Improvement of Purity Silicon Obtained from Natural Sand by Antioxidant and Antimicrobial Activities from Leaves of *Coleus atropurpureus* Benth

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Abstract. The antioxidant and antimicrobial activities of *Coleus atropurpureus* Benth leaves extracts were determined. Leaves *C.atropurpureus* Benth were extracted with methanol, ethylacetate and n-hexane. Test of antioxidant activity by using DPPH method. All tested extracts showed strong antioxidant activity. Ethylacetate extract were found to be the most active fractions with IC₅₀ values of 21.86 mg/L and methanol and n-hexane extracts with IC₅₀ values of 51.2 and 54.38 mg/L. The *C. atropurpureus* leaves extracts were tested against *Shigella SP*, *Streptococcus mutan*, *Escherichia coli*, *Staphylococcus aureus*, *Candida albicans*, *Saccharomyces cerevisia* and *salmonella thyppii* by the agar diffusion method showed antimicrobial activity against all tested microorganisms except n-hexane extracts was not active against *E. coli*. Research results showed that leaves extracts of *C. atropurpureus* Benth possess strong antioxidant and antimicrobial properties.

Keywords: *Coleus atropurpureus*, diffusion method, antioxidant activity.

INTRODUCTION

*Coleus atropurpureus* Benth is a species of the genus Coleus Lamiaceae family who are scattered throughout the tropics. The specialty of this plant is the diversity of its kind and color. This plant has been growing ornamental plants with beautiful varieties. The style, shape and color of plants is diverse, but the drug is efficacious as a brownish red. Indonesian people used this plant as a medicine Ambein, abdominal pain, fever, constipation, diabetes mellitus, laxative menstruation, boils, abscesses and wound ulcers [2,11,12]. *C. atropurpureus* Benth leaf extract (syn: *C. scutellarioides*) has been tested for antibacterial activity against *Staphylococcus aureus* and the potential to suppress bacterial infections of the ear [3]. Ethanol extract of leaves *Coleus atropurpureus* Benth has antibacterial activity because it can inhibit gram-positive and gram-negative bacteria[6].

Based on phytochemical screening showed that *Coleus atropurpureus* Benth leaf contains flavonoids and isolation of ethyl acetate extract of the plant as well as UV-Vis spectrum analysis, FT-IR and 1H-NMR spectrum analysis showed that the isolated compounds flavonoid class of flavon [7]. Flavonoid compounds are one of the many groups of secondary metabolites analyzed, because flavonoids are the largest constituent of plant pigments, such as anthocyanin which is a subclass of flavonoids that give red, orange, blue and purple in the leaves, flowers and fruit. Flavonoids are also used as a drug or dietary supplement because it has strong antioxidant activity [5]. Flavonoid compounds also showed biological activity such as hypo-allergenic, antiviral and anti-inflammatory [9,10], anti-aging effects caused by the presence of antioxidant compounds, especially phenolic compounds such as flavonoids and effective reduce the risk of cancer, where some of the flavonoid compounds effective as an anticancer and cancer chemopreventive [8]. In this study, antioxidant and antimicrobial activity test *C. atropurpureus* Benth leaf extracts by solvent extraction variations.

METHODS

Extraction. The leaves of *C.atropurpureus* Benth (900 g) were dried and powdered. The powder was extracted with methanol at room temperature for 72 h. Solvent was evaporated under reduced pressure to afford a methanol extract. The extract was partitioned with ethylacetate and H₂O (1:1). The ethylacetate extract was partitioned with n-hexane. The ethylacetate and n-hexane solution was concentrated under reduced pressure to afford a ethylacetate and n-hexane extract.

Antioxidant activity. The effect on antioxidant on DPPH radical-scavenging is thought to be due to their hydrogen-donating ability. DPPH is a stable free radical and accepts ab electron or hydrogen radical to become a stable
molecule. The reduction capability (on the DPPH radical) is determined by the decrease in its absorbance at its absorption maximum at 517 nm that is induced by antioxidant. This is visualised as a change in colour from violet to yellow. DPPH is usually used a substrate to evaluate antioxidant activity. Extract solution were prepared by dissolving of dry extract in ethanol (10, 20, 40 and 80 mg/L). 2.5 ml of extract solution were mixed with 1 ml DPPH solution 0.3 mM in the flask. The sample were kept in the dark for 15 min at room temperature and then absorbance was measured at 515 nm (changes in colour from violet to light yellow). Radical-scavenging activity was calculated by the following formula:

\[ \% \text{ Inhibition} = \left( \frac{A_B - A_A}{A_B} \right) \times 100 \]

Where \( A_B \), absorption of blank sample (t = 0 min); \( A_A \), absorption of tested extract solution (t = 15 min).

**Antioxidant activity.** The antimicrobial activities of the methanol, ethylacetate and n-hexane extracts were evaluated by means of the agar disc diffusion method. The media used were Mueller-Hinton agar for the bacteria and Sabouraud Dextrose agar for the fungi. Filter paper disc (6 mm in diameter) were individually impregnated with extract (0.5 g/ml), then placed on the inoculated plates, they were incubated at 37°C for 24 h for bacteria and at 30°C for 48 h for yeast. The potency of extracts was determined against *Shigella SP, Streptococcus mutan, Escherichia coli, Staphylococcus aureus, Candida albicans, Saccharomycyces cerevisia* and *salmonella thypii*. The antimicrobial activity was measured as the diameter (mm) of clear zone of growth inhibition.

**RESULTS AND DISCUSSION**

**Extraction.** The leaves of *C. atropurpureus* (900 g) were dried and powdered. The powder was extracted with methanol at room temperature for 72 h. Solvent was evaporated under reduced pressure and yielded 148 g of a methanol extract. The methanol extract was partitioned with ethylacetate and H₂O (1:1) at room temperature. The ethylacetate extract was partitioned with n-hexane. The ethylacetate and n-hexane solution was concentrated under reduced pressure to afford 11.42 g a ethylacetate extract and 58.17 g n-hexane extract.

**TABLE 1.** Extraction of leaves *C.atropurpureus*

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Extraction yield (gram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td>62.9</td>
</tr>
<tr>
<td>Ethylacetate</td>
<td>11.42</td>
</tr>
<tr>
<td>n-hexane</td>
<td>58.17</td>
</tr>
</tbody>
</table>

**Antioxidant activity.** The relatively stable organic radical DPPH has been widely used in the determination of antioxidant activity of single compounds as well as of different plant extract [4]. The IC₅₀ values for DPPH assay of the samples have been given in Table 2.

**TABLE 2.** Antioxidant activity of the various extracts from leaves *C.atropurpureus*

<table>
<thead>
<tr>
<th>Sample</th>
<th>IC₅₀ (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol extract</td>
<td>51.2</td>
</tr>
<tr>
<td>Ethylacetate extract</td>
<td>21.86</td>
</tr>
<tr>
<td>n-hexane extract</td>
<td>54.38</td>
</tr>
</tbody>
</table>

The ethylacetate extract of *C.atropurpureus* Benth was able to reduce the stable free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) to the yellow coloured with an IC₅₀ of 21.86 mg/L. Other extract had antioxidant values 51.2 and 54.38 mg/L, measured by the DPPH method. The mechanism of the reaction between antioxidant and DPPH depends on the structural conformation of the antioxidant. Some compounds react very quickly with DPPH, reducing a number of DPPH molecules equal to the number of the hydroxyl groups [1].

As it is shown, all the tested samples showed antioxidant activity in this method. Among the tested samples, the ethylacetate extract showed the most antioxidant activity, which may be attributed to the collective antioxidant
The plant extracts showed some degree of activity against microorganisms (as a clear zone of paper disc). The data obtained from disc diffusion method indicated that ethylacetate extract was the most sensitive against microorganism tested with the strongest inhibition zone (10.5 – 20.1 mm) followed by methanol and n-hexane extracts with inhibition zones < 12 mm except n-hexane extracts was most active to S. thyphii (22.9 mm) but not active to E. coli.

**CONCLUSION**

The results showed that ethylacetate extracts displayed the highest antioxidant and antimicrobial activity while methanol and n-hexane extracts showed lower antioxidant and antimicrobial activity. The n-hexane extract showed no antimicrobial activity against E. coli.

**ACKNOWLEDGMENTS**

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The Level of High School Student’s Awareness Toward Environment

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Abstract: This study aims to determine the level of environmental awareness among high school students in Indonesia and Malaysia. Environmental awareness is one of indicators in science and technology culture and measured by using Instrument of Science and Technology Culture. The research method is survey, conducted towards high school students in Indonesia (Java and Sumatra) and Malaysia (semenanjung). The data were analyzed by using descriptive statistics. This research results that Malaysian high school students have higher awareness level of human behavior that cause environmental problems (68 %), compared to Indonesian high school students (39 %). The similar result was also found that Indonesian high school students have low expectations toward the future of the environment (12%) while Malaysian high school students is more optimistic about environment future (38 %). It means that teachers and other stakeholders in education are strongly encouraged to give deep and holistic explanation on environmental problems to high school students.

Keywords: High School Students, awareness, environment, science characteristics, basic science.

INTRODUCTION

Group researcher of TIMSS (Trends in International Mathematics and Science Study) has developed frameworks to measure understanding of science and technology among high school students around the world. Understanding of science and technology is a central knowledge and plays important role in modern society [6]. In addition, understanding of science and technology gives significant contribution to individual, community, professionalism, and cultural life of every person. Therefore, the study of science and technology education now is not only focused on pedagogy of science education and technology, but also has evolved in many multidisciplinary fields such as environmental science education research [1], culture of science education research and technology [3,4], science technology and society education and scientific literacy education.

The level of measurement of existence or manifestation of science and technology culture among high school students includes 9 indicators, namely (1) attitude towards Science and Technology, (2) environmental awareness, (3) nature of scientific knowledge, (4) ethics of science and technology, (5) attitudes towards use of trial test, (6) understand the limitations of human mind, (7) my view related to the following indicators, (8) the habit of scientific-minded students, (9) Student school activities outside of school, and (10) basic knowledge of science [3,7,8].

Environmental Awareness in this study is high school students' awareness towards environment around their schools or neighborhoods. In context of science and technology culture study, environmental awareness is one of the most relevant indicators that have high contribution to science and technology culture among high school students. This fact is showed by the results of validity of science and technology culture instrument that is 0.81 for alpha Crombak and 0.99 for Reliability of indicator of students’ awareness toward the environment [8].

As an effort to enrich the knowledge, especially related to science and technology education. Through this research will be assessed the level of environmental awareness to high school students in Indonesia and Malaysia. This research purpose specifically on students’ views and perception of: (1) role of science and technology in solving environmental problems, (2) future of environment, (3) The equal right of lives towards human and
animals, (4) society’s awareness on environment, (5) society’s responsibility towards environment, and (6) human activity as one of causes that triggers environmental problems.

**METHODOLOGY AND DISCUSSION**

This study used survey technique towards 467 high school students in Indonesia (Java and Sumatra) and 690 high school students in Malaysia (peninsula), the respondents are aged 15-17 years old. Data was collected by using instrument of Science and Technology Culture, where one of indicators is students’ awareness toward environment. Based on indicator of environmental awareness is developed eight items, namely; (1) Environmental problem can be solved by science and technology, (2) I believe the future of our environment, (3) Animals have the same right to life as humans, (4) We need to get a solution to our environmental problems, (5) Society need to be aware or sensitive to the problem environment, (6) Society need to be responsible for protecting the environment, (7) Human activity is a cause of environment problem, and (8) We need to provide a meaningful contribution to protecting the environment.

The pattern of students’ response use questionnaire and Likert scale by 5 points, namely 1 = Strongly Agree (SS), 2 = Agree (S), 3 = No Knowledge (TP), 4 = Disagree (TS), 5 = Strongly Disagree (STS). The instrument (only for indicators of awareness of environment) are shown in Table 1, below.

**TABLE 1.** Indicators and environmental awareness Item

<table>
<thead>
<tr>
<th>No.</th>
<th>Section B: Awareness toward environment</th>
<th>SS</th>
<th>S</th>
<th>TP</th>
<th>TS</th>
<th>STS</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Environmental problem can be solved by science and technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B2</td>
<td>I am optimistic about the future of our environment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B3</td>
<td>Animal should have the same right to life as people</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B4</td>
<td>We should find solution to our environmental problem</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B5</td>
<td>Society should be aware about environmental problem</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B6</td>
<td>Society should care more about protection of the environment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B7</td>
<td>Human activity is a cause of environment problem</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B8</td>
<td>Each one of us should make a significant contribution to environmental protection</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

(Source: Halim.et.al. 2009)

Based on 5 point Likert scale above is developed students’ levels of awareness toward environment, as shown in Table 2 below.

**TABLE 2.** Levels of awareness based on the Likert scale 5 points (1 – 5)

<table>
<thead>
<tr>
<th>No.</th>
<th>Range of Likert scale</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00 – 2.44</td>
<td>Have a high awareness</td>
</tr>
<tr>
<td>2</td>
<td>2.45 – 3.44</td>
<td>Have a medium awareness</td>
</tr>
<tr>
<td>3</td>
<td>3.45 – 4.44</td>
<td>Have a low awareness</td>
</tr>
<tr>
<td>4</td>
<td>4.45 – 5.00</td>
<td>There is absolutely no awareness</td>
</tr>
</tbody>
</table>

(Sources: Jack R. Fraenkel. 2011)

Each item is examined, analyzed with descriptive statistics refer to Table 2 above. The results of the data analysis are shown in figure 1 below. The graph in Figure 1 represents the response pattern of 690 high school students in Malaysian Peninsula on 8 items of environmental awareness indicator (B1 to B8). Based on measurement, shows that item B8 has the largest average that is 2.3.

There is indication that students are less aware of importance of given thoughts and ideas to solve environmental problems. This view can be justified, due to education at high schools in Malaysia do not much involves
environmental problem solving activities scientifically. Therefore, science teachers are strongly encouraged to provide training or learning project activities associated with forms of project solution for environmental problems through the use of ideas or thoughts.

In contrast, Malaysian high school students have very high awareness related to item B2, namely the belief towards environmental sustainability in the future. If we research and observed, the way of Malaysian government address environmental issues create high awareness to the students. One of the government actions are regulations on reducing forest fires, prohibiting illegal logging, giving punishment for people who pollute the environment, and other forms of legislation. All these laws aim to preserve environment. Whether through learning in school or through observation of law implementation in everyday life, unconsciously students build awareness and assure about future of environment.

The results of data analysis for Indonesian high school students' responses are shown in Figure 2 below. Extreme response found on items B2 with average of Likert scale 2.6. Based on data analysis can be inferred that awareness of Indonesian high school students is at middle level. It means that students are unsure or less optimistic about the
future sustainability of the environment in Indonesia. It is caused by lacking of attention or efforts by government to protect environment. The fact that government less commitment in implementing regulation of forest protection and giving punishments to people who violate the laws, where at the end triggers many illegal logging and deforestation. This phenomena create less assure or optimistic attitude on the students toward future forest environment in Indonesia. The highest awareness shown by students in Indonesia is related to the role and responsibility of community to preserve the environment. It shown by students' responses on item B5 and B6 with average of Likert scale is 1.2. Based on the response can be inferred that high schools students in Indonesia put more trust on community to protect environment rather than government.

Comparison of level of high school students' environmental awareness in Indonesia and Malaysia were analyzed using t-test with different amount of respondent. The results of data analysis provided average response 1,907 for Malaysian and 1,667 for Indonesian. While the results of value-t calculation obtained 9.7. Based on the degree of freedom from total of respondent of high school students in Malaysia and Indonesia provided T table 2.58. Both t and T values as statistic show significant difference with significant level of 0.05 and probability P = 0.00. As the result, it shows that in overall high school students in Indonesia have higher levels of environmental awareness than the students in Malaysia. But, the Malaysian students have higher level of environmental awareness compared to the Indonesian students at certain items.

CONCLUSION

In overall, high school students in Indonesia have level of environmental awareness better than the Malaysian students. But, Malaysian high school students have higher level of environmental awareness on certain items compared to Indonesian high school students. For example is item B2, level of Malaysian high school students (1.6) is higher consciousness than the Indonesian high school students (2.5). Based on data analysis, can be inferred that the level of environmental awareness of Indonesian high schools students is at middle category. It indicates that Indonesian students are not sure or less optimist towards environmental sustainability in Indonesia. Students' low awareness and belief due to less commitment by government in protecting our environment.

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Increased of Purity Silicon from Natural Sand with Variation of Heating Time through Magnesiotermal

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Abstract. Extraction of silicon from natural sand obtained from Asahan in North Sumatera has been done. The reaction was carried out using magnesium and followed by a purification using inorganic acids. Silicone products were characterized using XRD and quantitatively analyzed using Relative Intensity Ratio (RIR) method. The level purity of product silicon on heating for 3 hours was obtained (90.5%), 4 hours was obtained (92.1%) and 5 hours was obtained (100%). Silicone products are reacted with chlorine gas produces a semi-crystalline silica and is hygroscopic.

Keywords: natural sand, silicone, magnesiotermal, XRD, RIR

INTRODUCTION

Quartz sand is a mineral composed of crystals of silica (SiO2) as the main component and other minerals in the form of metal oxides in small amounts. Quartz sand has a translucent white or other colors depend on the compound impurities. Quartz sand are found along the coast at Tanjung Tiram Asahan North Sumatera has a chemical composition of SiO2 (72.92%), Fe2O3 (0.31%), Na2O (1.59%), K2O (6.17%), CaO (2.81%), Al2O3 (14.73%) and MgO (0.65%) (Distam-prpsu-2, 2004). Thus silica is very abundant source of silicon. Silicon (Si) as the second element in the earth’s crust after oxygen [2], is not found in a free state that is usually obtained from the extraction of silica and other materials. There are several ways of extraction of silicon from silica such as quartz sand reduction with carbon at high temperatures using an electric furnace [3,4,5], extraction of silica from rivers Zauma, Zamfara state [6], reduction fume silica by magnesium powder, reduction silica using aluminum and sulphur [7], reduction of amorphous silica using calcium [8], reduction of porous SiO2 pellets electrochemically using fused CaCl2 and/or CaCl2-NaCl salt mixture [9].

Silicon exists in the form crystallin shiny metal and silicon powder as brownish-black. Because it has properties of metals and non-metals (metalloids) are widely used as materials in various fields. The level of purity silicon determine its usefulness. Chemical analysis of the level of purity silicon for the semiconductor industry were divided into four groups [10]: (1) metallurgical-grade silicon (99 ppm), (2) solar-grade silicon (99.999 9 ppm), (3) polycrystalline solar-grade silicon (99.999 99 ppm) and electronic-grade silicon (999 999 999 999 ppm). Silicon powder can be oxidized to the ceramic material (Si3N4) [11], in the form of crystalline silicon used for solar cells [3,10]. To improve the purity silicon, in this paper we perform the extraction of silicon from natural sand using magnesium. Reaction conditions by varying the heating time in the furnace. Analysis of the structure of silicon products were characterized by XRD and composition quantitatively analyzed using the Reference Intensity Ratio (RIR) base computer. The RIR method to analyze quantitatively the microstructure and mineralogy. Furthermore, silicon product obtained is reacted with chlorine gas to obtain a compound of silicon tetrachloride (SiCl4). The products obtained were analyzed using FT-IR.

EXPERIMENTAL

Instruments. The instrument used are: glass tools, droping funnel, metal bowls, stone mortar and pestle, an electric sieve, hotplate and stirrer, scales, centrifuges, furnaces, ovens. Characterization of the crystal structure and composition using XRD performed at Yogyakarta State University Yogyakarta, FT-IR characterization conducted in Indonesian Research Institute (LIPI), Jakarta.
Materials. Materials used: natural sand were obtained from Tanjung Tiram Asahan in North Sumatera, concentrated sulfuric acid and hydrochloric acid, hydrofluoric acid, magnesium powder, acetic acid, manganese dioxide, sodium hydroxide, aerosil, distilled water and aquabides. Experiments conducted in the Research Laboratory (LP), Basic Science Laboratory (LIDA), Inorganic Chemistry Laboratory University of Sumatera Utara.

Purification of Silica (SiO$_2$) from Natural Sand. Silica (SiO$_2$) is purified from natural sand obtained from the Tanjung Tiram Asahan in North Sumatra, performed as ever dilkukan in [13]. White silica solids were characterized by XRD and analyzed quantitatively using the RIR method.

Extraction of Silicon (Si) from silica (SiO$_2$). Silica (SiO$_2$) natural sand mixed with magnesium powder with a ratio (1:1.75), is inserted into a vessel of metal, stirring until blended and sealed properly. Inserted into the furnace and heated at a temperature 800°C for 4 hours. The reaction mixture was cooled and purification with three steps. In the first stage solids added 150 mL of 2M HCl, stirred while heated at 800°C for 3 hours. Then filtered, the solids washed with aquabides and dried. After drying the second stage purification process is done by adding a mixture of 2M HCl and CH$_3$COOH 25% with a ratio(1: 2). The mixture were stirred and heated at 80°C for 3 hours. The solid was separated and washed with aquabides and dried. Further purification third step is done by adding hydrofluoric acid 4.8% and acetic acid (CH$_3$COOH) 25% with a ratio (1: 2), stirred and heated at 80°C for 3 hours. The mixture is cooled and the solids are separated then washed with aquabides and dried. The solids were characterized by X-ray diffraction (XRD). Silicon extraction process of natural sand is done by varying the heating time for 4 hours and 5 hours.

Synthesis of silicon tetrachloride (SiCl$_4$). The circuit first instrument was prepared and supplied nitrogen gas. Into a three-neck flask which was filled with 14 g of MnO$_2$ solids, dropped into concentrated HCl (20 mL) slowly using a dropping funnel connected to a tube containing sulfuric acid to absorb water. Then the tube is connected to the U pipe containing aerosil. Furthermore pipe U connected to a container tube silicon which is heated with gas flame. SiCl$_4$ vapor produced flowed into the condenser and container products cooled using ice cubes.

RESULTS AND DISCUSSION

The solid silica (SiO$_2$), which is obtained from natural sand [13], is reacted with magnesium powder and heated to a temperature 800°C with silica and magnesium ratio (1:1.75). The heating time varied for 3 hours, 4 hours and 5 hours. Product silicon with variation of heating time for 3 hours obtained silicone products blackish brown. Characterization of the structure using X-ray diffraction (XRD) (Figure 1). XRD diffractogram of silicon (Si) shows the angle 02 at 28,487° hkl (111); 47,330° hkl (220); 56,154° hkl (311); 59,34° hkl (222); 69,145° hkl (400); and 76,392° hkl (331). XRD data adjusted with the literature [14].

![FIGURE 1. Peak Difraktogram XRD Silicon Product at Heating Time for 3 hours](image-url)
Purity silicon products were analyzed quantitatively using Relative Intensity Ratio (RIR) method based computer and its composition is shown in Table 1.

**TABEL 1. Composition of Silicon Product Using Relative Intensity Ratio (RIR) method from Heating Time for 3 Hours**

<table>
<thead>
<tr>
<th>Phase name</th>
<th>Formula</th>
<th>Figure of merit</th>
<th>Phase reg. detail</th>
<th>DB card number</th>
<th>Weight ratio Content(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon, syn</td>
<td>Si</td>
<td>0.290</td>
<td>ICDD (PDF-2/Release 2012 RDB)</td>
<td>01-070-5680</td>
<td>90.5(8)</td>
</tr>
<tr>
<td>Spinel, syn</td>
<td>(Mg0.47 Al0.53)</td>
<td>0.959</td>
<td>ICDD (PDF-2/Release 2012 RDB)</td>
<td>01-078-6060</td>
<td>9.5(4)</td>
</tr>
</tbody>
</table>

Silicon products from silica reduction by heating time for 4 hours obtained silicone products blackish brown. Characterization of the structure using X-ray diffraction (XRD) shown in Figure 2. Diffractogram peak silicon (Si) shows the angle $\theta$ are at 28,557° hkl (111); 47,411° hkl (220); 56,218° hkl (311); 59,46° hkl (222); 69,210° hkl (400); 76,456° hkl (331) and 88.089° hkl (422). The results of the XRD data adjusted with the literature.

**FIGURE 1. Peak Difraktogram XRD Silicon Product at Heating Time for 4 hours**

Purity silicon products were analyzed quantitatively using Relative Intensity Ratio (RIR) method based computer and its composition is shown in Table 2.

**TABEL 2. Composition of Silicon Product Using Relative Intensity Ratio (RIR) method from Heating Time for 4 Hours**

<table>
<thead>
<tr>
<th>Phase name</th>
<th>Formula</th>
<th>Figure of merit</th>
<th>Phase reg. detail</th>
<th>DB card number</th>
<th>Weight ratio Content(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon, syn</td>
<td>Si</td>
<td>0.417</td>
<td>ICDD (PDF-2/Release 2012 RDB)</td>
<td>01-070-5680</td>
<td>92.1(7)</td>
</tr>
<tr>
<td>Spinel, Hp, syn</td>
<td>MgAl2O4</td>
<td>0.525</td>
<td>ICDD (PDF-2/Release 2012 RDB)</td>
<td>01-072-6946</td>
<td>7.9(3)</td>
</tr>
</tbody>
</table>

Silicone products from reduction of silica by heating time for 5 hours obtained silicone products blackish brown. Characterization structure using X-ray diffraction (XRD) shown in Figure 3. XRD diffractogram peak at an angle $\theta$ showed the presence silicon (Si) at 28,520° hkl (111); 47,365° hkl (220); 56,155° hkl (311); 69,192° hkl (400); 76,398° hkl (331) and 88.060° hkl (422). The results of the XRD data adjusted with the literature.
Purity silicon products were analyzed quantitatively using Relative Intensity Ratio (RIR) method based on computer and its composition is shown in Table 3.

### TABEL 3. Composition of Silicon Product Using Relative Intensity Ratio (RIR) method from Heating Time for 5 Hours

<table>
<thead>
<tr>
<th>Phase name</th>
<th>Formula</th>
<th>Figure of merit</th>
<th>Phase reg. detail</th>
<th>DB card number</th>
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<tr>
<td>Silicon, syn</td>
<td>Si</td>
<td>0.355</td>
<td>ICDD (PDF-2/Release 2012 RDB)</td>
<td>01-070-5680</td>
<td>100.0(9)</td>
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Silicone product with 92.1% purity level obtained with the heating time for 4 hours then treated with chlorine gas in nitrogen conditions to obtain compounds silicon tetrachloride. After the reaction is carried out silicon tetrachloride compound is obtained in the form of white gas and a pungent odor. Besides, it also produced other products such as white solid (Figure 4) contained in the sample container and condenser. The white solid separated and characterized using FT-IR to prove the functional group contained in the compound.

FT-IR spectrum of the white solid product is shown in Figure 4. Absorption peak at the wave number of 3035.71 cm\(^{-1}\) indicate the presence of Si-OH stretching vibration of the hydrogen bonding of Si-OH functional group, at 1637.19 cm\(^{-1}\) due to the OH bending vibration of adsorbed molecular water, at 1078.96 cm\(^{-1}\) shows the asymmetric...
stretching vibration bands of Si-O-Si of functional groups of Si-O-Si, at 918.26 cm\(^{-1}\) shows the bending vibration of Si-O (H-H\( _2\)O) of Si-OH functional group and at 806.32 cm\(^{-1}\) shows the Si-O bending vibrations of the functional groups of Si-O-Si. Based on data from FT-IR is a white solid compound of silica (SiO\( _2\)) which is hygroscopic so it can be used as a water absorbent material. In this case we test it by letting the open air after a few minutes turned into a moist white solid (lumpy) but once dried again in an oven at a temperature of solids 80°C becomes dry again. The ability to adsorb water on silica solids derived due to the Si-OH groups (silanols) on SiO\( _2\) surfaces that can bind with water molecules through hydrogen bonding.

FIGURE 3.16 FT-IR spectra Semi-crystalline SiO\( _2\) Results Reaction Products Silicon (92.1%) with Chlorine Gas (Cl\( _2\))

Because the synthesis of SiCl\( _4\) produced gaseous products then our next product SiCl\( _4\) reacted immediately with dry ethanol produces compounds Si (OC\( _2\)H)\( _4\) in order to isolate and to characterize the products. These works has not been completed and are under characterization.

CONCLUSIONS

1. Extraction of silicon from natural sand obtained from the Tanjung Tiram Asahan in North Sumatera has been done. Extraction was carried out using magnesium and followed by a purification process using inorganic acids. Silicone products were characterized using XRD and quantitatively analyzed using the Relative Intensity Ratio (RIR). The level of purity silicon products obtained at the time variation of heating for 3 hours was (90.5%), 4 hours (92.1%), and 5 hours (100%). Based on these data, the time of heating in a furnace affect the level of product purity silicon.

2. Synthesis of compounds of silicon tetrachloride using silicone product purity (92.1%) resulting white gaseous SiCl\( _4\) and has strong odors. Besides, the resulting white solid material of silica (SiO\( _2\)) which is hygroscopic so it can be used as an adsorbent to absorb water.

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