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The Design of a New Fall-pipe Bucket

In the maritime industry, ensuring the longevity and efficiency of equipment is critical to the success of offshore projects. One significant aspect of this is the development and maintenance of subsea infrastructure, which includes the installation of pipelines, cables and protective measures on the ocean floor. Advances in materials science and engineering play a crucial role in this sector, as they lead to the creation of more durable, cost-effective, and environmentally friendly solutions. Among these innovations, subsea rock installation (SRI) is a vital technique used to protect and stabilize underwater structures. The design and material composition of the equipment used in SRI are essential for optimizing performance and minimizing environmental impact.

This project focused on the design and development of a new top ring and sleeve for the fall pipe system of three subsea rock installation (SRI) vessels used by Van Oord. The purpose of this redesign was to enhance the reusability, improve the assembly process, and ensure compatibility with the vessels' existing fall pipe systems. These vessels are used to accurately deposit rock on the seabed in offshore construction projects up to a water depth of around 1600m. The objective was to create a top ring design that not only meets operational requirements but also aligns with Van Oord's sustainability goals because it will help with the usage of biodegradable plastics. The main research question to this project, was, *To what extent is it possible to design a new top ring for the three subsea rock installation vessels?*

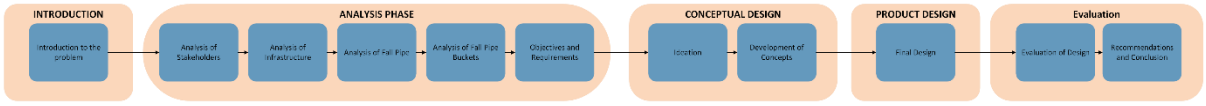

Figure 1: Design Process

The first step was to identify the primary design constraints. This was done through research into the various aspects of SRI vessels. The infrastructure of the vessels and the current fall pipe buckets were analysed, which included the dimensions of the fall pipe system, load-bearing capacity, and integration with existing components such as the chain attachment mechanism. Discussions were held with stakeholders at Van Oord to ensure that the new design would meet operational and environmental requirements.

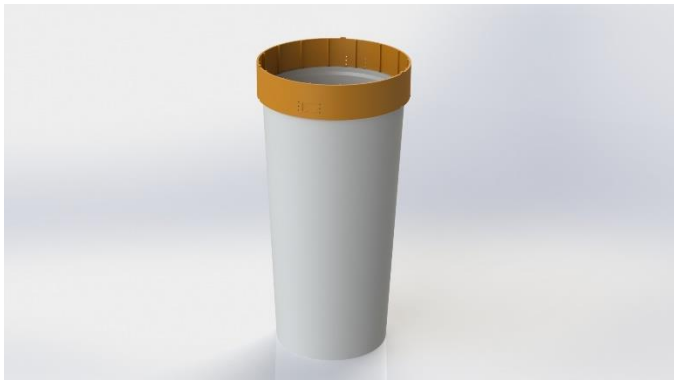

Figure 2: New Design of Fall Pipe Bucket

Following the research, three concepts were developed and evaluated against a selection criterion based off of the key objectives and requirements. Based on the results of the analysis, one concept was developed further into the final design. The new design successfully met the key dimensional requirements and showed a reduction in overall weight while maintaining sufficient strength to withstand the specified operational loads. FEA simulations revealed that the majority of the top ring could handle the required loads, but some areas around the chain attachment exhibited higher-than-acceptable stress levels. While the design shows significant promise, the next steps involve physical testing to validate its performance under operational conditions. Stress and fatigue tests, particularly around the chain attachment, will help refine the design further. Moreover, testing the assembly and disassembly process in real-world scenarios will be essential to confirm the expected reduction in time and labour.

In conclusion, the redesign of the fall pipe bucket represents a significant advancement in Van Oord's subsea rock installation capabilities. By focusing on improving the reusability, assembly efficiency, and sustainability of the equipment, this project has made strides towards aligning with Van Oord’s long-term operational and environmental goals. While further testing is necessary to validate the design under real-world conditions, the progress achieved thus far demonstrates the potential for this innovation to enhance offshore construction operations and reduce environmental impact. This project not only contributes to immediate operational improvements but also lays the groundwork for future advancements in sustainable maritime engineering.