

# The Study of Silica Gel in Particleboard

Rozilaili Mustapa, Norizan Zakaria & Nor Muslaili Mukhtar

Department of Civil Engineering, Politeknik Sultan Idris Shah,  
45200 Sungai Lang, Selangor, Malaysia.

*eziy1111@gmail.com*

## ABSTRACT

Particleboard has a widespread use in current industry construction. In this study, the manufacture of particleboard mixed with silica gel is to study the effectiveness of silica gel itself in the particle board in water absorption. Silica gel function also easily absorbs the air and reduces moisture content of moisture particles. Some of the processes that will be carried out on mix wood are wasted before being processed into board particles. The silica gel is also crushed into a fine powder before being mixed with a wooden attack to produce particleboard. After that, the dried mix wood with the fine powder of silica gel is mixed together with urea-formaldehyde resins (UF). The mixture is based on a certain ratio and made some calculations before producing a particleboard. After all the ingredients are mixed, the process of producing particle boards is run with the Cold Press Process and Hot Press Process. Three samples with different ratios were produced and the samples were tested with several tests is the Bending Strength Test, Internal Bond Test, Water Absorption Test and Thickness Swelling Test. The data obtained from the test results for the samples were compared with BS EN 312: 2003 specification

**Key Words:** particleboard, silica gel, water absorption, UF, EN 312

## 1. INTRODUCTION

The increasingly favorable development in Malaysia led to the construction of various infrastructures for public utilities. When the country grows up, demand for building construction for community use also increases. The construction industry is one of the drivers of the Malaysia economy. Various types of construction materials have been introduced in the industry to meet the demands and needs of the latest engineering design (Bank Negara Malaysia, 2016).

There is a few construction areas that produce a lot of waste after constructed have done. Some of the waste was wood disposal (Essays, UK, 2018). These woods are found to accumulate in polluted areas and various problems in our country. Besides that, wood chips that are thrown away without the necessity of making it harmful (Tom Napier). In the wood processing laboratory also contributes to the abundance of timber removal. This should be emphasizing that any work of construction or many facture timbers as well as in the laboratory is no longer loss of cost (Wood Handbook, 2017).

In this case, the emphasis of the problem to be discussed is damage to property, especially furniture made of particleboard. Particles are known as the properties of materials that easily absorb moisture that occur when floods or heavy rain. Particle board also easily absorbs the heat around it. From that problem, it can cause the quality of small particles to easily decay and break down due to uncertain weather.

Here, the emphasis on the repair of particleboard is mixed with silica gel. Silica gel gets the water absorption characteristics or more to reduce the moisture content of particle board which can improve the quality of the particles and thus durable furniture made from particle board. Thereby, particle board which has been mixed with silica gel can increase long term of particleboard and reduce the cost.

## 2. MATERIALS

Wood dusts which have been drained on dries machines for 24 hours (Figure 1) for removed and measured in the quantities calculated for the mixing process.



Figure 1: The Wood Dust from Dries Oven Machine

Adhesives used in the production of particle boards are Urea Formaldehyde UF. This UF adhesive is a commonly used adhesive in the particleboard production industry for its internal use with its waterproof properties, not resistant to organic solvents and acids and alkalis. The collected silica gel has been crushed into powder for mixing into particle blends (Figure 2). Silica gel is determined by different percentages of 20% and 40%.



Figure 2: Crushed silica gel

## 3. METHODS

The wasted wood dust has been put into the tray and left in the drying oven where the temperature is 60°C for 24 hours. This is aimed at obtaining suitable moisture bonds for binding between particles with adhesives.

The particles are blended together with adhesive materials and additive substances by using dries mixer. This machine uses a spray method to mix the particle ingredients with additives. Forming process is carried out manually which is to blend particles that ensuring the distribution is flat and to obtain a uniform density of the entire mats formed. This process needs to be done carefully to produce quality particles.

The pre-pressure process is proceed by using Cold Press Machine followed by heat pressure process. The pre-pressing process is intended to obtain the initial compression of the panel so that it is not so fragile and simplifies the next compression process of heat pressure. This pre-pressure process is carried out using a hydraulic press.

The heat pressing process is carried out on samples that have been compressed through a cold pressing process Particle board samples that have been through a cold pressing process are placed on the 'Hot Press Machine'. After that, the sample is placed under the Hot Pressure Machine until the sample is fully compressed.

Before the test will be done, the samples will be cut into pieces based on the European Standard (EN) below:

1. IB-EN 319:1993 (Determination of Tensile Strength)
2. BS-EN 310:1993 (Determination of Modulus of Elasticity of Bending)
3. TS-EN 317:1993 (Determination of Swelling in Thickness After Immersion in Water)

Tests to the mechanical characteristics are internal bond strength and bending strength. While the physical characteristics test towards the particleboard is immersion test. The quantity of samples that be use for each tests are based on the EN 326-1:1994 (Sampling and cutting of the test pieces and expression of the test result).

#### 4. RESULTS AND DISCUSSION

The results of the testing are evaluated and discuss [5]. The samples are divided into 3 samples with different ratio

Table 1 Ratio Mix Wood: Silica Gel

Sample No.	Ratio Mix Wood : Silica Gel
Sample A	100 : 0
Sample B	60 : 40
Sample C	80 : 20

From the data analysis, we can discuss the average for each test which is from bending strength test, internal bond test, thickness swelling test and water absorption. Bending strength has two type modulus of value that we need to include in test which is Modulus of Rapture (MOR) and Modulus of Elasticity (MOE).

The average for MOR for sample A with 6.303 MPa dramatically than the sample B with the value of 1.689 MPa and slightly decrease for sample C with 5.772 MPa. Meanwhile, MOE for sample B is a lot of changes with 291.415 MPa that sample A with value of 1004.943 MPa and slightly low for sample C with 905.421 MPa (Figure 3).

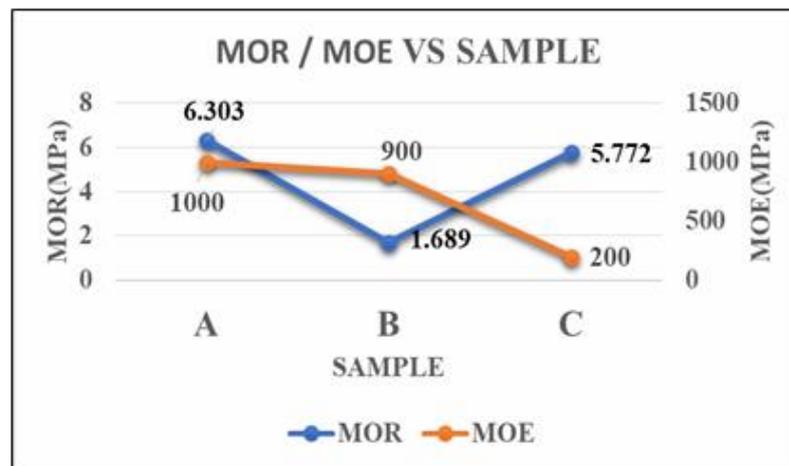


Figure 3: The Average MOR and MOE Data for Sample A, B and C

For internal bond test, from the data analysis as shown in Figure 4 above, is for sample A with the value 0.250 MPa and sample C with 0.327 MPa which is a bit difference. While, sample B with 0.036 MPa is much more difference than the sample A and C.

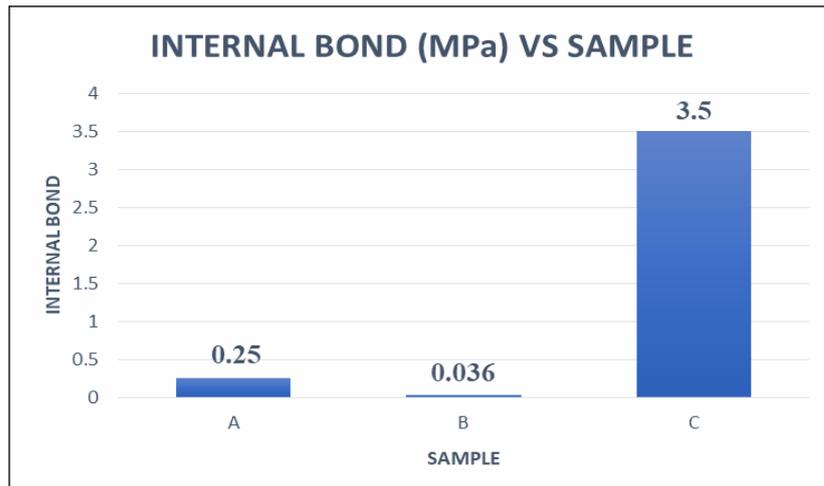


Figure 4: The Average Internal Bond Data for Sample A, B and C

For thickness swelling test, from the data analysis in Figure 5, there are in a good scale for each samples, which is 15.29% for sample A, 19.13% for sample B and 12.70% for sample C.

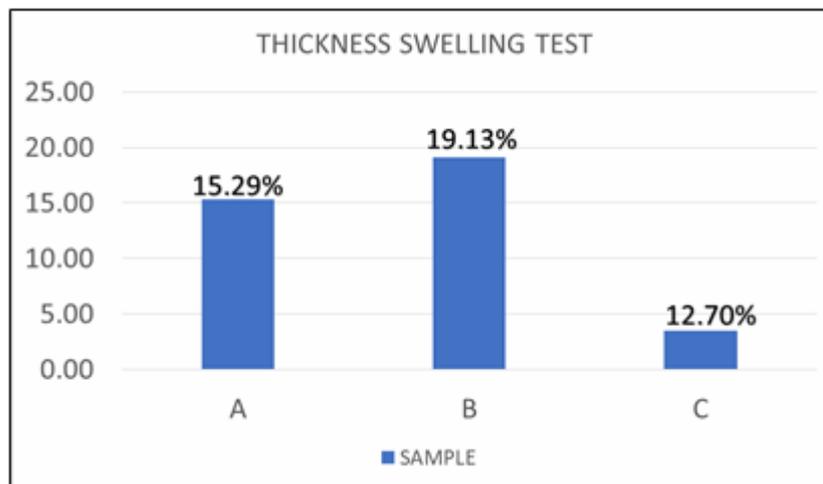


Figure 5: The Average Thickness Swelling Data for Sample A, B and C

The last test that we can discuss is water absorption. The value for sample A is 95.07% and 104.52% which is slightly higher to the sample C with 90.45%.

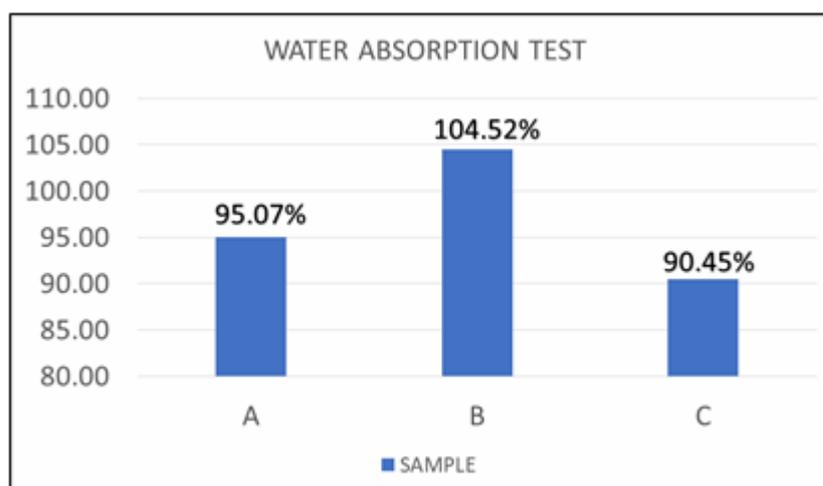


Figure 6: The Average Water Absorption Data for Sample A, B and C

## 5. CONCLUSION

Conclusion, the objective for producing the study of silica gel in particleboard is reached. The study shown that the silica gel can be used in producing the particleboard in Malaysia industries with improvements. As a raw material, it is readily available and cheap.

Based on the experiments and results, density is the main characteristics for particleboard improvements. For make sure the particleboard meet the standard of EN 312:2003(E) (Particleboards. Specifications). The test of Modulus of rupture (MOR) and Internal Bond (IB) has been assigned and be taken in producing the particleboard with silica gel. The particleboard with 40% silica gel has not pass the standard for general use with dry condition. The value of MOR for mix wood : silica gel ratio for sample 100:0, 60:40, 80:20 is 6.303 Mpa, 1.689 Mpa and 5.772 Mpa. While the internal bond test is 0.25 MPa, 0.04 Mpa and 0.32 Mpa. For bending strength test the samples with silica gel has not passed the standards EN 312:2003(E). While for internal bond test, the results of the samples has pass the EN 312:2003(E).

The usage that emphasizes for general use only, it can be used to structural that did not bear load. For example, signboard, writing board, panel wall, wall finishing and others. For this experiment, the particleboard can be use as the general usage and for drying and moisture condition but not watery condition because the water absorption is not passed the standard as the thickness swelling result. The usage of particleboard in moist condition can be depends on the suitable ratio of the raw material and silica gel. However, the improvements are importance for these experiments for high quality of particleboard.

## REFERENCES

- Bank Negara Malaysia (2016). "Demystifying the Affordable Housing Issue in Malaysia," Box article in Annual Report. Kuala Lumpur.
- Essays, UK. (November 2018). Issues Of Construction And Demolition Waste Environmental Sciences Essay. Retrieved from <https://www.ukessays.com/essays/environmental-sciences/issues-of-construction-and-demolition-waste-environmental-sciences-essay.php?vref=1>
- Jun Li Shi. (2004). Flexural properties, internal bond strength, and dimensional stability of medium density fiberboard panels made from hybrid poplar clones. Department of Composite Products Forintek Canada Corp. 319, rue Franquet, Québec, Canada, G1P 4R4.
- M.H. Colakoglu , 2009. Determination of Bending Strength Elongation in Bending Screw Withdrawal Strength and Swelling in Thicness of Some Panels. Journal of AppliedSciences,9:4061-4065. 10.3923/jas.2009.4061.4065 <https://scialert.net/abstract/?doi=jas.2009.4061.4065>
- Tom Napier, Research Architect U.S. Army Corps of Engineers, Engineer Research and Development Center / Construction Engineering Research Laboratory, 10-17-2016
- Wood Handbook: Centennial Edition, national hardwood lumber association, Published on Apr 12, 2017