# PROCEEDINGS

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# A Study of Polypropylene, Sodium Hydroxide and Quartz Composition on the Capacitive Property of Cu

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**ABSTRACT:** A conductor material is used in the electricity transmission sector as a transfer media. The conductivity of the material depends on the atomic microstructure in metal crystalline form. When the electricity transfers through the metal conductor, each atom in its crystalline microstructure will tremble and stretch, leading to a disordered microstructure that causes momentum and electron wave diffraction. This occurrence leads to energy losses. The biggest energy losses in electricity occur through transmission, and this depends on path and resistance of the conductor material. Many attempts have been made to reduce energy losses from transmission, such as using the highest conductive material and capacitor bank. The combination of polypropylene, sodium hydroxide and quartz at certain proportions on Cu material at high temperature using blasting furnace was studied. The method produces Cu material of closed face-centered cubic crystalline microstructure. The greater number of voids in such a microstructure causes the conductive Cu material to become capacitive as well. This new material may reduce energy losses in electricity transmission. Polypropylene, which has polymeric chain and orthorhombic microstructure with $CH_3$ cluster in its sequences, will release carbocation at melting temperature to homogenous Cu and quartz combination. Sodium hydroxide was added to reduce the melting temperature of quartz to 1088 °C, as sodium silicate. In the blasting furnace method, the approximate compositions of polypropylene – 3/4x at % quartz, sodium hydroxide – 19.71 at % Cu and quartz – 15 at % Cu display the best capacitive value and performance with RLC meter and X-Ray Mapping analysis.

**Keywords:** crystalline microstructure; capacitive, quartz, sodium hydroxide, polypropylene

## INTRODUCTION

As an infrastructure, the electrical sector has been growing so fast. In 1966 years, the electrical capacity in Indonesia was only 500 MW. And just in five years later, the capacity has increased to 1000 MW. Until these days, an electric power plant capacity in Indonesia has reached to 29.705 MW (Mega Watt) which 25.000 MW of it from PLN electric power plant and the rest from private sector. (J.Purnomo, 2008). The electricity demand of a household in Indonesia increased to 10.4% per year, the industrial sector grew up 8.2% per year and 7.1% per year in a commercial sector, and this increasing demand would be impact to the electricity supplies and price.

Household sector is the biggest source for the electrical loss in transmission. (J.H.Asy'ari et al, 2003), it is because of the power transmitted depends on the path and the resistance of the conductive material used. Metal conductor such copper, etc have been used as the electricity transfer media. When the electricity transfers through the metal conductor, each atom in its crystalline microstructure will tremble and stretch, leading to a disordered microstructure that causes momentum and electron wave diffraction. This occurrence leads to energy losses. Many attempts have been made to reduce energy losses from transmission.

Based on analysis of sand sample from Sukajadi (Banyuasin) and Lematang (Lahat) in South Sumatra which the analysis is conducted by mining and energy department in years 2008, the results showed that sand sample from Sukajadi consist of $SiO_2$ till 98.55% while sand sample from Lematang consists of $SiO_2$ 43.49% and oxides such $Al_2O_3$, CaO, MgO and Fe. It is mean that sand from South Sumatra area could be use as a mixture of conductor material, to produce new material which has conductive and capacitive characteristics and reduce energy losses in transmission.

## MATERIALS AND METHODS

Many attempts have been made to reduce energy losses from transmission, such as using the highest conductive material and capacitor bank. In this research, researchers tried to find another ways to reduce the energy losses by changing microstructure of the electricity transfer media such copper microstructure.

### Materials

Copper as a custom metal conductor only has conductive characteristics, though this research a new material from copper as a base composition is made by mixed it with polypropylene, sodium hydroxide and quartz at certain proportions to have capacitive characteristics. Copper weight as a fix variable in this research, while quartz weight is vary from 5 – 15 gr at % Cu, polypropylene weight is vary from 0 gr;5 gr;3/4x;2x at % quartz. And sodium hydroxide is vary from 3.29 – 19.71 gr at % quartz (in stoichiometric).

### Methods

A sample which is a combination of polypropylene, sodium hydroxide and quartz at certain proportions on Cu material to result a new composite material is made at high temperature 1088°C by using blasting furnace. A sample put in smelting spot which is made by fire brick in closed-cylindrical shape. The result of a new composite material then tested by using RLC meter to show it conductive and capacitive characteristics, and using X-Ray Mapping analysis to show it microstructure form.

## RESULTS AND DISCUSSION

The effects of mixing polypropylene, sodium hydroxide and quartz to Cu material in certain composition to the conductive and capacitive characteristic on Cu material has been learned and showed in figures below.

### Performance analysis

Due to the performance analysis, result samples showed variation in weight and uniform of material formed. With a variation of polypropylene added to Cu material combination in a same process condition. The result variation has been showed in **Figure 1**.

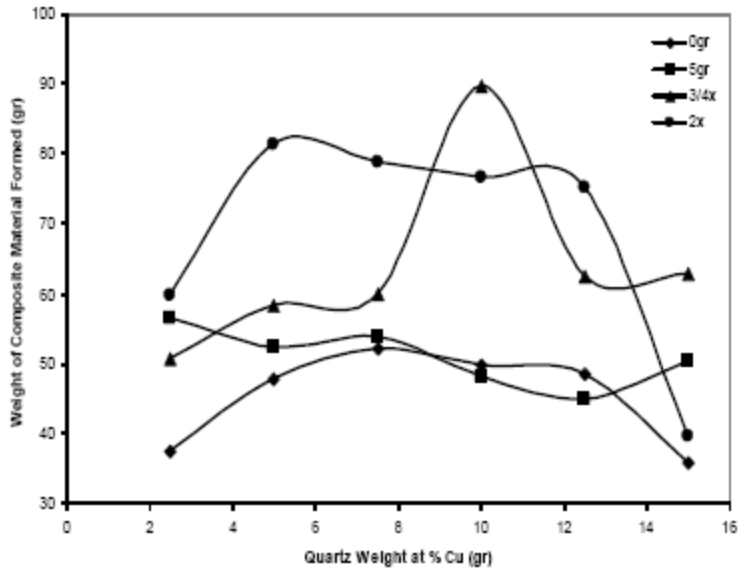


**Figure 1. Variation of polypropylene in quartz weight at % Cu to the weight of composite material formed.**

From Figure 1, it showed that quartz added up to 10 gr at % Cu will make a decreasing in composite material formed and hygroscopic ceramics material which is not united to Cu material and other material added will be form also. With polypropylene added to mixing sample, it will give uniformly in composite material form because of rhombic structure in polypropylene microstructure could insert hexagonal quartz and cubic cuprum material structure into its microstructure easily. From the analysis, ¾x polypropylene added to the sample showed the best result in analysis, with 10 gr quartz at % Cu added in sample.

**RLC Meter and Oscilloscope Analysis**

Capacitive characteristics in composite material formed have been analyzed with RLC meter and oscilloscope to see its degree movement on phase (ɵ) which is showed in **figure 2**.

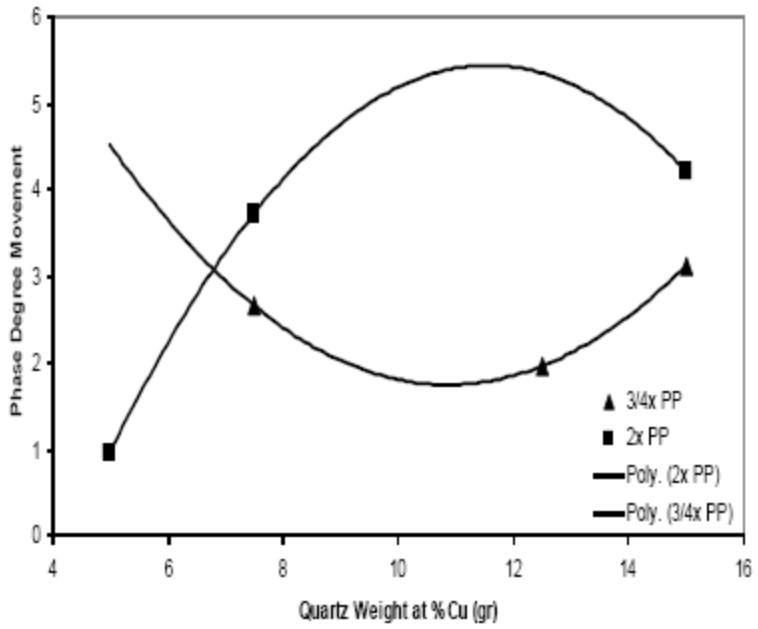


**Figure 2. Phase degree movement in quartz weight at % Cu to the variation of polypropylene added**

From the RLC meter and Oscilloscope analysis, sample with no polypropylene added did not show the capacitive characteristic to the composite material formed. In figure 2 above, polypropylene which is added two times of quartz weight, the capacitive characteristics on composite material would decrease by the added quartz weight, while polypropylene with ¾x quartz weight, the capacitive characteristics would increase by the added of quartz weight. From this analysis, 2x of polypropylene added to the sample with 15 gr quartz at % Cu added to the sample showed the best result. Furthermore, quartz weight which is up to 12.5 gr at % Cu would show not good in performance or not uniform.

**X-Ray Mapping Analysis**

Microstructure of the composite material formed has been photographed by the x-ray mapping analysis, showed in **figure 3**. This micrograph taken for the best result from the performance and RLC meter-Oscilloscope analysis before, which is the best result showed by polypropylene – 3/4x at % quartz, sodium hydroxide – 19.71 at % Cu and quartz – 15 at % Cu. From this figure, it is seen that composite material formed look like fiber and gully where the compounds material detected from the mapping analysis are $Na_2O$, $Al_2O_3$, $SiO_2$, FeO and CuO in certain fraction. And iron oxide detected as noise.

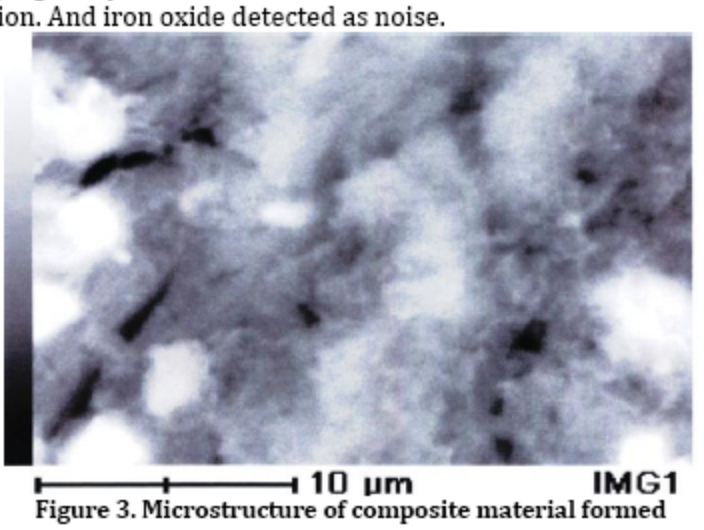


**Figure 3. Microstructure of composite material formed**

## CONCLUSIONS

Based on results and discussion, the approximate compositions of polypropylene – 3/4x at % quartz, sodium hydroxide – 19.71 at % Cu and quartz – 15 at % Cu display the best capacitive value and performance with RLC meter and X-Ray Mapping analysis. Furthermore, Polypropylene which has polymeric chain and orthorhombic microstructure with $CH_3$ cluster in its sequences, will release carbocation at melting temperature and react as electron donor to homogenous Cu and quartz combination. And Sodium hydroxide was added to reduce the melting temperature of quartz to 1088 °C as sodium silicate, so sample in this research could homogenous immediately. The adding material such quartz may not more than 10 gr at % Cu in sample to give best result.

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