JOB SAFETY ANALYSIS FOR AUTO COMPONENT MANUFACTURING FOUNDRY PROCESS

Sivalingam .S
ME Industrial Safety Engineering
Department of Mechanical Engineering
Bannari Amman Institute of Technology
Sathyamangalam, Tamil Nadu, India
sivalingams625@gmail.com

Dr. Muthu kumar K
professor
ME Industrial Safety Engineering
Department of Mechanical Engineering
Bannari Amman Institute of Technology
Sathyamangalam, Tamil Nadu, India
muthukumarkm@bitsathy.ac.in

Abstract— **This study delves intricate operation gives rise to significant hazards present in foundry, including fire, explosions, carbon monoxide poisoning, hot metal sparks, heat stress and the emission of air pollutants such as particulate matter, sulfur dioxide, and nitrogen oxides.It highlights the risks of face and leg injuries from flying debris or slips. In order to establish a secure working environment, organizations must proactively address these risks and their potential consequences. Several measures have been introduced in the realm of automation to enhance workplace safety effectively. To enhance safety protocols within the foundry, fostering an environment where productivity aligns seamlessly with the utmost safety for everyone involved in the process. These initiatives aim to prevent industrial incidents and mitigate injuries within the workplace. Nevertheless, achieving zero accidents remains elusive even for industries that have embraced automation. The practical implementation of safety measures is a formidable challenge that necessitates the collaboration and commitment of every worker. This case investigation delves into the effective implementation of safety management using management approaches to identify and address potential hazards.**

Keywords: Foundry Operations, Job Safety Analysis (JSA), Hazard Identification,

INTRODUCTION

This case study was conducted at an auto component manufacturing company situated in Thiruppur, India. Prior to inspecting the workplace, the assessor gathered information about hazards related to auto component manufacturing, including entanglement, sharp edges, slip trip and falls, finger amputations, and so forth, although this information was limited. Subsequently, upon inspection, various hazards were identified across the different units of the company. The Foundry is also into supply of casting product to abroad countries. The average good casting production per month is around 1200 tons. The infrastructure availability in this foundry are Induction furnace, Sand plant, Fully automatic and Semi-Automatic moulding machines, Core shooter, Shot blasting machineries, Fettling machineries, Robotics fettling machineries and Knock out machineries.The company produces a range of products, including knuckles, differential cases, brake drums, flywheels, discs, piston rods, etc. Additionally, it provides services such as reconditioning of flywheels, discs, and foundry work, with applications in the automobile industry.This project centres on bolstering Foundry safety through the strategic application of Job Safety Analysis (JSA).By systematically scrutinizing key processes like pattern development, moulding, melting, knock out, shot blasting, and fettling. Initially, risk assessment was conducted in the foundry division, and following inspections across all units, it became evident that hazards were predominantly concentrated in that specific location. The rates of accidents and incidents were observed to be increasing daily. Consequently, the decision was made to prioritize the foundry division. The case assessments were carried out using two methodologies: one before the implementation of safety measures and another after. initially identify ,evaluate and categorize various potential risks .The implementation of JSA not only fosters a proactive safety culture but also empowers workers to actively engage in upholding a secure and efficient working environment. This approach aims to enhance overall safety standards within the Foundry industry.

LITERATURE SURVEY

From the literature survey it is clear that some researches job safety analaysis M.S. Nandhakumar, M. Gnanasekaran (2014) ‘‘Job safety analysis in material handling” reported that JSA is a method to find the potential Hazards/Risks in the Workplace. The operator whom commitment with job role with the risk in the operation to prevent

In their 2023 systematic review, Fakhradin Ghasemi, Amin Doosti-Irani, et al., underscored the widespread application of Job Safety Analysis (JSA) across industries, with a predominant focus in construction, followed by process industries and healthcare. While its primary goal is hazard identification, JSA has demonstrated versatility

beyond this core objective. Shortcomings identified in the review encompassed time-consuming processes, the absence of initial hazard lists, the lack of a universal risk assessment method, oversight of surrounding activity hazards, ambiguities in the implementing team, and neglect of the hierarchy of controls. Recent advancements in JSA aim to address these limitations, with a notable seven-step JSA framework proposed to comprehensively tackle identified shortcomings. This framework offers a promising approach for more effective hazard identification and risk assessment in diverse workplace settings.

In his 2017 study, Mohsen Mohammadi Asl discussed Job Safety Analysis (JSA) as a vital safety technical tool designed for the meticulous examination of both human and equipment aspects within a specific job or task. This proactive approach is implemented before commencing work to establish safety guidelines, identify potential risks, and ensure a secure working environment. By scrutinizing the intricacies of tasks and roles, JSA plays a crucial role in the elimination of risks during operations, thereby contributing to overall workplace safety. Beyond its immediate impact on individual tasks, the implementation of JSA is instrumental in fostering a safety culture within the workplace. It encourages a collective commitment to safety protocols and practices, instilling a mindset where every member of the workforce actively contributes to creating and maintaining a secure and hazard-free work environment. As a comprehensive safety tool, JSA not only safeguards individuals and equipment during specific tasks but also lays the foundation for a broader safety-conscious organizational culture.

In their 2020 study, Esmail Badoozadeh, Maryam Feiz Arefi, et al., conducted an investigation into work-related accidents within an Iranian printing house. The study utilized Job Safety Analysis (JSA) to thoroughly assess employee tasks and propose pertinent safety measures. Employing a descriptive approach, the research pinpointed 23 distinct risks across eight work stages, categorizing ten as undesirable, eleven in need of revision, and two as acceptable. Notably, the transportation of cargo to the warehouse emerged as the most precarious task, presenting four specific hazards, while activities like stapling and operating sewing machines exhibited fewer risks. Mechanical hazards were particularly highlighted, underscoring the significance of imparting ergonomic principles, utilizing appropriate footwear, practicing safe manual handling, and adhering to proper carrying protocols to effectively mitigate these risks. Prioritizing the implementation of these identified safety measures is imperative for minimizing workplace hazards and ensuring the well-being of employees.

In their 2021 study, Rajkumar, K. Subash, et al., highlight the ongoing challenge of workplace safety despite the advancements in Industry 4.0 automation. This investigation places a particular emphasis on safety management achieved through managerial strategies, incorporating risk assessment methods alongside the Job Safety Analysis (JSA) approach. The synergistic integration of these methodologies, particularly in the form of Job Safety Hazard Identification and Risk Assessment (JSHIRA), led to a noteworthy accomplishment of over 60% hazard mitigation. The effectiveness of JSHIRA was evident in its critical evaluation and systematic addressing of potential workplace threats, underscoring its pivotal role in conducting comprehensive safety assessments.

In their 2009 study, Ophir Rozenfeld, Rafael Sacks, et al., addressed the unique safety challenges posed by construction sites, characterized by their dynamic nature and diverse activities. The study introduced the 'Construction Job Safety Analysis' (CJSA) method, specifically tailored for the construction industry. Unlike traditional Job Safety Analysis (JSA) methods used in manufacturing, CJSA takes into account the ever-changing environment, worker mobility, and the inherent risks associated with diverse team activities on construction sites. Operating within a lean safety management framework, CJSA aims to predict and effectively manage the fluctuating safety risks inherent in construction settings. The method involves a meticulous process of identifying potential loss-of-control events in specific construction activities and assessing their likelihood. Through workshops, engineer interviews, and site assessments focusing on 14 primary construction activities, the study unveiled 699 potential loss-of-control events, notably emphasizing the risks associated with elevated exterior work.

In their 2022 study, Muhammad Abdan Syakuro Billah, et al., examined the surge in worker accidents within PT. XYZ, a company engaged in contracting, outsourcing, and services, particularly noting an increase in incidents during fabrication work from 2021 to 2022. Utilizing Job Safety Analysis (JSA), the research aimed to mitigate these incidents by assessing accidents and risks across various company activities. The analysis identified the drilling section as the highest-risk area, with a likelihood rating of three and a severity level of four. Proposed risk control strategies encompassed both technical measures, such as installing Occupational Health and Safety signs, and administrative controls, including pre-work briefings and specialized tools. The study emphasized enhancements in Personal Protective Equipment (PPE), with recommendations specifically advocating for upgraded provisions at the fabrication site. Key PPE enhancements included gloves, masks, safety shoes, and welding goggles, deemed essential safety gear to effectively mitigate identified risks.

RESULTS & DISCUSSION

The project focused on the auto components manufacturing process, Utilizing Job Safety Analysis (JSA) in the foundry industry project enabled the identification of potential hazards associated with each job task, including risks such as amputation, entrapment between objects, exposure to sharp edges, awkward positioning, falling objects, electric shock, inhalation of welding and chemical fumes, contact with burning fumes, collisions with stationary objects, slip and trip hazards, thermal burns, respiratory issues, and others. By implementing recommendations tailored to each task, proactive measures were taken to minimize these risks and enhance workplace safety during operations.

JSA FOR VARIOUS JOBS

JSA were carried out the processes such as material storing, melting, pouring, cleaning process ,moulding process ,sand mixing, manual material handling, testing, transporting,

EOT crane operation, electromagnetic crane operation, casting operation, shell core making,grinding operation.

JOB SAFETY ANALYSIS			
Name of the company			
Department:	Production department	In charge name	
Job tittle:	Furnace melting operation	Machine name:	
Personnel protective equipment : helmet,goggle,mask,safety shoes,apron			
Si.no	**Step in sequence job**	**Hazard/risk**	**control measure /recommendation action**
1	Temperature checking	Heat radiation is affected employee body. In case slip and trip occur employee fall into the furnace	Furnace should be guarded by fencing. Employee must be wear heat resistance jacket and goggle and PPEs.
2	Alloy composition checking	In case slip and trip occur employee fall into the furnace. Heat radiation is affected employee body.	Furnace should be guarded by fencing. Employee must be wear heat resistance jacket and goggle and PPEs.
3	Operator till the furnace for fully combustion.	Fire flash take place due to non combustion of material.	Don't put closed or semi closed container to the furnace.because ,if any oil or water content inside container it make fire flash.
4	Slag removal from furnace	Heat radiation is affected employee body.	Employee must be wear heat resistance jacket and goggle and PPEs.
5	Grinding process	in grinding process hand injury occur to employee.	Trained person only working in grinding machine. We must wear PPEs.

JOB SAFETY ANALYSIS			
Name of the company			
Department:	Production department	In charge name	
Job tittle:	Grinding operation	Machine name:	
Personnel protective equipment : helmet,goggle,mask,safety shoes,apron			

Si.no	**Step in sequence job**	**Hazard/risk**	**control measure /recommendation action**
1	Grinding wheel selection	If Damage wheel any time broke throw on human body it cause of injury.	Before inspect wheel after use .if any damage wheel is rejected. Must wear goggle,apron and other PPEs
2	Machine setup	Entanglement and pinch point	Provide a safety guard . conduct regular inspection to identify entanglement
3	Grinding operation	Fire hazard and burn injury. Kickback and contact injury. Noise exposure it cause of hearing loss	Must wear apron and other PPEs.kept in near fire extinguisher. Trained operator only operate the machine. Wear the ear plug
4	Maintenance work	Electrical hazard. Human suffer from electric shock.	Properly switch off machine .Log out and tag out must be followed.
5	Noise Exposure	Hearing Damage	Implement hearing protection measures, such as earplugs or earmuffs. Isolate noisy machinery or use barriers to reduce noise levels.
6	Tool Inspection and Handling	Breakage and Flying Debris	Regularly inspect tools for damage or wear. Store and handle tools properly to prevent breakage. Use tool rests and guards to contain debris.
7	Work operation	Ergonomic hazard it caused by Musculoskeletal Disorders	Provide ergonomic workstations and tools to reduce strain. Train workers on proper body mechanics and encourage regular breaks to prevent fatigue.

CONCLUSION

The foundry process in auto component manufacturing poses significant hazards to worker safety, including chemical exposures, physical injuries, ergonomic strains, noise exposure, and safety hazards. However, by conducting a comprehensive Job Safety Analysis and implementing appropriate control measures, such as engineering controls, administrative controls, and personal protective equipment, these risks can be effectively mitigated. Continuous monitoring, training, and improvement of safety protocols are essential to ensure a safe working environment for all employees involved in the foundry process

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