

# Effect of NaOH Treatment on Bamboo Biocomposites

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## INTRODUCTION

Biocomposites are gaining popularity in the composite industry due to their renewability and environmental impact. Due to bamboo's fast growth cycle and compact space requirements, it would be a great candidate for different applications.



Figure 1. Bicycle model with a frame made of bamboo composite (Soben Advanced Bamboo Composites, 2019)

## OBJECTIVE

The objective of this study is to evaluate the effect of sodium hydroxide (NaOH) solution and water conditioning on bamboo-reinforced biocomposites with quasistatic tensile testing.

## MATERIALS

Two laminates were made and conditioned using:

- Bamboo woven fabric
- ONE/ONF bio-resin
- 0.25M NaOH solution
- ASTM type II deionized (DI) water.

## METHODOLOGY

Using the vacuum assisted resin transfer molding (VARTM), shown in Figure 2, two laminates were made: one with unwashed bamboo fabric and one with washed bamboo fabric soaked in NaOH for 1 h and dried for 5 days at room temperature.

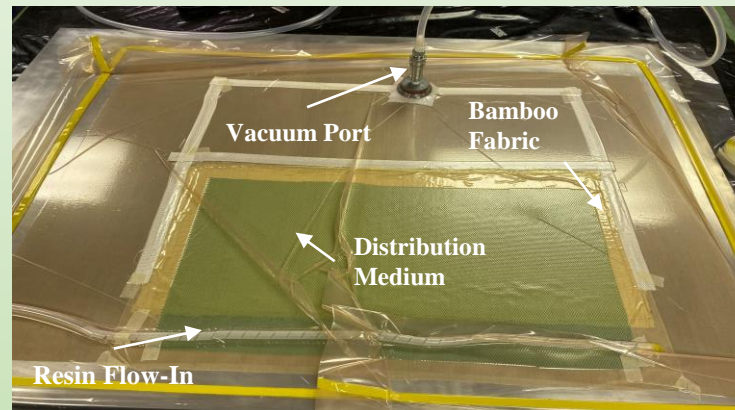


Figure 2. The VARTM setup.

To condition the specimen, 10-11 specimens from each material were soaked in deionized water at 150 °F for 24 hours before performing tensile testing. The specimens were weighed before and after the soak to determine the water absorption amount.

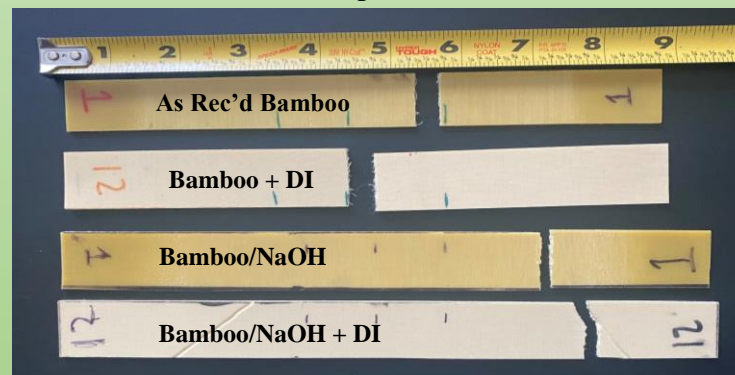


Figure 3. Broken specimens after tensile test.

## RESULTS

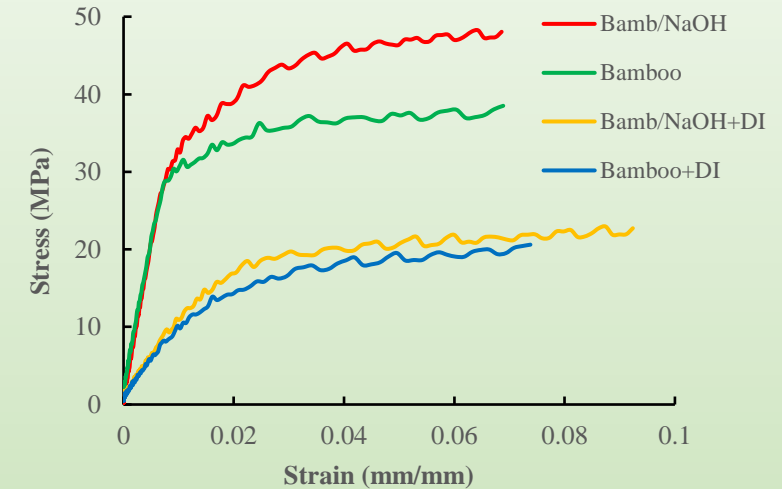


Figure 4. Representative tensile test of different specimen types.

Table 1. Modulus, UTS, and yield strength results (average ± std. dev.).

Sample	Condition	E (GPa)	$\sigma_{ut}$ (MPa)	$\sigma_y$ (MPa)
Bamb/NaOH	As Rec'd	3.99±0.30	48.5±2.38	31.0±1.89
Bamboo	As Rec'd	3.83±0.23	38.5±1.09	30.1±1.15
Bamb/NaOH	DI Water	1.24±0.18	22.6±1.21	13.4±1.56
Bamboo	DI Water	1.16±0.09	21.4±1.04	11.9±1.50

## CONCLUSIONS

- Washing bamboo fabric with NaOH improves the modulus (4-6%), UTS (21%), and yield strength (3%).
- DI water soak has a heavy detrimental impact on the mechanical properties of bamboo composites (up to 69% reduction in modulus).
- Specimens with either fabric gained about 13% water.