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The use of solid waste in rubber gloves industry and natural polyurethane in making sound dumping polymer's roof

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Abstract: Polymer's roof has been done using solid waste in rubber gloves industry with the best mixing composition from the making of polymer's roof. Samples from any composition, which is done thus being pressed by hot compressor with temperature 150 ^{0}C during 30 minutes. After providing samples, examining the physical and mechanical properties, include testing the surface of SEM, DSC, absorption from XRD, and sound dumping. The results shows that an addition of rubber waste causes the absorption and porosity decreasing, while flexural strength and effect increasing. The result from DSC shows that samples have an endurance from 300 - 470 ^{0}C, while SEM shows that the shape of surface from some samples are less homogeneous. The result from absorption using XRD seems that samples absorb as another sample, which is the more addition of rubber waste, the bigger intensity of absorption. From the sound dumping test by thick of samples about 5 x 10^{-3} m producing the sound dumping to the average samples with α = 0,138. From the result above, polymer's roof is so suitable which physical and mechanical properties, which is needed by the standard polymer's roof.

Keywords: Natural Polyurethane, Polymers' Roof, Rubber Waste, Sound Dumping

1. Introduction

Industrial development requires the provision of alternative building materials that are superior to conventional building materials, such as roof, which is an important building material, have functions as a protective barrier against external factors such as wind, sunlight, storm, and rain [1]. Today, we need an alternative roof, which is stronger, lighter, more durable, and more resistant to weather and temperatures, as well as relatively low in order to fulfill the above functions. Besides, the roof material is easily obtainable. Industrial solid waste rubber gloves are derived from industrial waste by PT Perkebunan Nusantara III Medan, which is one of non-oil exported commodities. Polyurethane adhesive is a mixture of nature created through polymerization of lignin isolated with MDI [2]. Linear form produces material properties that are robust, easy to set up meetings and structure. Definition of granular aggregate is material, i.e sand, gravel, crushed stone, or slag from the combustion of scrap metal in the blast furnace with medium sementik used as filler in the manufacture of roof, based of polymers' roof [3]. Asphalt is one of the adhesive substance of hydrocarbons produced from petroleum that is solid at room temperature until slightly dense and is thermoplastic. [4,5]

2. Experimental Procedures

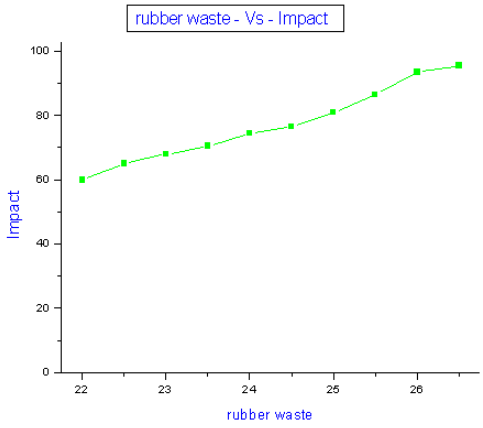
The main materials used for this study is industrial rubber wastes that we have to cut into small pieces, thus extruded it in the extruder with heating temperature 150 ^{0}C, then mixed with the asphalt mixture that has melted. After that, add the sand and polyurethane nature. Put the mixture into an internal mixer with 170 ^{0}C heating temperature during 30 minutes. Mold and press the mixture with Hot Compressor in the 150 ^{0}C heat for 15 minutes. Tests carried

out on samples of the impact strength, flexural strength, water absorption and porosity. The impact strength testing was performed with a Wolpert impak to determine the nature of the dynamic loading, the method used is the Charpy method [6] . Flexural strength testing is performed to determine the elasticity of the sample by using The Universal Tensile Machine Tools [7] with three-point bending method, while the water absorption refers to the American Standard Testing and Material (ASTM) C-20-00-2005 to determine the percentage of absorption water by the sample and the reference to ASTM 373-88 porosity to determine the volume of empty cavities in the sample. The samples were also tested by DSC to determine resistance to temperature. We tested for SEM to determine the surface morphology and the final test to determine the coefficient sound proof the samples have been determined [8,9].

3. Results and Discussion

3.1. Test Impact Analysis

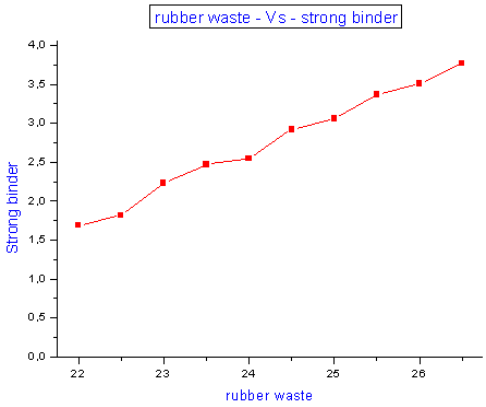
The result of strong impact test that have been conducted on samples of polymers roof, aims to determine the toughness of samples to dynamic loading. Impact test was conducted using Charpy method [6]. From the tests we can determine the energy absorbed by a material until the material is broken, so it can be determined whether a substance is tested fragile or robust. The more energy is absorbed, the greater strength of impact from the ingredients added to the mixture. It is suitable to the properties of this mixture, which is more homogeneous. In other words, great value impact test is influenced by the homogeneity of the mixture [10,11].



Pigure 1 graph. *rubber waste –Vs – impact*

3.2. Strong Bending Test Analysis

Flexural strength testing is to determine the resistance of the polymer to the imposition of the three-point bending. The flexural strength testing also aims to determine the elasticity of a material nature. In this research, a given load is perpendicular to the direction of the sample with a three-point bending. When the mixture is added with rubber waste, the better bending strength. The result of the test is influenced by homogeneity of a mixture sample. Based on the graphic above, we see the relationship between the effect of mixture used with the flexural strength of the samples. We can also see in the chart above the maximum value for the flexural strength test on the sample provided by the composition of the existing composition of the image. Although we can see from the graph there is a fluctuation of data samples, is influenced by the degree of homogeneity of the mixture.



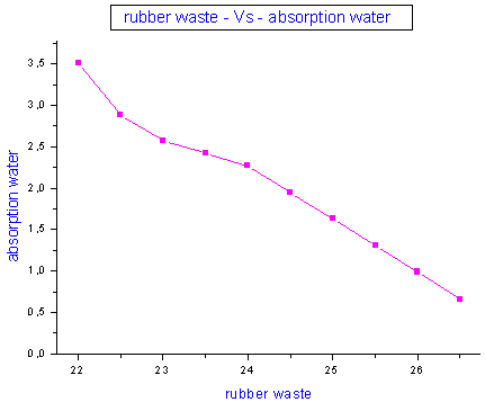
Pigure 2 graph. *rubber waste –Vs – strong bending*

3.3. Analysis of Water Absorption

In the analysis of water absorption, we need to add the mixture with asphalt as a waterproof to prevent water seeping through a layer or translucent roof. Asphalt also content water in the asphalt mixture tends to reduce the durability of asphalt mixtures because it can cause erosion, so with the addition of material, the percentage of water absorption becomes smaller.

This process is influenced by the homogeneity mixture, the more homogeneity its mixture, the less water absorption, moreover the quality is going to be better.

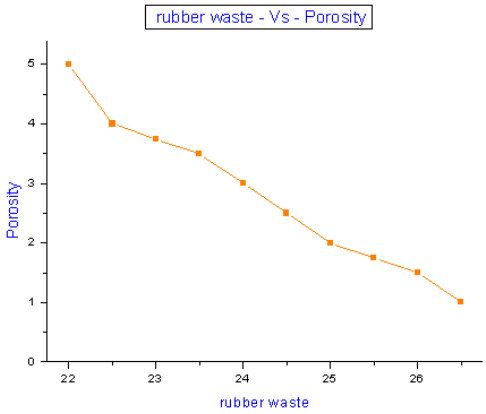
By SNI-03-1969-1990, it is known that the water content in the asphalt to a maximum of 2.5%. It shows that the value of water absorption has met the minimum standards for asphalt absorption of water by the Indonesian National Standard (SNI).



Pigure 3 graph. *rubber waste – Vs – absorption water test*

3.4. Porosity Test Analysis

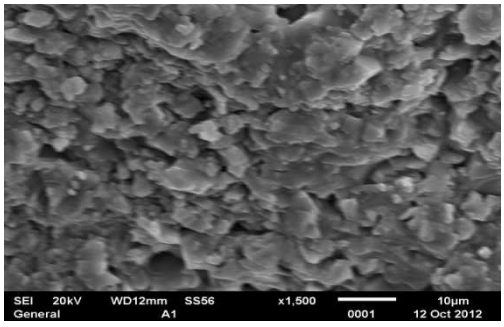
According to ASTM C 373-88, we can see the value of the minimum porosity in the composition of a mixture of rubber waste and a maximum porosity in the composition of the mixture at a minimum of waste rubber. From the data obtained in the addition of a mixture of polymers' roof tends to reduce porosity values as seen from the results that can be of diminishing value of porosity along with the addition of rubber Massa. We can see the graph about porosity test to the mixture and the sand. Based on the graph above the maximum porosity of 5% contained in the sample and the minimum porosity value of 1.25%. From the pigure 4 graph it can be seen that the porosity values tend to decrease with the addition of mass.



***Pigure 4 graph**. rubber waste – Vs – porosity*

3.5. Analysis of Scanning Electron Microscopy (SEM)

From the Scanning Electron Microscopy, we can see the morphology of polymers' roof. In this picture, we can also see a wad of gun and sands grains covered by wad of gun.



***Pigure 5.** Result SEM*

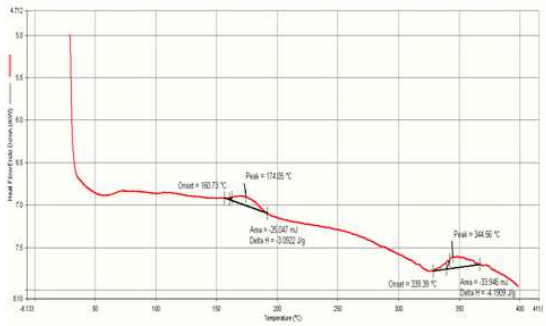
3.6. Analysis of Differential Scanning Calorimetric (DSC)

(Δt) = 5 x Total Scale = 5 x 4 = 20 µv = 0.02 mv,

table C = 600 ^{0}C: 5.5635 µv.

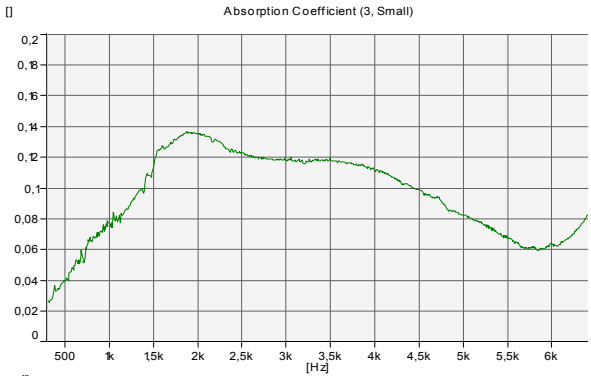
(Δt) = 0.02 µv x 600 ^{0}C/5.5635µv = 2.15 ^{0}C.

Meaning: When the first 2 molecule evaporate, the temperatures decrease between comparative material (Al_2O_3) with a sample size of 2,15 ^{0}C.



***Pigure 6 graph**. DSC from sample*

3.7. Coefficient Soundproof Analysis



***Pigure 7.** Absorption Coeficient*

From the graph obtained sound proof highest peak at 1904 hz frequency of the test is α = 0.138

4. Conclusion

Based on the results of research on polymers by using a roof-making raw material waste rubber industry with a solid mix of natural polyurethane and other mixtures such as sand and asphalt testing the physical properties and mechanical properties of the sample, it can be concluded as follows:

1. The test results of water absorption and the porosity of the roof that is the greater the addition of rubber waste given the percentage of water absorption and the porosity of the tile is small so that generated the better the quality.
2. Analysis of flexural strength test results and strong impact on the larger tile where the addition of rubber waste given the strong bending strength and the resulting greater impact.
3. Analysis of test results shows that the DSC samples at temperatures above 300 ^{0}C and will start to burn to ashes in the temperature of 500 ^{0}C.
4. SEM result shows that the grain samples will be obvious if the manufacture of homogeneous samples, whereas the samples grain looks a bit chaotic if the sample is less homogeneous.
5. Sound absorption coefficient of the sample α = 0.138

5. Suggestion

This research do not make any variation for size sample, so the next research should make any differenceses for size in the sample, even until 0,02 m. It is suitable with standard from absorption coeficient and it can show polymers's effect to increase the quality, and the superiour of polymers' roof.

Acknowledgments

The results above, for the manufacture of polymer roof made from a mixture of solid rubber waste are suitable for production.

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