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Visco-elasto-plastic behaviour law of a Polyamide 6 floating wind turbine mooring line based on long-term creep tests

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ABSTRACT

Design of floating wind turbine mooring lines and choice of the suitable material are crucial for the systems' design and scaling. However, the ropes of those mooring lines have a complex visco-elasto-plastic behaviour that is therefore difficult to model. An additional modelling difficulty is that the expected lifetime is up to 25 years and it is of course not reasonable to perform such long experiments. Some laws have been developed, like the SYROPE law of Falkenberg et al. (2017), in order to be able to simulate and predict short-term and long-term mooring lines behaviour. Civier et al. (2024) developed the POLYAMOOR one-dimension law (Figure 1). This law is composed of a fast spring, representing the instantaneous elastic response, and a time-dependant or viscous part. This model is accurate to simulate the response to short-term loadings, (i.e. with characteristic times under a few hours), but is not enough accurate for long-term loadings, such as long-term creep tests (i.e. lasting a few years), see Civier et al. (2022).

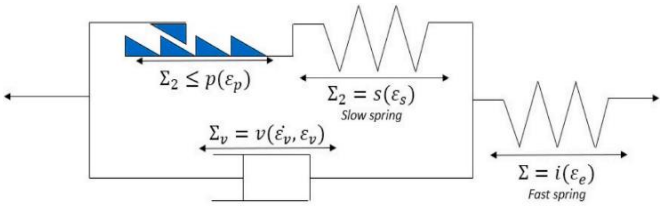

Figure 1: Rheological scheme of the POLYAMOOR law

So far, the parameters of the POLYAMOOR behaviour law were identified with a multi-relaxation test. The 1hour-relaxation plateaus are not long enough for the modelling of long-term solicitations. As long-term creep tests have been done by Civier et al. (2022), the objective of the present study is to also use those data to identify the parameters, especially those from the viscosity element, but also the plasticity ones, as all the parameters of the time-dependant part are interdependent. An alternative approach can be considered by adding several Maxwell elements in parallel of the time-dependant part, in order to describe the different relaxation times met by the rope.

References

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