

DESIGN AND CONSTRUCTION OF AN APPARATUS TO PERFORM TENSILE TESTS AT LOW TEMPERATURES IN MOORING ROPES

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Summary: *Mooring ropes used in offshore oil platforms are exposed to a set of environmental conditions that can be crucial to their behavior in service. When one is talking of synthetic fiber ropes, such as Nylon, PET or HMPE, for instance, of all these peculiar conditions, the water temperature at the seabed can be pointed out as the one that affects the ropes mechanical response the most. For this specific reason, sometimes there can be a significant discrepancy between data collected at room temperature during tensile test in these components and their actual behavior in service. Seeking to acquire more accurate data during tensile tests and, consequently, better simulate mooring ropes behavior in service, the aim of this paper is to design and construct an apparatus to be attached to an existing 300 ton tensile/fatigue testing machine of ropes and sub-ropes in order to allow the application of different water temperatures to the samples. As boundary conditions for this project, the device shall be capable of admitting both ropes and sub-ropes types of samples and it also has to be thermally efficient. Mechanical, structural and thermal projects will be detailed, as well as the specification of a commercial chiller capable of maintaining the water at steady temperature throughout an entire test. Projects, to discuss due questions and problems and to promote the co-operation between individuals as well as between institutions. Therefore in the symposium discussions will play a highly significant role.*

Keywords: *Synthetic mooring ropes, tensile test, low temperature*

1 Motivation

The increased depth in offshore profiteering of oil become the conventional mooring system platforms that uses steel cables impracticable, emerging the necessity of new lighter synthetic materials.

As the materials studied for being used in this kind of mooring are new synthetic materials, mainly fibers based on Polyester, Polyamides, Polyethylene, Aramid, the experimental analysis on them to verify their suitability to requests that will be submitted, becomes an essential tool, since there is no information about its characteristics. In this context, new equipments are developed, simulating real conditions to test these materials. Aiming at realization of a test as close as possible the real situation, this paper presents a proposal for a construction of an immersion tank to test ropes and sub-ropes in low temperature, where ropes of synthetic fibers will be tested immersed in chilled water.

2 Objective

Tensile tests on synthetic fibers are very important to detect their characteristics, enabling their use in the field safely. In addition, these tests facilitate the discovery of new materials, with better mechanical characteristics for platforms mooring.

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Currently, tests performed in ropes on the laboratory are made on equipment at the room temperature with a shower type system that keeps the sample wet during the test. The objective of this work is to design and build a pipeline for ropes and sub-ropes immersion to make tests on existing equipment closest to the real condition found in the ocean, so the tests results more reliable.

3 Equipment

The lab already has a huge experience in multifilaments tests, but recently developed an equipment to test sub-ropes [1], shown on the Figure 1. This equipment can perform both static and dynamic tests, by a hydraulic



Figure 1: Sub-rope Tests Equipment.

actuator, with a capacity of 170 TON.

To approximate the test to the conditions found in the oceans, were first made mechanical and structural design of an immersion tank [3], so the rope could be immerse in the water during the test. This tank will have a water intake in the side of the hydraulic actuator and a water outlet to return to the refrigeration equipment, on the opposite side of the intake, as is shown at Figure 5.

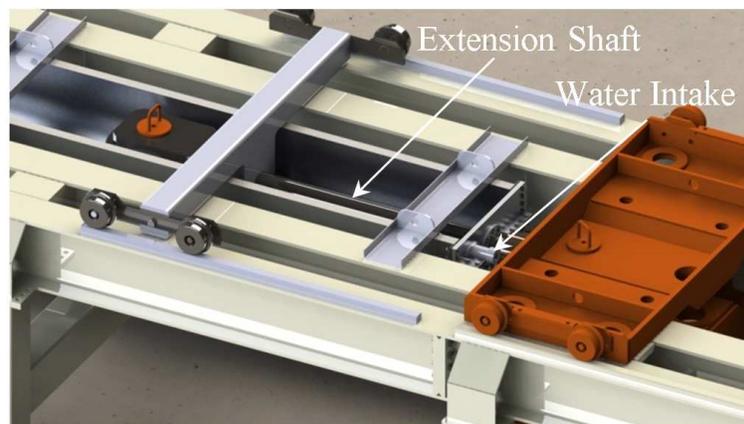


Figure 2: Extension Shaft

To make possible the usage of the tank on the test equipment, was necessary the design of an extension shaft to avoid the contact between the water in the tank and the oil of the hydraulic actuator. This extension shaft, as shown on Figure 2, is connected to hydraulic actuator on the equipment and is allocated within the tank.

The tank must be thermally insulated with rigid polyurethane foam, which is a material with low thermal conductivity [7]. Thus, the thermal load generated by the water inside the tank is approximately 90% of the total thermal load, being this is the main plot for the selection of the chiller. This chiller is shown in Figure 3 and is specified by the thermal load. With the selection of the Chiller, the equipment can be mounted, with

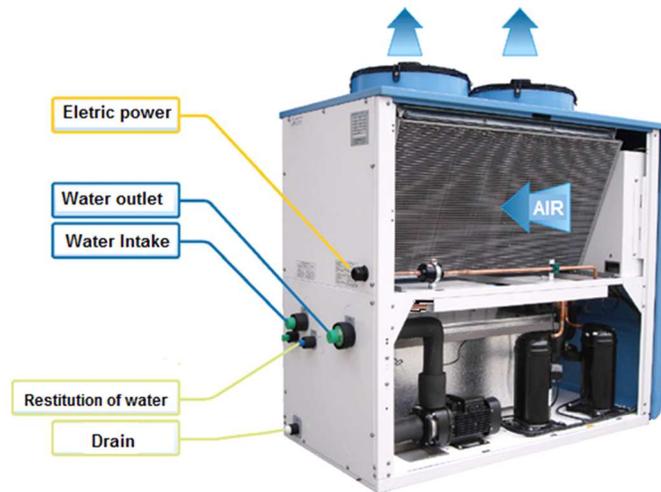


Figure 3: Chiller

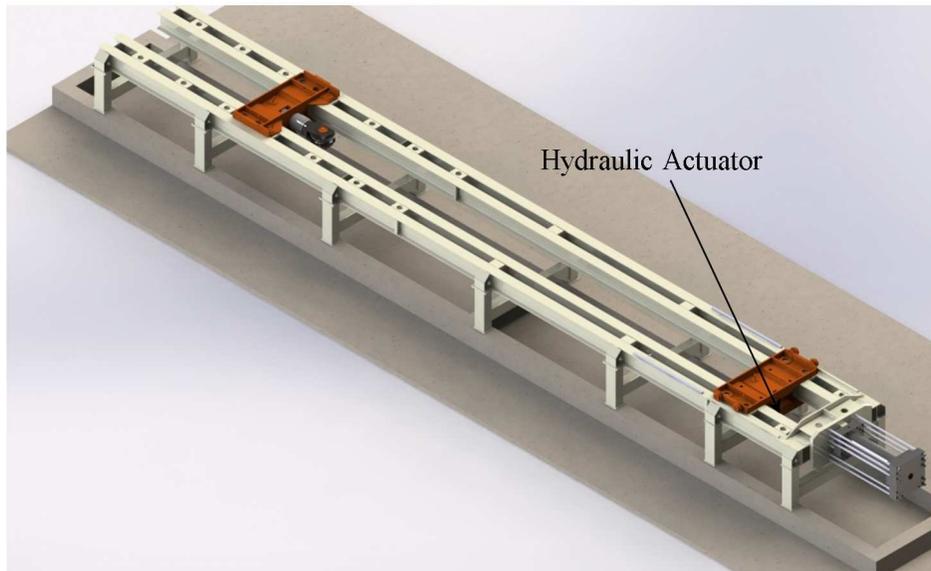


Figure 4: Sub-rope Testing Machine

the installation chiller and the tank. The Figure 4 shows the sub-rope testing machine. The Figure 5 shows the tank and the chiller installed on the machine.

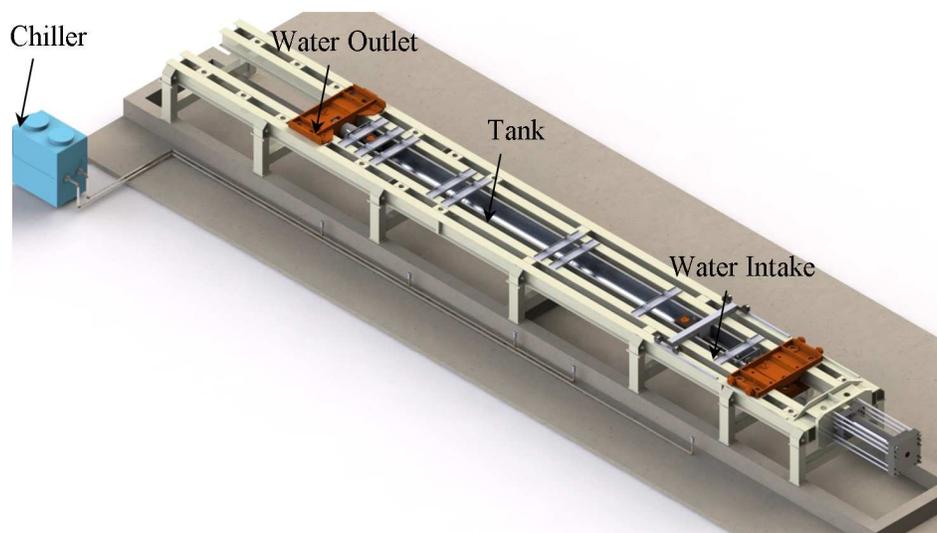


Figure 5: Chiller and tank installed

4 Conclusion

In the present paper, was presented a brief explanation about the equipment being developed in the laboratory Policab. This equipment should approximate the tests condition on synthetic fibers ropes and sub-ropes to the real condition that they are subjected when they are in service.

The selected chiller meets the needs of the project and should keep the water temperature throughout the test.

As the low temperature affects the behavior of synthetic fibers, this new equipment should avoid the discrepancy between the data collected in the lab and their actual behavior in service.

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