The Feasibility Test of Physical and Chemical Properties Of Muaro Binguang Pasaman Barat Iron Sand For Semen Padang

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Abstract. The purpose of this study was to examine the physical and chemical feasibility of iron sand on the west coast of Muaro Bingguang west Pasaman. This research needs to be done because the west coast of the island of Sumatra is known to be rich in iron sand and Semen Padang as a large company in West Sumatra needs iron sand to mix its cement. Test physical properties by calculating specific gravity, determine the characteristics of iron sand, and susceptibility of iron sand magnets. 5 sample bags were taken at coordinates S004°46.49"E99°46'6.33", S005°8.93"E99°46'2.34", S007°39.40"E99°45'25.60", S008°20.60"E99°44'55.5", and S008°39.00"E99°44'55.4". While the chemical feasibility test is done by testing the sample using XRF. The results of this study obtained, the average iron sand density of 2.99-4.23, iron sand including superparamagnetic with magnetic susceptibility 4.947 x10^-6m³kg^-1– 14,946 x10^-6m³kg^-1. Based on XRF analysis, iron sand is in accordance with Padang's cement needs in making portland cement Fe2O3 = 10% - 35% and TiO2 = 1% - 3%.

Key words: iron sand, specific gravity, susceptibility, superparamagnetic, pasaman west coast

1. Introduction
PT. Semen Padang is one of the companies located in West Sumatra that requires iron sand as a raw material in making cement. PT. Semen Padang still brings iron sand from the Java region, if the sea wave season is large, shipping will be constrained and production costs will be greater. West Sumatra has abundant natural resources, but many of these natural resources have not been processed and utilized optimally. One of the abundant wealth is iron sand which is found in the west coast of Sumatra island such as in Pariaman.

The potential and distribution of iron sand are often found in various regions in Indonesia such as: West Coast of Sumatra, South Coast of Java, Kalimantan, Sulawesi, Nusa Tenggara, Maluku Islands and Papua. Iron sand deposits are sourced from volcanic rocks. The distribution of volcanoes in Indonesia is in the western part of the island of Sumatra and the southern part of the island of Java. So that more iron sand is found on the southern coast of Java and the western coast of Sumatra. This is because the material that is transported in the southern part of the island of Sumatra and the south of the island of Java experiences transportation that is closer in distance. Meanwhile, in the eastern part of the island of Sumatra and the northern part of Java, the distance of material transportation from volcanic eruptions tends to be further. Thus, material from the source origin has been used up first during the transportation process.
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Previous research at Pasir Paneh beach, Tiku District, iron sand reserves were at a depth of 0-20 m with a horizontal distance perpendicular to the beach 100-130 m [2]. Pasaman Beach area adjacent to Pariaman beach which is also the west coast of Sumatra has not been examined the quality and distribution of iron sand. So this research aims to reveal the feasibility of the iron sand beach Kinali Pasaman to meet the needs of Semen Padang.

2. Cement materials

Iron sand is one of the minerals from the iron ore group, a kind of dark colored sand containing iron ore particles (magnetite) found along the coast. Generally, iron sand consists of opaque minerals that have been mixed with granules of non-metallic minerals, such as quartz, calcite, feldspar, pyroxene and biotite. Opaque minerals contained in iron sand include magnetite, titaniferous magnetite, ilmenite, limonite and hematite.

Iron sand in Indonesia is one of the basic raw materials in the steel industry. In addition, iron sand can also be used as a raw material for the cement industry in the manufacture of concrete, basic ingredients for dry ink (toner), the main material for cassette tapes, dyes and mixes (filters) for paints and basic materials for the permanent magnet industry [3].

Cement (cement) is the industrial product of the raw material alloy: limestone as the main ingredient and clay or iron sand with the final result in the form of powder / bulk solids, regardless of the manufacturing process, which hardens or helps in mixing with water. Limestone is a natural material containing Calcium Oxide (CaO), clay is a natural material containing compounds: Silica Oxide (SiO2), Aluminum Oxide (Al2O3), Iron Oxide (Fe2O3) and Magnesium Oxide (MgO). Whereas iron sand is a natural material containing compounds (Fe2O3) to produce cement, the raw material is burned until it melts, partly to form its clinker, which is then crushed and added to the gypsum in the appropriate amount.

Portland cement is one of the hydraulic cement. Hydraulic cement is cement that can harden in water to produce stable solids in water. Portland cement is a hydraulic adhesive produced from milling clinker with its main ingredient, Calcium Silicate (CaSiO2), and one or two Calcium Sulfate (CaSO4) ingredients as additives. In accordance with its function, raw materials in the cement industry are divided into three groups namely [4]:

a. The main raw materials (Raw Materials), namely Limestone and Clay because they contain calcareous minerals (CaCO3 > 75%) and argillaceous minerals (CaCO3 < 75%) present or in the form of CaO. In limestone cement mixture has a composition of 70% - 75% and Claystone 15% - 20%.

b. Corrective Materials

Corrective materials for making cement are sand iron (Fe2O3) and quartz sand (SiO2). The composition for the cement mixture of these two ingredients includes minor elements because they are the smallest. Quartz sand has a composition of 0.5% - 1.0% while 0.0% - 0.5% iron sand of the whole cement mixture.

c. Additive Materials

An additional ingredient, gypsum, which is added when cement is in progress, is mixed in the clinker or added to the raw-mix. Gypsum composition in cement is around 4% -6% of the total cementitious material and this material can contain sulfate (SO4).
The raw materials for cement have different compositions for the manufacture of portland cement, as well as the elemental content of each raw material is also different from each other, and in general the composition of cement-forming materials are as follows: Limestone = 70% - 75%, Claystone = 15 % - 20%, Gypsum = 4% - 6%, Quartz Sand = 0.5% - 1%, and Iron Sand = 0.0% - 0.5%. For portland cement raw material the composition of iron sand must meet the following criteria: SiO2 = 30% - 45%, Fe2O3 = 20% - 35%, TiO2 = 1% - 3%, CaO = 7% - 10%, and H2O = 0% - 1%

3. Research Methods
The study began by reading literature and surveys to the Pasaman area. In Kinali Pasaman area, the beach looks rather blackened and used as a research location.

Research procedure:

a. Taking a sample at a predetermined location, namely the coordinates: S004 '46,49 "E99046'6,33"; S005'8,93 "E99046'2,34"; S007'39,40 "E99045'25,60"; and S008 '20,60 "E99044 '55,5" and S008 '39.00 "T99044'55.4".

![Figure 1. Sampling](image)

b. Sample preparation conducted at the UNP Mining Engineering laboratory. Sample preparation uses a 4x4 matrix. This preparation is important to do to divide the sample in accordance with the test to be carried out and the sample taking to be representative.

c. Testing the sample to eliminate the moisture content, so that the magnetic susceptibility test can be performed.

d. The sample that has been woven, is used for analysis of physical properties (specific gravity and magnetic susceptibility) and is used for chemical analysis with XRF. XRF analysis is carried out in the Chemistry laboratory

e. Analyzing the results of the study whether it meets the criteria needed by Padang cement or not.

4. Result and Discussion

4.1. Magnetic Susceptibility
Measurement of magnetic susceptibility using Bartington MS2 Magnetic Susceptibility meters. Measurements were carried out at the Physics Laboratory FMIPA UNP.
From the measurement results above, it was obtained that sample 4 had a higher susceptibility compared to other samples. Based on the results of $\chi_{LF}$ the data above shows the obtained iron sand has a value of $4.947 \times 10^{-6} \text{m}^3\text{kg}^{-1}$ is a topsoils and ultrabasic rock which is magnetic (superparamagnetic) [8] according to the graph provided by Dearing.

4.2. Analysis of Mineral Contains Iron Sand

XRF measurements were carried out in the Physics laboratory FMIPA Universitas Negeri Padang. The XRF results provide the following data:

| Element/Mineral | Sample 1 (%) | Sample 2 (%) | Sample 3 (%) | Sample 4 (%) | Sample 5 (%) |
|-----------------|--------------|--------------|--------------|--------------|--------------|
| Fe              | 16.171       | 10.199       | 18.083       | 40.78        | 15.874       |
| $\text{Al}_2\text{O}_3$ | 14.38        | 14.794       | 13.97        | 6.581        | 17.311       |
| Fe$_2$O$_3$     | 9.998        | 5.535        | 10.81        | 34.202       | 9.623        |
| CaO             | 6.521        | 5.601        | 6.726        | 12.231       | 6.813        |
| MgO             | 2.591        | 1.507        | 3.708        | 2.45         | 2.098        |
| SiO$_2$         | 51.464       | 66.016       | 58.185       | 23.475       | 51.204       |
| TiO$_2$         | 0.783        | 0.424        | 0.683        | 4.016        | 1.118        |
| P2O$_5$         | 5.299        | 3.272        | 2.953        | 8.376        | 6.634        |

If we see from sample 4, the mineral content of iron sand has the same characteristics as the requirement for making Portland cement. SiO$_2$ 23%, Fe$_2$O$_3$ 34%, CaO 12% and TiO$_2$ 4%. The relationship between magnetic susceptibility and Fe$_2$O$_3$ mineral content can be seen in the following graph.
Figure 2. Relationship of Susceptibility with Fe2O3 mineral content

From the graph obtained, sample 4 has high susceptibility and high Fe and Fe2O3 content. This shows that the presence of high Fe content makes the mineral higher the magnetic susceptibility. When associated with minerals (Fe2O3) is a paramagnetic mineral, in contrast to ferromagnetic Fe3O4.

5. Conclusion

The conclusion is: 1) The iron sand area of Muaro Binguang has a magnetic susceptibility of 500 x10-8m3kg⁻¹ to 2,640 x10-8m3kg, 2) The mineral content of Fe2O3 is in the range of 6% -34%, so this criterion can be used as a corrective material for making Portland cement in Semen Padang, 3) The highest susceptibility of magnets and Fe2O3 content was found in sample 4 which was at coordinates S008°20.60 'T99044 '55.5". So that further investigations need to be done to see the distribution area to describe the iron sand resources they have dan 4) The susceptibility of the iron sand obtained is smaller than the research in Sunur Beach, and Masang Pariaman Beach, and Arta Beach [5]. Magnetic susceptibility is the ratio of the induced magnetic field strength in a sample to the given external magnetic field [6]. The sample susceptibility of 4 (four) is higher because it has a lot of magnetic minerals and has a finer grain size.

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