Problems and Solutions for Improving Competence and Quality of Submarine Pipeline: A Literature Review on Concepts, Applications, and Challenges

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Problems and Solutions in Improving Subsea Pipeline Competency and Quality: A Comprehensive Literature Review

Abstract

Subsea pipelines are an important means of transporting oil and gas offshore. However, subsea pipelines also face various problems that can reduce their competence and quality, such as corrosion, leaks, free span, and structural failure. This research aims to review literature related to problems and solutions in improving the competence and quality of underwater pipelines. The method used is a systematic review using the Scopus, Web of Science, and Google Scholar databases. The research results show that several solutions have been developed by researchers, such as using corrosion-resistant materials, installing support structures, covering bionic water plants, and self-necking plates. This research also identified several gaps and challenges that still need further research, such as the development of leak detection methods that are more accurate, efficient, and environmentally friendly, as well as optimizing the design and installation of subsea pipes to suit diverse marine environmental conditions.

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1. Introduction

Subsea pipelines are an important piece of infrastructure in the oil and gas, fisheries, and telecommunications industries. Subsea pipelines function to distribute oil, gas, water, or optical cables below the sea surface. However, deploying and operating underwater pipelines is not an easy risk. Subsea pipelines must be designed and installed taking into account environmental, technical, economic, and social factors that can affect their performance and safety. Apart from that, underwater pipes must also be monitored and maintained regularly to prevent damage, leaks, or disturbances that could hurt the marine environment and its use.

Therefore, improving the competence and quality of underwater pipelines is very important

and urgent. Subsea pipeline competency includes aspects such as design, installation, inspection, maintenance, and repair of subsea pipelines. Subsea pipeline quality includes aspects such as durability, reliability, safety, and efficiency of subsea pipelines. To achieve optimal competence and the quality of subsea pipelines, innovative, integrated, and sustainable solutions are needed. These solutions can come from various fields of knowledge, such as engineering, science, management, law, and social sciences.

This research aims to comprehensively examine the problems and solutions related to the competence and quality of underwater pipelines. This research uses a literature review method, namely by collecting, analyzing, and synthesizing various sources of relevant and reliable information. Sources of information used include books, journals, reports, papers, and articles from various institutions, organizations, and media. This research is expected to provide a holistic and systematic picture of the issues and challenges faced by undersea pipelines, as well as recommendations that can be implemented by stakeholders.

2. Method

a. Object of Research

The research object used in this literature review is underwater pipes used for offshore oil and gas transportation. Subsea pipes can be divided into two types, namely rigid pipes and flexible pipes. Rigid pipes are usually made of carbon steel and have high rigidity but are difficult to install. Flexible pipes are easier and cheaper to install, but difficult to maintain. Subsea pipes can also have different diameters and thicknesses, depending on the desired flow capacity and pressure.

b. Treatment of Research Objects

The treatment carried out on the research object is to examine problems and solutions related to the competence and quality of underwater pipes. Problems examined include corrosion, leakage, free range, and structural failure. The solutions studied include the use of corrosion-resistant materials, installation of support structures, bionic aquatic plant closures, and self-neck plates. The fixed variables used are the type, diameter, and thickness of the subsea pipe. The variables used are factors that influence underwater pipeline problems and solutions, such as wave currents, seabed topography, residual or thermal stress, and human activities.

c. Solving Methods/Methods and Procedures Used For Research

The method used for research is a systematic review, namely a method that aims to collect, evaluate, and analyze all evidence relevant to the research question being asked. Specific. The procedure used to examine is as follows:

- Determine the inclusion and exclusion criteria, namely: articles in English, published in the last 10 years, sourced from scientific journals, and those that discuss underwater pipeline problems and solutions.
- Conduct a literature search using the Scopus, Web of Science, and Google Scholar databases, using the keywords: “subsea pipeline” AND (“problem” OR “solution” OR “competence” OR “quality”).
- Filter literature search results using inclusion and exclusion criteria and check the quality and relevance of articles using a predetermined assessment scale.
- Identify themes, debates, and gaps that exist in the selected literature, using thematic analysis methods.

3. Result And Discussion

Subsea pipelines face various problems that can reduce their competence and quality, namely their ability to flow oil and gas safely, efficiently, and environmentally friendly. These problems

include:

a. Corrosion, namely the process of material degradation due to chemical or electrochemical reactions with the environment surroundings. Corrosion can occur both inside and outside subsea pipelines. Corrosion can cause a reduction in pipe thickness, strength, and stiffness, as well as increase the risk of leaks and failure structural. Factors that influence underwater pipe corrosion include material type, coating quality, operating conditions, seawater content, and activity microbes.

b. Leakage, namely loss of oil and gas due to gaps or cracks in the downpipes. Leaks can be caused by various factors, such as corrosion, joint failure, mechanical damage, thermal stress, or attack. Leaks can have negative impacts on the environment, safety, and economy, such as marine pollution, fires, explosions, production losses, and lawsuits law.

c. Range free, namely a condition where the underwater pipe does not contact the seabed, thus forming an arch or wave. Free range can occur due to various factors, such as wave currents, seabed topography, residual or thermal stress, and external loading. Free range can cause increased stress and deformation in the pipe, as well as reduce the natural frequency of the pipe. This can trigger pipe failure due to phenomena such as fatigue, local failure, or vortex resonance.

Figure 1. Pipe Leak Inspection

Subsea pipelines are strategic infrastructure that act as the main supporter of national economic growth, especially in the energy and resources sector mineral. Subsea pipelines are used to transport oil, gas, water or chemicals from one point to another below the surface sea. Subsea pipelines must have high competence and quality, namely being able to operate efficiently, safely and in a friendly manner environment.

However, in practice, there are various problems faced in the production, installation and maintenance of subsea pipes, which can reduce the competence and quality of subsea pipes, as well as have a negative impact on performance, safety and environment. Some of these problems include:

a. Damage to underwater pipes due to external factors, such as ships, anchors, nets, currents, waves, earthquakes, or human activities other. This damage can cause pipe leaks, ruptures, or explosions, which can disrupt transportation, damage the environment, and endanger health man.

b. Corrosion or damage to underwater pipe metal due to substances in the environment, such as sea water, oxygen, carbon dioxide, hydrogen sulfide, or bacteria[2]. This corrosion can

reduce the thickness, strength and durability of the pipe, which can increase the risk of failure pipe.

c. Errors in the production, installation or maintenance process of subsea pipes, both from a technical, management and other perspective regulations. These errors can result in pipes not conforming to applicable standards, specifications, or requirements, which can result in operational, quality, or problems safety.

Therefore, there is a need for solutions that can be implemented to overcome these problems, both from a technical, management and regulatory perspective. These solutions are expected to improve the competence and quality of subsea pipelines, as well as provide benefits to industry, society and the environment.

4. Conclusion

Subsea pipelines are pipes used to transport oil, gas, water or chemicals from one point to another below the surface sea. Subsea pipes consist of several components, including: main pipe, branch pipe, riser pipe, flexible pipe, pipe umbilical (umbilical pipe), and insulated pipe (insulated pipe)[2]. Subsea pipelines are also equipped with several equipment, including: valves, flanges, joints, welding, supports, protection and sensors. competence Subsea pipeline is the ability of underwater pipelines to operate efficiently, safely and friendly environment. Subsea pipeline competence can be measured by several indicators, including: capacity, speed, pressure, temperature, viscosity, density and fluid composition transported; thickness, strength, durability, and balance pipe; as well as the costs, time, and environmental impacts of production, installation, and maintenance pipe.

Subsea pipe quality is the level of compliance of subsea pipes with standards, specifications or requirements happen. The quality of underwater pipes can be guaranteed in several ways, including: testing, monitoring and certifying at every stage of production, installation and maintenance pipe; carry out regular inspections, measurements and monitoring of conditions and performance pipe; as well as carrying out repairs and maintenance.

5. References

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