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XRF AND XRD TESTING FOR SAND MINERAL CONTENT IDENTIFICATION AT TALANG SIRING BEACH

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Abstract :
In the Talang siring tour of the Pamekasan district, numerous illegal mining operations along the coast for sale and personal use produce building materials with low economic value. However, if the sand is processed further, it will produce materials with high technology utilization and economic value. This research is a preliminary investigation into converting sand into high-value minerals to be utilized economically. Using X-Ray Fluorescence (XRF) and X-Ray Diffraction (XRD) experiments, this study aims to determine the sand's mineral content in the Talang Siring tourist area in Pamekasan Regency. Initial identification is the XRF test function for analyzing sand's chemical elements and composition. The purpose of XRD is to analyze the crystal structure and correlate the results with Macth and origin software based on the XRF results. The results of the XRF test indicated that Silicone had the highest concentration of minerals at 63.8%, followed by Calcium at 29.4% and Iron at 2.45%. The XRD test results indicated that the sand's mineral composition was qualitatively SiO2 90%, CaCO3 8%, Iron 1%, and the remainder 1%.

Keywords: Natural Minerals; XRD; XRF

INTRODUCTION

Indonesia is one of the countries with abundant natural resource wealth, including oil, gas, and other natural mineral materials, one of which is natural mineral material found in Pamekasan Regency, specifically the Talang Siring Tourism beach, where the majority of the area consists of white sand beaches. Pamekasan Regency is one of the regencies located at the intersection of the Sampang-Sumenep road network in the Madura region. Comprised of 13 Districts and 189 Villages, the entire area of Pamekasan Regency is 79,230 ha, encompassing 13 Districts. In general, the Pamekasan Regency comprises lowlands in the south, highlands in the central and northern regions, and a slope of

at least 2% in the central region. Pamekasan Regency's astronomical coordinates are 6°51'–7°31' south latitude and 113°19'–113°58' east longitude (Figure 1).

Talang siring beach is located on Jalan Raya Pamekasan - Sumenep, Pacanan Hamlet, Montok Village, Larangan District, Pamekasan Regency, Madura, East Java. 14 kilometers separate from the city center of Pamekasan from the airport. In Talang siring tourism, there is a great deal of illegal mining along the coast for sale and self-use perfunctory that is used as a building material with low economic value and only a few of which maintain its beauty, specifically in beach resorts, even though if the sand is further processed, it will produce high economic value and has the potential to produce materials with high technology utilization. Insufficient knowledge renders this inherent potential ineffective.

Figure 1. Map of Pamekasan Madura Regency

Utilizing natural minerals as concrete components from a civil engineering standpoint demonstrates that self-healing in cement-based systems can be achieved by inducing biogenic calcium carbonate (CaCO) precipitation (Mert Tezer & Başaran Bundur, 2022). Natural materials are predominantly employed in the construction industry (in addition to concrete mixtures, the production of pavers, and gravel) or in water purification (Strejcová et al., 2020). Utilization of Natural Minerals in Pilot-Scale MBR to Reduce Membrane Fouling (Gkotsis et al., 2020). Natural minerals can also serve as sustainable metals and minerals for a low-carbon future (Benjamin K. Sovacool, Saleem H. Ali, Morgan Bazilian, Ben Radley, Benoit Nemery, Julia Okatz, 2020). Natural minerals can also be transformed into basic materials (Kenzhaliyev et al., 2022). Sand as Concrete Fine Aggregate (Malathy et al., 2022). From previous research, To maximize natural products, preliminary research is required to convert sand into high-value minerals, thereby enhancing the economic value of the people in the Talang Siring beach region.

Mineral constituents, discrete mineral species, and ion exchange elements present in coal, biomass, and bottom ash residues have been identified using XRD, XRF, FTIR, and SEM-EDX (Kumar & Lingfa, 2020) (Yao et al., 2021) (Correa-Ochoa et al., 2023). Research utilizing XRF and XRD to determine the distribution pattern and content of Si and Fe as well as the mineral composition of Jeneberang catchment rocks (Massinai et al., 2021) (Suriyanto Bakri, Muhammad Anas, Muhamad Hardin Wakila, 2023) (Supiyani et al., 2022) (Tice et al., 2022). X-ray diffraction (XRD) is the most trustworthy technique for identifying material phases (Shen & Shen, 2021) (Samouh et al., 2021). On this island, representative mineral sand samples from various coastlines were collected and analyzed using cutting-edge techniques including WD-XRF, XRD, SEM, and EDX for their diverse mineralogical compositions (Md. Ripaj Uddin, Mayeen Uddin Khandaker, Nahida Akter, Md. Farid Ahmed, Syed Md, Minhaz Hossain, Abdul Gafur & Idris, 2022). Permeability, water retention, raindrop erosion resistance, strength, wind erosion resistance, durability, scanning electron microscopy (SEM), and X-ray diffraction (XRD) measurements were used to evaluate the cementation effect (Lai et al., 2021). The microstructure of treated and untreated sand samples was analyzed using scanning electron microscopy (SEM) and X-ray diffraction (XRD) to determine the presence of crystalline

materials (Almajed et al., 2020) (Ardiani et al., 2020) (Yu et al., 2021) (Hadi et al., 2022). So that XRF and XRD assays can be used to examine natural materials.

The influence of sand quality on the tensile strength and thermal distortion of chemically bonded sand cores is investigated (Gyarmati et al., 2021). Material testing and XRD analysis to examine the sulfate resistance behavior of granite sand as fine aggregate in concrete (Arivumangai et al., 2020). This research concentrates on testing concrete using XRD analysis, but the natural materials in sand have not yet been analyzed.

Based on X-ray Fluorescence (XRF), the amount of alumina in Bintan's crimson mud is 28.87 weight percent (Ramdhani et al., 2018). The focus of this investigation was on the extraction of alumina from red mud, not sand. therefore sand research is required.

XRF results of Waru 3 Si 43.3%, Waru 2 Ca 71.37%, Waru 1 Si 58.3%, XRD results in Waru 3 is composed of 75.2% CaCo3, while Waru 2 and Waru 1 are composed of 88% SiO2 (S. V. Ariyanto & Joni, 2019). This research is still focused on landslides using XRD and XRF tests, not on minerals that can be used as production materials, and the tested material is non-sand soil.

Hot springs contained 66.2% Natural Fire 1 Ca, 37.4% Api Alam 2 Si, and 39.6% SiO, according to the results of an XRF analysis (I. J. and S. V. Ariyanto, 2023). This research focuses on natural fires but has not yet analyzed natural materials that can be used as basic materials for manufacturing.

The findings of this study can be used to ascertain the mineral content of sand, which can be utilized as a high-tech material to reduce illegal mining (Joni & Ariyanto, 2021). This study's findings centered on mineral content, while the Sampang district served as the research site. Consequently, there is still a need for research elsewhere, so we conducted research in the Pamekasan district.

In this instance, XRF and XRD examination is necessary to determine the mineral composition of the sand in the Talang Siring Tourism area. This research is extremely essential because it represents the initial investment to stimulate the local economy, and it is the first time it has been conducted on the Talang Siring tour. This investigation aimed to determine the natural mineral content of Talang Siring Tourism, Pamekasan Regency, utilizing the XRF and XRD tests

RESEARCH METHOD

This research employs both qualitative and quantitative methods. This investigation was conducted in 2023, with the Talang Siring tour, Pamekasan Regency serving as the location. The qualitative research method consists of photographs taken before and after processing, followed by a description of the results. for a quantitative approach to the XRF and XRD test results.

Sampling in this qualitative method consists of photographing sand at the Talang Siring tourism site in Pamekasan Regency and photographing sand after processing for use as samples for XRF and XRD research materials. In the quantitative method of sampling, the sand sample is heated to eliminate the water content, then sieved and filtered.

The research procedure for this qualitative approach involves preparing digital photographs taken with digital cameras or mobile phone cameras. The sand is heated in a furnace at 100 °C for 48 hours to determine its water content quantitatively. Using a flour sieve, sand, and tiny pebbles were extracted from the samples. The sand is then finely ground using a mortar until it is entirely flat. A final separation/sifting with a particle size of 350 mesh is required for fine sand. To analyze sediment samples, X-Ray Fluorescence (XRF) and X-Ray Diffraction (XRD) were utilized.

The instrument with the collection of technical data used in this investigation was XRF testing on granulated sand to determine the sand's composition, followed by XRD testing to determine the crystal structure formed. This study uses XRF testing to analyze the chemical composition/elements present in the sand as a data analysis technique. On the premise of XRF results, XRD is used to analyze the crystal structure, with Macth and origin software completing the results.

RESULTS AND DISCUSSION

It was determined that the sand at the Talang Siring tourist attraction in Pamekasan Province was relatively coarse based on initial observations. In addition, visual observations reveal that both the unprocessed and processed sediment have a darker hue (figure 2). Variations in the hue of sand indicate variations in its mineral content.

Before Processing

After Processing

Figure 2. Characteristics and color variations of tourist seashore sand.

Based on the results of X-Ray Fluorescence (XRF) testing of the sand at the Talang Siring tourist location, it was determined that the mineral content of Silicone with the highest predominance was 63.8%, Calcium 29.4%, and Iron 2.45%; this is what causes the beach sand to be predominantly white (Table 1).

Table 1. XRF Test Results from Talang Siring Tourism Beach Sand, Pamekasan Regency

Element	Name	Talang Siring (%)
Si	Silicone	63,8
K	Potassium	0,45
Ca	Calcium	29,4
Ti	Titanium	1,37
Cr	Crom	0,075
Mn	Manganese	0,22
Fe	Iron	2,45
Cu	Copper	0,082
Sr	Strontium	1,5
Zr	Zirconium	0,75

Silicone Has the potential to be used as a material for ceramics, glass cups, and plates; when combined with lime and water, it produces cement, which is a widely used raw material for cement production. Silicon for chemical and physical alterations to textiles (Chruściel, 2022). Silicone materials have numerous applications, including electronics, sensors, and coatings (Wu et al., 2020). Silicone material as a Coating Material (Zielecka et al., 2020). Silicone materials have excellent all-around properties and are used extensively in outdoor insulation, aerospace, and other disciplines (Wang et al., 2021). The incorporation of silicon material improves battery efficacy (Md. Ripaj Uddin, Mayeen Uddin Khandaker, Nahida Akter, Md. Farid Ahmed, Syed Md, Minhaz Hossain, Abdul Gafur & Idris, 2022). Due to its high SiO2 content, It appears that the examined sand can be used in the glass industry as a raw material. Therefore, if we separate the silicon material, it will become a substance with a greater economic value than sand.

Ca or CaCO3 (calcite) becomes a carbonate precipitate upon the addition of hydrochloric acid (HCl). CO2 gas is released, which is extensively used for Portland cement, steel refining, paper industry, construction materials, and paints, among other things. Calcium as a cement admixture (Zunino et al., 2020). CaCO3 can be further engineered using template-induced Biomineralization and layer-by-layer assembly to create porous, hollow, or core-shell organic-inorganic nanocomposites (Niu et al., 2022). Calcium Creates Durable Composite Materials (Assi et al., 2020). Therefore, if we separate Calcium, it will become cement, chemical and pharmaceutical, glass, ceramics, and fiber optics.

Based on the findings of X-Ray Fluorescence (XRF) tests conducted on the tourist dunes of Talang Siring, Pamekasan Province. This test is conducted at an angle (20^0-70^0) intended for the initial test to identify the presence of the expected oxide, as well as by examining the XRF test results to determine the suitability based on the outcomes of the XRF and XRD tests and the sample quantity.

The crystallinity of the sample was as expected, as depicted in Figure 2, according to the XRD test results. In this image, the crystal diffraction peaks are quite high and conical, necessitating additional analysis to confirm the XRD data results. In this analysis, Match software was utilized to match the Match software database with the XRD results. A material's phases, crystal structure, cell parameters, densities, and HKL values can be determined with the assistance of the Match software.

In the tourist sand of Talang Siring, Pamekasan Regency, a SiO2 phase of <90%, CaCO3 of <8%, Iron of <1%, and the remainder of <1% form. There is a possibility that Si will bond to other minerals, as well as the possibility that additional impurities will deposit in the sand. Silica sand is composed of SiO2, CaO, Al2O3, Fe2O3, K2O, and MgO, and its hue differs based on the presence of impurities.

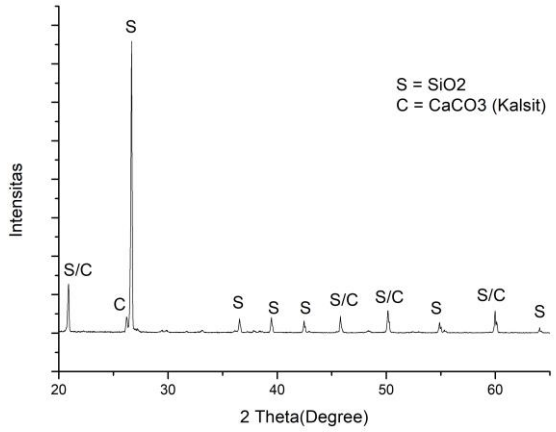

Figure 3. XRD results of Talang Siring Tourism Beach Sand, Pamekasan Regency

CONCLUSION

Silicon had the highest mineral concentration at 63.8%, followed by Calcium at 29.4% and Iron at 2.45%, according to the XRF test results. The XRD analysis revealed that the mineral composition of the sediment consisted of 90% SiO2, 8% CaCO3, 1% Iron, and the remaining 1%. If we separate the silicon-containing material, it will become a substance with a higher economic value than sediment. Calcium will become cement, chemicals and pharmaceuticals, glass, ceramics, and optical fiber if it is separated.

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