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

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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.

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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 (Fe₂O₃) and magnetite (Fe₃O₄) 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 (Fe₂O₃ and Fe₃O₄) [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 MnO₂ [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 NH₄OH 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 by 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>
<thead>
<tr>
<th>Water Quality Parameters Before Mixing with the Results of the Synthesis of Magnetic Material Nanosilica River Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Quality Parameters</strong></td>
</tr>
<tr>
<td>Temperature (°C)</td>
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<tr>
<td>29.3 °C</td>
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</tbody>
</table>

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<tr>
<th>Water Quality Parameters After Mixing with the Synthesis Results of River Sand Nanosilica Magnetic Materials</th>
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<tbody>
<tr>
<td><strong>Iron Sand Sampling Location</strong></td>
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<tr>
<td><strong>Temperature (°C)</strong></td>
</tr>
<tr>
<td>27.8 °C</td>
</tr>
<tr>
<td>28.0 °C</td>
</tr>
</tbody>
</table>
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 °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].

![Value of Water Temperature Before and After Mixing Iron Sand](image)

**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


