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## Durability of Impregnated Fast Growing Wood by Nano Silica from Betung Bamboo Sticks

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### INTRODUCTION



Sengon tree

Sengon wood (*Falcataria moluccana*) is one of fast growing species that is widely planted in Indonesia. It has low durability particularly against termites. Based on Rahayu et al. (2014), five years old sengon consisted of 100% of juvenile wood. Therefore, impregnation method was required to improve sengon's durability. Rahayu et al (2019) stated that impregnation by using MEG (Monoethylen glycol) and SiO<sub>2</sub> nanoparticle could increase dimensional stability and density of sengon wood. In this study, we used nano silica from betung bamboo sticks as impregnant. The objective of this research was to analyze the durability of impregnated sengon wood by using MEG (monoethylen glycol) and nano silica from betung bamboo sticks.



Betung bamboo sticks

### METHOD

#### MATERIAL

- Five-years old Sengon wood,
- Monoethylene Glycol (MEG),
- Nano silica from betung bamboo sticks (437.19 nm) (made by ultrasonication method)

#### TREATMENT

- Untreated (Water Treated)
- MEG
- MEGSilica 0,5%
- MEGSilica 0,75%
- MEGSilica 1,0%

#### SAMPLE TESTING

- ASTM D 1758-06 (Grave yard)
- SNI 7207 : 2014 (Dry-wood termites)

#### IMPREGNATION TREATMENT



Dried at the temperature  
103 ± 2 °C



Vacuum at 0,5 bar for 60 min  
pressure at 2,5 bar for 120 min



Polymerization for 24 h



Oven dried until reached  
constant weight



Grave yard test



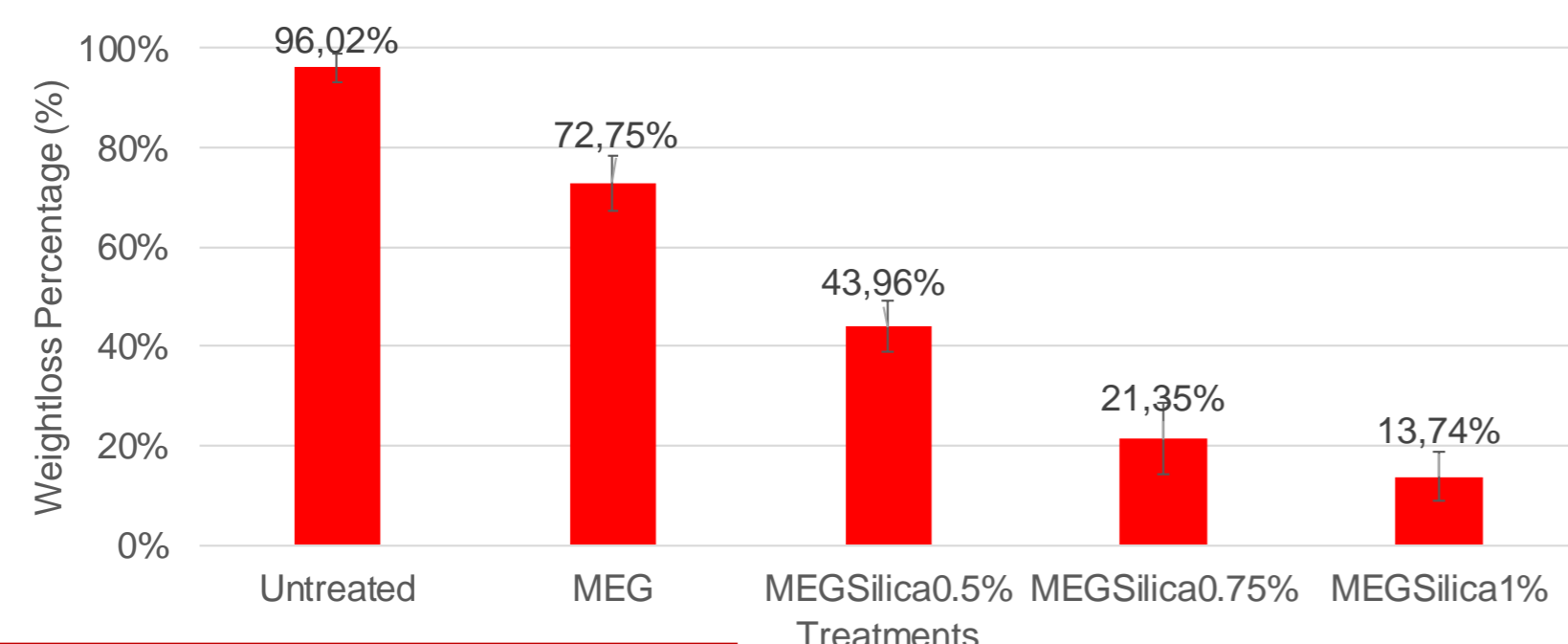
Dry-wood termites laboratory testing method

### RESULT

#### Grave yard

##### Scoring degradation in treatments after grave yard test

Replicates	Untreated	MEG	MEGSilica0.5%	MEGSilica0.75%	MEGSilica1%
1	0	0	0	10	10
2	0	0	1	8	10
3	0	0	2	8	9
4	0	0	1	10	10
5	0	0	4	9	9



#### Grave yard test



Untreated



MEG 50%



MEGSilica 0.5%

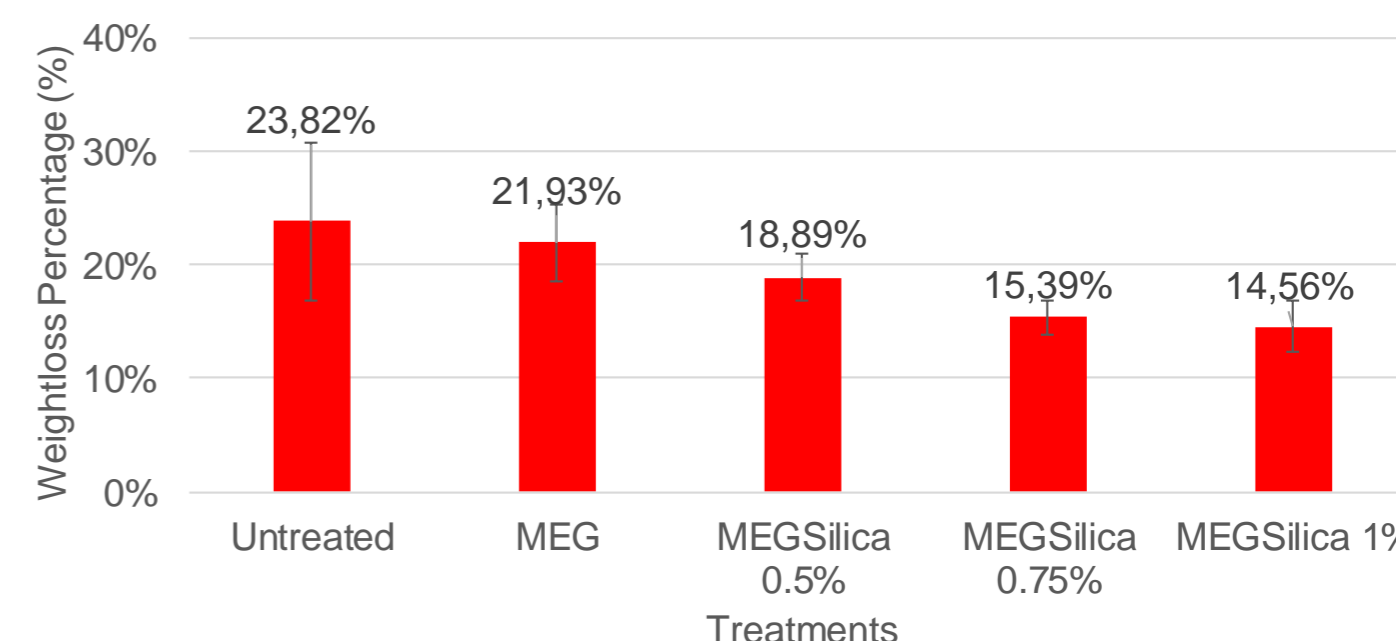
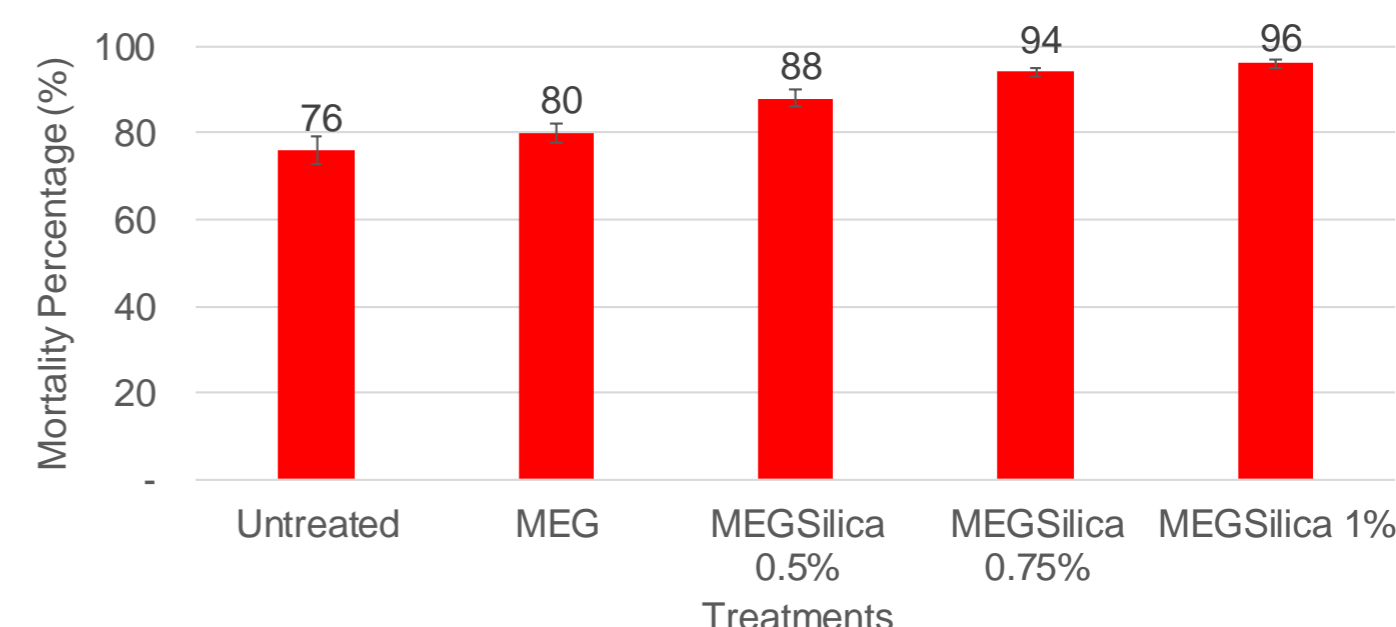


MEGSilica 0.75%



MEGSilica 1%

#### Dry-wood termites



### CONCLUSION

Impregnation of sengon wood by nano silica increased durability sengon wood against wood destroying organism particularly termites. Zhang et al. (2011) found that nano silica is poisonous against wood destroying organism. The higher concentration of nano silica inside sengon wood, the lower weightloss percentage and the higher mortality percentage. It was due to higher concentration nano silica could increase wood durability (El-bandary dan EL-Halay 2013). Treatment of MEGSilica 1% is the optimum treatment for five-years old sengon wood based on weightloss and mortality percentage

#### References:

- [ASTM] American Society for Testing and Materials. 1991. Standard method of evaluating wood preservatives by field test stakes. D 1758-06. Annual book of ASTM Standards, vol. 04.09 (Wood).
- El-bandary HM, El-Helaly AA. 2013. First record nanotechnology in agricultural: Silica nanoparticles a potential new insecticide for pest control. App. Sci. Report 4 (3): 241-246
- Rahayu I, Damawan W, Nugroho N, Nandika D dan Marchal R. 2014. Demarcation point between juvenile and mature wood in sengon (*Falcataria moluccana*) and jabon (*Antiocephalus cadamba*). J Trop For Sci.26(3):331-339
- Rahayu I, Damawan W, Zaini LH, Prihatini E. 2020. Characteristic of fast growing wood impregnated with nano particles. J For Res. 31(2):677-685.
- [SNI] Standar Nasional Indonesia. 2014. Uji Ketahanan Kayu dan Produk Kayu Terhadap Organisme Perusak Kayu. Jakarta (ID): Badan Standarisasi Nasional. SNI 01. 7207-2014.
- Zhang XQ, Yin LH, Tang M, Pu YP. 2011. ZnO<sub>2</sub>, TiO<sub>2</sub>, SiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub> Nanoparticle-induced Toxic Effect on Human Fetal Lung Fibroblast. Biomedical and Environ Sci 24(6): 661-669.

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