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Synthesis of Magnetic Nanosilica Material Based on River Sand to Improve Water Quality

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Abstract

Research has been carried out on the synthesis of river sand-based nanosilica magnetic material to improve water quality by utilizing iron sand taken from four rivers in the Lombok island region as a natural material for the water filtration process; this study aims to determine whether the iron sand nanosilica magnetic material able to improve the quality of healthy water or not. This study uses an experimental method where iron sand has gone through the co-precipitation process and the water quality parameters measured are temperature, pH, and conductivity. The measurement results showed that after mixing with iron sand, healthy water decreased temperature and conductivity parameters and increased pH parameters. Of the three parameters, only one does not meet the water quality standard requirements, namely the pH value before being mixed with iron sand, below the standard of 6.32. However, water to combined with the four samples of river iron sand. The pH value increased to 7.99, 7.85, 7.75, and 8.00 so that it was able to meet water quality standards for pH parameters.

INTRODUCTION

Magnetic material is a material that has magnetic properties in its formation [1]. In addition, the magnetic material can be found in iron sand. Iron sand is a magnetic material that has many uses. Iron sand is generally synthesized as an additional ingredient for cement and steel, which can be used in nanotechnology. Iron sand is found on beaches or rivers. Iron sand deposits in Indonesia are scattered along the coasts of Sumatra, Java, the Lesser Sunda Islands, Sulawesi, West Nusa Tenggara, and the Maluku islands. Iron sand from beaches and rivers contains iron such as hematite (Fe_2O_3) and magnetite (Fe_3O_4) oxides, as well as other compounds such as Fe, Zn and Ni, and Titanium [6]–[8].

So far, residents have taken sand from the river to sell it as building materials at relatively low prices. Even though there are many uses for iron sand, iron sand can be used as a microwave absorption material because it contains iron oxide (Fe_2O_3 and Fe_3O_4) [9] and silica oxide (SiO2) as well as other compounds such as Fe, Ni, and Zn in small amounts [7], [10], [11]. Iron sand also has the potential to be a carrier or as a binder to improve the quality of a material, such as manganese dioxide (MnO2) adsorbent, which is widely used for water remediation processes from heavy metals and non-metallic waste [12]. The content of iron oxide in iron sand, which has a relatively high level of stability, can be used as a matrix to immobilize MnO_2 [13]. Manganese dioxide that has immobilized in iron sand will increase its strength and ability to reduce pollutants so that it will be able to reduce pollutant levels that destroy the balance of the aquatic environment. [14], [15].

Many studies on iron sand carried out on river iron sand, such as iron sand in the Brantas river and iron sand in the Boli Kiba river in West Kalimantan, as well as beach sand and river sand in the

Ketapang and Sungai beaches in the Pringgabaya area [16]. This research was conducted to identify the content of iron sand and to determine the mineral content in river iron sand to reduce the levels of phosphate ions in the water and to analyze the ratio of iron content in beach and river sand [4].

Based on previous research, several studies of iron sand have been carried out on beaches and rivers. However, research on the content of river iron sand has not found it is used to improve water quality. So this research aims to determine whether the iron sand nanosilica magnetic material can improve healthy water quality.

RESEARCH METHODS

This research was conducted by analyzing iron sand in several rivers on the island of Lombok, including the Thread Stokel River and waterfall in Central Lombok Regency, the Company River in East Lombok Regency, the Sokong River in North Lombok Regency and the Kokoq Babak River in West Lombok Regency. Meanwhile, the healthy water quality tested is well water around the Kebon Kongok TPA, West Lombok [17].

The research method used is the co-precipitation method, in which the sample preparation stage is carried out at the Physics Laboratory of UIN Mataram by exposing the sand to the sun for four days [18]. After drying, the samples were separated from the impurities using a 200 mesh sieve and a permanent magnet and then washed again using distilled water.

The stages of sample measurement using the co-precipitation method were carried out at the Mandalika University Science Laboratory by dissolving 10 g of iron sand in 20 ml of 12 M HCL using a magnetic stirrer and precipitating with 25 ml of 6.5 M NH_4OH solution each for 1 hour.

The precipitated sand was then washed with distilled water and heated in an oven at 100 ° C for 2 hours. After that, the Kebon Kongok TPA well water quality was measured using heated iron sand. The healthy water quality parameters measured included temperature, pH, and conductivity using the COM-600 Water Quality Tester [19]. The data obtained will be analyzed descriptively and presented in tables and diagrams.

RESULTS AND DISCUSSION

Determine the quality of the measured healthy water. Nutritional water quality parameters were measured before and after mixing with iron sand, which had been synthesized using the co-precipitation method. To compare whether there is a significant difference in water quality caused by adding magnetic material to healthy water. Water quality parameters measured include temperature, pH, and conductivity. Will be presented in table 1.

Table 1. Measurement of Water Quality Parameters Before Mixing with the Results of the Synthesis of Magnetic Material Nanosilika River Sand

Water Quality Parameters		
Temperature (° C)	**pH**	**Conductivity (µS/cm)**
29.3 °C	6.32	2000

Table 2. Measurement of Water Quality Parameters After Mixing with the Synthesis Results of River Sand Nanosilica Magnetic Materials

Water Quality Parameters			**Iron Sand Sampling Location**
Temperature (° C)	**pH**	**Conductivity (µS/cm)**	
27.8 °C	7.99	1295 µS/cm	Stokel Thread River
28.0 °C	7.85	1211 µS/cm	Sompang River

28.0 °C	7.75	1246 µS/cm	Support River
27.6 °C	8.00	1041 µS/cm	The Kokoq Babak River

To live a healthy life, humans need water that must meet the quality and quantity requirements (amount). Based on the quality aspect, clean water can be considered suitable for use if it meets the physical, chemical, and microbiological requirements. For physical conditions, among other things, the water must be clean, colorless, not cloudy, odorless, tasteless, have a temperature that does not differ from air temperature or more than 30 ^{0} C, and not leave sediment and the pH value of the water ranges from 6.5 -8.5. The existence of sewage will undoubtedly reduce the quality of water. One of them is leachate waste which can be found around the TPA and has a high organic matter content, so it is feared that it will reduce the water quality in the area there.

The addition of magnetic material hoped to improve the quality of healthy water around the Kebon Kongok TPA. Nanosilica magnetic material can be used as a water filtration material to enhance water quality. Table 1, it that the temperature of the water mixed was 29.3 °C and in table 2, the temperature of the water after being mixed with magnetic material in several rivers was 27.8 °C, 28.0 °C, and 27.6 °C respectively. Before and after mixing the magnetic material, healthy water quality is still within the safe limits set by Permenkes No. 32 of 2017, namely ± 3°C [20]. The urgency of temperature in measuring this water quality parameter is that temperature affects oxygen solubility; the higher the temperature, the decreased the temperature level [17], [21].

As for the pH value, it can seen in table 1 where the degree of acidity before the addition of iron sand magnetic material was 6.32, and after the addition of magnetic material, the degree of acidity was 7.99, 7.85, 7.75, and 8.00 respectively. The measurement results show that changes in the pH value tend to be close to normal. The difference in the pH value indicates that healthy water quality is still within the predetermined threshold [19].

The conductivity value before adding nanosilica magnetic material shows in table 1 of 2000 µS/cm. In comparison, the conductivity values after being mixed with nanosilica magnetic material were respectively 1295 µS/cm, 1211 µS/cm, 1246 µS/cm, and 1041 µS/cm. The results of measuring the conductivity parameter show that healthy water quality is still within the criteria of suitable water for consumption because the threshold is 30-2000 µS/cm [12].

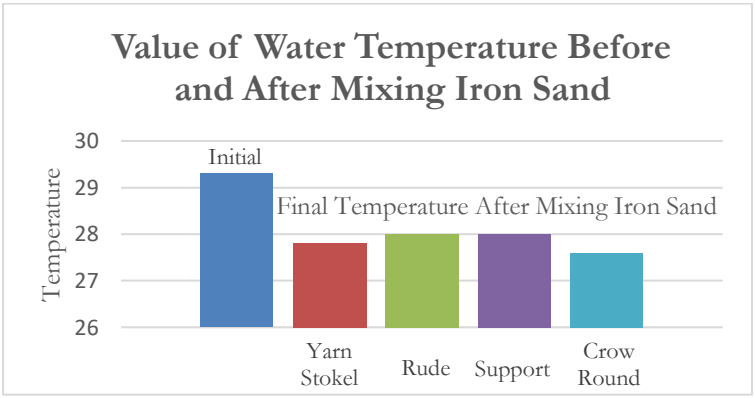

Figure 1. Well Water Temperature Values Before and After Mixing with Iron Sand

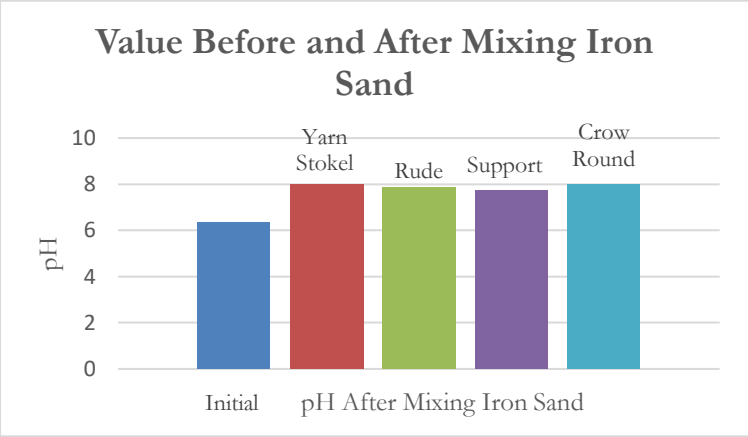

Figure 2. The pH value of healthy water before and after being mixed with iron sand

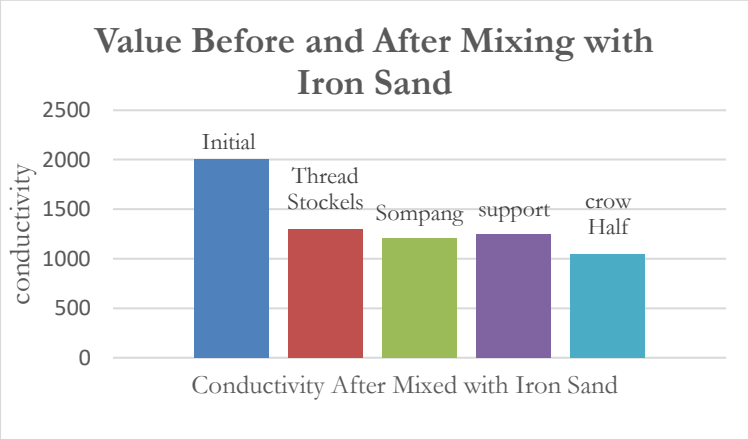

Figure 3. Conductivity Value of Well Water Before and After Mixing with Iron Sand

In figure 3, show the results of measuring the water quality of the Kebon Kongok TPA, before mixing with iron sand show that of the three test parameters pH, and conductivity, Figure 3 where the results obtained show the pH value of healthy water is 6.32 which is less than the standard requirements for the pH parameter values ranging from 6.5 to 9.0. Meanwhile, the results of measuring the water quality of the Kebon Kongok TPA well after being mixed with the four river iron sand samples showed that of the three test parameters, namely temperature, pH, and conductivity parameters, all of them were able to meet the criteria for water quality standards. The results obtained were that river iron sand was able to increase the pH value of the Kebon Kongok TPA well water, which was previously below par, namely 6.32, then after being mixed with the four samples of river iron sand, it increased so that it was able to meet water quality standards. The parameters for temperature and conductivity in Figure 1 and Figure 2 show changes in values before and after being mixed with iron sand, where the values have decreased and are still within predetermined quality standards.

CONCLUSION

After being mixed with sand iron, Measurement results show healthy water experiences a decline in temperature and conductivity parameters as well as experience increase in pH parameters. Of the three parameters, only one parameter that is not Fulfill the condition of raw water quality, i.e., significant pH value before mixed with sand iron below standard, i.e., 6.32. However, after water combined with the fourth sample sand iron river, the pH value experienced enhancement to 7.99, 7.85, 7.75, and 8.00, capable of fulfilling standard raw water quality for pH parameters.

BIBLIOGRAPHY

[1] A. L. Rettob, "Characterization of iron sand magnetic materials coated with 2-aminobenzimidazole modified silica," *Int. J. Mech. Eng. Technol.*, vol. 10, no. 2, pp. 620–627, 2019.

[2] S. Azizi and N. Shadjou, "Iron oxide (Fe3O4) magnetic nanoparticles supported on wrinkled fibrous nanosilica (WFNS) functionalized by biimidazole ionic liquid as an effective and reusable heterogeneous magnetic nanocatalyst for the efficient synthesis of N-sulfonylamidines," *Heliyon*, vol. 7, p. e05915, 2021, doi: 10.1016/j.heliyon.2021.e05915.

[3] M. Rianna *et al.*, "Characterization of Natural Iron Sand From Kata Beach, West Sumatra With High Energy Milling (Hem)," *J. Nat.*, vol. 18, no. 2, pp. 97–100, 2018, doi: 10.24815/jn.v18i2.11163.

[4] L. A. D. Meiliyadi, M. Wahyudi, I. Damayanti, and A. Fudholi, "Morphological characteristics and electrical properties analysis of silica based on river and coastal iron sand," *J. Ilm. Pendidik. Fis. Al-Biruni*, vol. 11, no. 1, pp. 129–140, 2022, doi: 10.24042/jipfalbiruni.v11i1.12390.

[5] S. Nengsih, "Potensi Nanopartikel Magnetit Pasir Besi Lampanah Aceh Besar Melalui Studi Kajian Teknik Pengolahan, Sintesis Dan Karakteristik Struktur," *CIRCUIT J. Ilm. Pendidik. Tek. Elektro*, vol. 2, no. 1, pp. 1–8, 2018, doi: 10.22373/crc.v2i1.3246.

[6] L. A. Didik and M. Wahyudi, "Analisa Kandungan Fe dan Karakteristik Sifat Listrik Pasir Besi Pantai Telindung yang Disintesis Dengan Beberapa Metode," *Indones. Phys. Rev.*, vol. 3, no. 2, pp. 64–71, 2020, doi: 10.29303/i pr.v3i2.58.

[7] F. Ningsih;, Fitrianingsih;, and L. A. Didik, "Analisis Pengaruh Lama Penggerusan terhadap Resistivitas dan Konstanta Dielektrik pada Pasir Besi yang disintesis dari Kabupaten Bima," *Indones. Phys. Rev.*, vol. 2, no. 3, pp. 92–98, 2019, doi: 10.29303/ipr.v2i3.31.

[8] Bramantya, L. P. Yonando, M. Rifaldi, and R. Oktavian, "Sintesis dan Karakterisasi Silika Aerogel Hidrofobik dan Oliofilik Dari Pasir Laut Sebagai Absorben Tumpahan Minyak," *J. Tek. Kim. dan Lingkung.*, vol. 2, no. 2, pp. 49–54, 2018.

[9] L. Asri, L. A. Didik, and B. Bahtiar, "Sintesis Dan Analisis Kandungan Mineral Dan Karakteristik Sifat Listrik Nanopartikel Pasir Besi Pantai Telindung Kabupaten Lombok Timur," *JST (Jurnal Sains dan Teknol.*, vol. 10, no. 1, pp. 85–91, 2021, doi: 10.23887/jst-undiksha.v10i1.22765.

[10] D. T. Nurrohman and J. S. Pribadi, "Kajian struktur kristal, lattice strain, dan komposisi kimia nanopartikel pasir besi yang disintesis dengan metode ball milling," *KONSTAN*, vol. 3, no. 2, pp. 94–101, 2018.

[11] E. A. Setiadi *et al.*, "The effect of temperature on synthesis of MgFe2O4 based on natural iron sand by Co-precipitation method as adsorbent Pb ion," *J. Phys. Conf. Ser.*, vol. 985, no. 1, 2018, doi: 10.1088/1742-6596/985/1/012046.

[12] S. Noor, S. Muhammad, A. Azid, M. Shirwan, and A. Sani, "Heavy metals in the air : Analysis using Instrument , air pollution and human health-a review Heavy metals in the air : Analysis using Instrument , air pollution and human health - a review," *MJFAS*, vol. 14, no. 4, 2018, doi: 10.11113/mjfas.v14n4.967.

[13] P. A. Nugraha, S. P. Sari, W. N. Hidayati, C. R. Dewi, and D. Y. Kusuma, "The origin and composition of iron sand deposit in the southern coast of Yogyakarta," *AIP Conf. Proc.*, vol. 1746, no. June 2016, 2016, doi: 10.1063/1.4953953.

[14] P. Sebayang *et al.*, "Preparation of Fe3O4/Bentonite Nanocomposite from Natural Iron Sand by Co-precipitation Method for Adsorbents Materials," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 316, no. 1, 2018, doi: 10.1088/1757-899X/316/1/012053.

[15] J. Khan, S. Lin, J. C. Nizeyimana, Y. Wu, Q. Wang, and X. Liu, "Removal of copper ions from wastewater via adsorption on modified hematite (α-Fe2O3) iron oxide coated sand," *J. Clean. Prod.*, vol. 319, p. 128687, 2021, doi: 10.1016/j.jclepro.2021.128687.

[16] L. A. Didik, H. Aini, and A. Zohdi, "Analisis Perbandingan Kandungan Fe dan Karakteristik Sifat Listrik Pasir Besi Sungai dan Pantai," *J. Fis. Flux J. Ilm. Fis. FMIPA Univ. Lambung*

Mangkurat, vol. 17, no. 2, pp. 138–145, 2020, doi: http://dx.doi.org/10.20527/flux.v1i1.7689.

[17] A. Syuzita, L. A. D. Meiliyadi, and Bahtiar, "Tingkat Pencemaran Lindi Pada Air Tanah Dangkal Di Sekitar TPA Kebon Kongok Menggunakan Parameter Fisika dan Kimia," *J. Fis. Flux J. Ilm. Fis. FMIPA Univ. Lambung Mangkurat*, vol. 19, no. 2, pp. 126–134, 2022, doi: 10.20527/flux.v19i2.13030.

[18] L. A. Didik, I. Damayanti, J. Jumliati, and P. D. Alfadia Lestari, "Morphological Characteristics and Mineral Content Analysis of Magnetic Minerals Based on River and Coastal Sand using SEM-EDX," *J. Sains Dasar*, vol. 10, no. 2, pp. 44–50, 2021, doi: 10.21831/jsd.v10i2.42217.

[19] L. A. Didik, "Penentuan Ukuran Butir Kristal CuCr0,98Ni0,02O2 dengan Menggunakan X-Ray Difraction (XRD) dan Scanning Electron Microscope (SEM)," *Indones. Phys. Rev.*, vol. 3, no. 1, pp. 6–14, 2020, doi: https://doi.org/10.29303/ip r.v3i1.37.

[20] Nurhidayati, L. A. Didik, and A. Zohdi, "Identifikasi Pencemaran Logam Berat di Sekitar Pelabuhan Lembar Menggunakan Analisa Parameter Fisika dan Kimia," *J. Fis. Flux J. Ilm. Fis. FMIPA Univ. Lambung Mangkurat*, vol. 18, no. 2, pp. 145–146, 2021, doi: 10.20527/flux.v18i2.9873.

[21] M. Sari and M. Huljana, "Analisis Bau, Warna, TDS, pH, dan Salinitas Air Sumur Gali di Tempat Pembuangan Akhir," *ALKIMIA J. Ilmu Kim. dan Terap.*, vol. 3, no. 1, pp. 1–5, 2019, doi: 10.19109/alkimia.v3i1.3135.

[22] E. Kurniati, F. Anugroho, and A. A. Sulianto, "Analisis Pengaruh pH dan Suhu pada Desinfeksi Air Menggunakan Microbubbble dan Karbondioksida Bertekanan," *J. Pengelolaan Sumberd. Alam dan Lingkung. (Journal Nat. Resour. Environ. Manag.*, vol. 10, no. 2, pp. 247–256, 2020, doi: 10.29244/jpsl.10.2.247-256.

[23] B. Hamuna, R. H. R. Tanjung, S. Suwito, H. K. Maury, and A. Alianto, "Kajian Kualitas Air Laut dan Indeks Pencemaran Berdasarkan Parameter Fisika-Kimia di Perairan Distrik Depapre, Jayapura," *J. Ilmu Lingkung.*, vol. 16, no. 1, p. 35, 2018, doi: 10.14710/jil.16.1.35-43.

[24] Menteri Kesehatan Republik Indonesia, "Peraturan Menteri Kesehatan Republik Indonesia Nomor 32 Tahun 2017 Tentang Standar Baku Mutu Kesehatan Lingkungan Dan Persyaratan Kesehatan Air Untuk Keperluan Higiene Sanitasi, Kolam Renang, Solus Per Aqua dan Pemandian Umum," *Peratur. Menteri Kesehat. Republik Indones.*, pp. 1–20, 2017.

[25] L. A. Didik, "Pengukuran Kalor Jenis Material Menggunakan Modifikasi Persamaan Teorema Stefann Boltzman," *Konstan*, vol. 2, no. 2, pp. 47–50, 2017.

[26] L. A. Didik, "Pengaruh Pemberian Medan Magnet Terhadap Konstanta Dielektrik Material AgCrO2," *KONSTAN*, vol. 2, no. 1, pp. 1–5, 2016.

[27] R. B. Islami, L. A. Didik, and Bahtiar, "Determine of The Nira Water Viscosity by Using Video Based Laboratory Falling Ball Method with Tracker Software," *Gravity J. Ilm. Penelit. dan Pembelajaran Fis.*, vol. 7, no. 2, pp. 8–20, 2021, doi: 10.30870/gravity.v7i2.10165.

[28] L. A. Didik and Muh. Wahyudi, "Crystal Structure Analysis of CuCrO2 Based On XRD Data Using GSAS Software," *Indones. Phys. Rev.*, vol. 4, no. 1, pp. 10–17, 2021, doi: https://doi.org/10.29303/ipr.v4i1.73..