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# THE EFFECT OF SALT WATER TREATMENT ON BENDING TEST OF JUTE TISSUE/EPOXY COMPOSITES

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***Abstract:*** *Nowadays composites can be made by replacing synthetic fibres with different types of natural fibres. Main factor in the composite is to have a good strength of adhesion between polymer matrix and fiber. More unidirectional samples with different number of jute tissue layers was immersed in salt water with different concentrations for 90 days (2.160 hours) at room temperature. This paper present the bending test before and after treatment in salt water for some samples. The bending test evaluation was performed with Universal Testing Machine – WDW-150S type, from Jinan TE Corporation.*
***Keywords:*** *jute fibre, natural composites, polymer-matrix composites, salt water, flexural strength.*

## 1. INTRODUCTION

During the last years, the natural fiber based polymer composites have become an great interests among scientists in order to developing derivate biodegradable ecologic materials and partly reducing the dependency of synthetic fibers [1].
In the past, the use of synthetic materials dominated the industry of confectioning composite materials; nevertheless, the use of natural fibers has become an important point in their development for obtaining composites for various applications.
The interest in the use of the polymeric composites, reinforced with natural fibers, has increased rapidly due to their mechanical properties, to their significant processing advantages, to their density and reduced costs [2]. The use of natural fibers in obtaining composites is very benefic as their resistance and hardness are higher than those of the plastic materials, which are not reinforced [3].
It is good to know the fact that the composites performance depends in a big extent on the individual properties of each material and their interface regarding the compatibility between them. A significant impediment in obtaining fiber reinforced composite materials is the weak connection between the fiber and the matrix, which is due to the hydrophilic characteristic of the cellulose and the hydrophobic nature of the matrix material, which leads to a weak adhesion on the interface between the materials [4].

## 2. EXPERIMENTAL DETAILS

For this research, hemp canvas and epoxy resin type materials were purchased ( ROPOXID 501). The manual formation technique, presented in Fig. 1 (a), known as the oldest method, was used to obtain composite materials. Plates (with 1-3-5-7 layers) were obtained, where, following polymerization, they were left for drying several days in order to obtain the optimal mechanical properties.

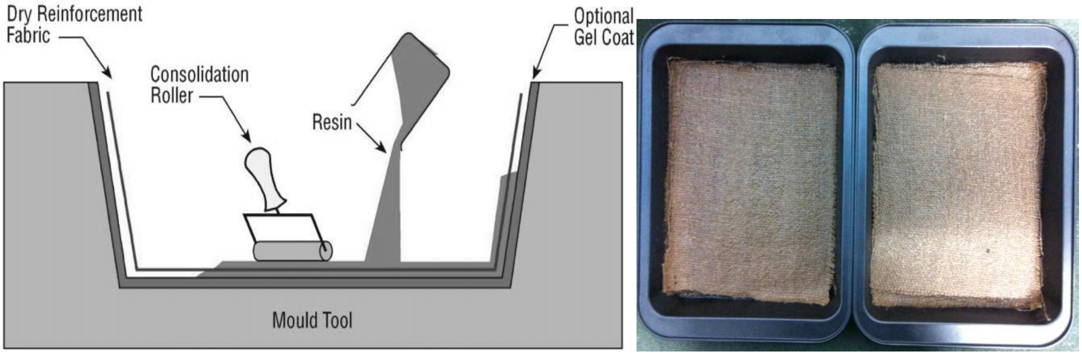
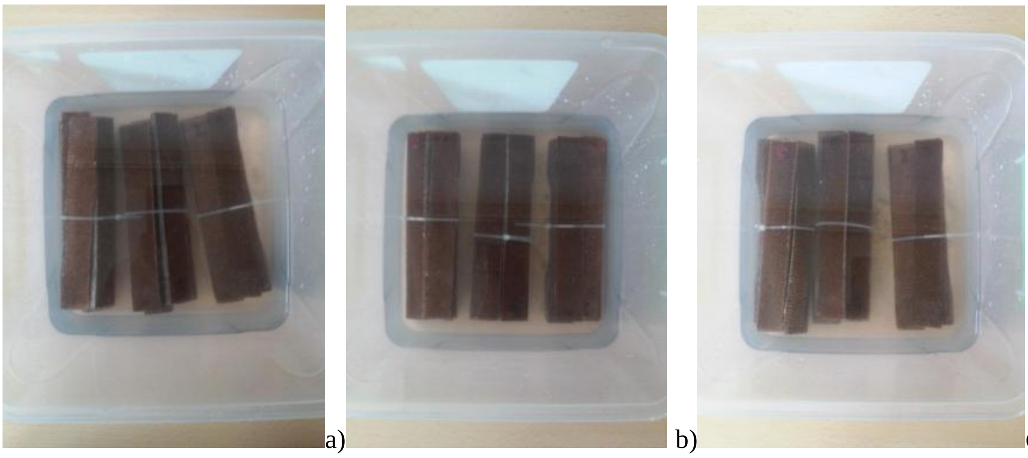



**Figure 1:** a) Hand lay-up Technique [5] b) Jute composites

Specimens were obtained and subject to treatments with saline water of different concentrations ( 3, 4, 5 g NaCl / 100 ml $H_2O$ ), on a 3-month period (2160 hours). For the saline treatment with a concentration of 3,4,5 g NaCl / 100 ml $H_2O$, 5 specimens were prepared for each composite with 1-3-5-7 layers, as presented in Fig. 2.



a) b) c)

**Figure 2:** Composites with 1-3-5-7 layers under treatment with different concentration:
a) 3g NaCl /100ml $H_2O$,4g NaCl / 100ml $H_2O$;b) 4g NaCl /100ml $H_2O$,4g NaCl / 100ml $H_2O$;
c) 5g NaCl /100ml $H_2O$,4g NaCl / 100ml $H_2O$

In order to measure the water absorption, the specimens were took out and periodically weighed with a precise electronic balance, for 2 weeks (336 hours), every 24 hours, for monitoring the variation of the sample mass during the ageing process. The absorption process was expressed with the relation (1) [3]:

$$Water\ uptake\ (\%) = \left(\frac{P_w - P_o}{P_o}\right) * 100 \quad (1)$$

Where, $P_w$ is the wet weight, $P_o$ is the dry weight of the specimen.

## 3. RESULTS AND DISCUSSION

### 3.1. Water uptake

In most cases, the humidity absorption process may be described by Frick's law, where the absorbed water mass grows linearly with time's square root and then decreases gradually up to a constant equilibrium. The diffusion coefficient (D) is the most important parameter, where it shows the easiness with which the water molecules penetrate inside the composite, which is calculated by the relation (2) [7].

$$\frac{M_t}{M_s} = \frac{4}{h} * \left(\frac{D}{\pi}\right)^{1/2} t^{1/2} \quad (2)$$

Where, h is the specimen's thickness, $M_t$ and $M_s$ represent the absorbed and desorbed solution mass.
The absorption curves for the specimens obtained from reinforced hemp tissue in epoxy resin with 1-3-5-7 layers are presented in Figure 4. Each diagram represents the average water absorption for each type of layer in a different concentration.

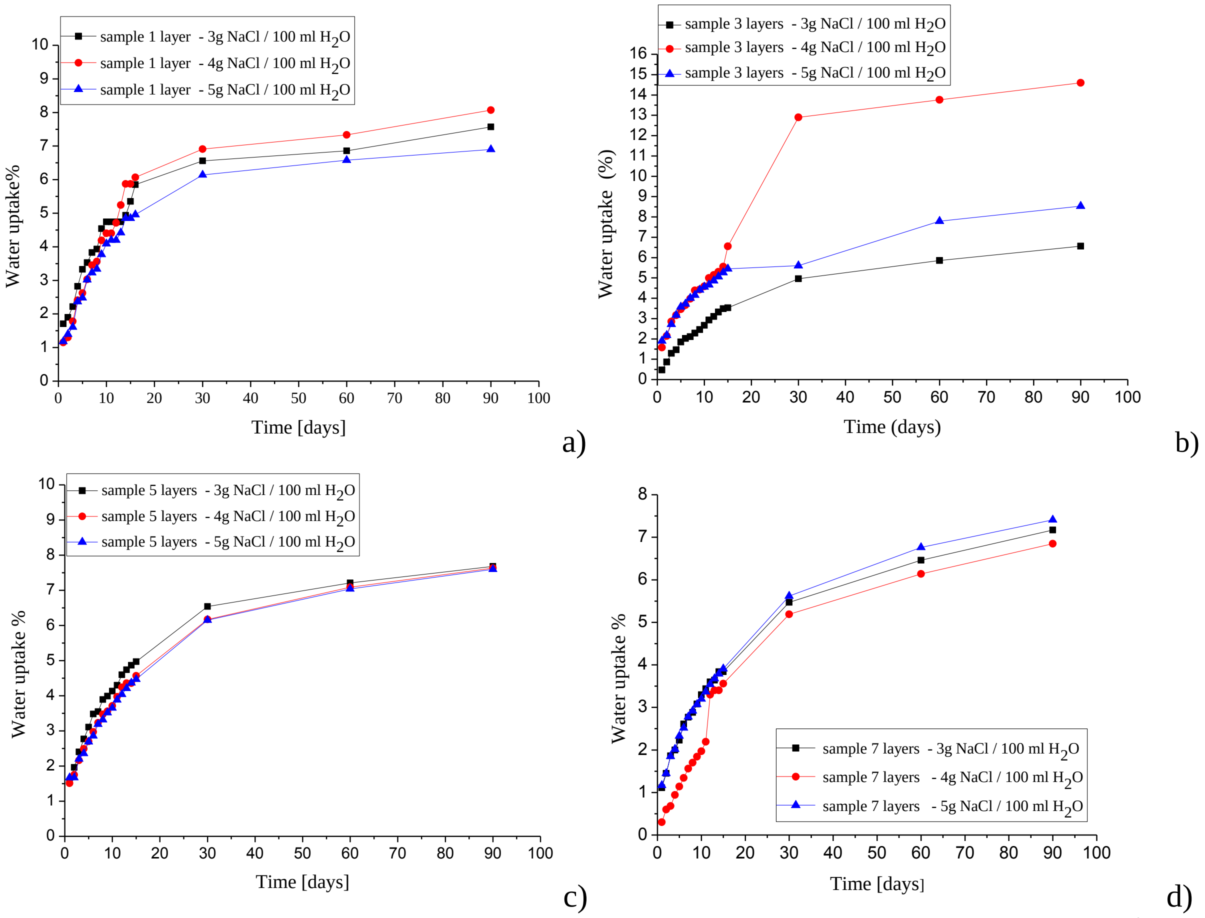



**Figure 4:** Absorption curve for JE composites immersed in salt water with different concentration at 22 $^0$C: a) 1 layer in 3g NaCl /100ml $H_2O$, 4g NaCl / 100ml $H_2O$, 5g NaCl/100ml $H_2O$; b) 3 layer in 3g NaCl /100ml $H_2O$,4g NaCl / 100ml $H_2O$, 5g NaCl/100ml $H_2O$; c) 5 layers in 3g NaCl /100ml $H_2O$,4g NaCl / 100ml $H_2O$, 5g NaCl/100ml $H_2O$; d) 7 layers in 3g NaCl /100ml $H_2O$, 4g NaCl / 100ml $H_2O$, 5g NaCl/100ml $H_2O$

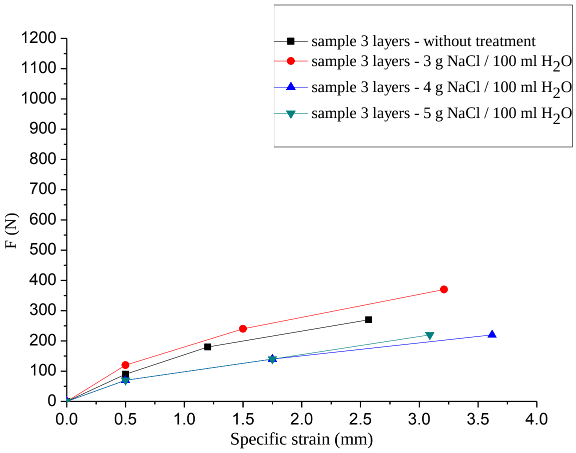
The absorption curves for the specimens obtained from reinforced hemp tissue in epoxy resin with 1-3-5-7 layers are presented in Figure 4. Each diagram represents the average water absorption for each type of layer in a different concentration. From the absorption curves in Fig. 4 a),b),c),d) it results that, for each concentration in the first two weeks, the water content absorbed by the specimens increased with the increase of the immersion time. We can notice that, in Fig. 4 a),b),c),d) regardless of the number of curves, the water absorption curves tend to equilibrium, which results upon the appearance of the saturation moment. The significant increase of the water absorption curve in Fig. 4 b) with a concentration of 4g NaCl / 100 ml $H_2O$ highlights the presence of certain defects occurred during obtaining the composite material. The significant justification of the percentage of absorbed water by all types of specimens obtained by the manual method may be drawn from the lack of a lamination process.

### 3.2. Flexural strength

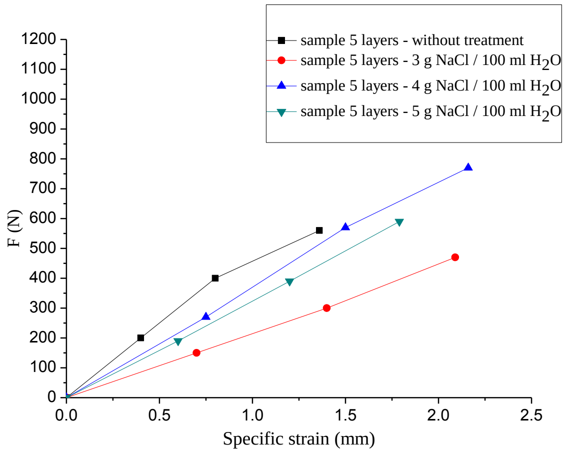
In order to determine the bending stress in three points, specimens were obtained according to SR EN ISO 7438:2005 and tested with the Universal Testing Machine – WDW-150S, from Jinan TE, presented in Fig. 5 [6].

**Figure 5:** Universal Testing Machine – WDW-150S

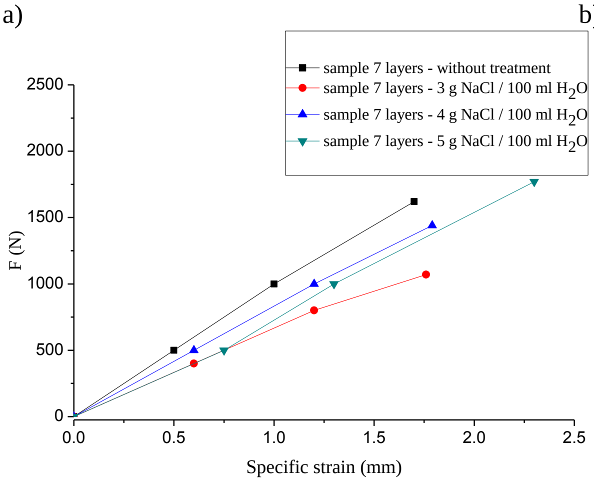
The results obtained represent the average of tests made for 5 specimens of each type of composite formed with 1-3-5-7 layers for each type of treatment.




a)




b)




c)

**Figure 5:** Diagrams regarding the average bending strength for specimens without treatment and with saline treatment: a) with 3 layers for 3,4,5 g NaCl / 100 ml $H_2O$; b) with 5 layers for 3,4,5 g NaCl / 100 ml $H_2O$; c) with 7 layers for 3,4,5 g NaCl / 100 ml $H_2O$

Figure 5 shows the results of the bending strength for each type of specimen without treatment and with saline treatment with a concentration of 3,4,5 g NaCl / 100 ml $H_2O$. Determination of flexural strength for single-layer specimens were removed due to their high elasticity. We could notice that, for all specimens, the bearing strength increased with the increase of the number of layers, the deformation degree being smaller for the dry ones and higher for the immersed ones. With regards to the bending strength, we can notice that the values for the immersed specimens are smaller as compared to the dry ones, leading to the deduction that saline treatments of different concentrations do not help in the increase of the resistance, but they highlight a significant increase of the elasticity degree.

## 4. CONCLUSION

The effect of the saline water absorption over the mechanical properties of the composites formed of hemp tissue and epoxy matrix was studied. It was revealed that the water absorption increased with the immersion time on the entire treatment period, according to Fick's diffusion process.
With the increase of the number of layers, it was also noticed an increase of the properties of composites without treatment, but also the effect of all treatments applied to composites led to an increase of elasticity.

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