IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 10, Issue 3 Ver. III (May. – June. 2018), 40-42
www.iosrjournals.org

Synthesis of Magnetite Based Iron Sand by Using Coprecipitation method

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Abstract: *Iron sand is a natural material that is easy to obtain. The low utilization of iron sand in Indonesia causes the low price of iron sand material. So, needed a technology in processing iron sand in order to become a producer that has usability. In this study we studied the synthesis of iron oxide materials in the form of magnetite (Fe_3O_4) and hematite (α-Fe_2O_3). The process of synthesis is done coprecipitation method. For dilution of hydrochloric acid HCl sands (12M), while for the deposition of ammonia filtrate (NH_4OH). The coprecipitated precipitated powder of magnetite powder (Fe_3O_4) by XRD method (X-ray Diffraction) and XRF (X-ray Flourences). The characterization results indicate that the precipitate is identified as magnetite.*

Keywords : *Iron sand, Magnetite, Coprecipitation Method*

Date of Submission: 07-06-2018 Date of acceptance: 26-06-2018

I. Introduction

Iron sand is one of the abundant natural magnetic materials in Indonesia, especially in Lombok Island, which is along the Ampenan coast of Ampenan District. Iron sand which is rich in Fe content is generally oxidized and forms iron oxide, such as Fe_3O_4 magnetite, hematite (α-Fe_2O_3), and maghemit (γ-Fe_2O_3) [9]. But so far the utilization of natural iron sand has not been optimal, that is only limited to be used as a mining material in the absence of processed. In a previous study by Fithriyani [4] explained that the iron sand samples obtained from Ampenan Beach-Lombok contain Fe 69.8%; Si 11.6%; Ti 6.71%; Al 4.49%; Ca 2.08% and other minor components.

Iron sand is one of the most widely used magnetic material in many fields such as electronics, energy, chemistry, ferofluid, catalyst, and medical diagnosis. The application of iron sand was inseparable from the development of studies of nanomaterials demanding that they be in the order of nanometers [8].

Iron contained in iron sand can be diektraski with existing technology at this time and have economic value. Extraction is the process of separating a substance from a mixture so as to separate the Fe metal from its source [2].

Various methods have been carried out in extracting Fe_3O_4 and Fe_2O_3 powders from natural iron sand into nanometer sizes such as Chloride Acid Dissolved Metals Method [6], Solid Reaction [5], Oxidation Prose [7], Mill scale [1].

In this research, iron sand is synthesized through coprecipitation method. Coprecipitation method is one method of nanoparticle synthesis based on precipitation of the substance that is chosen. The choice of coprecipitation method is due to its perosenya using low temperature and easy to control particle size so that the required time is relatively short [3].

In this study characterization of purified natural iron sand, using XRF to reveal the iron sand content and XRD to reveal the phase, structure, and grain size.

II. Experimental

Material

The material used in this research is sand taken from Ampenan Beach –Lombok

Sample Preparation

The sample preparation begins with drying iron sand at a temperature of 100 ℃ to remove water content. Furthermore, the process of separating (extraction) the magnetic material content of the sand using a hard magnet.

Synthesis of Magnetite and Hematite is done by using Coprecipitation Method. The basic ingredients for forming Fe_3O_4 and hematite (α-Fe_2O_3) magnetic materials are natural iron sand, hydrochloric acid (HCL) and ammonia (NH_4OH). These basic ingredients are called percussors. Based on chemical reaction for the manufacture of Fe_3O_4 magnetite and hematite (α-Fe_2O_3) using coprecipitation method can be done as follows:

Disolving Iron Sand

50 Fe of Fe_3O_4 powder was dissolved in HCL (12 M) as much as 100 ml at 70 ℃ and stirred about 30 min with magnetic stirrer.

Reaction equation :

$$3Fe_3O_{4\,(s)} + 8HCl_{(l)} \rightarrow 2FeCl_{3(l)} + FeCl_{3(l)} + 3Fe_3O_{4(s)} + 3H_2O_{(l)} + H_{2(g)}$$

Deposition Filtrate

After the solution is shaped filtered by using filter paper. The result of the filtered solution was filtrate. Then to precipitate the filtrate NH_4OH added as much as 120 ml and allowed to stand for 60 minutes so that the sediment is obtained. The Fe_3O_4 precipitate formed in dark black color is separated from the solution which is then washed by using aquades 3 times so that the results obtained are completely clean.

Reaction equation:

$$2FeCl_{3\,(l)} + FeCl_{2(l)} + H_2O_{(l)} + 8NH_4OH_{(l)} \rightarrow Fe_3O_{4(s)} + 8NH_4Cl_{(l)} + 5H_2O_{(l)}$$

Making Magnetite Nanoparticles (Fe_3O_4)

The subsequent precipitate was heated in an oven with a temperature of 100 ℃ for 4 hours. Furthermore, it was crushed using mortar and formed Fe3O4 hematite powder.

III. Results And Discussion

The analysis carried out in this study begins with a magnetic separation process in natural iron sand in the Ampenan-Lombok Beach area and then on iron sand samples which have been prepared to be separated chemically using coprecipitation method.

Reprinted iron sand is characterized using XRF to determine the iron oxide content and other metal elements therein. The XRF characterization results obtained by chemical element data in natural iron sand as in Table 1.

Table 1. Test results of elemental content and natural iron sand compound with XRF

No	Element	%mass	Compounds	%mass
1	Fe	69,8	Fe_2O_3	60,8
2	Si	11,6	SiO_2	17,8
3	Ti	6,71	TiO_2	7,46
4	Al	4,49	Al_2O_3	6,18
5	Ca	2,08	CaO	1,99
6	Other Elements	<1	Other Compounds	<1,5

Furthermore, iron sand that has been diseparasi through chemical separation process that is by using method of copresipitasi. The results of elemental compositions and compounds are shown in Table 2.

Table 2 Test results of elemental content and natural iron sand compound (Method of Copresipitasi) with XRF

No	Element	%mass	Compounds	%mass
1	Fe	72,06	Fe_2O_3	75,01
2	Cl	22	Cl	17,5
3	Ti	3,16	TiO_2	4,05
4	Ca	1,1	CaO	1,2
5	Mn	0,731	MnO	0,691
6	Other Elements	<0,5	Other Compounds	<0,5

Characterization results using XRF showed that the metal content of natural iron sand in Ampenen-Lombok Beach was dominated by Fe metal with presentation of 69.8% element composition. Then followed by Si metal exposure of 11.6%. For Fe_2O_3 compounds prior to the chemical separation process (Coprecipitation Method) has a 60.8% content presentation. Furthermore, the natural iron sand samples that have been synthesized based on quantitative data results show that the Fe metal element increased to 72.06%. Followed by an increase of Fe_2O_3 compounds by 75.01%. While the Si and SiO_2 compounds are not visible. Then after going through the process of oxidation showed an increase in the presentation of Fe metal content elements and Fe_2O_3 compounds of 90.02% and 87.99%. This indicates that in this process has formed Hematite (α-Fe_2O_3).

The result of identification of chemical compound of iron sand sample which has been through chemical process that is coprecipitation method shows that the highest peak at 2θ angle can be indicated as magnetite (Fe3O4). With magnetite presentations of 28.7% and hematite of 71.3% as shown in Figure 1.

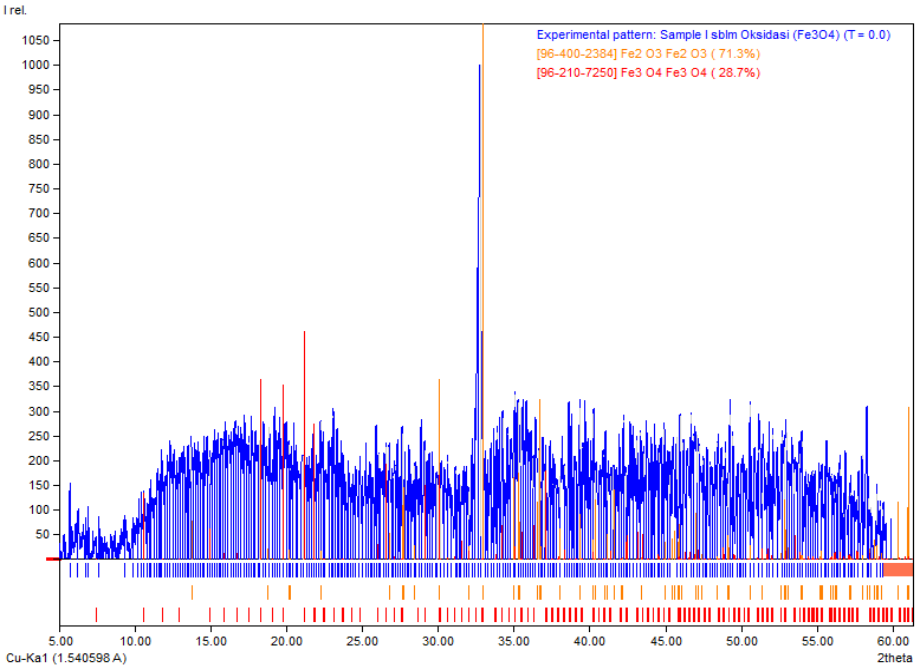

Figure 1. XRD result of iron sand Coprecipitation Method

IV. Conclusion

Based on the results of the description and discussion that have been described, it can be concluded that the Magnetite (Fe_3O_4) have been synthesized from the natural sand material of Ampenan-Lombok Beach using the method of Copresipitasi.

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IOSR Journal of Applied Physics (IOSR-JAP) (IOSR-JAP) is UGC approved Journal with Sl. No. 5010, Journal no. 49054.

Andimutiafitri " Synthesis of Magnetite Based Iron Sand By Using Coprecipitationmethod." IOSR Journal of Applied Physics (IOSR-JAP) , vol. 10, no. 3, 2018, pp. 40-42.