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Purification and Characterization of SiO2 Based Quartz Sand from "Pasir Putih" Village, South Pamona District

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***Abstract*-The objective of this study is to measure the purification and characterization of the quality of quartz sand from Pasir Putih village, South Pamona district. The purification was done to increase the pureness of the silica by soaking the sample with HCl 2M then was titrated using aqueous to reach the pH of 7 (neutral). The sample was characterized using the XRF and XRD. Moreover, the element content of SiO2 (Silica) after the purification based on the results of the analysis was 99,88%. Therefore, the element can be used as the raw material for solar cell. Matching the result of the XRD analysis with the software Search Match shows that the purification of the sample SiO2 contains the crystal trigonal system (Hexagonal axes) with the orientation field.**

Keywords-silica; quartz; purification

I. INTRODUCTION

Solar cells are an environmentally friendly energy conversion tool. This equipment utilizes solar energy so that its effectiveness depends on the amount of sunlight intensity. The solar cell industry is an alternative source of renewables. This industry utilizes silica sand as its base material. Indonesia has natural wealth of silica sand. Silica sand reserves with high concentrations in Indonesia are a support for the development of advanced materials.

Mastery in advanced technology material, one of the main hope in framework of independence of the community to provide the raw materials of solar cell. The technology material for solar cell have experienced a rapid progress in developing [1]–[3]. In the past years, a few silicon purifying industries had started producing the silicon as the material especially to be applied for the solar cell system by looking at the development of the silicon production for solar cell, as well as the projection of the solar cell marketing in the future [4]. Today, silicon solar cell (first generation) is still dominating the marketing world which is about 80% [5]. The third generation of the solar cell like dye-sensitized solar cell, organic photovoltaic, and others are still under a research phase and haven't entered the mass production phase yet [2], [6], [7].

Quartz sand contains crystals of silica (SiO2) as well as sedimentary materials that carry over the settling process. Quartz sand or white sand is the result of weathering rocks containing major minerals, such as quartz and rock ore. Quartz sand as a result of weathering that is naturally washed and carried by water or wind and settles on the banks of a river, lake, or sea. The content of silica in sand is at least 97-98%. This content depends on the mineralogical characteristics of the original silica sand deposit. The physical properties of silica sand minerals are the specific gravity, magnetism, and electricity. With the overflowing of the spare silica sand in Indonesia, it gives a huge opportunity for the development of the national industry. The solar cell industry that is being referred to is the industry that has the independence in providing their raw materials for their production. In this study, the purifying of the white sand silica sand have been done by using the purification method.

II. EXPERIMENTAL METHOD

The main material that is being used in this study is quartz sand from the village of "Pasir Putih", area of South Pamona,

Poso. Firstly, the sand was washed by using aqueous six times; then it was dried up and being separated from the iron sand by using a magnet.

Before the purifying process, milling was done first using the ball milling where there is a grinding ball as the balls that will give the dynamic pressure to crush the sand into powder. For the milling process to be effective, a critical velocity was used and was adapted with the diameter bowl. If the ball milling speed was slower than the critical velocity, the pressure of the ball will cause the milling not to run as perfect. On the other hand, if the speed was faster than the critical velocity, it will cause the ball to rotate with the centrifugal force. Therefore, the critical velocity will be the only one to cause friction and collision.

Then the quartz sand was soaked in a solution of 50 ml HCl 2 M for 12 hours. After 12 hours, the difference of the quartz sand can be seen before and after the purification, such as the change of the colour and size. In this process, the sand will be separated with the impure compounds that was brought from the settling process and will form into a colloid, then the colloid of the HCL solution being the former soaking material was thrown out. The sample of the sand was washed using aquaos until the pH of the sample reach to normal (pH 7). The sand was dried in a normal temperature so that the remains of water disappears for the result of the purification can be characterized to know the element components and the structure of the crystal.

The results of the synthesising were characterized by using XRD (X-Ray Diffraction) and XRF (X-Ray Fluorescence).

III. Results and Discussion

The result of the characterization of the sample using the XRF can be seen in the table 1 and the table 2. Quartz composition on sand as match as 99.51% and other content doesn't as exceed 1% it indicates that sand can be used as material in the solar cell. The purification process doesn't cause changes in sand characteristics. The similar characteristics indicate on the XRD result (figure 1 and figure 2).

Table 1. The XRF Result of the Quartz Sand before Purification

Compound	Weight(%)
SiO_2	99.51
P_2O_5	0.224
Fe_2O_3	0.0982
TiO_2	0.0726
Cr_2O_3	0.0726
CaO	0.0192
Nb_2O_5	0.0141
MoO_3	0.0107
ZrO_2	0.0073

Table 2. The XRF Result of the Quartz Sand after Purification

Compound	Weight(%)
SiO_2	99.51
TiO_2	0.0604
SiO_2	0.0982
Nb_2O_5	0.0157
MoO_3	0.0122
Cr_2O_3	0.152
In_2O_3	0.0051

Based on the table 1 and the table 2, it can be seen that the compounds that dominates the sand is SiO2, this can be seen before the purifying with the percentage of 99.5% and after purifying with the percentage of 99.88%.

Meanwhile, XRD was used to see the crystal structure of the sample. The result can be seen on the figure 1 and the figure 2.

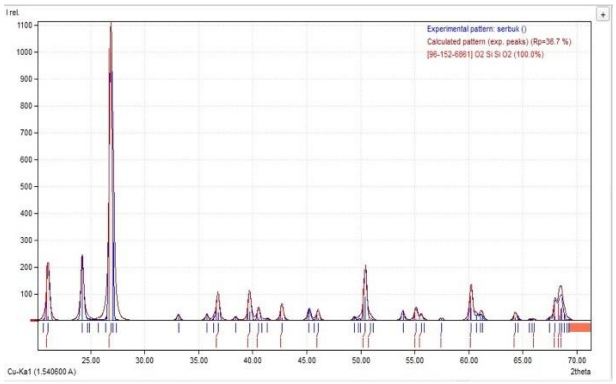

Fig. 1. XRD of The quartz sand before purification

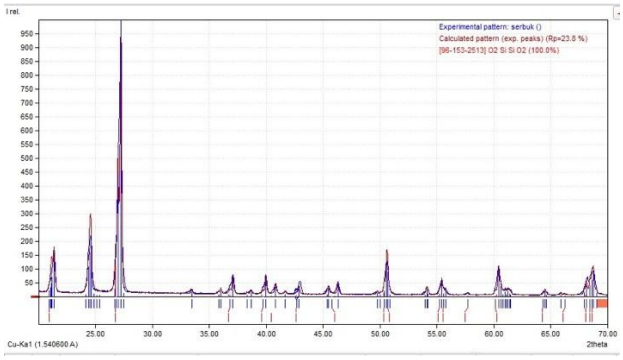

Fig. 2. XRD of The quartz sand after purification

The XRD characterization is done to see the pureness of the sand itself. The result of the XRD by using the program match on Figure 1 and Figure 2 on the quartz sand sample from the village of "Pasir Putih", shows the quartz phase. It indicates that the peak of the graph which was resulted by the compound SiO2 with the red line was found in the highest intensity which is 1000.

IV. CONCLUSION

This shows that the crystal from the silicon compound (SiO2) is near perfection and explains that the more crystal field found in the sample, the stronger the intensity of the refraction can be done. In this result, the XRD sample before and after the treatment can be seen that the peak of the polluter decreases. This shows that most of the polluter had been reduced. The silica found was the silica with the pureness of 99.88%.

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