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Mitigation of air pollution in sponge iron industries

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ABSTRACT

The manufacture of steel involves the production of a metallic product called sponge iron. The electric furnaces are fed with the sponge iron for manufacture of steel or use foundries for the manufacture of wrought iron. In the manufacture of wrought iron, sponge iron is used as a raw material in the furnaces. Air pollutants like oxides of sulphur oxides, nitrogen and compounds of carbon released during sponge iron production cause diseases relating to the lungs such as lung cancers, breathing difficulties, asthmatic attacks.

KEY WORDS: sponge iron, steel, air pollution, stack emissions.

1. INTRODUCTION

Sponge iron also called as direct reduced iron is produced from the reduction process of iron ore (in the form of solid lumps, fines and pellets). The gases used for reduction are the reducing products like hydrogen (H_2) and carbon monoxide (CO) gases. This reduction is called as the direct reduction process of processing iron ore.

The Industrial procedure for making steel consists of pelletizing and sinter sing plants, coking ovens, furnaces, and iron ore furnaces. The sponge iron plants need huge investments and raw materials. In order to make coke strong and tough to the reaction environments in the blast furnace coking of coal is done. Steel plants having various integrated operations are highly polluting the air environment due to the presence of blast furnaces and reduction units for iron ore. The sponge iron plants are highly polluting and very expensive.

Sponge iron is produced by processes using coal and natural gas as the raw material. Wrought iron is manufactured using sponge iron as the raw material. In this process iron ore is reduced under extremely high temperatures using coal. Wrought iron is initially prepared by beating the sponge iron from the furnace using heavy hammers and folding process. The wrought iron produced by this method contents three percent impurities as slag and small percentages of impurities. Wrought iron produced is further treated under intense heat conditions to produce the final wrought iron product. Nowadays, reduction process of iron ore is used to manufacture sponge iron. This reduction process is found to be an environmental friendly and energy saving technology and reduces the amount of waste production.

Air pollution:

Sources of Air Pollution

- Combustion of coal in the preheating zone, kiln
- Oxidation of iron ore in the process zone, kiln
- Flue gas from the kiln through the upper end.
- Dust of char, unburnt lime, sulphur, alumina and others through the discharge end.
- Flue gas through the cap of the After Burn Chamber.
- Particulate matter from ESP Fugitive.
- Raw material handling and feeding area.
- Discharge end and cooler discharge
- Product separator

Sponge iron industry causes air pollution by stack emissions. Pollution control equipment at stacks are to be provided to control these emissions can be controlled by installing equipments to check the pollution. Air pollutants like oxides of sulphur oxides, nitrogen and compounds of carbon released during sponge iron production cause diseases relating to the lungs such as lung cancers, breathing difficulties, asthmatic attacks.

There are two types of pollutants in the sponge iron industry, namely, primary air pollutants and secondary air pollutants which are due to basic human works and due to the release of harmful chemicals into the atmosphere respectively. It us also found that the primary and secondary air pollutants react and cause more harmful air polluting chemical products.

Sulphur dioxide (SO_2), oxides of nitrogen, hydrocarbons, carbon dioxide and suspended particulate matter (SPM) are the most important air pollutants causing air pollution formed from fossil fuels used in generation of power, eruptions of volcanoes etc.

Typical health effects include:

- Lung Fibrosis, kidney failure, skin allergies
- fever with by nausea and headache
- Loss of Lung function
- Eye problems like dry eyes

Control pollution of air: The control measures to be followed are given below:

- Electrostatic separators are used for checking the pollutants in the rotary kiln.
- Bag filters are provided. ESP connects to a Rotary kiln to reduce the impact of air pollution.
- Coal feed fines are reduced to reduce emissions.
- Stack emissions are monitored to increase the performance of the air pollution control units.
- Periodical monitoring of stack gas is periodically maintained to check ambient air quality.
- Spraying of water is adopted at loading and unloading points and raw material storage yards to reduce fugitive emissions due to transport of raw materials like iron ore.
- Fugitive dust due to transport of raw materials like iron ore is reduced by asphalting of internal roads.
- Provision of trees for eco balance is needed.
- Air pollution control equipment has to be properly maintained.
- vehicles and machinery's have to be maintained in order to control emissions

Environmental standards: The Sponge iron industry comes under the Red category of industries to the Government of India. Sponge iron plants have different standards for stack emissions. Coal based plants should emit particulate matter of only 100 mg/Nm^3. Carbon dioxide levels and carbon monoxide should not be more than 12% and 1% respectively.

Sponge iron industries should follow national ambient air quality (NAAQ) standards. The air pollutants dispersed from sponge iron industry should have only Suspended Particulate Matter (SPM) not more than 100 µg/m^3. The industry has to follow the CPCB standards for the letting out effluent water. An electrostatic precipitator should be installed in the industrial manufacturing site. Equipment to control air pollution should be provided with continuous power supply. A dust collection system has to be installed in the industrial site. Equipment for fugitive emission measurement should also be installed in the industrial area.

Zero discharge plants are to be setup in the site and measures to reuse the water have to be taken. To prevent mixing with effluent drain to dispose rain water should be provided within the plant. CREP does mention solid waste related guidelines. Power generation can be achieved by setting up boilers for energy recovery. Alternate sources of fuel should identified in this boiler. Agricultural fields should not be used for disposing the wastes from the industry. Road construction or landfilling can be used for disposing the wastes from the kilns. Recycling or reusing principle can be used for energy efficiency.

Industrial steam recovery boiler for power generation can be used in sponge iron plants. Sprinkling of water near loading area has to be done. Green belt of 15m width should be provided done. Separate stack for kilns should be given. The following measures have to be taken for environment protection in sponge iron industries

- A distance of one kilometer (km) from residential areas and ecologically protective areas.
- Half a km distance to be left important highways.
- Five km radial distance to be maintained for plants with 0.165 MTPA capacities.

2. CONCLUSION

Air pollution is a basic problem in today's world. Air pollution causes many health problems, like infections in the respiratory tract and reduced lung function, difficulty in breathing, fibrotic lungs and even death. Statistical data reveal the need for urgent need to stop the ill effects of air pollution. All sponge iron industries should abide by the compulsory standards, under the Corporate Responsibility for Environmental Protection (CREP).

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