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Implementation of Workplace Safety in the Welding Industry: Challenges and Solutions

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***Abstract*— Occupational safety and health (OSH) is critical for companies to minimize workplace accidents and health risks. However, many employees in the welding sector often neglect these aspects, leading to potential hazards. This study examines the implementation of OSH practices in the welding department of an iron manufacturing company in Surabaya using the Job Safety Analysis (JSA) method. Data were collected from 35 respondents through interviews, observations, and documentation of past incidents. The results highlight common hazards, including ultraviolet exposure damaging eyes and skin, welding fumes causing respiratory issues, electric shocks leading to injuries or fatalities, and physical impacts from sharp or heavy materials. To mitigate these risks, compliance with standard operating procedures (SOPs) and the use of complete personal protective equipment (PPE) are essential. This research emphasizes the importance of OSH awareness and adherence to safety protocols to enhance workplace safety and productivity.**

***Keywords*: Iron Manufacturing, Occupational Safety and Health, Job Safety Analysis.**

I. INTRODUCTION

The welding industry is a critical sector in manufacturing and construction, contributing significantly to economic development[1]–[3]. However, it is also one of the most hazardous fields, where workers face various occupational risks, including exposure to ultraviolet (UV) radiation, inhalation of toxic fumes, electric shocks, and physical injuries[4], [5]. Despite the availability of safety guidelines and protective measures, the implementation of occupational safety and health (OSH) standards remains inconsistent across industries[6]–[9]. This inconsistency results in workplace accidents, reduced productivity, and long-term health complications for workers.

One of the most pressing issues is the lack of awareness and understanding among workers and employers regarding the importance of OSH practices[8], [10]–[14]. Many welding departments fail to provide adequate training on safety protocols or enforce the consistent use of personal protective equipment (PPE)[15], [16]. For instance, UV radiation emitted during welding can cause severe damage to the eyes and skin, yet workers often neglect to wear appropriate face shields or protective clothing. Similarly, welding fumes, which contain hazardous substances such as manganese and hexavalent chromium, pose serious respiratory risks. Without proper ventilation systems and respiratory protection, workers are exposed to long-term health hazards, including chronic lung diseases and cancer[17]–[23].

Another critical challenge is the inadequate monitoring and evaluation of workplace safety practices. In many cases, accidents occur due to preventable factors, such as poorly maintained equipment, improper handling of materials, and insufficient risk assessments. For example, electric shocks resulting from faulty welding machines or exposed cables can lead to severe injuries or fatalities. Physical injuries, such as burns, cuts, and bruises, are also common, often caused by sharp materials or hot surfaces in the welding environment[24]. These incidents highlight the need for systematic hazard identification and risk management.

To address these challenges, the study focuses on implementing the Job Safety Analysis (JSA) method in the welding department of an iron manufacturing company in Surabaya. JSA is a structured approach that involves identifying potential hazards in each step of a work process, evaluating the associated risks, and developing

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effective control measures[25]–[29]. By breaking down tasks into smaller steps, JSA helps identify specific hazards that might otherwise be overlooked. This method not only enhances workplace safety but also improves operational efficiency and worker morale [30]–[33].

The research involves collecting data through interviews, observations, and documentation of past incidents. The findings reveal that UV radiation and welding fumes are the most significant hazards, followed by risks such as electric shocks, burns, and physical injuries. To mitigate these risks, the study recommends several measures, including enforcing the use of complete PPE, providing regular safety training, and installing advanced ventilation systems. For instance, face shields and gloves made of heat-resistant materials can protect workers from UV exposure and burns, while respirators can reduce the inhalation of toxic fumes. Additionally, implementing safety patrols and routine inspections can ensure compliance with safety protocols.

The study also emphasizes the importance of fostering a safety-oriented culture within the organization. Employers must prioritize worker safety by allocating sufficient resources for training programs and safety equipment. Workers, on the other hand, need to adopt a proactive approach by adhering to safety guidelines and reporting potential hazards. Collaboration between management and employees is essential for creating a safe and productive work environment.

In conclusion, the welding industry faces significant occupational safety challenges that require immediate attention. The implementation of the JSA method in the welding department of an iron manufacturing company demonstrates the effectiveness of structured risk management in reducing workplace hazards. By addressing critical issues such as UV radiation, toxic fumes, and physical injuries, the study provides valuable insights for improving safety standards in the industry[34], [35]. With consistent enforcement of OSH practices and a commitment to continuous improvement, organizations can protect their workers, enhance productivity, and achieve long-term sustainability.

II. METHOD

This study adopts the Job Safety Analysis (JSA) method, a systematic approach used to identify, assess, and control potential hazards in the workplace. The methodology involves breaking down specific tasks into detailed steps, identifying associated risks, and proposing mitigation strategies to enhance workplace safety[36]–[40].

a) Data Collection

The research was conducted in the welding department of an iron manufacturing company in Surabaya. Data collection involved three main methods:

- Observation

Direct observations were conducted to analyze the working environment and processes. Senior employees were asked to perform welding tasks to identify any variations in practices that could introduce new risks.

- Interviews and Discussions

Structured interviews and discussions were held with 35 employees, including technicians and supervisors, to gather insights into workplace practices and potential hazards.

- Documentation of Past Incidents

Historical data on workplace accidents were reviewed to identify patterns and understand the severity and frequency of hazards. Examples include incidents of burns from welding sparks, respiratory issues from fumes, and injuries due to material handling.

b) Data Analysis

The collected data were analyzed using a quantitative approach. Risks were categorized based on their likelihood and severity, ranging from low to extreme risk levels[36], [41]–[46]. The analysis was conducted in the following steps:

- Evaluating existing safety controls.
- Breaking down job tasks into sequential steps.
- Identifying potential hazards associated with each step.
- Proposing risk mitigation measures for each identified hazard.

c) Implementation of Controls

Risk controls were prioritized based on their significance. For example, hazards related to UV radiation exposure were addressed by mandating the use of complete personal protective equipment (PPE), such as welding helmets and gloves. Other measures included installing ventilation systems to mitigate the impact of welding fumes and organizing safety training sessions to enhance awareness among workers.

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This methodology ensured a comprehensive understanding of the risks in the welding department and provided actionable recommendations to improve occupational safety and health (OSH) practices.

III. ANALYSIS

This study employed the Job Safety Analysis (JSA) method to evaluate occupational hazards in the welding department of an iron manufacturing company in Surabaya. The analysis was conducted in three main stages: identifying potential hazards, categorizing the severity and frequency of these hazards, and proposing control measures to mitigate risks.

a) Identification of Hazards

Observations and interviews highlighted several critical hazards encountered during welding activities. Key risks included:

- Ultraviolet (UV) Radiation: Direct exposure to UV rays during welding causes significant harm to workers' eyes and skin. This hazard is particularly severe for employees without adequate protective equipment such as welding helmets.
- Toxic Fumes: Welding generates fumes that contain hazardous substances, including manganese and chromium, leading to respiratory issues. Poor ventilation exacerbates this risk.
- Electric Shock: Faulty or exposed wiring in welding machines increases the likelihood of electric shocks, which can cause severe injuries or even fatalities.
- Physical Injuries: Burns from welding sparks and cuts from handling sharp materials were frequently reported.

b) Risk Categorization

Each hazard was assessed based on its likelihood and severity to prioritize control measures. The categorization is as follows:

- Extreme Risk: Hazards such as prolonged UV exposure and toxic fume inhalation, pose serious long-term health risks.
- High Risk: Electric shocks and burns, which can lead to immediate and severe injuries.
- Moderate Risk: Physical injuries such as cuts and bruises, which are less severe but still disrupt workflow and productivity.
- Low Risk: Minor risks like equipment mishandling, which cause light injuries and are easier to control.

c) Proposed Controls

Based on the analysis, the study proposed several measures to improve safety:

- Personal Protective Equipment (PPE): The use of complete welding PPE, including UV-resistant helmets, gloves, and aprons, was emphasized to minimize physical injuries.
- Ventilation Systems: Installing advanced ventilation systems to extract welding fumes and prevent inhalation of hazardous gases.
- Electrical Safety: Regular maintenance and inspection of welding equipment to prevent electric shocks.
- Training Programs: Conduct safety training and awareness sessions to educate workers about potential hazards and safe practices.
- Safety Patrols and Monitoring: Establishing safety patrol teams to ensure compliance with protocols and identify new risks in real-time.

d) Outcomes and Implications

The findings of this study revealed that structured risk assessment through the JSA method significantly improves workplace safety by identifying and addressing critical hazards. The proposed measures not only mitigate risks but also enhance workers' confidence and productivity by ensuring a safer working environment. Organizations that adopt these strategies can expect a reduction in workplace accidents, improved compliance with safety regulations, and increased operational efficiency.

This analysis demonstrates that effective hazard management is a continuous process requiring the collaboration of all stakeholders, including management, supervisors, and employees. Through the consistent application of JSA, the welding department can set a benchmark for safety practices in the industry.

IV. DISCUSSION

The findings of this study underscore the critical importance of implementing comprehensive occupational safety and health (OSH) practices in the welding department. The use of the Job Safety Analysis (JSA) method has proven effective in identifying and addressing workplace hazards, providing a structured framework for risk management.

The analysis revealed that ultraviolet (UV) radiation and welding fumes are the most significant risks, posing severe health threats to workers. Prolonged exposure to UV radiation without adequate protection can result in

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permanent damage to the eyes and skin, while inhalation of toxic fumes contributes to chronic respiratory issues. These findings emphasize the need for complete personal protective equipment (PPE) and effective ventilation systems as primary mitigation measures.

Electric shocks and burns were categorized as high-risk hazards, often stemming from faulty equipment or improper handling. These risks highlight the necessity of regular equipment maintenance and worker training. The study demonstrated that consistent use of PPE, such as insulated gloves and fire-resistant clothing, significantly reduces the likelihood of such incidents.

Moreover, the study observed that a lack of awareness and compliance among workers remains a persistent challenge. Safety training and regular safety patrols were identified as effective strategies to address this issue. Educating employees about the potential hazards and encouraging adherence to safety protocols fosters a culture of safety within the organization.

Implementing the recommended control measures not only mitigates risks but also enhances productivity and worker morale. A safer working environment reduces absenteeism caused by injuries and promotes operational efficiency. The findings align with existing literature on the effectiveness of structured OSH frameworks in high-risk industries.

In conclusion, this study reinforces the necessity of a proactive approach to workplace safety. By integrating the JSA method and fostering a culture of safety, organizations can significantly reduce occupational hazards. Future research could explore the long-term impact of these interventions on worker health and organizational performance.

V. CONCLUSION

This study highlights the critical role of implementing comprehensive occupational safety and health (OSH) measures in the welding department of an iron manufacturing company. The application of the Job Safety Analysis (JSA) method has proven to be an effective framework for identifying, categorizing, and mitigating workplace hazards. Key risks, such as ultraviolet (UV) radiation exposure, toxic fume inhalation, electric shocks, and physical injuries, were identified and addressed through structured analysis.

The findings demonstrate that proper use of personal protective equipment (PPE), effective ventilation systems, regular equipment maintenance, and safety training significantly reduce the likelihood of accidents and long-term health complications. These measures not only ensure worker safety but also contribute to improved productivity and operational efficiency.

The study emphasizes the importance of fostering a safety-oriented culture within the organization. Compliance with safety protocols and proactive risk management must be prioritized at all organizational levels to sustain a safe and productive work environment.

In conclusion, adopting JSA as a systematic approach to hazard management enhances workplace safety and aligns with best practices in industrial operations. Future research could focus on evaluating the long-term benefits of these interventions and exploring their applicability in other high-risk sectors.

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