

# Manufacture and Characterization of Polymeric Tile Made From Natural Rubber Latex, Sand and Asphalt with Polypropylene as Adhesive

Mega Puspita Sari\* , Kurnia Sembiring, Syahrul Humaidi

\*<sup>1</sup>Department of Physics, Faculty of Mathematics and Natural Sciences, University of Sumatera Utara Medan, Indonesia

<sup>2</sup>Department of Physics, Faculty of Mathematics and Natural Sciences, University of Sumatera Utara Medan, Indonesia

<sup>3</sup>Department of Physics, Faculty of Mathematics and Natural Sciences, University of Sumatera Utara Medan, Indonesia

## ABSTRACT

Research has been undertaken for the manufacture of polymeric tiles made with natural rubber latex mix, Polypropylene, Asphalt, Sand and Epoxy. A study was conducted to determine the best mixture of natural rubber sand and latex as an independent variable with a variation of 30: 20, 32,5: 17,5, 35: 15, 37,5: 12,5, 40: 10, 42,5: 7,5, 45: 5, 47,5: 2,5 composition (all in % by weight). Then fixed variables are asphalt 5 g, Polypropylene 30 g and epoxy 15 g. Natural rubber latex is extracted and then mixed with asphalt, sand, polypropylene and then pressed with compressor for 20 minutes at 200<sup>0</sup> C with 38 atm( 38,5 x 10<sup>5</sup> Pa). The properties of polymeric tile tested were physical properties including water absorption and porosity, mechanical properties including impact test and flexure strength test. The result showed that the optimum mixture was a mixture of sand and natural rubber latex with addition of 5 g of asphalt as binder, and epoxy 14% and 1% catalyst.

**Keywords:** Natural Rubber Latex, Polypropylene, Polymeric Tile,

## I. INTRODUCTION

Polymer tile is made by composite particles of first converting the fillers into particles, the particles are then mixed with the polymer matrix at the temperature of the melting point of the polymer (Murni,dkk.2008).

Some researchers are doing a lot of research on polymer tile improvements, such as the results from Mulawarni (2012) that made polymer composite tiles from polypropylene, Resin mixtures, Asphalt, sand and Coconut husk. Suryati (2012) which makes polymer composite tiles from a mixture of Polyester

resin, Asphalt, Styrofoam traces and fibers. Neni Juli Astuti (2014) which makes polymer tile using asphalt and polypropylene with variations of composition and pineapple oriented fiber. Tiopan Aruan (2017) which makes polymer tiles based on bagasse and pumice as aggregates with polyester and rubber sir 20 as matrices.

The purpose of this investigation thus was to manufacture polymer tile with asphalt mixture, natural rubber latex, polypropylene and sand. To determine the appropriate concentration of mixtures in polymer tile manufacture. To know its physical

properties and mechanical properties from the polymeric tile.

## II. MATERIAL AND METHODS

The materials used is natural rubber latex, Polypropylene, sand, asphalt and epoxy. The mixed output from the internal mixer is fed into the mold and then printed with a regulated hot compressor of 200<sup>o</sup> C. Emphasis given when pressing the mold is done manually. The length of stress for one sample at the time oh heating was 20 minutes and 20 minutes to cool the sample.

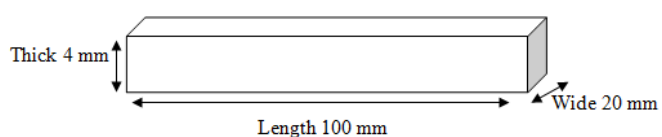


Figure 1. Sample size of polymer tile

### Polymer Tile Manufacturing Procedure

Inserted 20 grams natural rubber latex pieces and Polypropylene 30 grams into beaker glass I then in blending with MIFPOL BRS 896 extruder at temperature 200<sup>o</sup> C to finish. Asphalt along with sand is put into a beaker glass II and heated with hot plate at 200<sup>o</sup> C and waited until it melts, within ½ hour in stirring until evenly distributed. Then after evenly mixing on the beaker glass I and beaker glass II are inserted into the internal mixer that has set the heating temperature 200<sup>o</sup> C within 1 hour. Then the final mixture is poured into a mold that is 100 mm in length, 20 mm in width and 4 mm in thickness is added epoxy and catalyst and squeezed at 200<sup>o</sup> C with hot compressor within 1 hour.

Table 1. Composition (weight %) of total weight 100 g

Number of Samples	PPg	sandg	Natural Latex g	rubt g	Asphalt g	Resin Epoks g	Catalyst KMNO <sub>4</sub> g
Sample I	30	30	20		5	14	1
Sample II	30	32,5	17,5		5	14	1
Sample III	30	35	15		5	14	1
Sample IV	30	37,5	12,5		5	14	1
Sample V	30	40	10		5	14	1
Sample VI	30	42,5	7,5		5	14	1
Sample VII	30	45	5		5	14	1
Sample VIII	30	47,5	2,5		5	14	1

## III. RESULT AND DISCUSSION

### Water Absorption Test Result

Water absorption test refers to ASTM C-20-00-2005 on testing procedures, Which aims to determine. The

percentage of water absorbed by the sample soaked for 24 hours.

$$\text{Water Absorption} = \frac{M_b - M_k}{M_k} \times 100 \% \dots\dots\dots(1)$$

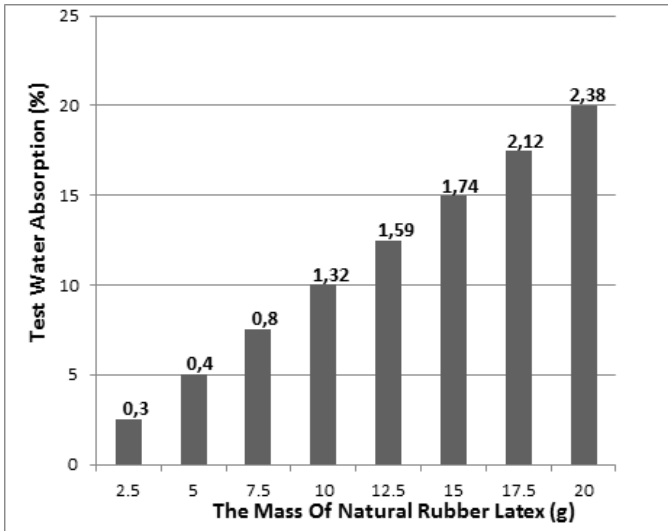


Figure 2. Mass Sample Relationship Vs Water Absorption Test

In the composition of fine sand and natural rubber latex (47,5: 2,5) the minimum water absorption value of 0.3 % among all these variations indicates the material in the composition is the best result for the water absorption test.

**Porosity Testing**

Porosity is the proportion of the void volume of the cavity. The export is also directly related to the density. Based on ASTM C 373-88, Porosity of the sample can be calculated using the following equation:

$$\text{Porosity (\%)} = \frac{M_J - M_K}{V} \times \frac{1}{\rho_{\text{air}}} \times 100 \% \dots\dots(2)$$

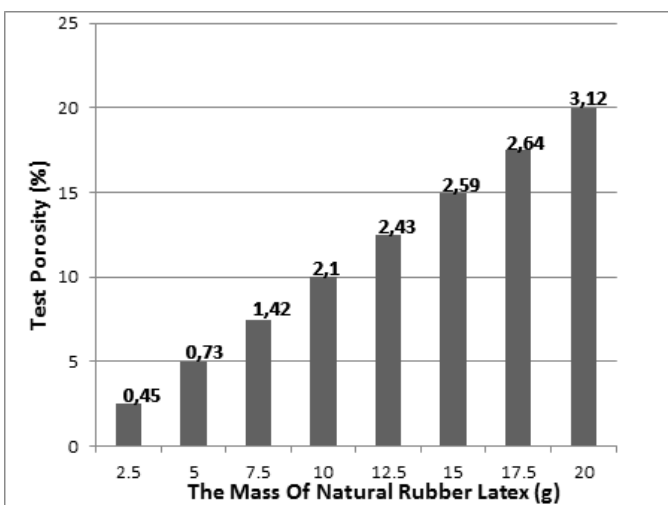


Figure 3. Mass Sample Relationship Vs Porosity Test

From the graph above shows that the composition of 2,5 grams of natural rubber latex + 47,5 grams of sand has the smallest porosity. This is because with the large amount of soft sand that mixed will fill the voids so that porosity is reduced (Minimum).

**Impact Strength Testing**

The resulting impact strength is the ratio between the absorptive (Es) energy and the Cross- Sectional (A).

$$I_s = \frac{E_s}{A} \dots\dots\dots(3)$$

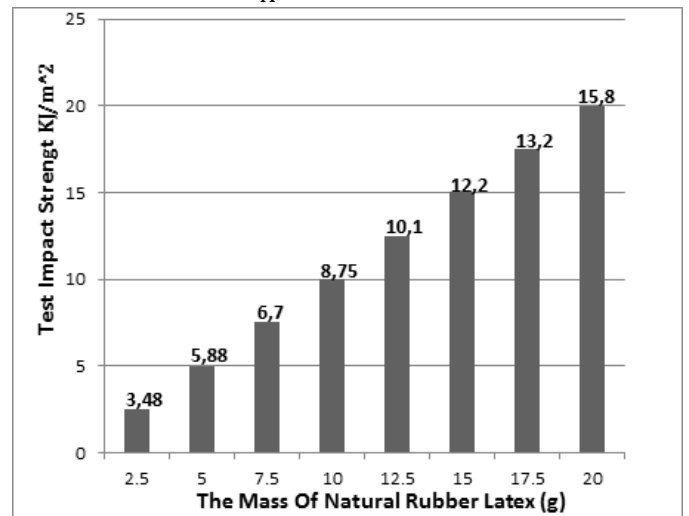


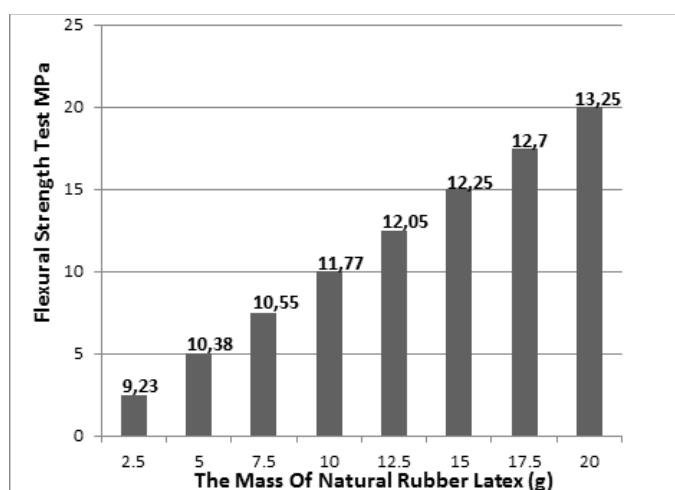
Figure 4. Mass Sample Relationship Vs Impact Test

From the graph it can be seen that the maximum impact test value found on the composition of the mixture of sand and natural rubber latex is the variation (30: 20) of 15,8KJ/ m<sup>2</sup>. While the minimum impact test value on the composition of the mixture of sand and natural rubber latex in the variation (47,5: 2,5) was 3,48 KJ/ m<sup>2</sup>.

**Flexural Strength Test**

Testing of bending strength is intendend to determine the resistance of the polymer to loading. With the method used three bending point method. This test is intended to know the elasticity of a material.

$$UFS = \frac{3 PL}{2 bd^2} \dots\dots\dots(4)$$



**Figure 5.** Mass Sample Relationship Vs Flexural Strength Test

Based on the graph results can be seen that the maximum value for flexural strength test that is found in the mixture composition between sand and natural rubber latex with variation (30: 20) with a value of 13,25 Mpa. While the minimum value on mixed composition between sand and natural rubber latex with variation (47,5: 2,5) with value 9,23 Mpa. From the graph results can also be concluded that the more natural rubber latex is used, the flexural strength test is produced.

#### IV. CONCLUSIONS

In accordance with the quality requirements of Indonesian National Standard Tile (SNI) 0096: 2007 polymer tile sand composition and natural rubber latex with ratio (35:15) provide good density and strength and flexibility, and as much as 5 g of asphalt from the total weight of the sample which serves as a water barrier. The Physical properties of water absorption is 1,74 % and porosity 2,59 %. The mechanical properties that have impact strength value 12,2KJ/ m<sup>2</sup> and Strength of 12,25 Mpa.

#### V. ACKNOWLEDGEMENT

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