in stacked condition (kg/m ³ and lb/ft ³)	200.0 and 12.5
Loose condition (kg/m ³ and lb/ft ³)	120.0 and 7.5
Angle or repose degrees	45–50 variables

6.4 Wood:

Wood is a complex vegetable tissue composed mainly of carbohydrates, and in common with all types of vegetation, it has a relatively low heating value in comparison with coal and oil. Heating value of different woods should have been nearly the same, but for the presence of varying amounts of resins, gums, and other substances, which creates a wide variation. For the same reason, any similar formula for estimation of GCV does not work with wood. Wood was the prime fuel till the early nineteenth century when coal and, later on, oil started displacing it. In the meanwhile the energy need and production has gone up dramatically. Progressive reduction of forests; better uses for wood, namely, furniture, paper, rayon, and so on; and enormous demand for energy that could be satisfied only by fossil fuels have combined to make wood and its products waste fuels today. In fact, wood-based steam generation is confined to Scandinavia, Canada, the United States, and certain South American countries, where forests are still abundant.

Properties of Wood on Dry Ash Free (DAF) Basis

VM (%)	80-85
H ₂	5.9-6.0
Theoretical air (Kg/1,000 kcal)	1.235
Theoretical CO ₂ (%)	20.25
GCV(DAF)(Kcal/kg)	4830

- Moisture content of freshly cut wood varies from 30 to 50%, which reduces to 18–25% after a year of drying. There is a loss of fuel value in the meantime.
- Woods with <50% moisture burn well. Owing to rain, snow, or transportation by water, moisture content can go to as high as 70%. At more than ~65% moisture, the combustion is not self-sustaining, as the heat produced is not sufficient to dry the moisture. Support fuel such as oil is then needed.
- Ash in wood is less at <2.5%.
- There is practically no nitrogen or sulfur, eliminating the fear of fuel NO_x formation and corrosion.
- The moisture content depends on the type, handling, storage, and age of wood.
- Generally, wood logs can be taken as containing ~40% moisture, sawdust, and chips 15–25%, and wood refuse from seasoned wood 15% moisture.

6.5 Agro fuels:

Agro fuels, or bio fuels, or vegetable fuels, as they are variously called, are essentially wastes generated by various crops. Fuels such as wood and bagasse are also agro fuels, but because of their relatively large availability, they have been used as regular fuels for a long time and generation of steam and power for a few decades now. The distinction between agro/bio fuels and biomass has to be clearly understood. Agro fuels form only a part of biomass, which is a comprehensive term embracing all organic matter formed, directly or indirectly, by virtue of photosynthesis. Besides agro fuels like crop, forest, agro-industrial residues and purpose-grown trees, biomass includes aquatic plants and even animal wastes.

Nature of Agro fuels with increasing energy costs and growing concern toward the environment, there is a heightened interest in harnessing the various agro fuels, although the steam and power they generate on a stand-alone basis is rather modest as of now. The main drawback of agro fuels is their limited and seasonal availability coupled with limited transportability due to their bulky nature. However, with low or no S and very low N₂, bio fuels are ecologically friendly. The disadvantage turns to favour, as small power plants can be put up, distributed over a wide area and close to small communities provided they are built with fuel flexibility. Based entirely on agro fuels, the benefit of carbon credits also accrue.

Alternatively the boilers are equipped to fire multiple agro fuels so that one or the other fuel can be burnt in each season. Power plants of only 5–30 MW are popular from the view of fuel collection. Often fuels are co fired in limited quantities in large boilers.

It is important to remember that no agro fuel can have, on a DAF basis, a GCV <13,500 kcal/kg (7,500 Btu/lb) or air requirement <1.21 kg/1,000 kcal (6.8 lb/10,000 Btu) of GCV, which is the minimum for cellulose (C₆H₁₀O₅).

Agro fuels are very friendly both from the ease of burning and from environmental compliance views. Also the ash in fuels is very low, typically <10%,

General Range of Properties of Agro fuels

Parameter	Range	Remarks
VM (DAF) (%)	72.0–90.0	
H ₂ (DAF) (%)	5.6-5.8	
M (%)	10.0	
Theoretical CO ₂ (%)	20.2–20.75	
<i>f</i> -factor	1.015–1.005	For CO ₂ calculation

GCV (DAF) (kcal/kg)	4500–5500	4000 ± 300 as received
GCV (DAF) (Btu/lb)	8000–10000	7200 ± 550 as received
Theoretical air (kg/kcal)	1.22/1000	Actual GCV
Theoretical air (lb/Btu)	6.85/10000	

7.0 Storage and Handling of fuel:

- 7.1** Uncertainty in the availability and transportation of fuel necessitates storage and subsequent handling.
- 7.2** The main goal of good coal storage is to minimize carpet loss and the loss due to spontaneous combustion.
- 7.3** Preparing a hard solid surface for coal to be stored
- 7.4** Preparing standard storage bays of concrete and brick industry, coal handling methods range from manual and conveyor systems. It would be advisable to minimize the handling of coal so that further generation of fines and segregation effects are reduced.
- 7.5** The fuel storage house shall be suitable to store the fuel required for 10-15 days continuous operation of the boiler.
- 7.6** Completely closed / covered dust free system shall be provided for storage & conveyance of solid fuel. The openings of fuel storage house shall be provided with proper shutters and flexi-curtains such that no dust shall go out in the plant.
- 7.7** Fuel Storage area must be covered with roof and wind breaking walls. The boundary walls shall have the height of more than the height of coal stack.
- 7.8** Approach roads (for movement of vehicles and handling of coal) must be paved and sprinkling system (with fine mist) shall be provided at solid fuel as well as at ash storage and handling areas to prevent fugitive emission.
- 7.9** De-dusting arrangement shall be made while loading and unloading of fuel as well as ash.
- 7.10** High pressure water atomizer nozzles shall be installed all along the conveyer and feeding system of fuel as well as at ash discharge point / conveyance. One such nozzle at every 3meter distance shall be provided.

7.11 Applicable and suitable measures mentioned in the “Guidelines of GPCB for Coal handling” shall be followed as available on the GPCB website.

8.0 Fuel Feed Mechanism:

- 8.1** Coal Fired boilers to use coal of low sulphur (<1%) and with suitable size (5-25 mm in combustion chamber or 0-50 mm in the yard as received). Bio fuels do not have the issue of NO_x & SO_x due to absence of Sulphur & lower combustion temperature (<1000⁰C).
- 8.2** The fuel shall be crushed to the size of 15 – 25 mm with the help of crusher. The crusher shall be provided with dust extraction system. The dust extraction system will extract the dust generated during crushing of fuel and maintain the crushing area dust free.
- 8.3** Fuel shall be fired uniformly and in less quantity at a time such that the bed thickness does not exceed about 6 to 9 inches (and not in big heaps). Depending on high/low steam demand, the frequency of firing could be increased or decreased (say 4 to 5 times / hour during higher steam demand, or say 2 to 3 times /hr. during lower steam demand).
- 8.4** All boilers/ utilities using coal or bio fuel shall fire with auto feeding arrangement and to be controlled with pressure or temperature.
- 8.5** Every time the fuel is fired, the damper should be set to “High” position for a minute or two (this would suck more combustion air required for burning volatile matter & thereby reduce soot / black smoke formation), and then it should be set back to “Low” position, till the next firing. (Setting could be made after a few trails). This damper adjustment should be done by the boiler operator throughout the boiler operation as a part of his regular duty like firing fuel for achieving optimised combustion at all time & thereby preventing pollution.
- 8.6** Multipoint fuel feeding to ensure uniform spread of fuel (coal/bio fuel) to ensure efficient combustion at controlled temperatures.

- 8.7 “Secondary air opening” to be kept full open at the time of firing for one or two minutes. Later, the opening "Must" be reduced till next firing. (Setting by trial & error).
- 8.8 Fire bed shall be cleaned at appropriate time to avoid build-up of “fire bed thickness”, if not, this would reduce the primary air supply successively & result into improper combustion.
- 8.9 Soot deposits in tubes shall be cleaned from time to time with proper tool. Build-up of deposits effects the steam generation adversely, and result into higher fuel gas temp. & higher stack loss.
- 8.10 The economiser shall be kept properly insulated.
- 8.11 Good quality feed water should be used for boiler & appropriate chemicals should be added, as directed by boiler supply, for avoiding tube deposits, else it would reduce steam generation.
- 8.12 CO₂ % shall be checked frequently (say once a day initially) to ensure proper boiler operation & take corrective actions, if required, immediately.
- 8.13 During operation of the boiler, the fuel stored in fuel storage house shall be loaded to a grizzly hopper, top opening of which is generally at 150 mm above ground level to facilitate easy loading of the fuel.

9.0 Combustion Chamber and flue gas:

9.1 Fully automatic, efficient and Complete Combustion of fuel in boiler

The fuel from hopper shall be fed in the boiler furnace with screw / rotary feeders. The Boiler shall be equipped with fully automatic Water/air Cooled Oscillating Grate for complete and efficient combustion of any type of solid fuel. The inclined water/air cooled oscillating grate shall be cooled by force circulation of boiler feed water/air, which shall maintain the lower bed temperature to reduce the ash fusion tendency. The heat absorbed by grate in this circulating water is put back to Pressurized De-aerator Tank. The primary under grate, combustion air shall be distributed, compartment wise along the length of grate in the proportion required for complete and efficient combustion of fuel. The gentle oscillations of the

oscillating grate moves fuel on inclined grate surface along length. The fuel burns completely during this movement.

9.2 Spray and tray type De-aeration of Boiler Feed Water

The dissolved oxygen in boiler feed water shall be completely removed in a spray and tray type de-aerator tank. In pressurized de-aerator tank boiler feed water temperature shall be maintained at approx. 105 Deg C at which the solubility of oxygen in water is very low and water shall be further to be passed through multiple trays for removal of oxygen and other gases from water.

9.3 Fully automatic, continuous modulation control for steam generation.

The heat released by fuel after combustion on oscillating grate shall be absorbed in water walled, membrane type furnace, followed by heat recovery economizer. Typical flue gas outlet temperature, at economizer outlet shall be 160 ± 10 Deg C.

The fully automatic continuous modulation control for steam generation shall include;

- a. Steam Drum Water Level Auto. Control – to maintain steady water level in steam drum
- b. Furnace Draft Auto control – to maintain negative pressure in furnace.
- c. Combustion Air Auto. Control – to maintain controlled excess air for combustion.
- d. Economizer Inlet temperature Auto control – to maintain temperature above dew point.
- e. Fuel feeding Auto control – to maintain steam pressure at load variations.

Oxygen in flue gas shall be continuously monitored to control the excess air; typically oxygen in flue gas will be below 7.5% by volume.

9.4 Fully automatic, online cleaning of boiler on flue gas side

Steam operated soot blowers shall be provided for automatic and online cleaning of boiler on flue gas side.

10.0 INSTALLATION AND OPERATION OF AIR POLLUTION CONTROL MEASURES:

- 10.1 Industry falling in critically polluted areas shall have to achieve norms of PM as 100 mg/Nm³ in stack emission and for that industry shall upgrade APCM.
- 10.2 The applicant shall be required to provide following minimum APCM based on **type of fuel and its consumption, fuel property like CV equivalent (NCV of fuel), equivalent ash content, equivalent moisture content etc. the industry may add to the APCM prescribed below, if need be so.**

Table-1

Steam generation capacity (in TPH)	Type of APCM
Less than 1	Cyclone + Water Scrubber
1 to 8	Multi cyclone + Bag Filter+ Water Scrubber
8 and more	ESP+ Water Scrubber

- 10.3 All the APCM viz. dust collectors, cyclones, multi cyclones, water scrubbers, bag filter and ESP shall be designed tailor made and applicant shall submit all the detailed design parameters considered by the equipment manufacturer based on the fuel to be utilized in Boilers and other utilities.
- 10.4 The APCM shall be approved by the schedule-I environmental auditor, which shall look in to feasibility of the change in fuel, with respect to this guidelines.
- 10.5 The unit shall install on line continuous emission monitoring system (CEMS) and link it with the server of GPCB for real time data transfer for boiler more than 8 TPH capacity or equivalent capacity of TFH.

10.6 If Boilers is of more than 8 TPH capacities, the unit shall install online CO₂ analyzer/ online CO₂ monitoring system and the combustion efficiency of the Boiler should be checked regularly.

10.7 The Bag filter shall conform to following minimum requirements for better efficiency and results:

- a) High temperature resistant bags like glass fiber bags shall be used.
- b) Manometer for indicating differential pressure shall be provided.
- c) GPS based alarm and buzzer system shall be installed for abnormal pressure difference.
- d) Pulse jet system shall be regularly checked for its efficient working.
- e) Reliable and efficient spark arrester should be installed prior to bag filter in case of biomass fired boilers.
- f) The differential pressure across bag filter shall not exceed 125mmWC or as per the design criteria supplied by the Bag Filter manufacturer. Recording facility should be available.
- g) Knocker or vibrators (pneumatic or electromagnetic) should be provided on hopper and to be operated automatically through sequential timer.
- h) Bag filter shall be properly insulated to avoid acid condensation due to cooling of flue gas temperature. Inlet flue gas temperature should be maintained above the acid dew point condensation temperature.
- i) Bag filter shall be preceded by cyclone/ multi cyclone for coarser particles and Economizer/ buffer/ quencher/ heat recovery system to avoid carry-over of spark in to the bag filter.
- j) If coal of higher sulphur content is used Bag filter shall followed by scrubber and lime injecting system (lime injection shall be done in the boiler furnace along with coal) should install boiler furnace.
- k) If fuel has high sulphur content (more than 0.1%) wet alkaline scrubber shall be provided in addition to (f) above.

10.8 In case of ESP, minimum 3 fields shall be provided.

10.9 Control of SO_x through one of the processes mentioned below (for coal fired boilers).

- Wet Limestone Process
 - Semi-wet Flash Absorption Process
 - Spray Drying-cum-Absorption Process
 - Sodium Alkali Process
 - Ammonia Process
- 10.10 Control of particulate matter by installing efficient ESP/Bag filters.
- 10.11 Control of NO_x with latest combustion grate technology, dynamically Air/Water cooled grate system (for multi fuel boilers & less than 20 TPH capacity).
- 10.12 PLC controlled operations.
- 10.13 Boiler efficiency shall be minimum 75 % and record for the same shall be maintained.
- 10.14 Boilers having capacity of 3 TPH or more shall be provided **with Online monitoring system** and **auto fuel feeding system** with conveyer/screw belt.
- 10.15 The cyclone bottom opening should be kept air tight & leak proof; else, it would reduce cyclone efficiency. The dust collected should be taken out from time to time (say once per shift) & appropriately disposed avoiding secondary pollution.
- 10.16 Cyclone, multi cyclone, bag filter and ESP shall be provided with rotary air valve for auto collection/discharge of fine dust.
- 10.17 Material of construction of wet scrubber should be S.S. 316 or equivalent to with stand against corrosion and acid effect. All water circulation pipe and pump should be S.S. 316 or acid and corrosion proof.
- 10.18 Sufficient water storage tank and filter arrangement to be provide for removing micro dust from circulating water.
- 10.19 Air pressure line of adequate capacity shall be provided for efficient working of air pulse jet system.
- 10.20 Energy meter for APCM shall be provided and record for the same should be maintained.
- 10.21 In bag filter technical by-pass can be allowed only heavy duty bypass damper arrangement in case if the by-pass is provided by manufacturer itself and can

operate with electro pneumatic system in case of high temperature or low temperature gas (due point temperature acid formation), RAV not operating. By-pass gas should pass through only cyclone or multicyclone before connected to chimney. In any case manual by-pass system is not allowed.

10.22 Auto by-pass system should display on control panel.

a) Stack/chimney requirements:

- i.** Stack height shall not be less than 33 meters in any case.
- ii.** The Stack height requirement based on sulphur dioxide emissions by using the equation – stack height = $14(Q)^{0.3}$ [where, Q is the emission rate of SO₂ in kg/hr.]
- iii.** By using simple Gaussian plume model to maintain ambient air quality requirements for all concerned parameters, in the receiving environment.

The required stack height shall be the maximum of the above three (i, ii & iii) considerations. In any case stack height should not be less than 11 meters.

- b)** If boilers to be connected with other utility's common chimney, the diameter of chimney should be square root of both chimney diameter. Sampling point should be provided as per GPCB requirement.
- c)** Sufficient space should be provided between boiler/utilities and chimney to install APCM.
- d)** Chimney should be provided with strong ladder and platform to take sample.
- e)** Approach road between boilers/utilities should be provided without any obstacles.
- f)** 230 V electrical points with weather proof plug and switch to be provided near chimney for sampling instrument.

10.23 Maintenance record i.e. regular cleaning, replacing damage part or changing the instrument should be maintained compulsory for all air pollution control devices.

10.24 The policy may be made more stringent based on the prevailing environmental scenario of in respective areas.

10.25 Since the reduction in emission is also related to better operation of the boiler, minimum loss of heat & steam, optimum speed of ID & FD fans, adequate area of the combustion chamber, proper balance of steam generation and transmission surface areas, a Standard Operating system shall be developed for each boiler by applicant and should be displayed at the boiler house.

11.0 Ash & Slag management

11.1 Water locking arrangement shall be provided for removal of ash/slag from the combustion chambers.

11.2 Where appropriate, options may be explored for recycling of ash/slag either within the facility or outside. Depending on the soluble fraction of the slag, as approved by concerned authority, slag can be used for utilization of metals, as road construction material etc.

11.3 Dry slag and ash (residues from combustion processes, boiler dust, residues from treatment of combustion gases etc.) shall be placed in closed bags, containers etc. to prevent diffused emissions.

11.4 The ash after complete combustion of fuel on water cooled oscillating grate shall be automatically discharged. It shall be removed outside the furnace through water quenched conveyors; hence ash discharge is at low temperatures. Also, as this ash is wet there is no dusting of ash in the boiler house.

11.5 Medium and Large scale industries, having coal / other solid fuel consumption about 50 MT/day shall provide silo with fully enclosed, dust proof conveyor, alarm system and pneumatic valve for ash handling.

12.0 Other requirement:

12.1 Proper sign boards shall be placed at all concerned areas.

12.2 In case of emergency, protocol to be followed shall be established and all operating staff shall be trained, accordingly. Inter-locking systems and alarm systems shall be provided at all reasonably possible areas.

- 12.3 Adequately qualified and trained staff shall be deputed for the operation; no unskilled personnel shall be engaged for operation of the boilers.
 - 12.4 The boiler shall incorporate all safety measures so as to provide complete protection to the operator and the unit against all possible operational/ machinery failures.
 - 12.5 Dedicated back-up power facility shall be provided with arrangement to automatically start functioning immediately in case of power failures.
 - 12.6 The whole equipment, not necessarily combustion chamber, may be painted with two coats of heat resistant (aluminium) paint.
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Annexure-1

ગુજરાત પ્રદૂષણ નિયંત્રણ બોર્ડ
પર્યાવરણ ભવન, નવ પકમ સેક્ટર
સેક્ટર-૧૦-એ, ગાંધીનગર

કાર્યાલય આદેશ

તાજેતરમાં મુખ્યત્વે સુરત, અમદાવાદ, અંકલેશ્વર અને વાપી આવેલ એકમો તરફથી કુદરતી ગેસના બળતણ તરીકેનો ઉપયોગ જેવા સોલીડ બળતણ તરફ વળવા માટે અથવા સોલીડ બળતણ નાખવા બોર્ડની સીઈટી/ સીસીએ મેળવવા માટે અરજીઓ મળી રા દરખાસ્તો ઉપર એક યુનિકોર્મ પોલીસી ઘડવામાં આવે જેથી આ વિસ્ત્ર ઉદ્ભવે નહી તે માટેની એક નીતિ વિષયક પોલીસી ઘડવા માટે ન એક આંતરીક સમિતિની રચના કરવામાં આવે છે.

- ૧) શ્રી કે.સી.મિસ્ત્રી, વરિષ્ઠ પર્યાવરણ વૈજ્ઞાનિક, યુનિટ હેડ-અંક
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- ૩) શ્રી ટી.બી.શાહ, પર્યાવરણ ઈજનેર, યુનિટ હેડ- વાપી
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નં.જીપીસીબી/અંકલેશ્વર-સી-૯૯૨/ 167193

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