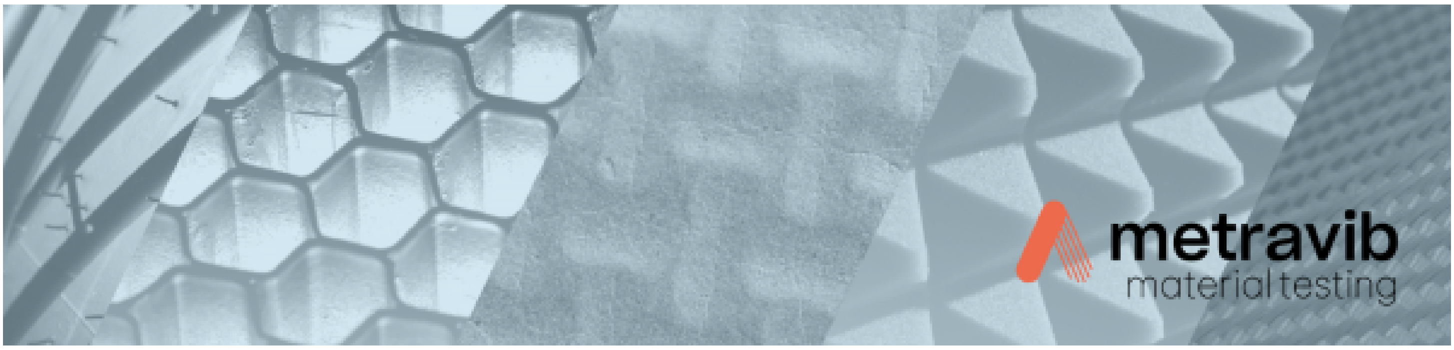


Effect of Relative Humidity on Chitosan Polymer

Keywords: DMA, Glass Transition, Relative Humidity, Chitosan, Viscoelastic Properties, Biomedical

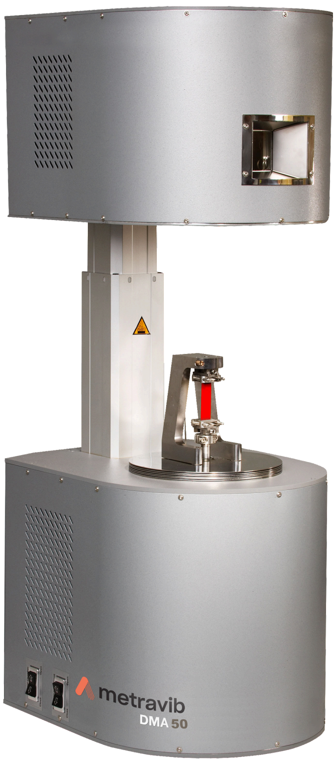


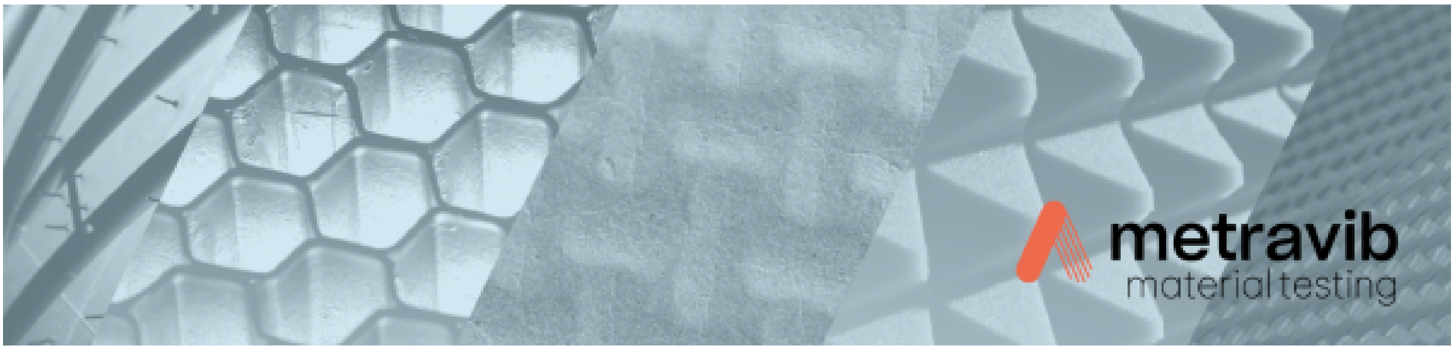
Figure 1. Metravib DMA 25/50

Introduction

Being an adequate technique for characterization of the viscoelastic (mechanical) properties of materials, Dynamic Mechanical Analysis (DMA) is in use even in biomedical applications. Chitosan polymer is one of the widely used polymers in the biomedical field, including tissue engineering and regenerative medicine, due to their structural and functional similarity to the components found in living tissues.

Chitosan polymer could be exposed to different levels of relative humidity, that can vary from moderate relative humidity levels, in biomedical applications. For example, in skin applications (such as in wound dressing), up to their maximum values of water uptake capability, in implantable conditions (such as internal sutures).

Considering the importance of investigation of the effect of relative humidity on chitosan polymer, this characterization of chitosan



polymer was performed and analyzed in the presence of several levels of relative humidity. Such analysis is relevant, as mechanical performance is crucial in functionality of biomaterials.

Materials & methods

Thin film of Chitosan polymer was characterized using Metravib DMA 25/50 in shear mode and at several relative humidity levels using a dedicated hygrometric module which helps generate humidity in the DMA chamber. This dedicated module can control the generation of humidity in the DMA at different temperatures required for the measurements too.

The schematic principle of shear mode can be seen in Figure 2 below. The characterized film was 0.075 mm thick and 18 mm large.

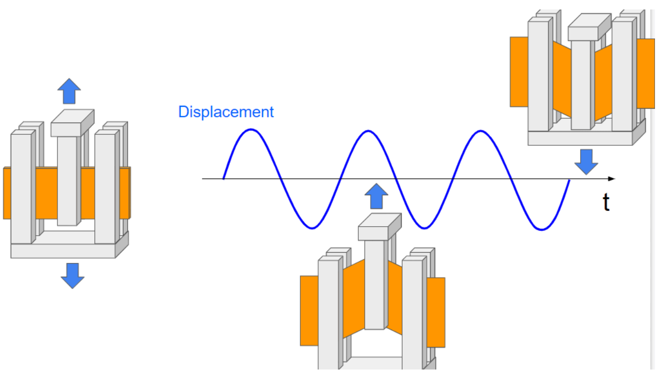


Figure 2. Schematic principle of shear mode measurements

This shear film specimen holder was specifically designed for thin film characterization.

The parameters used for the measurements are mentioned in Table 1.

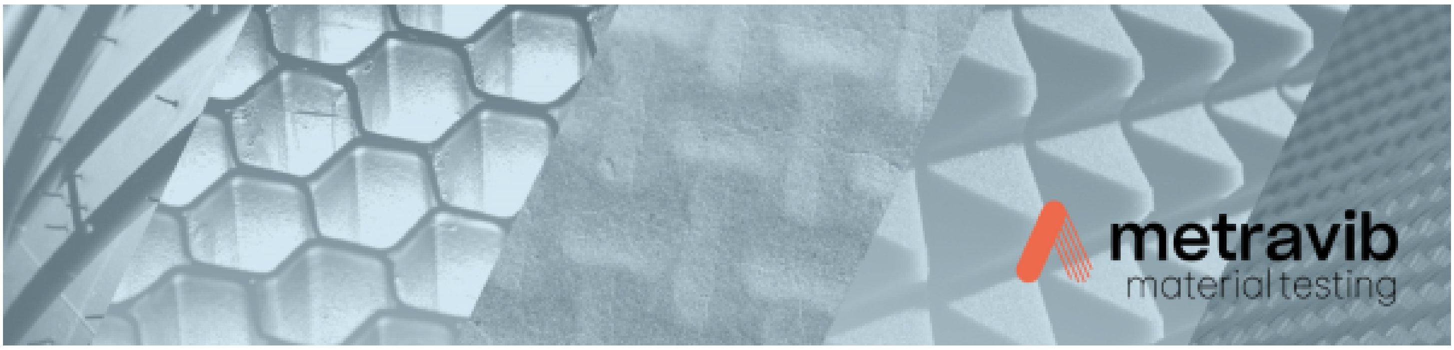
Dynamic Displacement (m)	5e-6
Frequency (Hz)	10
Temperature (˚C)	Room temperature
DMA	DMA 25/50
Test Mode	Shear film
Relative Humidity (%)	5-90

Table 1. Test parameters

Results

The viscoelastic properties (in terms of G' and Tan delta) of the chitosan polymer is presented in Figure 3, as a function of relative humidity.

Decrease in shear storage modulus was observed as a function of increase in relative humidity. Chitosan polymer, in the presence of relative humidity also showed a transition type behavior. This change in storage modulus by almost 2 orders of magnitude and the transition type behavior of chitosan at higher relative



humidity, showed the importance of investigating the mechanical properties of chitosan polymer.

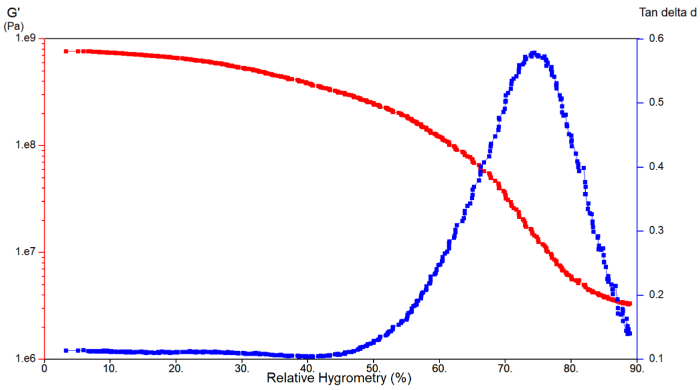


Figure 3. G' and Tan delta of chitosan polymer as a function of relative humidity

Conclusions

The viscoelastic properties of chitosan polymer were characterized by using DMA 25/50 and a special module for generating humidity in the DMA chamber.

At higher relative humidities, the decrease in shear storage modulus and a transition type behavior in Tangent delta showed the importance of characterizing chitosan polymer or different polymers in presence of several levels of relative humidity.

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