Component Reliability for Marine Energy Devices

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Work stream: Reliability

Introduction

In a highly dynamic wave environment **extreme loads** and **fatigue loads** present significant reliability challenges for floating marine energy devices. The University of Exeter is developing a **novel mooring tether** to mitigate against these mooring loads. In addition, the tether decouples the breaking load and stiffness properties of the mooring, allowing these to be specified independently for a specific device and location [1].

The anticipated reduction in loads will lead to improved system reliability, however, introducing a novel component creates its own reliability considerations. This poster will introduce how the reliability of the Exeter Tether is being addressed and present some early results from testing.

The Exeter Tether

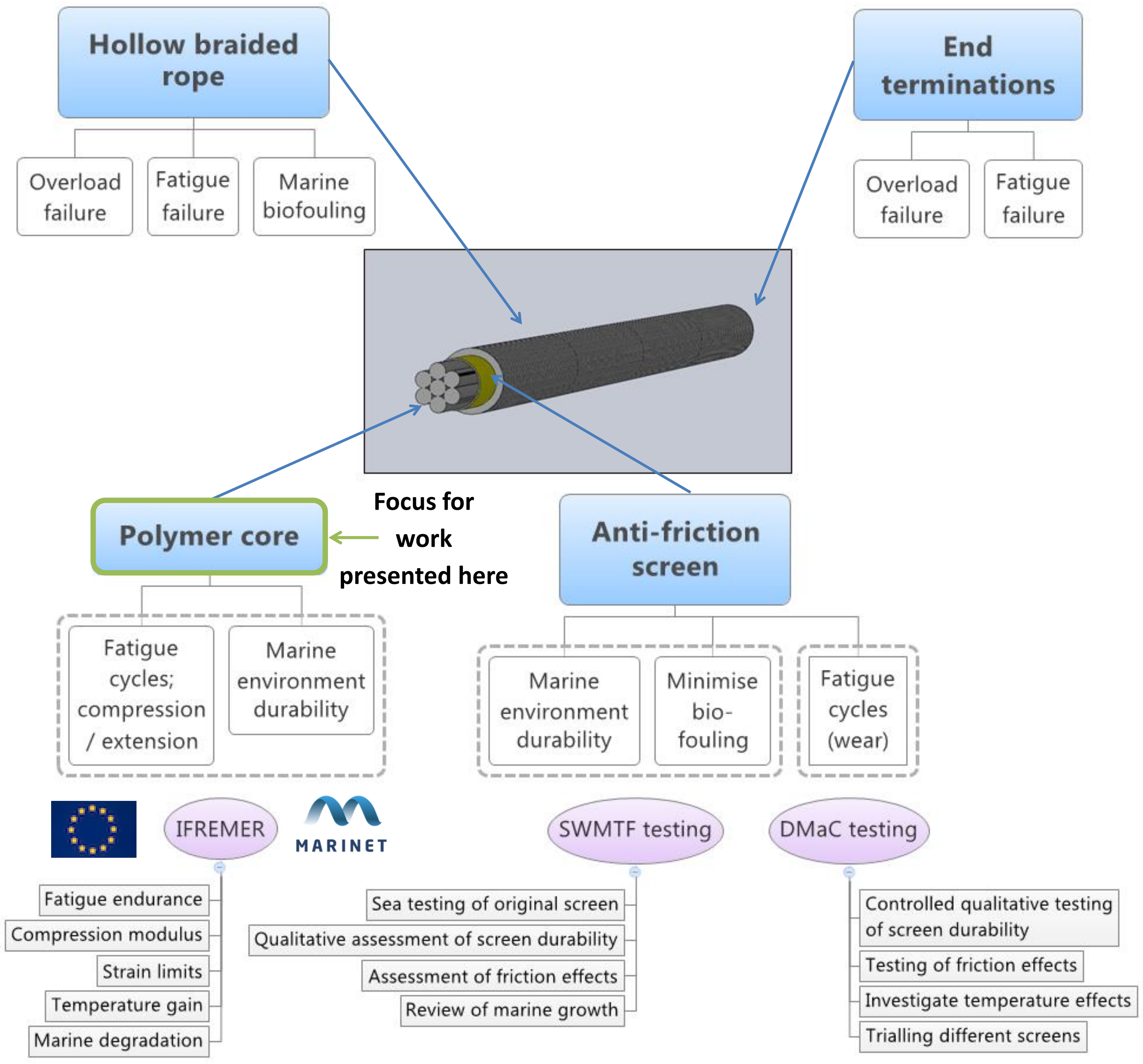

Figure 1: Key components and reliability considerations of tether, with research facilities and approaches detailed for selected components

Polymer core (EPDM) tests

Method

Fatigue cycling: Core samples were subject to radial compression fatigue cycling and the **'radial compression modulus'** (RCM) was measured before and after (at both 10 and 20% strain). This property controls the extension of the tether so understanding how it may change during long term operation is of great importance.

Marine environment durability: Sheet samples were left in baths of renewed sea water at 60ºC to simulate long term ageing in a marine environment. Key material properties of new and aged samples were then compared.

Results

Fatigue cycling:

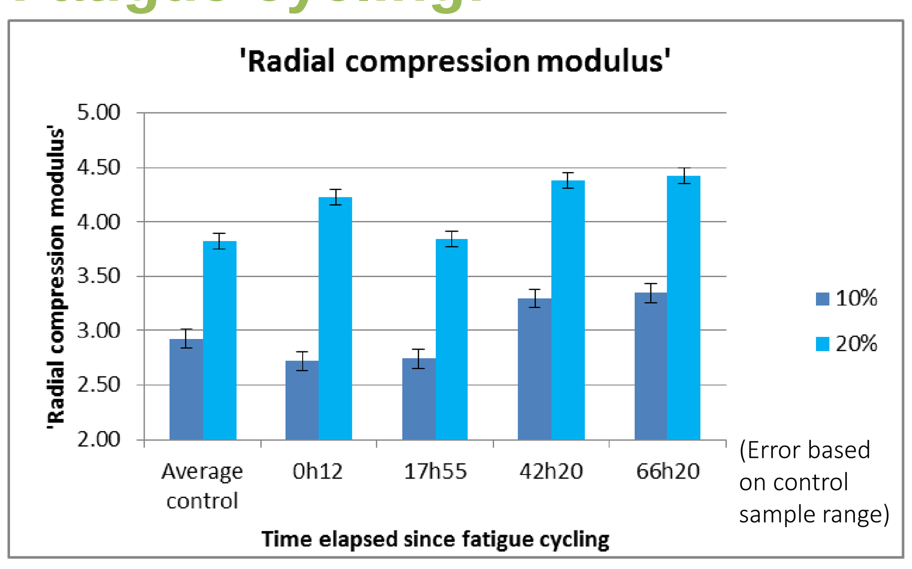

Figure 2: Measurement of 10% and 20% 'radial compression modulus' following radial fatigue cycling of EPDM (707,000 cycles at 20% strain and 2Hz)

In the long term, radial compression fatigue cycling at 20% strain **increases the RCM** of EPDM by an average of 15%.

Marine environment durability:

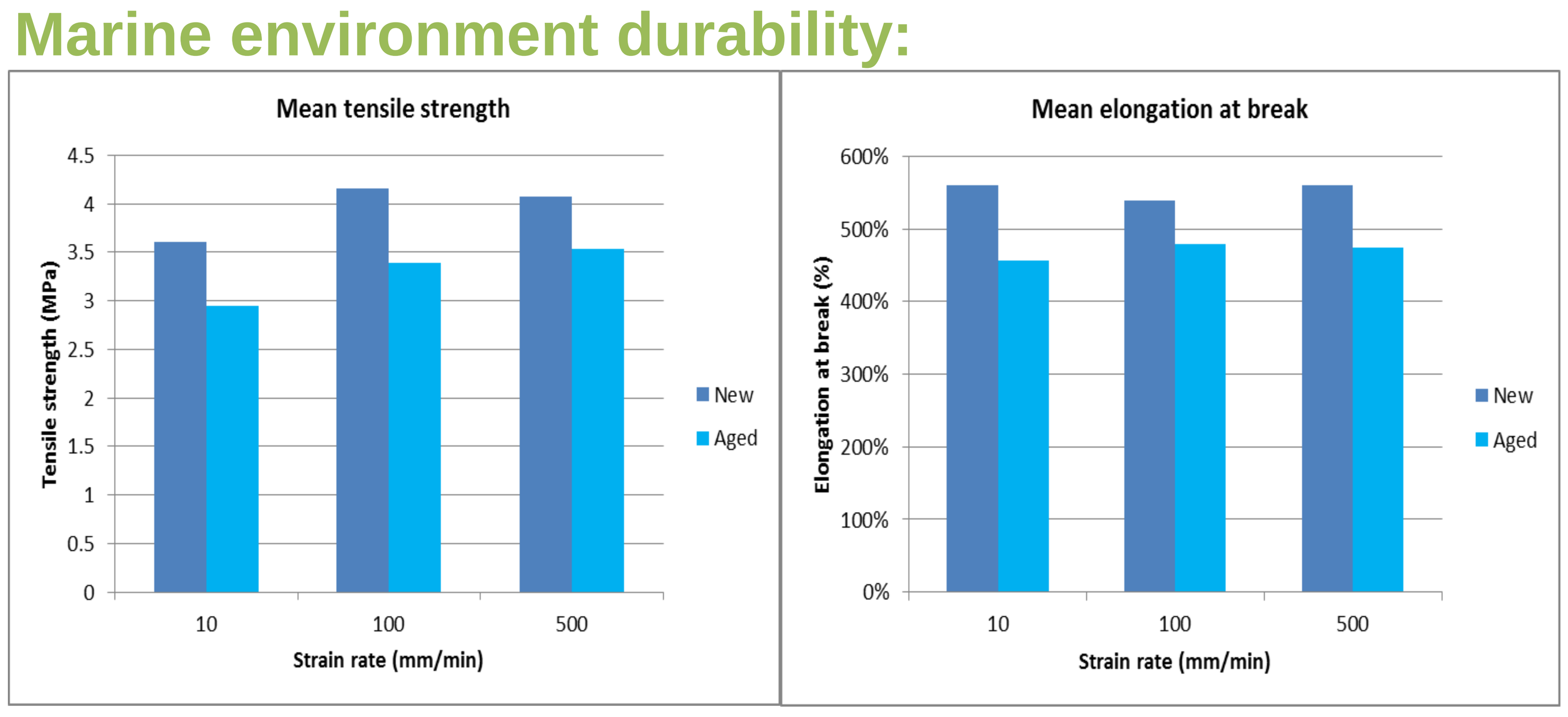

Figure 3: Material properties before and after marine ageing

On average marine ageing **reduces the tensile strength** of EPDM by 17% and **reduces elongation at break** by 15%.

Conclusions and next steps

- An increase in RCM is observed as a result of radial fatigue cycling; this could lead to a stiffer tether response which has implications for long term tether operation.
- Marine ageing of EPDM causes a deterioration of key material properties.
- Further work has been identified to relate the above to the long term durability and operation of the tether.

References

[1] Gordelier T, Parish D, Johanning L, Thies P.R (2014). *A novel mooring tether for highly dynamic offshore applications; mitigating peak and fatigue loads via selectable axial stiffness. Proc. of the International Conference on Offshore Renewable Energy, September 2014, Glasgow.*