GOVERNMENT OF DUBAI

تراخيص
Trakhees

Guidelines – Large Boilers and Furnaces

Issued by: Inspection Department – Operations Section

1.0 Introduction

Boiler is an enclosed device that uses controlled flame combustion to recover and export energy in the form of steam, heated fluid, or heated gases. Boilers must have a combustion chamber and primary energy recovery system of integral design to ensure the effectiveness of the unit's energy recovery system and to maintain a thermal energy recovery efficiency of at least 60%.

An industrial furnace is a unit that is an integral part of a manufacturing process and uses thermal treatment to recover materials or energy. At this time the following twelve devices are considered to be industrial furnaces:

- ✓ Cement Kiln
- ✓ Lime Kiln
- ✓ Phosphate Kiln
- ✓ Aggregate Kiln
- ✓ Blast Furnace
- ✓ Coke Oven
- ✓ Smelting, Melting and Refining Furnace
- ✓ Pulping Liquid Recovery Furnace
- ✓ Halogen Acid Furnace
- ✓ Methane Reforming Furnace
- ✓ Titanium Dioxide Chloride Process Oxidation Reactor
- ✓ Combustion Device used in the Recovery of Sulfur Valves from Spent Sulfuric Acid

These notes apply to works in which solid, liquid or gaseous fuel is burned, having a heat input equal to or greater than 30 megawatts (100 million BTU/h).

2.0 General Guidelines

2.1 Sampling, Measurement of Emissions and Monitoring

a. Emissions of sulfur dioxide, nitrogen oxides and particulate matter, including smoke from each boiler furnace shall be monitored continuously and shall be displayed on a meter visible to operating staff. Sampling ports and ladder/flanges facilities must be made available for monitoring.

b. The accepted form of particulate emission monitoring is by optical density measurements for fine particles and by a gravimetric method for coarse particles.

c. Zero and calibration checks on monitoring instruments shall be carried out by the company. The reference test method for particulates is by the procedure of British Standard 3405:1983.

d. All limit values in these notes are expressed as being at the reference conditions of 30°C and 1 bar and a standard of 12% CO_2 in the waste combustion gases.

2.2 Emission Limits and Controls

a. For oil-fired plant, sulfur dioxide removal equipment shall be installed with a removal efficiency of not less than 99.9%.

b. The design of the combustion system on oil-fired plant shall aim to limit the emission of nitric oxides to the air to a concentration not exceeding five hundred (500) mg/m^3 in normal operation for oil-fired.

c. The concentration of particulate matter in emissions to air shall not exceed two hundred fifty (250) mg/m^3 as a 2-hour average.

d. Emissions in normal operation shall be free from visible smoke and in any case shall not exceed two hundred fifty (250) mg/m^3.

e. For non-combustion plant, the concentration of particulate matter in emissions to air from the handling, crushing or screening of solid materials used in or produced by the combustion process shall not exceed two hundred fifty (250) mg/m^3.

2.3 Operational Controls

a. Means for preventing the emission of acid soot from oil-firing shall be operated continuously and the temperature of the gases in the chimney shall normally be maintained at not less than 150°C.

b. Chimney, flues and the duct, work leading to the chimney, shall be insulated to prevent liquid condensation on internal surfaces.

2.4 Chimneys

a. Chimney heights shall be assessed on the basis of estimated ground-level concentrations of the residual gases and taking account of local circumstances and recognized air quality standards or criteria.

b. The efflux velocity of the emitted hot, dry gases shall not be less than fifteen (15) m/s at maximum continuous rating for boilers or furnaces from 30 – 700 MW thermal rating, and not less than eighteen (18) m/s for combustion plant rated above 700 MW.

c. For non-combustion sources, chimneys shall normally be designed for an efflux velocity of not less than fifteen (15) m/s, but where a wet method of arrestment has been used in the chimney shall not exceed nine (9) m/s to avoid droplet entrainment from the chimney surface.

3.0 Technical Guidelines for Steam Boiler Installation

Prior to any steam boiler installation in the Free Zone, the following Guidelines are to be fulfilled:

a. Details of the steam boiler including capacity, fuel type (with sulfur content < 0.005% or 50 ppm), fuel rate, fuel sulfur content, etc. have to be provided.

b. Boiler room height and any adjacent building height to be provided. Boiler chimney height calculation will be provided by PCFC to the client.

c. The fuel tank should be bunded with impervious bund wall including the bund floor. The same should be designed to confine fuel of 110% fuel tank capacity and the underground bund area to be lined with proper PVC lining. Details of the bund wall volume calculation and design should be provided.

d. Solid fuels like coal briquettes etc. should be appropriately sized approx. 1 to 2 inch size /diameter (large pieces to be broken, wherever required).

e. Fuel should 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).

f. 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 optimized combustion at all time & thereby preventing pollution.

g. "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).

h. Fire bed should 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.

i. Soot deposits in tubes should be cleaned from time to time with proper tool. Build-up of deposits effects the steam generation adversely and result into higher fuel gas temperature & higher stack loss.

j. The economizer should be kept properly insulated.

k. The cyclone bottom opening should be kept air tight & leak proof; else, it would reduce cyclone efficiency. The duct collected should be taken out from time to time (say once per shift) & appropriately disposed avoiding secondary pollution.

l. Good quality feed water should be used for boiler & appropriate chemicals should be added, as directed by boiler supplier, for avoiding tube deposits, else it would reduce steam generation.

m. CO_2 % should be checked frequently (say once a day initially) to ensure proper boiler operation & take corrective actions, if required, immediately

n. Proper drainage facility should be provided for the boiler condensate and blow down to PCFC satisfaction, away form the domestic drainage of the facility. A detailed drawing in this regard should be provided.

- Conditions mentioned under the title "Large Boilers and Furnaces" should be fulfilled and acknowledged.

- Proper sampling point to be provided on the chimney for emission quality checks.

4.0 Health Effects

HCl emissions represent the predominant hazardous air pollutant emitted by industrial boilers. Industrial boilers emit lesser amounts of hydrogen fluoride, chlorine, metals (arsenic, cadmium, chromium, mercury, manganese, nickel and lead), and organic hazardous air pollutant emissions. Although numerous organic hazardous air pollutant may be emitted from industrial boilers and heaters, only a few account for essentially all the mass of organic hazardous air pollutant emissions. These organic hazardous air pollutants are formaldehyde, benzene and acetaldehyde.

Exposure to high levels of these hazardous air pollutants is associated with a variety of adverse health effects. These adverse health effects include chronic health disorders (e.g., irritation of the lung, skin and mucus membranes, effects on the central nervous system, and damage to the kidneys), and acute health disorders (e.g., lung irritation and congestion, alimentary effects such as nausea and vomiting, and effects on the kidney and central nervous system.

Acetaldehyde: Chronic (long-term) inhalation exposure to inorganic arsenic in humans is associated with irritation of the skin and mucous membranes. Human data suggest a relationship between inhalation exposure for women working at or living near metal smelters and an increased risk of reproductive effects. Inorganic arsenic exposure in humans by the inhalation route has been shown to be strongly associated with lung cancer, while ingestion of inorganic arsenic in humans has been linked to a form of skin cancer and also to bladder, liver, and lung cancer.

Benzene: Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells. Increased incidence of leukemia (cancer of the tissues that form white blood cells) has been observed in humans occupationally exposed to benzene.

Beryllium: Chronic (long-term) inhalation exposure of humans to high levels of beryllium has been reported to cause chronic beryllium disease (berylliosis), in which granulomatous (non cancerous) lesions develop in the lung. Inhalation exposure to high levels of beryllium has been demonstrated to cause lung cancer in rats and monkeys. Human studies are limited, but suggest a causal relationship between beryllium exposure and an increased risk of lung cancer.

Cadmium: Chronic (long-term) inhalation or oral exposure to cadmium leads to a build-up of cadmium in the kidneys that can cause kidney disease. Cadmium has been shown to be a developmental toxicant at high doses in animals, resulting in fetal malformations and other effects, but no conclusive evidence exists in humans. Animal studies have demonstrated an increase in lung cancer from long-term inhalation exposure to cadmium.

Chlorine: Chlorine is a commonly used household cleaner and disinfectant. Chlorine is an irritant to the eyes, the upper respiratory tract, and lungs. Chronic (long-term) exposure to chlorine gas in workers has resulted in respiratory effects, including eye and throat irritation and airflow obstruction. No information is available on the carcinogenic effects of chlorine in humans from inhalation exposure. A National Toxicology Program (NTP) study showed no evidence of carcinogenic activity in male rats or male and female mice, and equivocal evidence in female rats, from ingestion of chlorinated water.

Chromium: Chromium may be emitted by industrial boilers in two forms, trivalent chromium (chromium III) or hexavalent chromium (chromium VI). The respiratory tract is the major target organ for chromium VI toxicity for inhalation exposures. Bronchitis decreased pulmonary function, pneumonia, and other respiratory effects have been noted from chronic high dose exposure in occupational settings to chromium VI. Limited human studies suggest that chromium VI inhalation exposure may be associated with complications during pregnancy and childbirth, while animal studies have not reported reproductive effects from inhalation exposure to chromium VI. Human and animal studies have clearly established that inhaled chromium VI is a carcinogen, resulting in an increased risk of lung cancer.

Formaldehyde: Exposure to formaldehyde irritates the eyes, nose, and throat. Reproductive effects, such as menstrual disorders and pregnancy problems, have been reported in female workers exposed to high levels of formaldehyde. Limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer. Animal inhalation studies have reported an increased incidence of nasal squamous cell cancer.

Hydrogen Chloride: Hydrogen chloride, also called hydrochloric acid, is corrosive to the eyes, skin, and mucous membranes at high concentration. Chronic (long-term) occupational exposure to high levels of hydrochloric acid has been reported to cause gastritis, bronchitis, and dermatitis in workers. Prolonged exposure to lower concentrations may also cause dental discoloration and erosion. No information is available on the reproductive or developmental effects of hydrochloric acid in humans. In rats exposed to high levels of hydrochloric acid by inhalation, altered estrus cycles have been reported in females and increased fetal mortality and decreased fetal weight have been reported in offspring.

Hydrogen Fluoride: Chronic (long-term) exposure to fluoride at low levels has a beneficial effect of dental cavity prevention and may also be useful for the treatment of osteoporosis. Exposure to higher levels of fluoride may cause dental fluorosis. One study reported menstrual irregularities in women occupationally exposed to fluoride.

Lead: Lead can cause a variety of effects at low dose levels. Chronic (long-term) exposure to high levels of lead in humans results in effects on the blood, central nervous system (CNS), blood pressure, and kidneys. Children are particularly sensitive to the chronic effects of lead, with slowed cognitive development, reduced growth and other effects reported. Reproductive effects, such as decreased sperm count in men and spontaneous abortions in women, have been associated with lead exposure. The developing fetus is at particular risk from maternal lead exposure, with low birth weight and slowed postnatal neurobehavioral development noted. Human studies are inconclusive regarding lead exposure and cancer, while animal studies have reported an increase in kidney cancer from high-dose lead exposure by the oral route.

Manganese: Health effects in humans have been associated with both deficiencies and excess intakes of manganese. Chronic (long-term) exposure to low levels of manganese in the diet is considered to be nutritionally essential in humans, with a recommended daily allowance of 2 to 5 milligrams per day (mg/d). Chronic exposure to high levels of manganese by inhalation in humans results primarily in CNS effects. Visual reaction time, hand steadiness, and eye-hand coordination were affected in chronically-exposed workers. Impotence and loss of libido have been noted in male workers afflicted with manganese attributed to high-dose inhalation exposures.

Mercury: Mercury exists in three forms: Elemental mercury, inorganic mercury compounds (primarily mercuric chloride), and organic mercury compounds (primarily methyl mercury). Each form exhibits different health effects. Various major sources may release elemental or inorganic mercury; environmental methyl mercury is typically formed by biological processes after mercury has precipitated from the air.

Chronic (long-term) exposure to elemental mercury in humans also affects the CNS, with effects such as increased excitability, irritability, excessive shyness, and tremors.

The major effect from chronic exposure to inorganic mercury is kidney effects. Reproductive and developmental animal studies have reported effects such as alterations in testicular tissue, increased embryo resorption rates, and abnormalities of development. Mercuric chloride (an inorganic mercury compound) exposure has been shown to result in tumors in experimental animals.

Nickel: Nickel is an essential element in some animal species, and it has been suggested it may be essential for human nutrition. Nickel dermatitis, consisting of itching of the fingers, hand and forearms, is the most common effect in humans from chronic (long-term) skin contact with nickel. Respiratory effects have also been reported in humans from inhalation exposure to nickel. No information is available regarding the reproductive or developmental effects of nickel in humans, but animal studies have reported such effects, although a consistent dose-response relationship has not been seen. Nickel forms released from industrial boilers include soluble nickel compounds, nickel sub sulfide, and nickel carbonyl. Human and animal studies have reported an increased risk of lung and nasal cancers from exposure to nickel refinery dusts and nickel sub sulfide. Animal studies of soluble nickel compounds (i.e., nickel carbonyl) have reported lung tumors.

Selenium: Selenium is a naturally occurring substance that is toxic at high concentrations but is also a nutritionally essential element. Studies of humans chronically (long-term) exposed to high levels of selenium in food and water have reported discoloration of the skin, pathological deformation and loss of nails, loss of hair, excessive tooth decay and discoloration, lack of mental alertness, and listlessness. The consumption of high levels of selenium by pigs, sheep, and cattle has been shown to interfere with normal fetal development and to produce birth defects. Results of human and animal studies suggest that supplementation with some forms of selenium may result in a reduced incidence of several tumor types. One selenium compound, selenium sulfide, is carcinogenic in animals exposed orally.