JOB SAFETY ANALYSIS IN THE FOUNDRY PROCESS

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ABSTRACT

This study delves into the hazards present in foundries, such as eye burns, hand injuries, and skin damage due to exposure to hot metals, chemicals, and machinery mishaps. It highlights the risks of face and leg injuries from flying debris or slips. Employing Job Safety Analysis (JSA), it systematically evaluates tasks, equipment, and environmental factors to fortify safety measures and prioritize worker wellbeing. The core aim is to reduce accidents by thoroughly identifying and addressing potential hazards at every stage of foundry operations. By meticulously analyzing risks, this research seeks to establish JSA as a proactive strategy to navigate complexities and enhance safety protocols within the foundry, fostering an environment where productivity aligns seamlessly with the utmost safety for everyone involved in the process.

Keywords: Foundry Operations, Job Safety Analysis (JSA), Hazard Identification, Risk Mitigation, Workplace Safety, Task Analysis

1. INTRODUCTION

At Aquasub Engineering, our dedication to fostering a safe and secure workplace revolves around the cornerstone of Job Safety Analysis (JSA). This meticulous process serves as the bedrock of our commitment, enabling us to systematically evaluate and address potential hazards inherent in our foundry operations. Through careful deconstruction of each task into its constituent steps, we pinpoint potential risks and proactively implement measures to mitigate them. Collaboration lies at the heart of our JSA approach, with input from employees at all levels ensuring comprehensive hazard identification and the development of effective risk mitigation strategies. Our commitment to upholding the highest safety standards and compliance with regulations is unwavering, supported by continuous training and regular reviews. Our overarching objective is to cultivate a culture of safety consciousness where every team member feels empowered to prioritize safety in all aspects of their work, thus safeguarding the well-being of our workforce above all else.

In the realm of foundry operations, prioritizing safety is not just a necessity but a fundamental aspect of ensuring the welfare of workers and optimizing operational efficiency. Our current project focuses on enhancing foundry safety through the strategic implementation of Job Safety Analysis (JSA). By meticulously scrutinizing critical processes such as pattern development, moulding, melting, knock out, shot blasting, and fettling, we aim to identify, evaluate, and mitigate potential risks comprehensively. The integration of JSA not only fosters a proactive safety culture but also empowers workers to actively engage in maintaining a secure and productive working environment.

1.1 OBJECTIVE

The primary objective of this project is to establish a safe working environment within Foundry Industries by:

1) Identifying potential hazards inherent in foundry processes.
2) Implementing measures to prevent and minimize these potential hazards.
3) Mitigating incidents and accidents through proactive safety protocols.
4) Promoting awareness among employees regarding safety practices.
5) Emphasizing the importance of personal protective equipment (PPE) for personnel safety.

1.2 PROBLEM STATEMENT

The problem in safety within the foundry process lies in the potential hazards faced by workers during various job tasks. Job Safety Analysis (JSA) is essential for addressing this issue by systematically identifying and analysing the specific risks associated with foundry operations. The complex nature of the foundry environment, involving tasks such as material handling and exposure to high temperatures, necessitates a thorough JSA to implement effective preventive measures. Insufficient attention to these safety concerns may result in increased incidents of injuries and accidents, highlighting the urgency for a comprehensive JSA to enhance safety protocols and protect workers in the foundry industry.

2 LITERATURE REVIEW

Albrechtsen, Solberg, et al. (2019) investigated Job Safety Analysis (JSA) practices in construction projects. They analyzed 97 JSA forms from six projects, finding that some JSAs were conducted for activities lacking established barriers and procedures. Despite this, the study highlighted JSA's benefits: formalizing work processes, enhancing accountability, promoting worker participation, facilitating organizational learning, improving situational awareness, and preventing losses. These findings underscore the importance of safety in enhancing operational efficiency in construction.

Ghasemi, Doosti-Irani, et al. (2023) conducted hazard identification and risk assessment in a plantation company using Job Safety Analysis (JSA) to address safety concerns. They observed various workers and documented findings on JSA forms, identifying hazards among roles such as forklift operators, macerator workers, and shredder workers. The study highlighted extreme risk levels for certain roles, suggesting the need for preventive measures like providing Personal Protective Equipment (PPE), offering health and safety information, and incentivizing compliance with safety protocols.

We conducted a study using Job Safety Analysis (JSA) and hazard identification to prevent work accidents in Para rubber wood sawmills in Trang Province, southern Thailand. The study, conducted from March to September 2015, included a walk-through survey, JSA, occupational risk assessment, and environmental sampling at four sawmills. Identified hazards included wood dust and noise exposure, occupational accidents, chemical exposure, and ergonomic injuries. The study emphasizes the importance of providing personal protective equipment and implementing exposure control measures like local ventilation systems and noise reduction techniques. It underscores the need for an action plan to mitigate occupational health hazards in Para rubber wood sawmills.

Rajkumar, K. Subash, et al. (2021), Amid the advancements of Industry 4.0 and automation, workplace safety remains a challenge despite preventive efforts. This study focused on safety management through managerial strategies, combining risk assessment methods with the Job Safety Analysis (JSA) approach. The integration of these methodologies, particularly the Job Safety Hazard Identification and Risk Assessment

(JSHIRA), led to over 50% hazard mitigation. JSHIRA proved effective in critically evaluating and addressing potential workplace threats, emphasizing its role in conducting comprehensive safety assessments.

3. METHODOLOGY

3.1 METHODOLOGY INVOLVED IN JSA

JSA (Job Safety Analysis) is a systematic approach that involves the following five steps:

- Selecting the job to be analyzed.
- Breaking down the job into a series of steps or tasks.
- Identifying all potential hazards associated with each job task.
- Developing preventive or control measures for each job task.
- Regularly reviewing and updating preventive measures as needed.

During a field visit to a foundry, various stages of the metal casting process are observed, including pattern making, mould preparation, metal melting, pouring, cooling, and finishing. Safety protocols, quality checks, and workflow sequences are crucial aspects of the operation. Interacting with workers provides valuable insights into their roles and the challenges they face in ensuring efficient production.

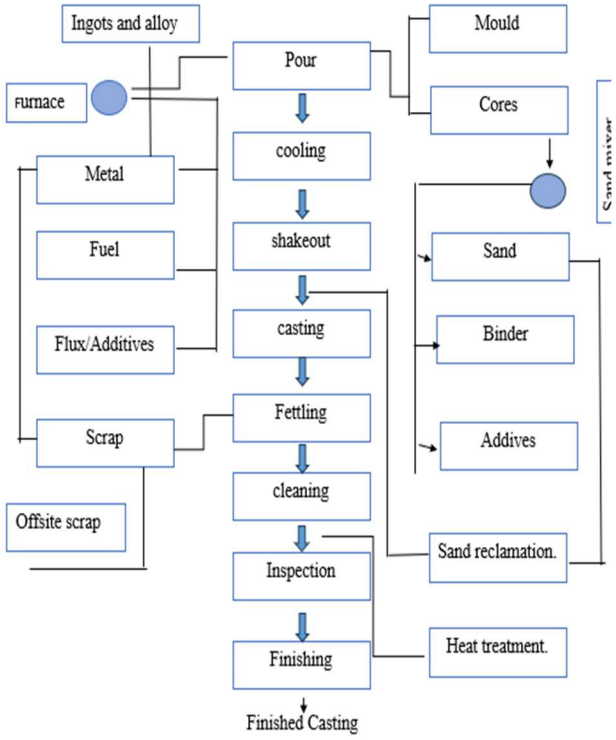
Observing the foundry process within a Job Safety Analysis (JSA) involves systematically examining tasks such as melting, casting, and finishing to identify potential hazards like heat exposure and heavy machinery usage. Risk assessments prioritize mitigation efforts, with control measures implemented to reduce identified risks, including engineering controls, administrative policies, and personal protective equipment (PPE). Regular training sessions on safety protocols outlined in the JSA are crucial, as are periodic reviews to accommodate changes and ensure continued alignment with best safety practices and regulations.

Selecting the job for analysis in a foundry process involves involving frontline workers and supervisors to focus on tasks with higher risks, ensuring a targeted JSA can effectively identify and mitigate potential dangers. Breaking down the job into a series of steps is crucial, with each step scrutinized to pinpoint potential hazards associated with handling molten metal and operating heavy machinery.

Identifying all potential hazards in each job task is essential for conducting a comprehensive JSA, addressing risks such as burns, crush injuries, heat-related illnesses, respiratory issues, and ergonomic hazards. Control measures are developed for each task, including heat-resistant PPE, physical barriers, routine maintenance, operator training, ventilation, hydration programs, and ergonomic workstation optimization.

Following preventive measures involves periodically reviewing and updating the JSA to ensure the effectiveness of existing safety protocols and to address evolving risks, incorporating new technologies, and reinforcing a continuous commitment to improving workplace safety.

4. FOUNDRY PROCESS

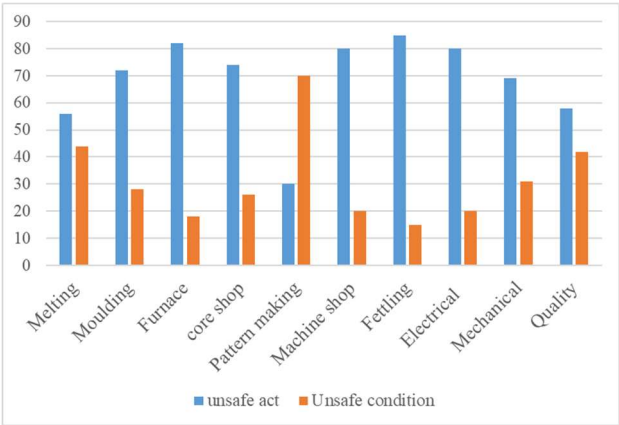


5. JOB SAFETY ANALYSIS

A Job Safety Analysis (JSA), also known as a Job Hazard Analysis (JHA), is a structured process aimed at identifying and mitigating potential hazards associated with specific tasks or job activities to protect workers. It involves breaking down complex tasks into manageable steps and assessing associated risks. The process begins with identifying tasks to be analyzed, considering routine tasks, new procedures, or tasks with a history of accidents. Potential hazards, including physical, chemical, biological, ergonomic, or environmental factors, are then identified for each task. Risks are assessed based on the likelihood of incidents and severity of potential outcomes, categorized as low, medium, or high risk. Control measures are implemented to mitigate hazards, employing engineering, administrative, or personal protective equipment controls. Documentation of findings serves as a record for monitoring and training workers on identified hazards and control measures. Regular review and revision of the JSA are essential to maintain effectiveness, incorporating changes in tasks or work conditions. By systematically analyzing hazards, assessing risks, implementing control measures, and documenting findings, organizations can effectively mitigate safety risks and create safer work environments.

5.1 UNSAFE ACT AND CONDITION

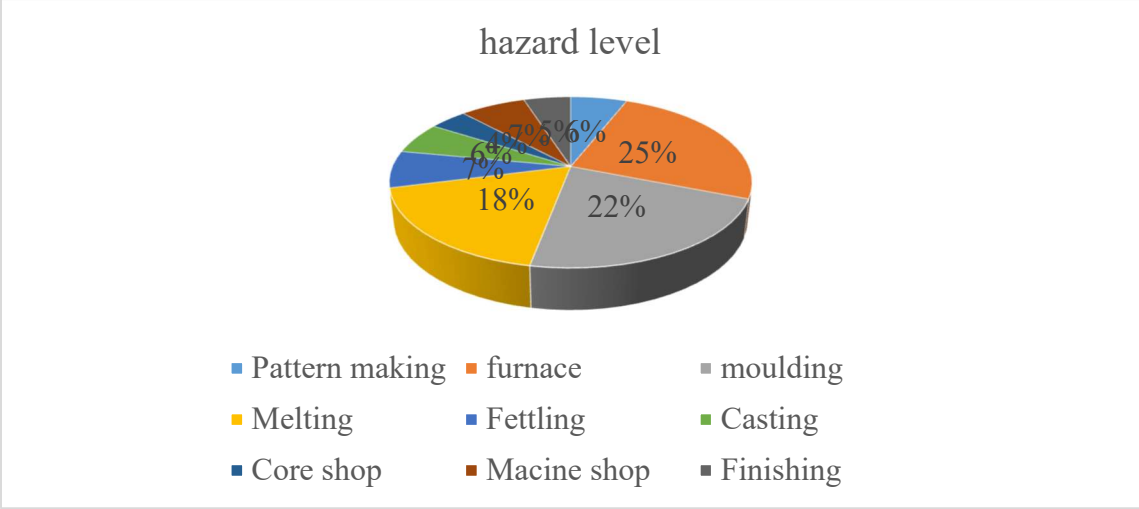
ess	Melting	Moulding	Furnace	core shop	Pattern making	Machine shop	Fettling	Electrical	Mechanical
e	56	72	82	74	30	80	85	80	69
fe ition	44	28	18	26	70	20	15	20	31



Addressing these unsafe acts and conditions necessitates a proactive stance towards safety management. This may entail instituting comprehensive safety training programs to guarantee workers' comprehension and compliance with safety procedures, conducting routine inspections to pinpoint and address hazards, supplying sufficient personal protective equipment (PPE) and ensuring its correct usage, and nurturing a safety-oriented culture where all employees feel empowered to voice safety issues. Furthermore, investing in engineering controls like enhanced ventilation systems, adequate lighting, and machine guarding can effectively mitigate risks and establish a safer working environment throughout the foundry process.

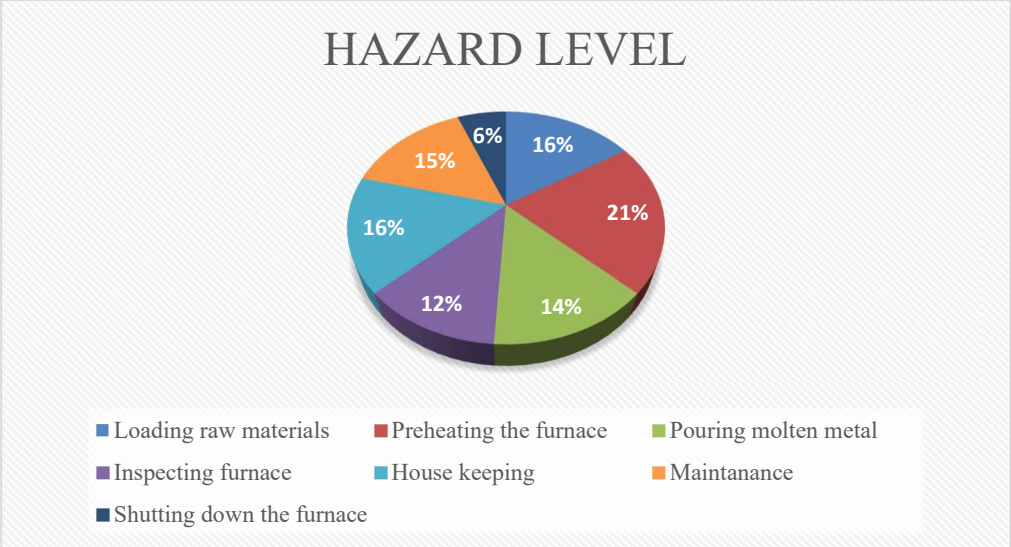
6. RESULT AND DISCUSSION

The project concentrated on the motor manufacturing process, offering recommendations for each job task to mitigate hazards like amputation, entrapment between objects, penetration by sharp edges, awkward positioning, falling objects, electric shock, inhalation of welding fumes, collision with stationary objects, slip/trip hazards, burns from heat, and other foreseeable risks. Utilizing this safety analysis tool aims to reduce risks during the performance of job tasks.



6.1 JSA FOR FURNACE

Conducting a Job Safety Analysis (JSA) for furnace operations entails identifying and addressing potential hazards related to heat exposure, confined spaces, and the handling of hot materials, all aimed at maintaining a safe working environment.



JOB SAFETY ANALYSIS	
Department: Production	Analysis By: DHAMODHIRAN K
Job title: **FURNACE**	Reviewed By: DINESH KUMAR S
Supervisor: Mr Chandrasekar	
Required personal protective Equipment (PPE): Safety helmet, cut-resistant or coated gloves, safety shoes, Goggles	

Sequence of Job Steps	Potential Hazards	Preventive Measures:
Loading raw materials	Exposure to dust and fumes	Wear appropriate respiratory protection
	Burns from contact with hot materials	Use insulated gloves and tools
Preheating the furnace	Burns from contact with hot surfaces	Wear heat-resistant clothing and gloves
	Fire hazard	Ensure furnace is properly vented and maintained
Pouring molten metal	Burns from splashes	Wear heat-resistant clothing and face shield

	Fire hazard	Ensure pouring area is clear and free from flammable materials
	Musculoskeletal injuries from lifting	Use mechanical aids for lifting (e.g., cranes)
Inspecting furnace	Exposure to high temperatures	Perform inspections from a safe distance
	Burns from hot surfaces	Wear appropriate heat-resistant clothing
	Inhalation of fumes	Use appropriate respiratory protection
Shutting down the furnace	Exposure to residual heat	Allow furnace to cool down before maintenance
	Electrocution hazard from electrical work	Follow lockout/tag out procedures to isolate electrical systems
	Fire hazard	Ensure all combustible materials are removed from the area

7 CONCLUSIONS

In the high-risk environment of a foundry, where molten metal, extreme temperatures, heavy machinery, and hazardous chemicals are commonplace, the Job Safety Analysis (JSA) stands as a crucial tool for safeguarding the health and well-being of workers. Through a meticulous examination of each stage of the foundry process, from furnace charging to casting and finishing, the JSA identifies potential hazards, assesses their associated risks, and proposes effective controls to mitigate them.

By systematically identifying hazards such as exposure to heat, molten metal, and harmful fumes, as well as risks related to heavy lifting, machinery operation, and ergonomic strains, the JSA enables proactive measures to be taken to prevent accidents and injuries.

The JSA emphasizes the importance of utilizing a combination of controls, including personal protective equipment (PPE) such as heat-resistant clothing, gloves, respirators, and hearing protection, alongside engineering controls like machine guarding, ventilation systems, and ergonomic improvemen

REFERENCE

1. Eirik Albrechtsen, Ingvild Solberg, Eva Svensli “The application and benefits of job safety analysis” Journal Safety Science 48 (2010) 491–498.

2. Muchamad Sugarindra, Muhammad Ragil Suryoputro, Adi Tiya Novitasari “Hazard Identification and Risk Assessment of Health and Safety Approach JSA (Job Safety Analysis) in Plantation Company” Journal of IOP Conference Series: Materials Science and Engineering.

3. Muhammad Abdan Syakuro Billah[1], Akhmad Wasiur Rizqi[2], Moh. Jufriyanto, “Efforts to Control Work Accident Risks In Steel Construction Work Using The Job Safety Analysis (Jsa) Method. (Case Study at Pt. Xyz)” Jurnal Sains, Teknologi Dan Industri, Vol. 20, No. 2, June 2023, Pp. 842 – 849.

4. Elisabeth Ginting , Mangara M. Tambunan “Analysis of Accidents Through the Approach of Human Error and Job Safety Analysis (JSA)”Journal of Advances in Health Sciences Research.

5. Phayong Thepaksor, Supawan Thongjer, Salee Incharoen, Wattasit Siriwong, Kouji Harada and Akio Koizumi, “Job safety analysis and hazard identification for work accident prevention in para rubber wood sawmills in southern Thailand J Occup Health 2017; 59: 542-551

6. I. Rajkumar, K. Subash, T. Raj Pradeesh, R. Manikandan, M. Ramaganesh “Job safety hazard identification and risk analysis in the

7. foundry division of a gear manufacturing industry” Journal of Materials Today: Proceedings.

8. Esmail badoozadeh1, maryam feiz arefi2, amin babaei-pouya “job safety risk assessment in the printing industry using job safety analysis method and offering control recommendations” journal of m h s vol. 14, no. 4, oct – dec 2020 1785

9. Finny N. C. Rotinsulu, 2ariestides K. Torry Dundu, 3grace Y. Malingkas, 4mielke R. I. A. Mondoringin, 5arthur H. Thambas “Risk Potential Analysis Using Hazard Identication, Risk Assessment and Determine Control (Hiradc) And Job Safety Analysis (Jsa) Methods” Journal of Engineering, Social and Health - Vol 2 (10) October 2023.

10. M. David and Heri Tri Irawan, “Analysis of Potential Hazards In The Palm Oil Processing Process At Pt. Karya Tanah Subur Using Job Safety Analysis (Jsa),” Inotera, Vol. 8, No. 1, Pp. 20–26, 2023, Doi: 10.31572/Inotera.Vol8.Iss1. 2023.Id200.

11. Bar, S., Shtrosberg, N., Prior, R., Neon, D. "National Insurance Compensation Claims." Research Report 89. National Insurance Institute, Research and Planning Administration, Jerusalem, Israel.

12. Bobick, T.G. "Falls Through Roof and Floor Openings and Surfaces, Including Skylights: 1992–2000." Journal of Construction

Engineering and Management Asce 130 (6), 895–907.

13. Rizqina, Z.A., Adam, M., & Chan, S. "Pengaruh Budaya Kerja, Kemampuan, Dan Komitmen Kerja Terhadap Kepuasan Kerja Pegawai Serta Dampaknya Terhadap Kinerja Badan Pengusahaan Kawasan Perdagangan Bebas Dan Pelabuhan Bebas Sabang (BPKS)." Jurnal Magister Manajemen Fakultas Ekonomi Dan Bisnis Unsyiah, 1, 59-69.

14. S. Mohamed, T.H. Ali., & W.Y.V. Tam. "National Culture and Safe Work Behaviour of Construction Workers in Pakistan." Safety Science, 47, 29-35.

15. Sari, S.C., Hamid, D., & Utami, H.N. "Pengaruh Lingkungan Kerja Fisik Dan Non Fisik Terhadap Keselamatan Dan Kesehatan Kerja Pada Karyawan Pabrik Gondorukem Dan Terpentin Sukun Perum Perhutani Kesatuan Bisnis.

16. Asoulzadeh Y, Gholamnia R. "Effectiveness of An Ergonomics Training Program on Decreasing Work-Related Musculoskeletal Disorders Risk Among Video Display Terminal Users." Health Promotion Perspectives. 2012; 2(1):89–91.

17. Rozenfeld O, Sacks R, Rosenfeld Y, Baum H. "Construction Job Safety Analysis." Safety Science. 2010; 48(4):491–98.

18. Alizadeh SS, Rasoulzadeh Y, Moshashaie P, Varmazyar S. "Failure Modes and Effects Analysis (FMEA) Technique: A Literature Review." Scientific Journal of Review. 2015; 4(1):1–6.

19. Alizadeh Ssh, Mortazavi SB, Sepehri MM. "Analysis of Iranian Construction Sector Occupational Accidents (2007- 2011)." Scientific Journal of Review. 2013; 2(7):188–93.

20. Ketabi D, Barkhordari A, Mirmohammadi SJ, Mehrparvar AH. "Aberrant Behaviors and Road Accidents Among Iranian Truck Drivers, 2010." Health Promotion Perspectives. 2011; 1(2):130–6.

21. Budiman, M.R., Suseno, A., And Wahyudin, W. "Identification of Potential Hazards to Minimize Work Accidents Using the Hazard and Operability Study (HAZOP) Method at PT SEGARA." Scientific Journal of Educational Vehicles, 8(9), Pp.333-339.

22. Djainal, H., Djunaidi, M., Maliyah, C., And Nurdin, N.D. "Potential Hazard Analysis Using the Hazard and Operability Study Method and Efforts to Control Work Accidents In The Unlicensed Gold

23. Nugroho, M.F., Masidah, E. And Utomo, S.B., 2022. Analysis Of Potential Hazards in The Paving Production Process Using the Job Safety Analysis Method. Journal Of Industrial Engineering, 1(1), Pp.31-40.

24. Ponda, H. And Fatma, N.F., 2019. Hazard Identification, Assessment, And Control of Occupational Safety and Health (K3) Risks In The Foundry Department Of PT. Sicamindo. Journal Of Heuristic Industrial Engineering, 16, Pp.62-74.

25. Phayong thepaksorn1,2,3, supawan thongjerm1, salee incharoen1, watt sit siriwong2 , kouji harada3 and akio koizumi3 “job safety analysis and hazard identification for work accident prevention in para rubber wood sawmills in southern Thailand” journal of occupational health 2017; 59: 542