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Characterization of Mineral Content of Iron Sand at Depok Beach, Sigandu Beach and Muara Beach in Batang Regency

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Abstracts

Research on the characterization of iron sand mineral content has been carried out. The purpose of this study was to determine the magnetic mineral content found in the iron sands of Depok Beach, Muara Beach and Sigandu Beach, Batang Regency. Iron sand samples were taken from Depok Beach, Muara Beach and Sigandu Beach, Batang Regency. Sand is extracted using a permanent magnet to separate magnetic and non-magnetic sand. The magnetic sand that has been separated is tested for the type of mineral content by XRD (X-Ray Diffraction). The results showed that the type of magnetic mineral sand from Depok Beach, Muara Beach and Sigandu Beach, Batang Regency, contained Geothite (FeO_2), Hematite (Fe_2O_3), Maghemite (Fe_2O_3) and Magnetite (Fe_3O_4) compounds. Calculation of the crystallitesize value on the iron sand of Depok Beach is 45.67, Muara Beach is 33.34 and Sigandu Beach is 33.11.

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1. Introduction

Indonesia has abundant natural magnetic materials. These natural magnetic materials are found in iron sand. Iron sand in Indonesia is abundant and abundant on the island of Java, especially on the north and south coasts. So far, iron sand is generally used as a building material, even though iron sand contains magnetic mineral materials which are the basis for the development of devices in modern life. Iron sand that has been separated from non-magnetic materials is widely used as an ingredient in steel mills, iron smelting materials and also cement mixtures. On the other hand, magnetic minerals containing magnetite, hematite, and maghemite have great potential in industrial development [1].

The potential and distribution of iron sand in Indonesia can be found on various islands, from the west coast of Sumatra, Kalimantan, Sulawesi, the Nusa Tenggara region, the Maluku Islands and the southern coast of Java. So far, inventory and exploration activities related to these iron deposits have not been carried out thoroughly and systematically so that they cannot be utilized optimally [2].

Iron sands containing magnetite minerals are widely found in coastal areas, rivers, and volcanic mountains [3]. Indonesia, which is an archipelagic country, certainly has many river estuaries in addition to a very wide coastal area [4]. However, the utilization of iron pairs in Indonesia, especially on the island of Java, is still very lacking due to the lack of knowledge of the Indonesian people and research in this field.

One of them in Batang district not many people know about the benefits of iron sand. One of them is used in the steel industry because iron sand contains a lot of iron as a raw material for making steel. Iron sand also contains a lot of magnetic minerals, hematite and maghemite so that it can be used in other industries [5]. Magnetite can be used as a raw material for the manufacture of dry ink / toner commonly used in photocopiers and laser printers. Maghemite is the main material for making cassette tapes. These three materials can also be used in the permanent magnet manufacturing industry [6].

Generally, iron sand found in nature contains ferrite of 58.39 – 60.23% in the form of hematite (Fe_2O_3) and maghemite (Fe_2O_3) although the chemical composition of the two materials is the same but the phases are different [7]. Maghemite is cubed and hematite is hexagonal. Researchers usually use hematite as the basic material for the synthesis of magnetic powder [8]. Maghemite can be obtained by oxidation of iron sand at a temperature of 300^{o}C, while hematite can be obtained at a temperature of 700-800^{o}C [9].

Iron sand is a sand deposit containing iron ore particles, which are found along the coast, formed due to the process of destruction by weather, surface water and waves against the original rock containing iron minerals, then accumulates and is washed away by waves of sea water [10]. Indonesia is often found in various beaches such as: West Sumatra, South Java, Kalimantan, Sulawesi, Nusa Tenggara and the Maluku islands, but so far exploration activities related to iron sand deposits have not been carried out thoroughly and systematically [11]. Based on this background, researchers will characterize iron sand with XRD at Sigandu Beach, Muara Beach and Depok Beach, Batang Regency to determine the mineral content.

2. Experiments Procedure

The materials used in the study were iron sand at Depok Beach, Muara Beach, Sigandu Beach in Batang Regency. The equipment used included: magnets, sample containers, sand pounders, shovels, plastic, digital balances, a set of X-Ray Diffraction tools.

The iron sand in this study was taken from 3 locations, namely Depok Beach, Muara Beach and Sigandu Beach, Batang Regency. This sand is black in color in its natural state. Sample preparation was started by drying the iron sand at 100°C for 3 hours to remove the water content. Furthermore, the process of separating the content of magnetic materials from the sand using a permanent magnet is carried out. Magnetic sand was characterized using X-Ray Diffraction equipment. Then the mineral content was analyzed based on the data of plane distance (d), angle of two tetha (2θ).

3. Result and Discussion

Iron sand in the Depok Beach area has characteristics, including black color and the results of the identification of chemical compounds in iron sand samples using X-ray diffraction showed that containing Geothite (FeO_2) was shot with Cu-Ka of 1.541874 A at an angle of 2θ of 21.24°, d of 4, 1743 and I/Ic of 3,26. Hematite (Fe2O3) was shot with Cu-Ka of 1.541874 A at an angle of 2θ of 33.14°, d of 2.7012 and I/Ic of 4.83. Maghemite (Fe_2O_3) is shot with Cu-Ka of 1.541874 A at an angle of 2θ of 35.72°, d of 2.5085 and I/Ic of 5.45. Magnetite (Fe_3O_4) is shot with Cu-Ka of 1.541874 A at an angle of 2θ of 35.77°, d of 2.5028 and I/Ic of 6.16. The image of the XRD results of iron sand taken in place in the coastal area of Depok is shown in Figure 1.

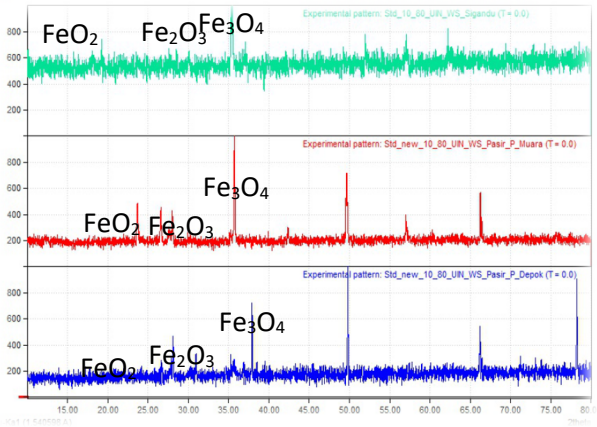

Figure 1. XRD results of iron sand from Depok Beach, Muara Beach and Sigandu Beach

Meanwhile, iron sand in the Muara Beach area has characteristics such as black color and the results of the identification of chemical compounds in iron sand samples using X-ray diffraction showed that containing Geothite (FeO_2) was shot with Cu-Ka of 1.541874 A at an angle of 2θ of 21.19° , d is 4, 1743 and I/Ic is 3,61. Hematite (Fe_2O_3) was shot with Cu-Ka of 1.541874 A at 2θ angle of 33.14°, d of 2.7012 and I/Ic of 4.83. Maghemite (Fe_2O_3) is shot with Cu-Ka of 1.541874 A at 2θ angle of 35.72°, d of 2.5143 and I/Ic of 5.45. Magnetite (Fe_3O_4) is shot with Cu-Ka of 1.541874 A at 2θ angle of 35.77°, d of 2.5028 and I/Ic of 6.16. The image of the XRD results of iron sand taken in place in the coastal area of Muara is shown in Figure 1.

Meanwhile, iron sand in the Sigandu area has characteristics such as black color and the results of the identification of chemical compounds in iron sand samples using X-ray diffraction showed that containing Geothite (FeO_2) was shot with Cu-Ka of 1.541874 A at an angle of 2θ of 21.28°, d is 4, 1743 and I/Ic is 3,25. Hematite (Fe_2O_3) was shot with Cu-Ka of 1.541874 A at 2θ angle of 33.14°, d of 2.7012 and I/Ic of 4.83. Maghemite (Fe_2O_3) is shot with Cu-Ka of 1.541874 A at 2θ angle of 35.72°, d of 2.5143 and I/Ic of 5.45. Magnetite (Fe_3O_4) is shot with Cu-Ka of 1.541874 A at an angle of 2θ of 35.77°, d of 2.5085 and I/Ic of 6.16. The image of the iron sand XRD results taken at the Sigandu coastal area is shown in Figure 1.

XRD results show that the three beach sands contain Fe and O elements in the Magnetite Phase (Fe_3O_4), this is in accordance with previous research conducted on Kata beach, West Sumatra [12]. This shows that the iron sand shows the possibility for soft magnetic applications [13].

The crystal grain size for all studied samples was calculated using the equation:

$$\text{Equation: } Crystallite\ size, t = \frac{0.9\lambda}{\beta_{hkl}\cos\theta_{hkl}}$$

Based on the XRD graph plotting the highest peak. Using the position of the main peak (2θ) with the height of intensity and the size of the full width at half maximal (FWHM) of the main peak, the crystal grain size can then be calculated. The crystal grain size is calculated in Table 1. The sizes of all samples are basically the same. This shows that all samples are good crystals [14].

Table 1. Calculation of the crystallitesize

Sample in	2θ (°)	λ	$FWHM$ (rad)	t (nm)
Depok	35,77	1,540598	0,0319	45,67
Muara	35,86	1,540598	0,0437	33,34
Sigandu	35,77	1,540598	0,0440	33,11

The result of the calculation the crystallitesize value on the iron sand is shown in Table 1. It is shown the value of Depok Beach is 45.67, Muara Beach is 33.34 and Sigandu Beach is 33.11. This is in accordance with previous research which states that when the difference between two optical phonon increases, the crystallite size decreases, and the strain will be uniform [15].

4. Conclusion

Based on the results of XRD (X-Ray Diffraction) characterization, it was found that the types of magnetic minerals contained in the iron sands of Depok Beach, Muara Beach, and Sigandu Beach in Batang Regency were Geothite (FeO_2), Hematite (Fe_2O_3), Maghemite (Fe_2O_3) and Magnetite (Fe_3O_4). Based on plotting the XRD graph or the highest peak. By using the position of the main peak (2θ) with the intensity height and the full width at half maximum (FWHM) of the main peak, the crystal grain size can be calculated using the formula:

$$\text{Equation: } Crystallite\ size, t = \frac{0.9\lambda}{\beta_{hkl}\cos\theta_{hkl}}$$

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