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Workplace Safety and Health Conditions in Small-Scale Foundries

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A B S T R A C T

Occupational safety and health is a critical problem that involves maintaining a safe working environment, preventing work-related illnesses and accidents, and promoting a workplace that is free from hazards. The foundry sector serves as the foundation for other sectors, and its expansion can be used to gauge the rate of industrialization and wealth. Humankind is exposed to a variety of hazards in foundries, including mechanical, chemical, physical, and environmental ones. In addition to protecting employees and their managers, occupational safety plays a critical role in industries by lowering the potential losses that may result from mishaps and increasing productivity. Heavy laborers perform a variety of specialized, interconnected tasks, including molding and pattern forming, core production, melting and pouring, shakeout and core knockout, cleaning, chipping, and finishing, in the foundry industry. The employees are exposed to a variety of occupational health risks by all these different tasks. The International Labor Organization (ILO) states that employers, employees, and the government are all accountable for issues related to workplace safety and the environment. To ensure that small-scale foundries fulfill international standards for environmental and occupational safety, all relevant parties should collaborate. In addition to creating small-scale foundries free from risks and hazards, limited to the level of foreseeability, the study's goal is to increase knowledge and awareness among employees, management, and staff, resulting in smaller-scale foundries that are safer, healthier, and more environmentally friendly.

Key-words: *Occupational safety, Health Hazards, ILO, environmentally-friendly*

1. Industrial growth in India

Since the implementation of economic development and the liberalization of government policies in 1991, India has seen a quick and continuous expansion in the economic and technological development of industrial organizations in numerous sectors. A nation cannot achieve economic development in all areas without also developing its industry. A nation's economic growth is directly correlated with its level of industrial organizational development.

Approximately thirty percent of India's GDP came from its industrial sector. As a result, industries contribute significantly to both national GDP and the growth of jobs across all industries. In general, industrial development in India does exceptionally well in terms of industrial growth. Since gaining independence, the Indian economy has grown quickly across the board. In order to create plans for the efficient and balanced use of resources, the Planning Commission of India was established in 1950. Its goal was to evaluate the nation's material resources.

The commission's goal was to increase output as much as possible in order to attain full employment and greater levels of national per capita income. During the second five-year plan (1956–1961), the Indian government developed an industrial policy with the goals of boosting industrial output, generating jobs, dispersing industries, eliminating regional disparities in industrial development, and fostering the growth of village and small-scale industries.

1.1 Global Foundry Scenario

Over three million people are employed by the approximately 35,000 foundries that produce 90 million tons of castings annually throughout the world. In terms of alloy casting production, the United States of America leads the pack, followed by China, Japan, Germany, and the Commonwealth of Independent States (CIS). China leads the world in foundry count, with India and the CIS following closely behind. The share of iron foundries is at its highest point, or almost 56%, followed by steel at 14% and nonferrous at 30%. An estimated $30 billion might be made in the global metal business.

1.2 Indian Foundry Scenario

The foundry sector serves as the foundation for other sectors, and its expansion is a key indicator of industrial progress and industrialization. The metal casting (foundry) business in India is well-established both for export and domestic use. As per the latest global casting census conducted by modern

castings, India ranks as second largest casting producer, producing an estimate of around 10.5 Million MT of various grades of castings as per international standards. An examination of the propellants and obstacles elucidates the elements propelling the market's expansion, including the burgeoning demand from the automotive industry, robust economic expansion, favorable government involvement, inexpensive labor, and advancing technological and modernization. A significant opportunity exists in the industry since the manufacturing of these items will be fueled by the rising demand for castings.

2. Objective of Research Work

The main objectives of the study are,

1. To ascertain how the foundry's attributes are seen in relation to safety-related aspects, such as individual safety, workplace safety, safety procedures, and occupational health.
2. To determine a methodical, objective technique to evaluating risks and hazards that would yield both an objective measurement of a recognized hazard and a means of risk mitigation.
3. To evaluate the state of the environment, health, and safety at work and to put the safety management system into place at the foundries.
4. To assess small-scale foundries' adherence to national laws and regulations regarding environmental, health, and worker safety.
5. To examine the effects of industrial mishaps, particularly in small-scale foundry clusters.

2.1 The Domino Theory

The creator of the "domino theory," W.H. Heinrich, asserts that worker error accounts for 88% of accidents, worker error accounts for 10%, and "acts of God" account for 2% of all accidents. It is suggested to use a "five-factor accident sequence," where each factor would activate the subsequent phase, similar to a series of falling dominoes.

The sequence of accident factors is as follows,

1. Ancestry and social environment
2. Worker’s fault
3. Unsafe act together with mechanical and physical hazard
4. Accident
5. Damage or injury

Similarly, the collapse process may be interrupted if a single domino in the row were removed. Eliminating one of the contributing variables would stop the collision and any injuries that followed, and the crucial domino would no longer be part of the process. Despite the lack of supporting evidence, the author's notion is nevertheless a good place to start a conversation and lays the groundwork for more investigation.

3. Safety Practice’s In Small Foundries

A safe work environment is one that eliminates or reduces threats to the health, safety, and welfare of employers, workers, and other parties, including suppliers and manufacturers of equipment and materials used in the workplace. All of these parties have a significant role in creating a healthy workplace. The greatest approach to keep employees healthy and increase output is to provide a safe work environment. A healthy workplace, according to the WHO, is one where managers and employees work together to apply a continuous improvement process to safeguard and promote everyone's health, safety, and well-being as well as the long-term viability of the workplace by taking the following into account, based on needs that have been recognized.

Health and safety concerns in the physical work environment a personal health resources in the workplace; b. Workplace culture and organizational structure; c. Health, safety, and well-being concerns in the psychosocial work environment; and d. Community engagement strategies to enhance the health of employees, their families, and other community members.

3.1 Accidents in Industries - A Perspective

Human resources constitute a vital role for the growth, development, productivity and all other aspects of the industry. Hazards can result in fatalities or serious injuries, property damage, disruptions to the social and economic order, or environmental degradation. They can also arise from unsafe practices, technological or industrial accidents, unsafe procedures, infrastructure failures, or specific wrongdoings by humans. A "discrete occurrence in the course of work" that results in a bodily or psychological occupational injury is referred to as a work accident, workplace accident, occupational accident, or accident at work. The International Labor Organization (ILO) reports that there are over 337 million workplace accidents and over 2.3 million occupational disease-related fatalities worldwide each year.

"An accident is an occurrence in an industrial establishment causing bodily injury to a person that makes him unfit to resume his duties in the next 48 hours," according to the Factories Act 1948.

An occurrence in a sequence of events which usually produces unintended injury, death, or property damage" is how the National Safety Council of the USA described an accident. Strict guidelines and rules have been established by the Factories Act of 1948 to guarantee safety procedures in the industries.

3.2 Incidence and Rate of Accidents

One way to quantify the differences in accident incidence risks across various industries, occupational groupings, and other similar groups is to look at the number of accidents relative to the total number of employees in each branch. Once this is completed, the ratios obtained can be thought of as the "risk figures" for a particular sector or profession. In reality, there are differences in accident propensity even within the same business or profession.

The number of unintentional deaths increased by 51.8% in 2012 compared to 2002, while there was a 0.2% decline in 2003 over 2002. This trend continued throughout the 2003–2012 period. While the rate of accidental deaths increased by 34.2% between 2003 and 2012, the population grew by 13.6% during same time. The % change in unintentional fatalities is displayed.

The year of 2012 had 3, 94, 982 unintentional fatalities recorded in India, which is 4,098 more than the number of such deaths recorded in 2011. This is a 1.0% increase from 2011. In line with this, there was a 0.3% increase in the population and a slight 0.9% increase in the rate of "Accidental Deaths" this year compared to 2011.

4. Occupational Safety and Health

As defined by the World Health Organization (WHO) "occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards.

"Occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards," according to the World Health Organization (WHO).

One of the most significant aspects of human concern, whether in the workplace or in daily life, is occupational safety and health. In order to promote and maintain the highest level of physical, mental, and social wellness for workers in all occupations for the duration of their service periods, it attempts to adapt the working environment to the workers. Industrial hygienists assess, detect, and quantify occupational risks or strains that may expose employees to chemicals, physical objects, awkward positions, or biological agents and result in illness, poor health, or severe discomfort.

India has had laws pertaining to workplace safety and health for many years, with the intention of benefiting both businesses and workers. The British Factories Act is the foundation for the majority of health and safety regulations. 1954, 1990, 1976, and 1987 saw amendments to the 1948 Factories Act. A separate chapter on occupational health and safety was introduced to protect workers employed in hazardous industries in the wake of the Bhopal gas disaster in India. The proposed amendment called for a shift from responding to illness or disasters to preventing them from happening in the first place. However, the Act only applies to factories with ten or more employees, and it includes all workers in the industry.

4.1 Challenges for OS & H

The WHO, in cooperation with occupational safety and health institutes, stated in a 1995 statement that the biggest obstacles facing occupational health in the future would include

1. Health issues at work related to automation systems and modern information technologies;
2. Novel physical and chemical energies and substances; Health hazards associated with innovative biotechnologies;
3. The exchange and transfer of dangerous technologies;
4. Working populations that include the elderly
5. Particular issues pertaining to marginalized and vulnerable groups (such as the chronically ill and disabled), including immigrants and the unemployed;
6. Issues concerning the growing mobility of worker populations and the emergence of new occupational diseases with diverse origins

5. Hazards in Foundries

Ensuring that job-related illnesses and accidents are minimized and a safe work environment is fostered is the main goal of occupational safety and health. Melting the metal to a molten condition and producing solid casting components is one of the main tasks in every foundry process. But extreme caution must be used to ensure that the environment is not harmed and that staff members' health and safety are not in danger. Safety, which is the state of being safe and guaranteeing freedom from accidents, is a crucial concern. The intricate procedures used in the metal casting business create a wide range of

significant risk factors, making the sector dangerous. Mankind is exposed to a variety of hazards in foundries, including mechanical, chemical, physical, and environmental ones.

Chemical and physical risks are two possible hazards that can arise in a foundry setting. Examples of chemical hazards include carbon monoxide, silica and other non-metallic dusts and fumes, and various chemical substances, including products of thermal decomposition like nitrogen and sulfur dioxide the nature of the task and the surroundings of the workstation determine the occupational dangers in the metal foundry business. Depending on what they did and where they really performed their tasks, workers will be exposed to varying dangers. There are greater eye injuries sustained by grinding workers, more heat injuries sustained by hot metal workers, and more strains, pulls, and rips sustained by molders.

Organizational or personal characteristics might be used to broadly characterize workplace dangers and injuries. Working methods, workstation configuration, exposure to dangerous noise, and material handling are examples of organizational elements. Age, experience, work-related stress, and other psychological variables are examples of personal factors. In addition to increasing production by lowering potential losses from accidents, industrial safety is crucial for the protection of workers, managers, supervisors, and other staff members.

The three ways of exposure of substances into the body which is considered for risk assessment are inhalation, absorption and ingestion.

Inhalation: The most frequent way for drugs to enter the body is through breathing them in. Damage can arise through multiple pathways, such as direct injury to the upper respiratory tract, encompassing the nose and throat, or absorption into the lungs and subsequently into the bloodstream for transient consequences.

Absorption: Exposure of this kind is most likely through the largest organ of the body – the skin. Certain dangerous drugs are more likely to be exposed in this fashion when they can result in immediate, long-term, or disease-related harm.

Ingestion: One way of exposure of substances is by eating the contaminant. It frequently results from occupational exposure and poor personal hygiene, such as not washing hands after handling uncontrolled contaminants and high levels of stress among factory workers.

The following are some of the potential risks that could affect the foundries' workers' health, safety, and environment: handling materials by hand and by machine; airborne contaminants; contact with hot materials and hazardous substances; noise and vibration; electricity; falling objects and equipment; tripping and falling; thermal conditions; radiation (e.g., ultraviolet, infrared, electromagnetic); ejection and explosion due to bridging and contaminated charge material; and liquid sintering (hardening of the lining with molten metal).In the molding, casting and fettling section a large amount of emissions is generated during the assorted molding stages, and produces nonmetallic particulates, metallic-oxide particulates, and metallic-iron. Nonmetallic particulates are emitted from casting, shakeout and finishing processes.

For ages, foundries have been a vital component of the industrial process. Technology is continually advancing, yet current workers are still at risk for health and safety issues. Controlling metal emissions is necessary while melting and casting. This could be released when melting and pouring molten metal into molds, as metals volatilize and condense. Depending on the steel grade casting being made and the scrap material used, particles in ferrous foundries may contain heavy elements including zinc (if galvanized steel scrap is used), cadmium, lead (from painted scrap metals), nickel, and chromium (in the manufacturing of alloy steel casting).

Iron and metallic dusts are produced in foundries during the melting, casting, and finishing processes. Sand and wooden dusts are produced during the molding phase. Workers used to be exposed to silica dust and iron oxide, which could contain heavy metals like manganese (Mn), nickel (Ni), chromium (Cr), and lead (Pb).

The dust present in the melting and casting shops is generated by high temperature operations, and the fine particle sizes, and potential metallurgical fumes, creates a serious occupational inhalation danger. In the molding shop, workers are exposed to sand dust, which may contain heavy metals, and wood dust, which may have carcinogenic properties, particularly if hard-wood is used.

6. Safety Practices

Because of the tiny particle sizes and possible metallurgical fumes, the dust produced by high temperature processes in melting and casting industries poses a considerable risk for occupational inhalation. Workers in the molding business are exposed to wood dust, which may have carcinogenic qualities, especially if hard wood is used, and sand dust, which may include heavy metals.

6.1 Safety Inspection

Manufacturing companies are aware of the dangers associated with foundries, including the possibility of catastrophic mishaps. Professionals have dedicated themselves to reducing these hazards through the adoption and application of suitable safety measures.The main health and environmental hazards of a foundry include the following:

1. Heat
2. Hazardous substances and dangerous goods
3. Gases, vapors, dust, and fumes

4. Noise and vibration
5. Molten metal
6. Dangers associated with the operation of the plant, machinery, and electrical components

For the workers doing foundry work to be protected, a safe workplace is essential. It is imperative that businesses offer their foundry floor employees with appropriately sized machinery, adequate ventilation, and personal protection equipment (PPE) in compliance with all applicable local, state, and federal laws. Let's take a closer look at a few crucial components of environmental preservation and safety in foundries.

7. Conclusion

Despite the fact that these are essential conditions to guarantee safety, there was no health and safety policy or organization with specialized officers and staff to deal with matters of safety. The foundries lack proper training and maintenance processes, communication systems, and a significant portion of the staff reported feeling stressed out at work. Periodic safety education and training is not provided. Future research will address the system for workplace health and safety. Gas cylinder storage, pressure vessels, hoisting machineries, waste disposal systems, emergency planning systems, and safety are all addressed. Small-scale foundries may not guarantee worker safety. For feeding and moving sand in the molding section, in particular, use enclosed and pneumatic conveying systems. Dust-controlled transfer locations have to be included in the line path for that. Either install a new approach by cleaning and fixing the scrubber, spraying nozzles, and droplet collector, or improve technical steps for updating and optimizing the current scrubbers. The technical and managerial components of occupational safety, health, and environmental issues must be given top attention, and implementation must be guaranteed without compromising any of these factors. Small-scale foundries must have a monitoring and surveillance system in place for factors related to environmental, health, and worker safety. Small-scale foundries are required to adhere to the requirements set forth by the Occupational Safety, Health, and Environment Management System (OSHEMS). It is imperative that small-scale foundries with limited resources allocate a sufficient budget towards safety measures. Most small-scale foundries will have dedicated staff to handle issues related to environmental, health, and workplace safety. In small-scale foundries, sustainability and monitoring of legal compliance are required for environmental, health, and occupational safety.

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