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Occupational Hazard And Control Measures In Foundry Dust

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Abstract: India has 4,600 foundry units, 80 per cent of them in the SME sector. Annual production is 7.4 million tons, approximately valued at $8 billion. The sector employs 0.5 million people directly and an additional 1.5% of Export production, and 90% of local casting or manufacturing units. A hazard in foundries starts at the very initial stage – material handling, dust, fumes, gases, heat, stress and noise are some of the major parameters which affect an individual physically and they also affect the environment. The health hazards causing material like silica sand, chromium, carbon monoxide, carbon, iron oxide, fluorides, are present abundant in foundries. Silicosis is one of the major health hazards in foundry due to silica sand. Hot and humid environment prevalent in certain workplaces, the heat strain may be produced on the human body, and the work productivity and human health will be affected. This project is an effort to study the level of dust prevailing in workplace and suggesting the control measures. Installing local exhaust ventilation (LEV), together with a mean of arrestment and disposal of airborne particulate, provides the basis of the vast majority of dust control solutions in foundry.

Keywords: foundry,LEV,Airbone.

I. INTRODUCTION

The Indian foundry industry manufactures metal cast components for applications in Auto, Tractor, Railway, Machine tools, Defense, Earth Moving, Textile, Cement, Electrical, Power machinery, Pumps, Values etc. Foundry industries has a turnover of approx. USD 15 billion with export approx. USD 2.billion.The Indian Metal Casting (Foundry Industries) is well established and producing estimated 9.344 Million MT of various grades of Castings as per International standards. However, Grey iron castings have the major share I.E. approx 68% of total castings produced. There are approx 4500 units out of which 85% can be classified as small scale units. In foundries molten metal are cast into objects of desired shapes. Castings of ferrous and non ferrous metals are made in units that may be independent or part of a production line. The main production steps include preparation of raw materials, metal melting, and preparation of molds, casting, and finishing (which includes fettling and grinding). Foundry workers may be exposed to many potential health and safety hazards. The potential hazards arising from sand handling, sand preparation, shakeout and other operation create dusty conditions exposing the workers free silica. Chipping, grinding operations to remove molding sand which adheres to the casting may create a dust hazard in the foundry. Foundry workers all so affected by the heat produced during melting and pouring operations. The working environment of foundries is hazardous and characterized by multiple simultaneous chemical, physical and mechanical hazards exposure, which would lead to injuries of foundry workers. The aim of the present work is to examine operational hazards in foundry-dust, heat and heat stress and to compile the available technology which would reduce the later mentioned; obviously they are the control measures. Thus cleaner production and pollution elimination will give a risk reduced environment at the foundry.

II. METHODOLOGY

workplace hazards (chemical, physical, etc.) can be controlled by a variety of methods. The goal of controlling hazards is to prevent workers from being exposed to occupational hazards. Some methods of hazard control are more efficient than others, but a combination of methods usually provides a safer workplace than relying on only one method. Some methods of controlare cheaper than others but may not provide the most effective way to reduce exposures. Maintaining the Integrity of the SpecificationsThe template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them.

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A. Identifying The Dust Hazard

To manage silica dust exposure in foundries effectively, it is necessary to identify and control significant sources of airborne silica dust. There are many potential sources of silica dust in foundries which use silica sand for mold making and core making etc.

Identifying which sources are significant and establishing ways to control exposures from these sources can be challenging. Silica exposure concentration can vary over the work shift, depending on worker involvement with dust-producing processes and the background air silica concentrations of those parts of the foundry in which the worker spends time. There are air sampling methods available to evaluate the causes of exposure that relate to the work operation itself and the causes of exposure that relate to the foundry air environment. The dust hazard can be measured by collecting the volume of dust sample by using various techniques available in the field. The results compared with International standards for Permissible Limit to identify the amount of dust in the work place.

B. Elimination/Substitution

Elimination of a specific hazard or hazardous work process, or preventing it from entering the workplace, is the most effective method of control. It is important to consider worker health and safety when work processes are still in the planning stages. For example, when purchasing machines, safety should be the first concern, not cost. Machines should conform to National safety standards. They should be designed with the correct guard on them to eliminate the danger of a worker getting caught in the machine while using it. Machines that are not produced with the proper guards on them may cost less to purchase, but cost more in terms of accidents, loss of production, compensation, etc.The most effective way of keeping hazards at bay is by elimination the use of the chemical totally or by substituting the toxic chemical to a less toxic chemical, which will not comprise the result of work to be carried out

1) *General principles for substitution of chemicals*

a) Volatile solvents with low boiling points and high vapour pressures should be substituted with solvents having high boiling points and low vapour pressures.
b) Toxic substances with low permissible exposure levels should be substituted with less toxic substances having higher permissible exposure levels, taking into account the effect and target organ that will be affected.
c) Liquids with low flash points should as far as possible be substituted with liquids having higher flash points or no flash point to minimize or prevent fire risk.
d) Materials in fine powder should be substituted with substances in granular, pellet or other bulk solid forms to reduce or prevent inhalation hazards.
e) Chemicals in liquid form should be substituted with chemicals in paste, gelatinous or other viscous liquid to reduce exposure hazards.

C. Engineering Controls

1) *Enclosure:* If a hazardous substance or work process cannot be eliminated or substituted, then enclosing it so workers are not exposed to the hazard is the next best method of control. Many hazards can be controlled by partially or totally enclosing the work process.
2) *Isolation:* Isolation can be an effective method of control if a hazardous job can be moved to a part of the workplace where fewer people will be exposed. Job can be changed to a shift when fewer people are exposed
3) *Ventilation:* Ventilation in the workplace can be used for two reasons, to prevent the work environment from being too hot, cold, dry or humid and to prevent contaminants in the air from getting into the area where workers breathe

D. Administrative Controls

Administrative controls limiting the amount of time workers spend at a hazardous job can be used together with other methods of control to reduce exposure to hazards. Some examples of administrative controls include: Changing work schedules (for example, two people may be able to work for four hours each at a job instead of one person working for eight hours at that job); Giving workers longer rest periods or shorter work shifts to reduce exposure time; Moving a hazardous work process to an area where fewer people will be exposed; Changing a work process to a shift when fewer people are working. Administrative controls only reduce the amount of time the workers are exposed to a hazard – they do not eliminate exposures.

E. PERSONNEL PROTECTIVE EQUIPMENT

As a supplementary protection against exposure to hazardous conditions in the production of iron and steel where the safety of workers cannot be ensured by other means, such as elimination the hazard, controlling the risk at source or minimizing the risk, suitable and sufficient PPE, having regard to the type of work and risks, and in consultation with workers and their representatives, should be used by the worker and provided and maintained.

III. HAZARD IDENTIFICATION

Total suspended particulate (TSP) refers to particles that are suspended in air at the time of sampling. TSP is measured by sucking air through a filter and determining the weight of dust collected from a measured volume of air. The results are reported in concentration terms (typically mg/m3). The equipment used for TSP measurements is intended to collect all particles from less than 0.1 up to about 100 microns, although different designs of sampling head can be used to make the system selective for specific size fractions.

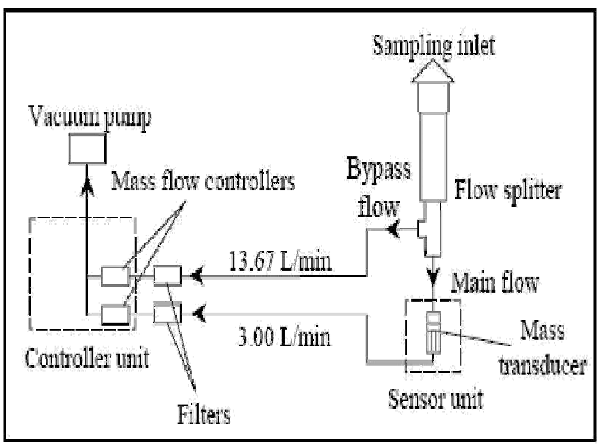
The inlet removes particles larger than 10 um by using their greater inertia to trap them on a greased plate. Smaller particles pass through the instrument onto the pre- weighted filter. Measuring the volume of air sampled and weighing the filter before and after sampling determines the concentration of PM10 particles in the air. The particle retained on the filter can be analyses to determine the concentration of other pollutants.

A. *Testing of Sample*

Total suspended particulate (TSP) refers to particles that are suspended in air at the time of sampling. TSP is measured by sucking air through a filter and determining the weight of dust collected from a measured volume of air. The results are reported in concentration terms (typically mg/m3). The equipment used for TSP measurements is intended to collect all particles from less than 0.1 up to about 100 microns, although different designs of sampling head can be used to make the system selective for specific size fractions.

1) TSP samples are typically collected over 24-hour periods,
2) The TSP method provides much more useful data in terms of dust variations over time, and the possible causes of these variations.

B. *Working Principle of Dust Monitor*



The inlet removes particles larger than 10 um by using their greater inertia to trap them on a greased plate. Smaller particles pass through the instrument onto the pre- weighted filter. Measuring the volume of air sampled and weighing the filter before and after sampling determines the concentration of PM10 particles in the air. The particle retained on the filter can be analyses to determine the concentration of other pollutants.

IV. CONTROL MEASURES OF DUST HAZARD

A. *Overview of Hazards and Control*

Formaldehyde, isocyanides, various resin products, hardwoods and acids associated with pattern making and core making processes

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can irritate the skin and may precipitate allergic skin reactions. Potential carcinogens there are evidence from the International Agency for Research on cancer that workers in iron and steel foundries may have an increased risk of developing lung cancer. The exact substance responsible has not been identified, but the risks appear to be associated with dusts and/or fumes present in the foundry atmosphere. The potential carcinogenic effects of dusts and fumes are a further reason for minimizing atmospheric contamination.

Evaluation by occupational health and safety personnel of noise should be undertaken to identify areas where noise levels may be excessive. Surveys of foundries have shown that dressing, fettling and shakeout operations give rise to considerable noise levels, with potentially harmful effects on the hearing of exposed workers. In addition to the workers immediately involved in these processes, people working in the vicinity may be exposed to noise level well in excess of 85 dB(A).

Radiant heat is the major contributor to the heat load imposed on the worker by the environment. Convective heat transfer adds to this radiant heat. Protective clothing is worn for protection against the heat radiating from the heat sources and against contact with molten metal. Such clothing greatly restricts the potential for body heat loss via evaporation. The foundry worker experiences a total heat load which is determined by the time spent at each workstation, the intensity of work, the clothing worn and the immediate workstation environment, including air circulation. If the heat load is sufficiently severe, effects on health and performance will occur. These range from decreased concentration to painful cramps, fainting, heat exhaustion and heatstroke. These signs and symptoms require immediate medical attention.

Serious burns may result from splashes of molten metal in the melting and pouring areas of foundries. Frequent, unprotected viewing of white-hot metals in furnaces and pouring areas may cause eye cataracts. Eye injuries from molten metal or fragments of metal may occur in pouring and dressing areas. During continuous casting processes, non-ferrous molten metal's, such as copper and aluminum, may explode violently if they contact water. Such explosions can occur in water-cooled furnace; whenever spillages of molten metal occur; during the changing of furnaces.

B. Elimination for Preventing Dust

1) Olivine sand to replace silica sand.
2) Elimination of a specific hazard or hazardous work process, or preventing it from entering the workplace, is the most effective method of control.
3) Eliminate hazards at the ―development stage
4) It is important to consider worker health and safety when work processes are still in the planning stages. For example, when purchasing machines, safety should be
5) The first concern not cost. Machines should conform to National safety standards. They should be designed with the correct guard on them to eliminate the danger of a worker getting caught in the machine while using it. Machines that are not produced with the proper guards on them may cost less to purchase, but cost more in terms of accidents, loss of production, compensation, etc.
6) The most effective way of keeping hazards at bay is by elimination the use of the chemical totally or by substituting the toxic chemical to a less toxic chemical, which will not comprise the result of work to be carried out

C. Engineering Control

1) Preparation of mould materials
2) Sand reclamation
3) Moulding operation
4) Core making operation
5) Melting
6) Electric induction furnaces
7) Knockout operation
8) Dust collector
9) Principle of filtration
10) Fabric filter design limits
11) Design of filter
12) Administrative control

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13) Personal protective equipment
14) House keeping

V. CONCLUSION

The majority of foundry workers are exposed to high, respirable silica dust concentration therefore a definite silicosis hazard exists in foundry. It must be kept in mind that, except in cases of massive exposure to high silica bearing dust, a number of years are required, sometimes 20 or more, before the evidence of disease appears in chest radiography. The use of olivine sand as replacement for a silica type of sand reduces the silica content of dust, and thus the silicosis hazard, can be reduced. The complete elimination of dust is not possible in foundries, but with the best available technology, it would often be possible to keep the dust at an acceptable level.

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