Air Pollutions Effect and Control Methods in Foundrie Industries

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***Abstract:* -The development of science and technology leads to environmental problems in both developed and developing countries. Air pollution is one of these problems. The impact of air pollutants on human health has become a major issue. Air pollutant means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration that may or tend to be injurious to human beings, other living creatures, plants, property or the environment in general. Air pollution emanates from many sources, stationary sources such as factories, power plants, smelters and smaller sources such as dry cleaners and degreasing operations, mobile sources such as cars, buses, planes, trucks, and trains; anthropogenic activities and naturally occurring sources such as windblown dust and volcanic eruptions. Air pollution has been aggravated by development that typically occurs as countries become industrialized growing cities, increasing traffic, rapid economic development and industrialization, and higher levels of energy consumption. In air pollution is widespread in urban areas where vehicles are the major contributors and in a few other areas with a high concentration of industries and thermal power plants. Vehicular emissions are of particular concern since these are ground level sources and thus have the maximum impact on the general population.**

***Keywords:* Air pollution, sources, health, environment, controlling techniques.**

1.INTRODUCTION:

To find out various pollutions and controls of pollutions levels. Identifications and assessment of potential pollutions involved in the foundry operations. The industry has to identify the hazards pollutions, assess the associated risk and bring the risk to tolerable level on a continuous basis. Foundry operations being hazardous operations have considerable safety risk to foundry. Industries pollutions lead to a number of accidents and causes loss and injuries of human lives damages of social environment, interrupt productions etc.

Air Pollution: Pollution is the harmful substance Pollution is a negative/undesirable change in the environment, usually the addition of something hazardous or detrimental. It is an undesirable change in the physical, chemical or biological characteristics of air. They are the substances which pollute the air. Some of the common pollutants are dust, soot, ash, and carbon monoxide, excess of carbon dioxide, sulphur dioxide, oxides of nitrogen, hydrocarbons, chlorofluorocarbons (CFC), lead compounds, asbestos dust, cement dust, pollens and radioactive rays.

Primary pollutants: Primary pollutants are substances that are directly emitted into the atmosphere from sources. The main primary pollutants known to cause harm in high enough concentrations are the following The major primary pollutants include particulate matter (PM),sulfur dioxide, nitrogen oxides,

Volatile organic compounds (VOCs), carbon monoxide, and lead.[6] Peter Osei Boamah, Ajacqueline Onumah,2004-2012

Secondary pollutants: Secondary pollutants are not directly emitted from sources, but instead form in the atmosphere from primary pollutants (also called “precursors”). Many types of pollution affect the environment There are two different types of pollution and they are called Point Source Pollution Non-point Source Pollution Each slightly affects the environment differently. Point source pollution is the type of pollution that can be easily tracked back to its source. You can identify (point to) the source of this pollution. Effects of Point Source Pollution, This type of pollution immediately may destroy habitats or kill life on large scales, because it is concentrated amounts of pollution .Non-point source pollution is the type of pollution that cannot be easily tracked back to its source. You cannot identify (point to) the source of this pollution; this type of pollution happens every day in all communities. Individuals must be responsible for their own actions, because we cannot identify who these polluters are. Non-point source pollution is more frequent than point source pollution and is the type of pollution that is responsible for harming most of the animals in the ocean. Effects on the environment Acid rain,Ozone depletion and Global warming, In human population- respiratory problems, allergies, strengthens lugs, and a risk for cancer

Human Health Effects Exposure to air pollution is associated with numerous effects on human health, including pulmonary, cardiac, vascular, and neurological impairments. The health effects vary greatly from person to person. High-risk groups such as the elderly, infants,

pregnant women, and sufferers from chronic heart and lung diseases are more susceptible to air pollution. Children are at greater risk because they are generally more active outdoors and their lungs are still developing. Exposure to air pollution can cause both acute (short-term) and chronic (long-term) health effects.
Acute effects are usually immediate and often reversible when exposure to the pollutant ends. Some acute health effects include eye irritation, headaches, and nausea.

Chronic effects are usually not immediate and tend not to be reversible when exposure to the pollutant ends. Some chronic health effects include decreased lung capacity and lung cancer resulting from long-term exposure to toxic air pollutants.

Effects on Human respiratory system: Both gaseous and particulate air pollutants can have negative effects on the lungs. Solid particles can settle on the walls of the trachea, bronchi, and bronchioles. Continuous breathing of polluted air can slow the normal cleansing action of the lungs and result in more particles reaching the lower portions of the lung. Damage to the lungs from air pollution can inhibit this process and contribute to the occurrence of respiratory diseases such as bronchitis, emphysema, and cancer. Air pollution affects respiratory system causing breathing difficulties and diseases such as bronchitis, asthma, lung cancer, tuberculosis and pneumonia. Air Pollution affects the central nervous system causing carbon monoxide poisoning.CO has more affinity for hemoglobin than oxygen and thus forms a stable compound carboxyl hemoglobin (COHb), which is poisonous and causes suffocation and death.

2. CONTROL OF FOUNDRY INDUSTRY POLLUTANT

Dust and Particulate Matter: Dust and particulate matter are generated in each of the process steps with varying levels of mineral oxides, metal (mainly manganese and lead), and metal oxides. Dust emissions arise from thermal (e.g. melting furnaces) and chemical / physical processes (e.g. molding and core production), and mechanical actions (e.g. handling of raw materials, mainly sand, and shaking out and finishing processes).
Prevention and control techniques for particulate matter arising from casting and molding.
Use dry dust collection technologies (e.g. bag filters and cyclones) instead of wet scrubbers, especially in green sand preparation plants. The dry techniques allow dust to be easily collected, transported, and recirculated into the sand mixing process, thus avoiding the creation of effluent from wet scrubbers

- Use of filters on exhausts, especially in casting and finishing shops
- Use of vacuum cleaning in moulding and casting shop
- Install closed dedusting units in working areas.

Nitrogen Oxides: Nitrogen oxides (NOX) emissions are caused by high furnace temperature and the oxidation of nitrogen. Techniques to prevent and control the generation of NOx are addressed in the General EHS Guidelines. Emission reduction can be achieved through primary process modification measures and secondary end-of-pipe abatement techniques.
Pollution prevention and control techniques: Minimize the air / fuel ratio in the combustion process. Use oxygen enrichment in the combustion process and Use low NOX burners in fuel firing furnaces. Install secondary controls (mainly for cupola furnaces, EAFs, and rotary furnaces) such as a catalytic incinerator, as necessary.
Sulfur Oxides: The presence of sulfur oxides (SOX) in waste gases from melting furnaces depends on the sulfur content of fuel and process coke. Sulfur dioxide (SO2) emissions are emitted from waste gases in cupola and rotary furnaces. Other emission sources include gas hardening processes in mold- and core Making with chemically bonded sand, and in magnesium (Mg) melting.
Pollution prevention and control techniques to reduce SO2 emissions: Select feedstock's and scraps with low sulfur content. Use fuel with low sulfur content, such as natural gas and Install gas wet scrubbing systems before dry scrubbers as part of dedicated collecting and dedusting system
Carbon Monoxide: The most significant sources of carbon monoxide (CO) are off gases from cupola furnaces and EAFs. The presence of CO in off-gases from cupola furnaces is due to the cupola process itself. In EAFs, CO is generated from the oxidation of the graphite electrodes and the carbon from the metal bath during the melting and refining phases. Carbon monoxide is also emitted when sand molds and cores come into contact with the molten metal during metal pouring activities.
Prevention and control to reduce fugitive emissions of dust: Use of pneumatic conveying systems, particularly for transferring and feeding additives into the process area and Use of enclosed conveyers with dust-controlled transfer points, especially when transferring sand into the molding shop. Clean return belts in the conveyor belt systems to remove loose dust. Use indoor or covered stockpiles or, when open-air stockpiles are unavoidable, use water spray system, dust suppressants, windbreaks, and other stockpile management techniques. Use of enclosed silos to store bulk powder materials.

Implement routine plant maintenance and good housekeeping to keep small leaks and spills to a minimum. In the melting process, particulate matter (PM) emissions in the form of dust, metallic materials, and metal oxide fumes, vary according to furnace type, fuel, and metal to be melted and melting characteristics. Cupola furnaces produce the most significant amount of particulate matter (e.g. coke, fly ash, silica, rust and limestone). Electric arc furnaces (EAFs) are another significant source of PM during charging, at the beginning of melting, during oxygen injection, and during the decarburizing phases. Lower emission rates are associated with other melting furnaces types, particularly induction furnaces. Load-based emissions for metal melting range from insignificant values for certain Nonferrous metals up to above 10 kilograms per ton (kg/ton) for melting of cast iron using a cupola furnace.

Pollution prevention techniques:

- Use of induction furnaces,
- Use of open hearth furnaces is no longer considered good practice for steel smelting and should be avoided;

Avoid use of traditional cupola furnace technology. If cupola furnaces are used, enhanced technologies should be adopted to increase furnace energy efficiency and reduce the coke charge, including Use of oxygen injection or enrichment of blast air. Superheating of blast air in hot blast cupolas. Use of coke less cupola. where the metal charge is heated by the combustion of natural gas. Implement technologies in melting furnaces which allow reduction of energy consumption (e.g. installation of oxyfuel burners, slag foaming practice in the EAFs, or oxygen injection when applicable).Installation of off-gas collection hoods for cupolas, canopy hood enclosures for electric arc furnaces (EAFs), and cover extraction for induction furnaces to reduce fugitive emissions. Installation of an appropriate furnace hooding system may facilitate the capture of up to 98 percent of the furnace dust. Use of dust control technologies, typically including installation of bag filters and cyclones to control emissions from melting processes.

3.COMMONLY USED DEVICES FOR CONTROLLING PARTICULATE EMISSIONS ABSORPTION & WET SCRUBBING EQUIPMENT

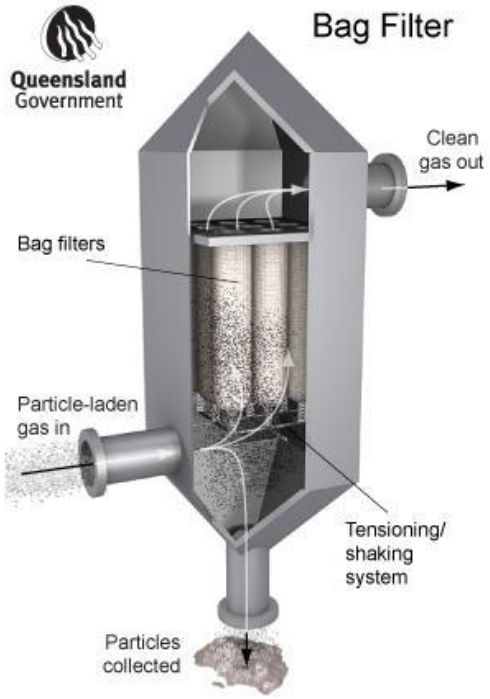
Scrubbing is a physical process whereby particulates, vapors, and gases are controlled by either passing a gas stream through a liquid solution or spraying a liquid into a gas stream. Water is the most commonly used absorbent liquid. As the gas stream contacts the liquid, the liquid absorbs the pollutants, in much the same way that rain droplets wash away strong odors on hot summer days. Gas absorption is commonly used to recover products or to purify gas streams that have high concentrations of water-soluble compounds. Absorption equipment is designed to get as much mixing between the gas and liquid as possible. Common types of gas absorption equipment include spray towers, packed towers, tray towers, and spray chambers. Packed towers are by far the most commonly used control equipment for the absorption of gaseous pollutants. However, when used with heavy, particulate-laden gas, they can be plugged by particulate matter (PM). Wet collection devices used for PM control include venturi scrubbers, bubbling scrubbers, spray towers, and in some instances, wet electrostatic precipitators (ESPs).

ADSORPTION

The process of adsorption involves the molecular attraction of gases or vapors (usually volatile organic compounds (VOCs)) onto the surface of certain solids (usually carbon, molecular sieves, and/or catalysts). This attraction may be chemical or physical in nature and is predominantly a surface effect. Activated carbon (charcoal), which possesses the large internal surface area needed to adsorb large quantities of gases within its structure, is often used to remove VOCs from flue gases. After the activated carbon is saturated with VOCs, it is often treated (by heat and/or steam) to strip off the collected VOCs.

FABRIC FILTERS OR BAG HOUSES

Fabric filters, also commonly referred to as bag houses, are used in many industrial applications. They operate in a manner similar to a household vacuum cleaner. Dust-laden gases pass through fabric bags where the dry particulates are captured on the fabric surface



Fabric Filters Or Bag Houses

After enough dust has built up on the filters, as indicated by a build up in pressure across the fabric, dust is periodically removed by blowing air back through the fabric, pulsing the fabric with a blast of air, or shaking the fabric. Dust from the fabric then falls to a collection hopper where it is removed. As dust builds up on the fabric, the dust layer itself can act as a filter aid improving the removal efficiency of the device. Fabrics used in bag houses can be made of a number of different materials, selected for the particular application.

CYCLONES

Cyclones operate to collect relatively large size particulate matter from a gaseous stream through the use of centrifugal forces. Dust laden gas is made to rotate in a decreasing diameter pathway forcing solids to the outer edge of the gas stream for deposition into the bottom of the cyclone. Efficiencies of 90% in particle sizes of 10 microns or greater are possible.Dust-laden gas is whirled rapidly inside a collector shaped like a cylinder (or cyclone). The swirling motion creates centrifugal forces that cause the particles to be thrown against the walls of the cylinder and drop into a hopper below.

The gas left in the middle of the cylinder after the dust particles have been removed moves upward and exits the cylinder. Cyclones operate to collect relatively large size PM from a gaseous stream, and can operate at elevated temperatures. Cyclones are typically used for the removal of particles 50 microns (μm) or larger. Efficiencies greater than 90% for particle sizes of 10 μm or greater are possible, and efficiency increases exponentially with particle diameter and with increased pressure drop through the cyclone.

ELECTROSTATIC PRECIPITATORS (ESPS)

ESPs are relatively large, low velocity dust collection devices that remove particles in much the same way that static electricity in clothing picks up small pieces of lint. Electrostatic Precipitators (esps)

Transformers are used to develop extremely high voltage drops between charging electrodes an collecting plates. The electrical field produced in the gas stream as it passes through the high voltage discharge introduces a charge on the particles, which is then attracted to the collecting plates. Periodically the collected dust is removed from the collecting plates by a hammer device striking the top of the plates (rapping) dislodging the particulate, which falls to a bottom hopper for removal. Electrostatic precipitators are often configured as a series of collecting plates to improve overall collection efficiency. Efficiencies exceeding 99% can be achieved, and ESPs are used in many of the same applications as bag houses, including power plants, steel and paper mills, smelters, cement plants, and petroleum refineries. In some applications water is used to remove the collected particulates.

ESPs using this cleaning mechanism are referred to as “wet ESPs” and are often used to remove fumes such as sulfuric acid mist.

BIOFILTERS

Biofilters operate to destroy VOCs and odors by microbial oxidation of these problem compounds. They are most effective on water-soluble materials. The polluted air is passed through a wetted bed, which supports a biomass of bacteria that absorb and metabolize pollutants. Efficiencies over 98% are possible with this application.

Steps taken to control Air Pollution

- Fuel Quality improvement for Pollution Control and Vehicular Pollution Control. Improvement in Vehicular Technology (Euro-I, Euro-II, CNG Vehicles, 4 stroke engines,
- Improvement in Fuel quality - Diesel with low sulfur content (0.25 in whole country and 0.05 in NCR & Mumbai).Low Sulfur content (0.1% in whole country and 0.05% in NCR and Mumbai
- Pollution Under Control (PUC) certificate for all vehicles every 3 months, Coal beneficiation/clean coal technology – notification regarding use of beneficiated coal
- Air Quality Monitoring at National Level s and Air Quality Index for public Information. Air Quality Data on TV channels and daily news papers for Public awareness.

4. Technologyevaluated/Disseminated to Industry for Pollution Control

- Development of control technology for suppression and prevention of dust emission from stone crushers (with NPC).Optimization of combustion efficiency and control of emission from small (less than 2t/hr) boilers (with NPC).
- Noise control system from stationary diesel generator sets (with IISC).Disposal and utilization of red mud from aluminum industries. Technologies for removal of SO_2 from flue gases (with CPRI).Technologies for control of NOx emissions (with DCL).Evaluation of technologies for different types of boilers (FBC, PFBC etc.) (With TERI)
- Evaluation of clean coal technologies. Characterization of fabric filter dust collector. Design and operating parameters of electrostatic precipitators and Utilization of fly ash in cement industry (with NCBM, UOR).The use of low-waste technology and of less hazardous substances.
- The furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate. Comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale. Technological advances and changes in scientific knowledge and understanding.
- The nature, effects and emissions concerned. The commissioning dates for new or existing installations.
- The length of time needed to introduce the best available technique. The consumption and nature of raw materials (including water) used in the process and their energy efficiency. Need to prevent or reduce to a

minimum the overall impact on the environment and the risks to it. The need to prevent accidents and to minimize the consequences for the environment. The information published by the Commission or by international organizations.

5. CONCULSIONS

Air pollution is a major environmental problem due to high population growth intensification of agriculture and industrialization. Air pollution is caused by a variety of different substances that include liquid, solid and gas particles. The effect of these pollutants on our health and the environment is enormous. The best way to achieve good air quality is to reduce pollutant emissions by changing to fuels and processes that are less polluting. Also, pollutants that are difficult to be eliminated by the aforementioned processes must be collected or trapped by appropriate air-cleaning devices such as cyclone, electrostatic precipitator, packed wet scrubber and bag filter before they can escape into the atmosphere.

Cyclones are used as pre cleaners and are followed by electrostatic precipitators and bag houses which are more efficient air-cleaning equipment. Furthermore, gaseous criteria pollutants as well as VOCs and other gaseous air toxics should be controlled by employing singly or in combination three basic techniques such as absorption, adsorption, and incineration.

REFERENCES

[1] Mrs. Chandralatha Senarath December, 2003 AN OVERVIEW OF AIR POLLUTION AND RESPIRATORY ILLNESSES IN SRI LANKA Chennai: Department of Geography, University of Madras and Faculty of Environmental Studies, York University. Pages 489 – 501.

[2] Dr.Savita Dubey, 2013 Acid Rain-The Major Cause of Pollution: Its Causes, Effects and Solution International Journal of Scientific Engineering and Technology (ISSN : 2277-1581) Volume No.2, Issue No.8, pp : 772-775

[3] Joseph Cacciottolo Lung health and outdoor air pollution - a review Environmental Management and Planning Division Institute of Earth Systems, University of Malta.

[4] A.G. Matani controlling industrial air pollution emissions in developing economies, Jr. of Industrial Pollution Control 22 (1)(2006) pp 83-88 © Enviromedia.

[5] G. Kanchev*, D. Kostandieva, S.Dimitrov, Environmental Pollution, Some Realized Projects And Suggestions Trakia Journal of Sciences, vol. 3, no. 8, pp 14-16, 2005 issn 1312-1723.

[6] Peter Osei Boamah, Ajacqueline Onumah, Bmohammed Takase, Cprince Osei bonsu & Dtayari salifu air pollution control techniques global journal of bio science &biotechnology 2004-2012 society for science and nature (SFSN).

[7] Rahul Pandey, Rajiv K.Srivastava Sa Srivastava..,Indian foundry limited Asian journals of management Cases.,1(2),2004 New Delhi/Thousand oaks/Londan.

[8] Karen grigges Indian university Non –Rule Environment Policy A Case Study of A Foundry Sand Land Disposal.

[9] Jayanta Mitra, Notes and Comments the Foundry Cluster in Howrah Socio-economic Dimens

[10] S.Mallette, Mem. A. S. M.E. A New Frontier: Air-Pollutions Control, James Clayton Paper.2002 [10] Andrew K. Jorgenson North Carolina State University Political-Economic Integration,Industrial Pollution and Human Health A Panel Study of Less-Developed Countries, 1980–2000.

[11] C.W.D.COLE, M.R.C.S., L.R.C.P., Chest Physician, Effect of Atmosphere Air Pollutions on the human chest.

[12] Douglas e. evans1, william a. heitbrink2*, thomas j. slavin3 and thomas m. peters ultrafine and respirable particles in an automotive grey iron foundry.] Serope Kalpakjian Illinois Institute of Technology.,Steven R. Schmid The University of Notre Dame Upper Saddle Manufacturing Engineering and Technology.

[13] Aaron Daly and Paolo Zannetti An Introduction to Air Pollution – Definitions, Classifications, and History

[14] Daly, A. and P. Zannetti. 2007. An Introduction to Air Pollution – Definitions, Classifications, and History. Chapter 1 of AMBIENT AIR POLLUTION (P. Zannetti, D. Al-Ajmi, and S. Al-Rashied, Editors). Published by The Arab School for Science and Technology

[15] Monotoring of air quality in an iron foundry (Case of NOx, SO2, benzene and dust) M. T. Abedghars , A. Hadji S. Bouhouch . Research Unit on iron and steel industry URASM/CSC, Annaba Algeria.

[16] Victoria petroesc, 2. roland iosif moraru industrial pollution and control measures in romanian foundries

[17] V. Ramanathan Y. Feng Scripps Institution of Oceanography, University of California at San Diego, United Kingdom Air pollution, greenhouse gases and climate change Global and regional perspectives

[18] Andrew K. Jorgenson North Carolina State University Political-Economic Integration, Industrial Pollution and Human Health A Panel Study of Less Developed Countries, 1980–2000.