

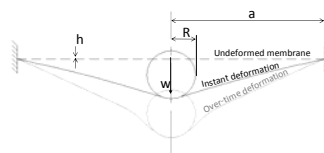


Mechanical Characterization of a Freestanding Polyvinyl Alcohol Hydrogel Membrane

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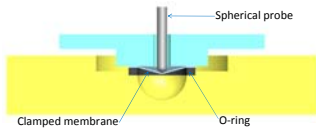
Introduction

Polyvinyl alcohol (PVA) hydrogel is a simple yet versatile material with increasing possibilities, especially in the biomedical field. Therefore an understanding of how the manufacture process affects the final properties of the material is required. Due to the particular characteristics of this material, similar to those of the human tissue, standard tests such as the ASTM tension test are not feasible. Instead the theory of large deformation of membranes is used to implement an unconventional method, known as the blister test configuration, to characterize the studied samples. The setup consists of a circular thin membrane clamped at its periphery and a spherical probe to apply the load.



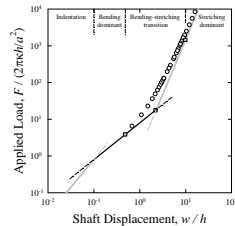
Different configurations for how the load is applied are used with the objective of obtaining the viscoelastic properties of the material.

1. Quasi-static test



The membrane experiences three different kinds of deformation: indentation (w_i), pure bending (w_b) and pure stretching (w_s), their sum is considered the total deformation.

Transition between deformation modes



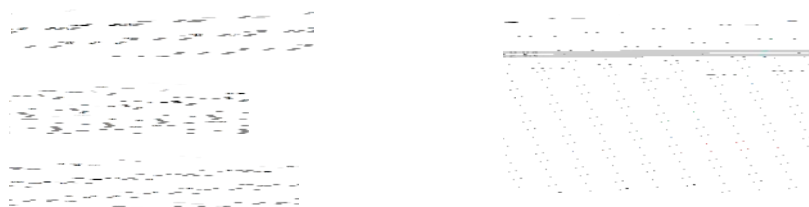
Equipment used: Agilent Nano UTM

Force resolution: 10 nN
Displacement resolution: 30 nm



The hydrogel fabrication process includes a series of freezing and thawing cycles in order to promote cross-linking. One of the objectives of the present research was to determine how the variation of the number of cycles affects the mechanical properties of the final product.

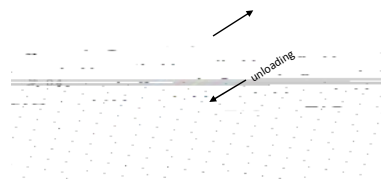
Deformation example on a "2 cycles" sample



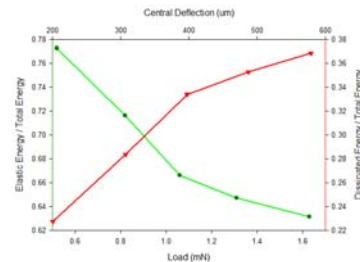
Resultant elastic modulus



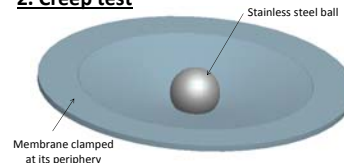
Loading and unloading loop on a "4 cycles" sample



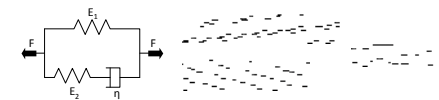
Elastic and dissipated energy vs load and deflection



2. Creep test

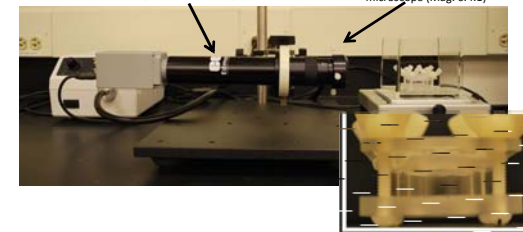


Standard linear solid



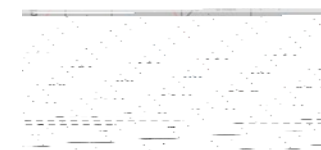
Equipment used: Long focal microscope

Pixelink camera (model: PL-B742U)
Edmund Optics – Long focal (90mm) microscope (Mag: 6.4:1)



Future work: cyclic loading

Future work will include the application of a sinusoidal load on the membrane, to determine the loss and storage moduli. This will allow a comparison between the parameters obtained in this test and the creep test.



Acknowledgements

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References

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