PREPARATION AND CHARACTERIZATION OF NATURAL IRON SAND FROM KATA BEACH, SUMATERA BARAT INDONESIA WITH HIGH ENERGY MILLING (HEM)

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Abstract. Preparation and characterization of natural iron sand from Kata Beach, Sumatera Barat Indonesia with High Energy Milling (HEM) has been done. Iron sand samples was extracted using permanent magnets to separate magnetic and non-magnetic materials. Then iron sand samples was preparation with high energy milling method. Characterization of iron sand samples using Scanning Electron Microscopy with Energy Dispersive X-ray (SEM-EDX), and Vibrating Sample Magnetometer (VSM). The result of characterization using SEM-EDX shows that iron sand samples contain Fe and O elements derived from Phase Magnetite (Fe₃O₄).

Keywords: iron sand, magnetic materials, SEM-EDX, VSM

I INTRODUCTION

Sand is an abundant natural material available in Indonesia. During this, sand is only used as building materials, whereas the sand contains many valuable minerals containing iron, titanium and other elements that can be utilized for industrial materials. Inside the sand is also contained iron sand that can be used as raw material for making cement. To produce high quality cement, in addition to limestone containing calcium oxide (CaO) compounds and clay containing silica dioxide (SiO₂), iron sand is required containing Fe element [1]. Iron sand deposits may contain magnetic minerals such as magnetite (Fe₃O₄), hematite (α-Fe₂O₃), and maghemite (γ-Fe₂O₃) [2]. Magnetic minerals contained in iron sand are very useful, but not all the minerals contained are all utilized [3]. The utilization of iron sand mineral which is now being developed is iron sand of nanoparticle size [4]. Iron sand in nanopedic sizes has many application opportunities in industry, electronics and medical [5], Earth magnetism studies [6-7] and defence as anti-radar materials [8]. Ref [9] has been synthesize of Fe₂O₃ nanoparticles from nature iron sands take from Buaya River in Deli Serdang, North Sumatra by co-precipitation method. So far, iron sand research is only done on the beach, such as research on the magnetic properties of iron sand by Ref [10] in Sunur Beach, Pariaman, W and Ref [11] at Air Tawar Beach Padang Sumatera Barat. Ref [11] found that the iron sand content in sand found in Air Tawar Padang Beach is quite high (41%) [12]. In this research use iron sand from Kata Beach, Sumatera Barat Indonesia with the aim to know the composition of iron sand especially mineral content and Fe grain size with High Energy Milling (HEM).

II METHODOLOGY

The first step is to extract natural sands iron. Natural sands iron that was used in this research was taken in Kata Beach, Sumatera Barat Indonesia. The sand samples were filtered using a screen to separate sand with dirt and other crude components. Next, separate the magnetic and non-magnetic material by using a permanent magnet. The
magnetic sample was washed with aquades, then dried. To obtain a smoother sample, the sampling method is wet using a method of High Energy Milling (HEM) wet in toluene solution for 3 h based in Ref [13]. The ratio of the ball and the powder is made 10:1 in% by weight. Drying of grinding powder with HEM is done in 100°C oven for 24 h. Characterization of iron sand samples using Scanning Electron Microscopy with Energy Dispersive X-ray (SEM-EDX) to determine the morphological structure and elemental content contained in iron sands, Vibrating Sample Magnetometer (VSM-Electromagnetic VSM250) for magnetic properties.

III RESULT AND DISCUSSION

The morphological structure of natural iron sand beach samples Kata, Sumatera Barat using SEM-EDX is shown in Figure 1. The figure shows that grain size of iron sand sample is not uniform. Samples have occurred agglomeration process of particle with particle size vary 4-6 μm. From the samples of natural iron sand there are elements of C, Al, Si, Mn, while Ca, Fe, and O have many elemental content. Table 1 shows that the main elements of iron sand are Fe, Ca and O.

Table 1 Content of the elements in natural iron sand samples

<table>
<thead>
<tr>
<th>Element</th>
<th>Sample (%wt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3.31</td>
</tr>
<tr>
<td>O</td>
<td>22.53</td>
</tr>
<tr>
<td>Al</td>
<td>0.42</td>
</tr>
<tr>
<td>Si</td>
<td>7.50</td>
</tr>
<tr>
<td>Ca</td>
<td>9.64</td>
</tr>
<tr>
<td>Mn</td>
<td>1.45</td>
</tr>
<tr>
<td>Fe</td>
<td>55.15</td>
</tr>
</tbody>
</table>

Fe and O content are derived from the phase of Magnetite (Fe₃O₄), maghemite (γ-Fe₂O₃), and hematite (α-Fe₂O₃) which is an iron oxide commonly found in iron sand [14, 12]. While some other elements such as K, C, Na, Mg, Al, Si, and Ca with content less than 10%. Characteristics of this magnetite iron are type that has a black color, difficult reduction, and magnetic properties are very strong [15]. Differences in physical characteristics of mineral content of sand such as Fe, Al, Ca, and Si are caused by differences in the location of the sediment. The iron sand content in sand (Fe) found in Kata Beach, Sumatera Barat is quite high 55.15%. Ref [11] found that the iron sand content in sand (Fe) found in Air Tawar Padang Beach is 41.32% [12]. This is due to Kata beach sample more Fe content than Air Tawar beach. Iron sand as one of the main raw materials in the steel industry and other heavy equipment industries in Indonesia, so its existence has recently played a very important role in Indonesia and even at international level [16,17].

Figure 2 shows the hysteresis curve of the VSM measurement. Based on the hysteresis curve, the coercivity, magnetic saturation, and magnetic remanent of iron sand sample are 93 Oe, 30 emu/g, and 4 emu/g consecutively. The small value of coercivity is one of the characteristic of superparamagnetic material. Then, based on the coercivities values (<132 Oe), so sample is classified as soft magnets [18].

CONCLUSION

The Fe₃O₄ particles have been successfully synthesized from natural iron sand of Kata Beach, Sumatera Barat Indonesia by high energy milling method. SEM-EDS results showed mineral main compiler of iron sand in Kata Beach, Sumatera Barat Indonesia
obtained information that the elemental content in iron sand most dominant is Fe and O derived from Phase Magnetite (Fe₃O₄).

ACKNOWLEDGMENT

This research was supported by Grand Master Program of Education Leading to Doctoral Degree for Excellent Graduates (Hibah PMDSU) 2015 from Directorate for Human Resource Qualifications Directorate General of Resource for Science, Technology & Higher Education Ministry of Research, Technology & Higher Education of Indonesia (KEMENRISTEK-DIKTI RI), Faculty of Mathematics and Natural Sciences University of Sumatera Utara and Indonesian Institute of Science, Research Center for Physics, Serpong, Jakarta.

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