Analysis Magnetic Mineral Content of Natural Iron Sand in Beach Island Lombok as Basic Materials of Micro Wave Absorbers

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Abstract: This study aims to analyze the content of the magnetic mineral compound of natural iron sand on the beach of Lombok Island. This study uses the experimental method by taking primary data which is carried out in three locations, namely at Ijobalit Beach (East Lombok), Cemara Beach (West Lombok), and Telindung Beach (East Lombok). The study stage begins with a separation of natural iron sand, then a magnetic mineral separation is carried out to obtain Fe_3O_4 powder. The last stage is testing the Fe content using AAS (atomic absorption spectrophotometry). The research results were obtained by the percentage of magnetic mineral content from Ijobalit beach sand, Cemara Beach, and Telindung Beach respectively 93.56, 72.99, and 87.00%. The results showed that natural iron sand from Ijobalit beach had great potential to be used as a basic material for making microwave absorbers.

Keywords: Magnetic mineral; Microwaves; Natural iron sand.

Introduction

West Nusa Tenggara Province has various tourist destinations. Lombok Island is one of the tourist destinations located in West Nusa Tenggara Province. Lombok Island is an island that has a fairly long coastline, which is 2,333 km so Lombok Island has quite a lot of beach tourism destinations (Susilawati et al, 2018).

Lombok Island has a variety of sand colors caused by geological activity (Doyan et al, 2015). The difference in the sand is spread throughout the island, starting from the dark in the northern part of the island, to white in the southern part (Doyan et al, 2020). Coastal sand is often found in the coastal area of the island, but its processing is still rarely used in the field of infrastructure development because it has the characteristics of grains that are fine and rounded, have a large grain, and contain salt (Elinda et al, 2022).

Iron sand is sand mixed with fine iron ores resembling sand found in nature (Susilawati et al, 2015). Iron sand is usually dark gray or black (Susilawati et al, 2019). Some beaches on Lombok island have black

characteristics, such as Ijobalit Beach in East Lombok, Cemara in West Lombok, and Telidung in East Lombok. The black color of the beach sand is thought to be caused by the percentage of high natural iron sand content (Hambali et al, 2021).

Iron sand has ferromagnetic properties with magnetic minerals contained such as magnetite, hematite, and maghemite (Susilawati et al, 2017). In addition, there are also non-magnetic in iron sand such as silicon oxide which affects its magnetic nature (Fatimah et al, 2022; Susilawati et al, 2022). Iron sand which has a high magnetite content (Fe_3O_4) will provide strong magnetic properties, while sand that has many minerals such as K, C, Na, Mg, Si, and Ca decreases the magnetic nature contained in the sand (Khaerunnisa et al, 2018; Sahlam et al, 2018).

Magnetic minerals such as Fe_2O_3 (hematite) and Fe_3O_4 (magnetite) in iron sand have great potential to be developed as industrial materials such as iron, steel, and other industries. That's because magnetic minerals have been widely used for the permanent magnetic industry and coloring and mixtures for paint. Magnetite itself is currently used as a basic material for dry ink (toner) on

photocopy machines and laser printers, while maghemite is the main material for making cassette bands (Hambali et al, 2021). The number of communication devices causes increased sources of radiation in the form of microwave exposure so that electronic devices with materials that are unable to absorb microwave exposure will easily experience system disorders (Ramadan et al, 2018; Susilawati et al, 2020).

Iron Sand (Fe_3O_4) Nano-sized has a wide opportunity for utilization. At present, the need to use electronic devices is increasing. For this reason, iron sand (Fe_3O_4) can be an alternative to meeting the needs of industrial raw materials in the electronics field. In addition, magnetic minerals in iron sand (Fe_3O_4) can be used as a material to absorb microwaves. This is in line with research conducted by Yunasfi et al (2018) and Susilawati et al (2021) which produce compounds in the form of composite with an increase in the content of (Fe_3O_4) which can be applied as an absorbent of microwaves.

Seniari et al (2020) state that microwave radiation on cellphones can cause impacts such as mild vertigo and chronic fatigue syndrome to severe impacts such as insomnia, leukemia, to breast cancer. Therefore, microwave absorption technology is needed. One of the studies in the field of science and technology that developed at the end of this decade answered the problem, namely research on magnetic material (Doyan et al, 2015).

Previous studies have identified the Fe content of natural iron sands in Mataram City, showing that the percentage of Fe content in natural sands in Gading beach, Loang Baloq beach, Penghulu Agung beach, and Ampenan beach were 73.4, 62.1, 76.8, and 69.8% (Susilawati et al, 2018). This research is further research on different beaches and districts on Lombok island.

Based on the description above, this study aims to analyze the content of natural sand magnetic mineral compounds on the beach of Lombok Island (Ijobalit Beach in East Lombok, Cemara in West Lombok, and Telidung in East Lombok). This study was directed to maximize the utilization of natural iron sand contained in an abundant manner on the coast of Lombok Island.

Through this research, the authors are expected to benefit in the form of natural iron sand data Lombok Island which has the greatest potential to be used as a basic material for making microwave absorbers. This research is a solution to making economical micro-wave absorbers by utilizing natural potential in the surrounding environment.

Method

This study uses an experimental method by taking primary data carried out in three different locations on

Lombok Island, namely Ijobalit beach (East Lombok), Cemara beach (West Lombok), and Telindung beach (East Lombok). The basic ingredients used in this study are natural sand taken from Ijobalit beach, Cemara beach, and Telindung beach. The sample preparation process was carried out at the Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Mataram University.
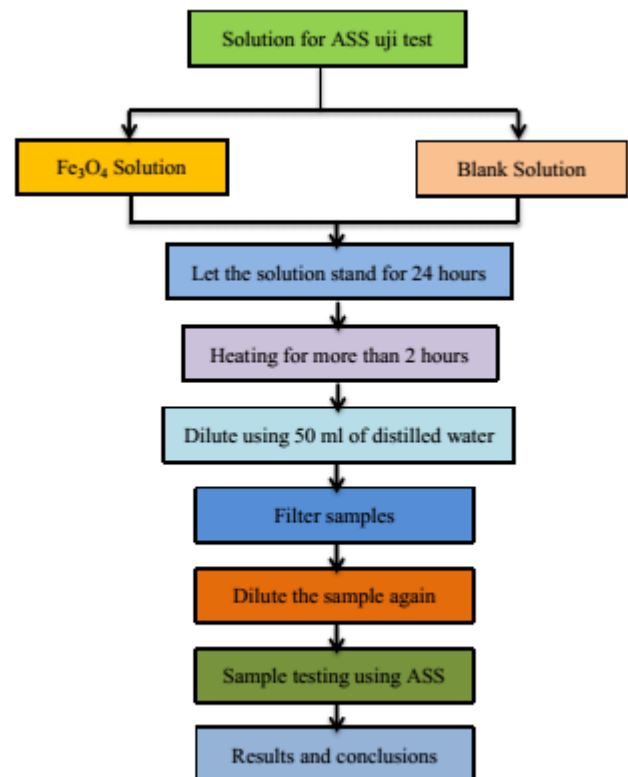

Figure 1. The process of testing the Fe metal content using ASS.

Data collection in this study begins with a separation of natural sand. Separation is done by bringing a permanent magnet closer to natural sand that had previously been dried and sifted. Iron sand attached to the magnet is sand that contains magnetic minerals in it. The percentage of magnetic minerals contained in natural sand can be calculated using equation 1 (Rozi et al, 2015).

$$P\ (\%) = \frac{M\ (gram)}{m\ (gram)} x100\% \qquad (1)$$

Where P is the percentage of magnetic minerals, M is the mass of magnetic minerals, and m is the mass of natural sand.

Furthermore, a separation between magnetic minerals with sand has been paraded to get Fe_3O_4 powder through a series of activities in the laboratory. Furthermore, testing the Fe metal content using atomic absorption spectrophotometry (AAS) at the Health

Laboratory Center for Testing and Calibration, Mataram to determine the percentage of Fe metal content in natural iron sand. The process of testing the Fe metal content using ASS is shown in Figure 1.

Result and Discussion

Natural iron sand on the beach of Lombok Island contains magnetic minerals. Magnetic minerals are obtained through the stages of natural sand separation. This separation stage is carried out by bringing a permanent magnet closer to the sand. Iron sand attached to the magnet is sand that contains magnetic minerals in it. The results of calculation of the percentage of mineral magnetic sand of natural iron are calculated using equation 1 and the results are obtained as in Table 1.

Table 1. Percentage of magnetic minerals in each location.

Sample Location	Natural Sand (gram)	Magnetic Minerals (gram)	Magnetic Mineral Percentage
Ijobalit Beach	50.00	46.78	93.56 %
Cemara Beach	274.62	200.46	72.99 %
Telindung Beach	50.00	43.50	87.00 %

Data in table 1 shows that from 50.00 grams of natural iron sand Ijobalit beach and Telindung Beach contain magnetic minerals of 46.78 grams or 93.56 % and 43.50 grams or 87.00 % respectively. Meanwhile, on Cemara Beach a natural iron sand sample of 274.62 grams obtained magnetic minerals of 200.46 grams or 72.99 %. The percentage of the data indicates the number of magnetic minerals on natural sand on the beach located on the island of Lombok. The high percentage produced indicates that in natural sand there is a magnetic mineral characterized by black sand and attached to a permanent magnet when defeated (Susilawati et al, 2022). This shows that the more magnetic minerals from natural sand attached to a permanent magnet, the more magnetic minerals are contained (Hambali et al, 2021).

Figure 2. Fe$_3$O$_4$ Powder from Ijobalit Beach.

Figure 3. Fe$_3$O$_4$ powder from Cemara Beach.

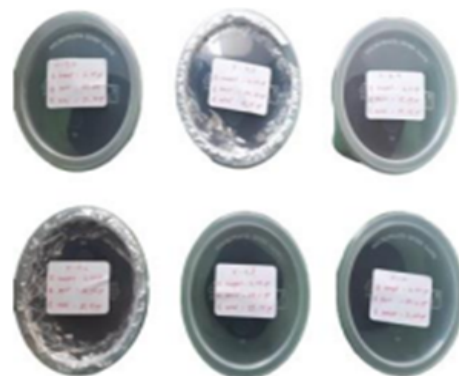**Figure 4**. Fe$_3$O$_4$ powder from Telindung Beach.

After that, a separation between magnetic minerals with sand has been paraded to get Fe$_3$O$_4$ (magnetite) powder. The results of the separation (Figures 2, 3, and 4) have high magnetic properties so that they are widely used as material for absorbing good microwaves (Doyan et al, 2020).

Magnetic minerals that have been obtained from natural sand are then analyzed in the iron metal content (Fe). Analysis of the Fe metal content is carried out using AAS based on the law of lambert-beer, which is the amount of light absorbed directly proportional to the level of substances. Because those who absorb light are atoms, Fe metal ions must be converted into an atomic shape. The sample solution is then put into a test tube available on the AAS tool. Furthermore, settings on the computer, turn on the fire and cathode lights, and the position of the lamp is set to get the maximum absorption. Atomic absorption measurements are recorded and obtained results are in Table 2.

Table 2. The content of Fe and Magnetic Minerals in each location.

Sample Location	Fe content (mg/L)
Ijobalit Beach Sand	1,495.0
Cemara Beach Sand	2,587.5
Telindung Beach Sand	1,091.0

Based on the results in Table 2, Cemara Beach has the highest Fe metal content compared to Ijobalit Beach

and Telindung Beach which is 2,587.5 mg/L. That is, in 1 liter of magnetic mineral solution on Cemara Beach there are 2,587.5 Metal Fe. Meanwhile, the lowest Fe metal content is found on Telindung Beach, which is 1,091.0 mg/L.

Conclusion

Based on research that has been done, the percentage of magnetic mineral content from Ijobalit, Cemara, and telindung beaches is 93.56, 72.99, and 87.00%. From this data, it can be seen that natural iron sand on ijobalit beach has a great potential to be used as a basic material for making microwave absorbers due to the highest percentage of magnetic mineral content.

Acknowledgements

References

Doyan, A., Khalilurrahman, K., & Susilawati, S. (2015). Sintesis dan Uji FTIR Barium M-Hexaferrite dengan Doping Logam Mn. *Jurnal Pendidikan Fisika dan Teknologi*, 1(4), 235-238. https://doi.org/10.29303/jpft.v1i4.264

Doyan, A., Susilawati, Taufik, M., & Wahyudi. (2020). Electrical properties of M-type barium hexaferrites (BaFe12ZnMnO19). In *AIP Conference Proceedings*, 2251(1), 040043. https://doi.org/10.1063/5.0015695

Elinda, B. U. P., Susilawati, Kosim, & Doyan, A. (2022). Synthesis BaFe12O19 based on natural iron sand with Cu and Ni doping using coprecipitation method. In *Journal of Physics: Conference Series*, 2165(1), 012008. https://doi.org/10.1088/1742-6596/2165/1/012008

Fatimah, Z., Susilawati, & Doyan, A. (2022). The process of making BaM (BaFe12O19) samples based on natural iron sand doped with metal (Co-Cu-Zn) using the coprecipitation method. In *Journal of Physics: Conference Series*, 2165 (1), 012007. https://doi.org/10.1088/1742-6596/2165/1/012007

Hambali, S., & Doyan, A. (2021). Synthesis and Characterization Barium M-Hexaferrites (BaFe12-2xCoxMnxNixO19) as a Microwave Absorbent Material. In *Solid State Phenomena*, 317, 46-52. Retrieved from

https://doi.org/10.4028/www.scientific.net/SSP.317.46

Khaerunnisa, K., Susilawati, S., Savalas, L. R. T., Taufik, M., & Wahyudi, W. (2018). Sintesis Bahan M-Hexaferrites Dengan Doping Logam Co Menggunakan Metode Kopresipitasi. *Jurnal Penelitian Pendidikan IPA*, 4(1). https://doi.org/10.29303/jppipa.v4i1.112

Rozi, F., & Budiman, A. (2015). Pengaruh Variasi Temperatur Terhadap Bentuk Bulir Mineral Magnetik Pasir Besi. *Jurnal Fisika Unand*, 4(2). https://doi.org/10.25077/jfu.4.2.%25p.2015

Sahlam, S., Doyan, A., & Susilawati, S. (2018). Sintesis Bahan M-Heksaferit Substitusi Logam Kobalt-Mangan dengan Metode Kopresipitasi. *Jurnal IPA & Pembelajaran IPA*, 2(2), 64-68. https://doi.org/10.24815/jipi.v2i2.12073

Seniari, N. M., & Baus Widhi Darma, S. (2020). Penyuluhan Bahaya Radiasi Gelombang Elektromagnetik Pada Organ Tubuh Mahluk Hidup di Kelurahan Pagutan Barat Mataram. *Prosiding Pepadu*, 2, 230-235.

Susilawati, & Doyan, A. (2021). Characteristics of Barium M-Hexaferrite with Doping Mn and Ni in X-Band Frequency for Microwave Absorption. In *Materials Science Forum*, 1028, 32-37. https://doi.org/10.4028/www.scientific.net/MSF.1028.32

Susilawati, Doyan, A., & Khalilurrahman. (2017). Synthesis and characterization of barium hexaferrite with manganese (Mn) doping material as anti-radar. In *AIP Conference Proceedings*, 1801 (1), 040007. https://doi.org/10.1063/1.4973096

Susilawati, Doyan, A., Khair, H., Taufik, M., & Wahyudi. (2018). Electrical, Magnetic and Microwave Absorption Properties of M-type Barium Hexaferrites (BaFe12-2x CoxNixO19). In *Journal of Physics: Conference Series*, 1011 (1), 012009. http://dx.doi.org/10.1088/1742-6596/1011/1/012009

Susilawati, Doyan, A., Taufik, M., & Wahyudi. (2018). Synthesis and Characterization of Barium M-Hexaferrite with Metal Doping Mn and Ni for Microwaves Absorbent. In *Journal of Physics: Conference Series*, 1120 (1), 012002. https://doi.org/10.1088/1742-6596/1120/1/012002

Susilawati, Doyan, A., Taufik, M., & Wahyudi. (2020). The structure of barium M-hexaferrite (BaFe12-2xCoxNixO19) powders using co-precipitation methods. In *AIP conference proceedings*, 2251 (1), 040028. https://doi.org/10.1063/5.0015750

Susilawati, Doyan, A., Taufik, M., & Wahyudi. (2020). The structure of barium M-hexaferrite (BaFe12-2xCoxNixO19) powders using co-precipitation

methods. In *AIP conference proceedings*, 2251 (1), 040028. https://doi.org/10.1063/5.0015750

Susilawati, Doyan, A., Taufik, M., & Wahyudi. (2020). The structure of barium M-hexaferrite (BaFe12-2xCoxNixO19) powders using co-precipitation methods. In *AIP conference proceedings*, 2251 (1), 040028. https://doi.org/10.1063/5.0015750

Susilawati, Doyan, A., Taufik, M., Gunawan, E. R., Fitriani, A., & Nazarudin. (2019). Characterization of Barium M-Hexaferrite with Doping Zn and Mn for Microwaves Absorbent. In *Materials Science Forum*, 966, 282-289. https://doi.org/10.4028/www.scientific.net/MSF.966.282

Susilawati, Fatari, H. A., Doyan, A., Makhrus, M., & Taryana, Y. (2022). Synthesis of BaFe12-xCrxMnxO19 material based on Telindung beach iron sand using coprecipitation method. In *Journal of Physics: Conference Series*, 2165 (1), 012006. https://doi.org/10.1088/1742-6596/2165/1/012006

Susilawati, S., Doyan, A., & Muliyadi, L. (2021). Synthesis of M-Hexaferrites Material Based on Natural Iron Sand with Metal Co Doping Using the Coprecipitation Method. *Jurnal Penelitian Pendidikan IPA*, 7(1), 1-4. https://doi.org/10.29303/jppipa.v7i1.461

Susilawati, S., Khairunnisa, K., & Doyan, A. (2015). Sintesis Bahan M-Hexaferrites dengan Doping Logam Co Menggunakan FTIR. *Jurnal Pendidikan Fisika dan Teknologi*, 1(3), 180-184. https://doi.org/10.29303/jpft.v1i3.256

Susilawati, S., Munib, M., & Doyan, A. (2015). Pengaruh Temperatur Kalsinasi Dan Subsitusi Logam Nikel Pada Pembentukan Fasa Barium M-Hexaferritte (BaFe12-xNixO19) Menggunakan FTIR. *Jurnal Pijar Mipa*, 10(1).https://doi.org/10.29303/jpm.v10i1.14