Based on the above prototype results, we conducted the prototyping and evaluation of full-scale polyester ropes intended for actual use as mooring lines.

Tokyo Seiko Rope Mfg. Co., Ltd.
Weight Reduction & High Strengthening of Synthetic Fiber Ropes

TOKYO ROPE GROUP
TOKYO SEIKO ROPE MFG.CO.,LTD

Akita Floating Offshore Wind Demonstration Project

Research & Development Overview

[E-8]: Weight Reduction & High Strengthening of Synthetic Fiber Ropes

Goal: Development & Demonstration of Low-cost and Internationally Competitive Synthetic Fiber Ropes

◘ Background & Challenges

・Floating offshore wind power development is accelerating globally, raising concerns about insufficient supply of steel chains. Furthermore, increasing in water depth leads to heavier steel chains and larger floating structures.

・Synthetic fiber ropes are lighter and less expensive than steel chains, and are expected to reduce the cost of mooring systems.

・In Phase 1, synthetic fiber mooring ropes were supplied for mooring field tests using scale model floater.

→ Development and demonstration of high-strength and low-cost synthetic fiber mooring ropes are essential for commercialization.

◘ Research & Development Details

① Development of Mooring Ropes with Enhanced Breaking Strength and Fatigue Strength

・Developing mooring ropes with enhanced breaking strength and fatigue strength by raw yarn selection and optimization of yarn / sub-rope twist configurations.

・Confirming the society certification process and aiming to obtain the certification.

・Considering productivity improvement measures with a view to commercialization.

② Improvements of rope end processing that causes bottlenecks in mass production

・Considering simplification of eye splicing termination.

・Exploring alternative termination such as socket processing.

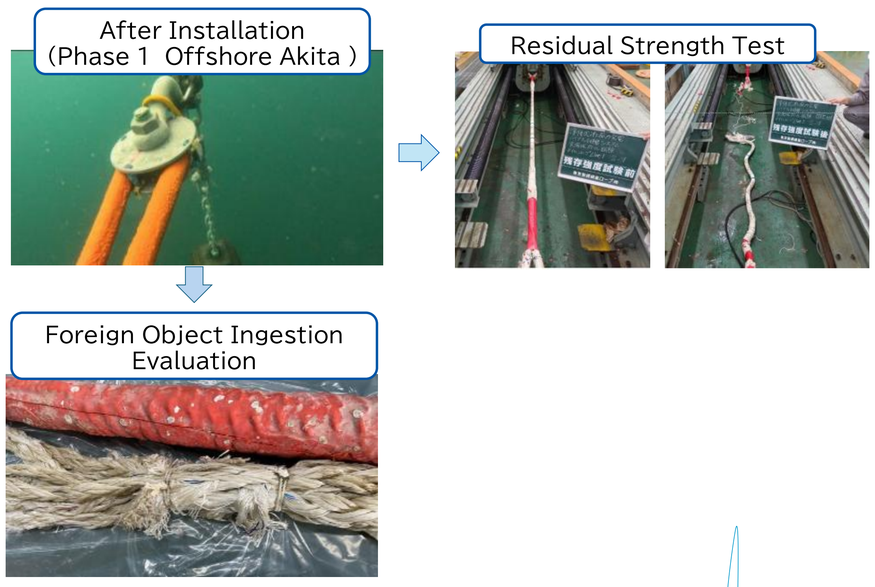
③ Consideration of manufacturing equipment, production processes, and ancillary facilities

・Reviewing manufacturing equipment and production processes aimed at reducing manufacturing costs.

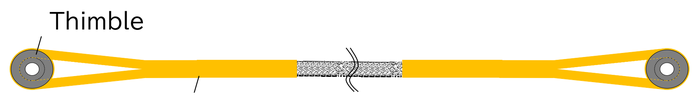
・Studying logistics cost reduction through standardized packaging for land & sea transport and installation work.

・Considering equipment and facilities for the construction of a dedicated plant with a view to commercialization.

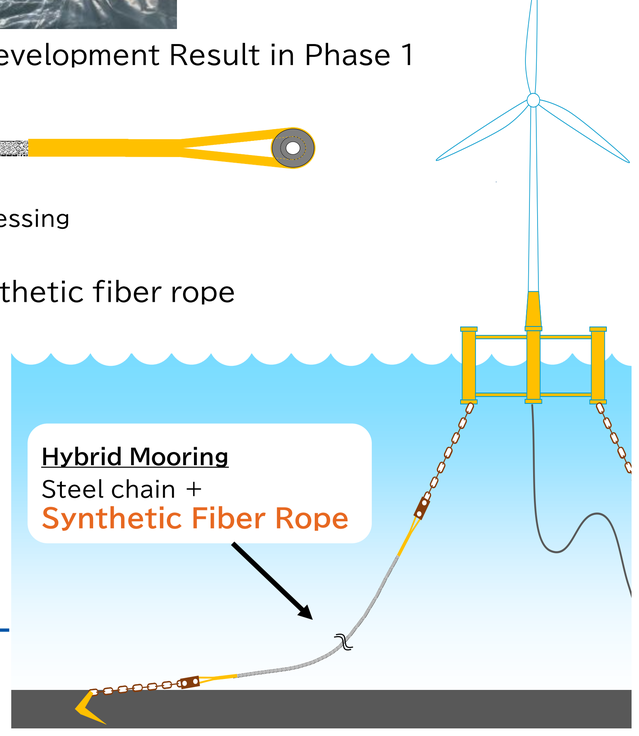
→ Establishing a path toward manufacturing costs reduction by enhancing the breaking strength and fatigue strength of mooring ropes compared to conventional design.



Research & Development Result in Phase 1



Termination of synthetic fiber rope



Mooring Configuration Using Synthetic Fiber Ropes

Research & Development Activities to Date

① Development of Mooring Ropes with Enhanced Breaking Strength and Fatigue Strength

・A polyester full rope with a diameter of ϕ200 and a tensile strength exceeding 10,000kN was designed for use as a mooring rope (Figure 1).

・To enhance breaking strength and fatigue strength, prototype evaluations of the load-bearing sub-rope and the yarn used in the sub-rope are conducted.

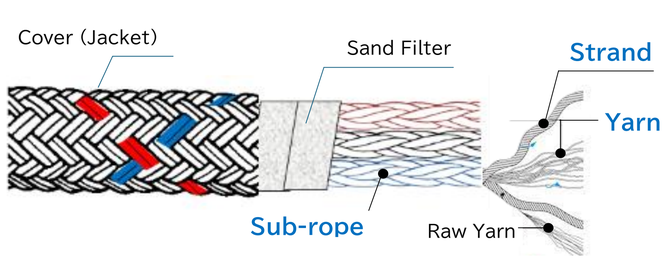
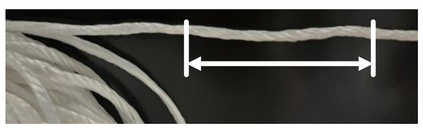
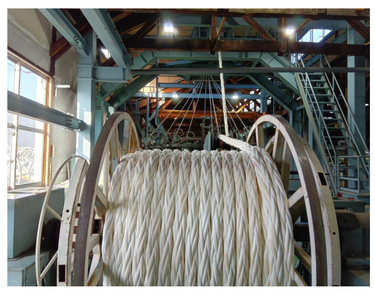


Figure 1. Structure of Full Rope



Yarn

Sub-rope

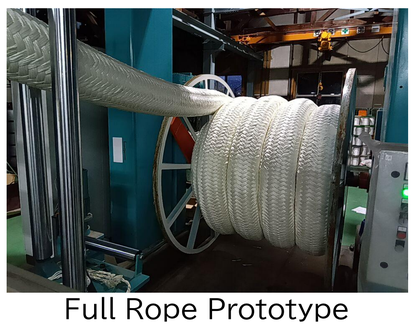


Sub-rope Prototype

Sub-rope Tensile Test

・Based on the above prototype results, a full-scale polyester rope prototype intended for actual use as a mooring line was manufactured and evaluated.

→ The tensile test results exceeded the design strength (Figure 2).



Full Rope Prototype

Rope End Processing of Full Rope

Full Rope Tensile Test
(DNV Technology Center, Bergen)

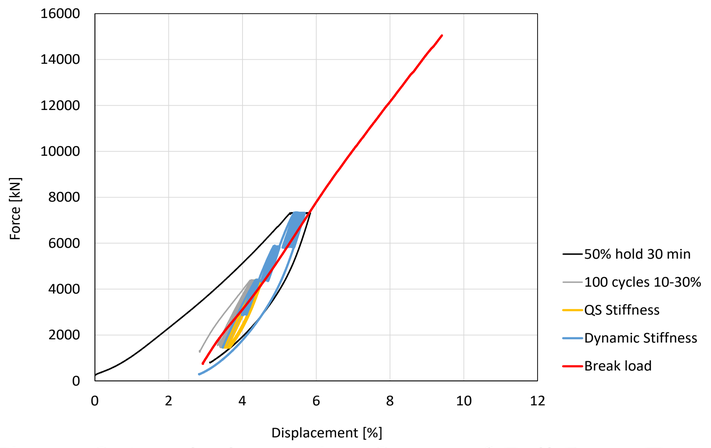


Figure 2. Load-elongation Curve of Full Rope Test

・Confirming the process of classification society type approval and project approval.

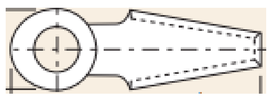
→ In parallel with confirming the certification process with DNV, efforts to obtain certification from Japan ClassNK are underway.

② Improvements of rope end processing that causes bottlenecks in mass production

・Verifying simplification of eye splicing termination using the full rope prototype developed in ①.

・Exploring socket processing as an alternative method to eye splicing.

Eye Splicing



Socket Processing

Verifying Simplification of Termination

③ Consideration of manufacturing equipment & processes, and ancillary facilities

・Stabilizing production and improving productivity by reviewing yarn manufacturing process.

・Confirming the size and cost of full-rope winding reels (Figure 3) for demonstration operation.

・Investigating transportation methods and costs from our Gamagori Plant to the anticipated base port.

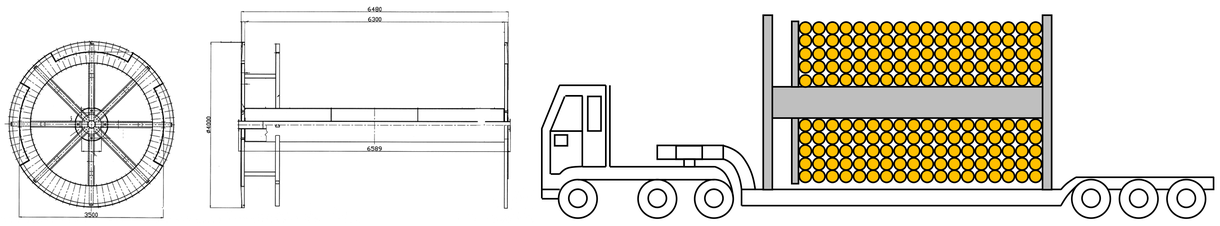


Figure 3. Image of winding reel of mooring rope and transportation