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Occupational Safety Risk Analysis in Onshore and Offshore Pipe Coating Processes at Wasco Coating Middle East

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Abstract

This study aims to analyze occupational safety risks in the onshore and offshore pipe coating process at Wasco Coating Middle East. The approach used is descriptive qualitative with data collection techniques through in-depth interviews, field observations, and documentation. Informants consisted of field workers, supervisors, and HSE officers selected purposively. Data analysis was conducted using the Miles and Huberman model, including data reduction, data presentation, and conclusion drawing. The results show that the main risks in the coating process include exposure to hazardous chemicals, high noise, potential physical accidents, and ergonomic risks. Although the company has implemented an occupational safety system, its effectiveness is still influenced by worker compliance, production pressure, and the complexity of the offshore project. This study recommends strengthening the safety culture and increasing risk-based training to reduce the potential for workplace accidents.

INTRODUCTION

Occupational safety is a crucial aspect in the industrial world, especially in the energy and infrastructure sectors that involve heavy work, extreme environmental conditions, and the use of high-risk materials and equipment. One industry that pays close attention to this aspect is the pipe coating industry, for both onshore and offshore needs, such as that carried out by Wasco Coating Middle East (WCME). This company is part of the Wasco Energy Group, which provides pipe protective coating services for global-scale oil and gas projects. Pipe coating activities at WCME not only involve high technology and hazardous materials, but also field workers who are exposed to the risk of work accidents every day.

Studies in the pipe coating process reveal various stages that can potentially lead to accidents, such as abrasive blasting, heating, epoxy coating, and curing or drying. Occupational safety risks can arise from the chemicals used, high temperatures, abrasive dust, tool pressure, and demanding working conditions. Especially in offshore projects, external factors such as weather, waves, and limited access add to the complexity and potential risks for workers.

Data from the International Labour Organization (ILO) shows that approximately 2.3 million work-related deaths occur annually, including in the oil and gas and construction industries. In the Middle East, including the United Arab Emirates and other Gulf states, the risk of workplace accidents in the energy and construction sectors is high due to the large number of strategic projects and high work intensity. Therefore, analyzing occupational safety risks is crucial to minimize accidents and improve worker productivity and well-being.

Wasco Coating Middle East, as a company with global standards, has implemented various Health, Safety, and Environment (HSE) policies. However, in practice, potential risks remain and

require systematic analysis to determine the type of risk, the likelihood of its occurrence, and its impact on workers and the company. Through a risk identification and hazard mapping approach, the company can develop more appropriate and effective mitigation strategies. The main problem in this study is the extent to which occupational safety risks in the pipe coating process can be systematically identified, assessed, and managed, both on onshore and offshore projects. Furthermore, it is important to assess whether existing HSE standards are sufficient to prevent accidents or whether they need to be refined through new approaches that are more adaptive to technological developments and working conditions.

The focus is on analyzing occupational safety risks in the pipe coating process carried out by Wasco Coating Middle East, thus providing applicable improvement recommendations and supporting the achievement of zero accidents in the company's work environment. Occupational Safety and Health (OHS) is a field related to the protection of workers, work equipment, and the work environment from potential risks and hazards that can cause workplace accidents and health problems. According to Goetsch (2020), OHS is a systematic approach to identifying, analyzing, and controlling risks in the workplace. Meanwhile, according to Suma'mur (2022), the main objective of OHS is to prevent accidents and occupational diseases and to create a safe, healthy, and comfortable work environment.

Implementing OHS is not only a legal and ethical obligation but also a crucial strategy in corporate risk management. A safe work environment has been shown to increase productivity, employee loyalty, and overall company reputation (Ridley & Channing, 2020). In the context of the pipe coating industry, OHS implementation is even more complex due to the heavy physical work involved, hazardous chemicals, and the use of heavy equipment and advanced technology.

The pipe coating process, both onshore and offshore, involves various stages that carry high safety risks. According to research by Singh et al. (2021), processes such as abrasive blasting, preheating, coating application, and curing have potential hazards such as high noise levels, exposure to toxic particles and chemicals, extreme heat, and the risk of fire and explosion. In offshore environments, these risks are increased by weather conditions, high work pressure, and limited emergency evacuation. Hallowell & Gambatese (2023) added that occupational safety risks increase when operational standards are inconsistently implemented, training is inadequate, and supervision is ineffective. Therefore, it is crucial for companies to implement a comprehensive safety risk management system, from hazard identification and risk assessment to mitigation and emergency response planning.

Risk analysis is a systematic process of identifying hazards, evaluating their level of risk, and establishing appropriate control measures. One method widely used in heavy industry is the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) and the Job Safety Analysis (JSA) approach. According to ISO 45001:2018, the risk identification and assessment process must be carried out in a participatory manner, involving workers at every stage of the production process. Several important parameters in risk analysis are probability (the likelihood of an event occurring), severity (the severity of the event's impact), and risk rating (a combination of probability and impact to determine the priority level of mitigation). According to Kjellén (2020), a good risk analysis focuses not only on hazard identification but also on implementing practical controls appropriate to field conditions. Therefore, the involvement of workers and management in this process is key to the success of OHS implementation.

Al-Ghamdi et al. (2020) examined occupational safety risks in the pipe-coating industry in Saudi Arabia and found that worker training and adherence to standard operating procedures were

key determinants in reducing accidents. Rahim et al. (2022) emphasized the importance of a safety culture in encouraging adherence to work procedures and the use of personal protective equipment (PPE). Zhou et al. (2022) demonstrated that the use of digital technologies, such as sensor-based automatic hazard detection systems, can help accelerate the response to potential accidents in the construction and pipe-coating sectors.

The importance of occupational safety risk analysis in the pipe coating industry, as conducted by Wasco Coating Middle East. The complexity of the process, the hazards of chemicals, and the extreme working conditions in the field require the implementation of an effective risk management system based on international standards. The theoretical and empirical studies presented provide a strong foundation for further research to support comprehensive occupational safety in this sector.

METHODS

This study uses a descriptive qualitative approach, which aims to gain an in-depth understanding of the phenomenon of occupational safety risks in the onshore and offshore pipe coating process at Wasco Coating Middle East. This method was chosen because the researcher wanted to holistically describe how working conditions, risk perceptions, and the implementation of occupational safety (K3) systems are carried out by workers and company management. Data collection techniques used were interviews, field observations, and documentation. The research subjects consisted of field workers directly involved in the pipe coating process, supervisors and the company's Health, Safety, and Environment Officer, as well as operational and technical managers who understand occupational safety policies. The collected data were analyzed using the Miles and Huberman (2019) model, which consists of data reduction, data presentation, and drawing conclusions. To validate the data, source triangulation, member checking, and discussion were used.

RESULTS AND DISCUSSION

Wasco Coating Middle East (WCME) is a company engaged in pipe coating services for oil and gas transmission, both onshore and offshore projects. The pipe coating process involves stages such as surface preparation (abrasive blasting), heating, coating application (FBE/3LPE/3LPP), curing, and inspection. Each of these stages carries different potential safety risks depending on the technology, chemicals, and working conditions.

1. Pipe Coating Process at Wasco Coating Middle East

Studies on onshore projects show that common hazards include exposure to abrasive dust, heat from pipe heaters, the risk of coating chemical explosions, and work-related accidents involving heavy equipment. Meanwhile, in offshore projects, risks are increased by external factors

such as ocean waves, limited access, and high work pressure. WCME has implemented standard safety procedures, but regular risk assessments are still required to prevent untoward incidents.

Offshore oil and gas are distributed in two ways from one facility to another: either by pipeline or in bulk (e.g., tankers). Compared to bulk distribution, pipeline distribution is relatively safe. A good level of safety during installation will provide a profitable long-term investment based on the desired useful life. Subsea pipeline design currently faces increasingly complex challenges related to high-pressure and high-temperature operations. Several technical aspects must be considered when designing subsea pipelines. Because of these numerous aspects, risk management has long been the first choice for subsea pipeline planning.

Efforts to distribute oil or gas using underwater pipelines also require careful consideration of the pipe material used. The selection of metal materials has been generally implemented since the 1950s, based on the API (American Petroleum Institute) 5L standard for pipe material selection. Each type of material has its own specific characteristics and constituents. The specifications of the steel used depend on the chemical composition, material strength, and pipe tolerances in industry and manufacturing.

Referring to the Decree of the Minister of Mining and Energy Number 300.K/38/M.PE/1997 concerning the Occupational Safety of Oil and Gas Distribution Pipelines in Article 13, it is stated that distribution pipes installed at sea must meet the following provisions:

a. If the seabed depth is less than 13 meters, the pipe must be buried at least 2 (two) meters below the seabed, and equipped with a ballast system so that the pipe does not shift or move, or supported by pipe piles.
b. If the seabed depth is 13 (thirteen) meters or more, the pipe can be placed on the seabed and equipped with a weighting system so that the pipe does not shift or move.

2. Onshore and Offshore Installations

Onshore refers to work carried out on land, including onshore, for oil and gas exploration and exploitation. Examples of onshore work include refineries and drilling wells located on land. Meanwhile, offshore refers to work carried out far from land or at sea. Offshore refers to oil and gas exploration and exploitation activities conducted offshore, or far from land. Offshore exploration and exploitation activities are carried out using platform structures installed in the middle of the ocean to support the equipment.

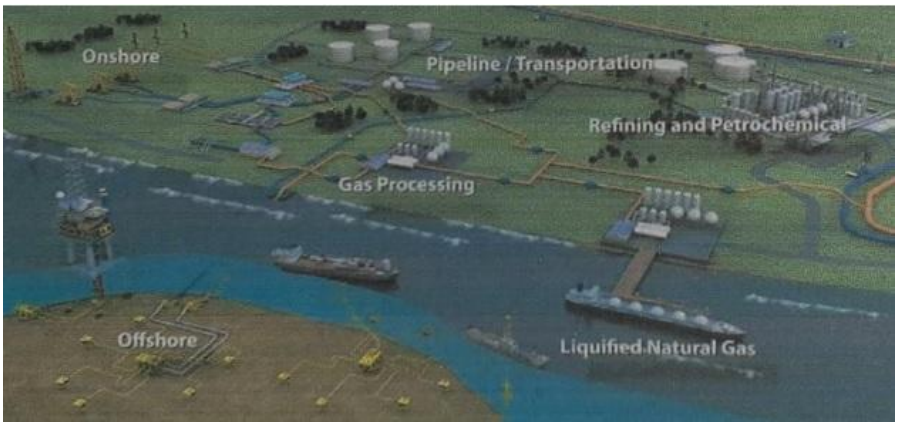

Figure 1. Onshore and Offshore Pipe Installation

Production and processing facilities include equipment for separating natural gas from liquid mixtures and for separating water and sand from crude oil. Some of the separated natural gas generates power for turbines that drive generators for electricity generation. Pumps and compressors on the platform are electrically powered. Processing equipment cannot be described in general terms because systems vary, in some cases involving two-stage separation. Crude oil is transported from the drilling/well protection platform in various ways, including pressurized storage tanks for flared gas, fuel gas storage tanks, and oil storage.

Pipes are equipment used to transport fluids for various purposes. In the household, we are familiar with pipes that carry clean water for daily needs and gas for kitchen needs or water and space heating. Due to their function of transporting fluids, pipes tend to be very long and, in some cases, even quite flexible due to their length. This makes them susceptible to leaks. If a leak occurs, the fluid flowing through the pipe can leak out or other substances can enter the pipe, affecting the fluid's purity.

Pipe leaks can be caused by a variety of factors. Incorrect installation or inherent defects in the pipe are the most common causes of leaks. However, other factors, particularly prolonged use without proper maintenance, can also contribute to leaks. Pipe leaks can significantly impact the fluid pressure within the pipe. Some types of pipes leak due to internal factors, including the material, welding, and imperfect pipe fittings. External factors can include corrosion, human error, and even natural disasters. This requires careful inspection of the pipe's condition, particularly in

areas where fluids flow frequently, to ensure unimpeded flow and stable pressure, preventing damage.

3. Occupational Safety and Health (K3) Risk Mitigation Efforts

Although offshore oil and gas mining activities in the middle of the sea are nearly identical to onshore activities, fieldwork for offshore oil and gas is inherently more challenging than onshore operations. This is because the technical requirements for offshore operations are significantly higher than those for onshore operations. Broadly speaking, the main challenges in offshore operations include several factors, including significantly higher costs, technology, and human resources. This further raises the possibility that ensuring the safety of workers is essential to maintain human resource productivity in order to support all offshore oil and gas activities efficiently and sustainably.

Based on these considerations, companies involved in offshore oil and gas mining activities need to pay attention to their Occupational Safety and Health (OHS) management to prevent the risk of workplace accidents that may occur. Large-scale offshore oil and gas safety and security measures (OHS) are a response to potential workplace disasters with significant environmental and human safety consequences. However, in the Asia Pacific region, the vulnerability to inadequate preventive measures is quite high due to a lack of capacity and coordination to prevent, respond to, and recover from incidents. Furthermore, there is a lack of collaborative arrangements for maritime safety and security around existing activities. Neglecting these essential aspects of occupational safety guidelines will create a high risk of workplace accidents. Therefore, it is imperative for companies to consistently ensure and encourage the implementation of applicable Occupational Safety and Health (OHS) for offshore oil and gas. At this stage, offshore oil and gas OHS training can be a solution and is quite important to hold.

Workers on oil and gas platforms are not only required to operate equipment. They also have to deal with unpredictable weather, long working hours, and isolated work areas. Being offshore means they are far from other places. They even have to interact with fellow workers on a daily basis. This challenging work carries a high risk of danger, especially due to the direct contact with heavy equipment. Not to mention the constant exposure to loud machinery. Most divisions operate with high-speed equipment, so caution is essential when using each piece of equipment.

Potential hazards, including workplace accidents, are always a focus in the oil and gas industry. They are a primary concern for workers when using tools. Furthermore, proper work

posture can help prevent explosions and fires. These two hazards are emphasized for their compelling reasons. Any minor friction in the installation system or increased pressure can trigger an explosion. Even a small error can affect an underwater well, leading to a sudden, catastrophic explosion. The resulting fires are devastating. If such an accident occurs, the rig crew could be wiped out. This is because the workers have no way to escape. They have difficulty finding a safe place, given the platform's distance from land. Jumping into the sea is not a viable solution.

Oil and gas mining sites are in close proximity to hazardous machinery and equipment. Spinning machines, cranes, drill pipes, and loaders are essential equipment. These machines tend to be loud, creating noise. Workers also have to deal with vibrations. Misoperation can lead to disaster. All equipment has the potential to cause workplace accidents. Workers must focus on their tasks, making communication difficult. The danger becomes even more apparent when mechanical failures or negligence occur. Incorrect contact and adjustment of work equipment can be fatal. It is crucial for workers to familiarize themselves with the machinery before starting work.

Various types of objects are installed in buildings and oil mining work equipment. Almost all of them are crucial to the production process. Building design is closely linked to dangerous heights. Furthermore, workers typically carry out their tasks using specific equipment. Of course, the equipment used is no joke. Some types of work require carrying heavy equipment. Therefore, falling objects are a possibility. The causes of these falls can vary. Outdoor weather conditions are extremely unpredictable, especially offshore. Winds can blow strongly, and wave currents are also unpredictable. This can cause damage to various parts of the platform framework, panels, or pipes. If something escapes supervision, it could fall on workers.

The potential for work accidents in offshore oil rigs often involves falls. This is because the entire work area is above water. To carry out their duties, workers are often faced with climbing and descending ladders. This journey takes place from one deck to another. Offshore oil and gas workers are vulnerable to chemical exposure. The chemicals used are high in concentration, and can be quite dangerous if errors occur. This is because these chemicals are toxic. The materials needed for drilling have serious impacts on workers. Exposure to these substances enters the worker's body through the skin, nose, and mouth, causing certain disease symptoms. The chemicals used in the production process not only endanger workers but also the surrounding environment can be exposed to hazardous substances. Poorly managed waste can damage marine ecosystems. The implementation of oil and gas safety and health (K3) in onshore and offshore environments is essential. A strict K3 management system is essential due to the significant potential for danger. If a major disaster occurs, the company will not only lose employees but also suffer significant losses.

CONCLUSION

Based on the discussion, it was concluded that the onshore and offshore pipe coating processes at Wasco Coating Middle East have a high level of occupational safety risks, especially in the abrasive blasting, heating, and coating application stages that involve chemicals and high-pressure equipment. Identification of key risks indicates that chemical exposure, high noise, physical hazards, and ergonomic risks are serious threats that need to be managed systematically. HIRADC-based risk analysis indicates that most risks are at moderate to high levels.

The mitigation efforts undertaken by WCME encompass technical and administrative approaches, but their effectiveness depends heavily on worker compliance and strict supervision. The use of PPE, regular training, and a permit-to-work system are crucial steps in risk control. Factors inhibiting the implementation of occupational safety include production pressure, diverse worker backgrounds, and limited control at the worksite. This highlights the need to strengthen a safety culture, increase worker participation, and provide consistent management support. Recommendations for companies include conducting regular risk evaluations, strengthening competency-based safety training, and establishing an open risk communication system between management and workers, particularly in offshore projects with more complex work dynamics.

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