The Characteristics of Surface Topography and Element of Sand from Flash Floods in North Luwu Regency

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Abstract. Research of surface topography characteristics and elements of sand from the flash flood in North Luwu Regency was motivated by the abundance of sand due to the natural disaster that occurred in mid-2020 in South Sulawesi, Indonesia. The aim ware to determine the surface topography and elements of the sand, so that it can be used as a reference for its use. The test method used was SEM-EDX. The results obtained show that the surface of the sand is coarse and not hollow, while the elements contained in the sand based on Weight (%) and Atomic (%) respectively are O (49.90% and 61.00%), Si (25.14% and 17.51%), K (9.39% and 4.70%), Al (8.37% and 6.07%), C (6.05% and 9.86%), Na (0.94% and 0.80%), Fe (0.21% and 0, 07%). The conclusion obtained was that the sand from the flash flood in North Luwu Regency includes silica sand.

Keywords: surface topography; element of sand; North Luwu Regency, SEM-EDX

1 Introduction

The flash flood that occurred in North Luwu Regency, South Sulawesi Province on Monday, July 13, 2020, then left various sad stories. In addition to the loss of life, severe infrastructure damage is also inseparable from this disaster. In contrast to other flash floods, from the observations of researchers, the flash floods that occurred in North Luwu were mostly sand and a little mud. The impact of the heap material was worst in two sub-districts, namely Sabbang and Baebunta sub-districts which reached a height of 3-4 meters, while for other sub-districts it was only about 1-2.5 meters [1].

To this day, the situation in North Luwu, especially areas affected by flash floods, is still not fully recovered because there is still a lot of sand left. Many houses, agricultural land, and plantations are still buried because there is no location for the disposal of the material. The best solution so that the material does not become an environmental problem anymore is to use it.

Besides being used as fine aggregate for the manufacture of building materials such as mortar and concrete, various other ways can be done to utilize the sand. It takes creation and innovation from the government or the local community so that the originally waste sand can become a material that has a higher economic value. However, as we know that to utilize a material from nature, it is necessary to first know the content of the material. A prior study is needed to determine whether the material is suitable for conversion into other useful materials.

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There have been many previous studies that have examined the content of sand or other natural materials to be used in certain cases and areas, for example, that conducted by Linda Silvia et al., 2018, regarding the analysis of the mineral content of beach sand in Pacitan Regency with the extraction method and the results show that most of the sand is Calcium (Ca) so it has the potential to be used as a basic material for the manufacture of Calcium carbonate (CaCo3) [2]. Research conducted by Redi K. Pingak et al., 2018, regarding the analysis of the potential of Tablolong and Koka Sand as a source of silica using XRF and XRD tests concluded that the sand is predominantly composed of Silica (Si) atoms[3].

A study conducted by Sumari et al., 2020 concluded that the mineral content of the sand at Bajul Mati Beach, Malang Regency, is the highest, Silica (SiO2), and has the potential to be used as nano-silica material [4]. Verryon Harap and Mukti Hamjah Harahap, 2013, examined the characteristics of Labuhan Batu red sand using SEM test and X-ray diffraction, it was found that the sand has cavities on its surface and the most atoms contained are Si[5]. As for Eri Widianto et al., 2018, who researched the characteristics of the sand of Samudera Baru Beach and its utilization, it was concluded that the sand he studied contained predominantly iron (Fe) and could be used as a filler in an electromagnetic filter system[6].

Meanwhile, Trianasari et al., 2017, examined the content of silica (SiO2) as a result of pumice extraction where it was concluded that pumice contains oxide compounds in the form of SiO2, Al2O3, Na2O, CaO, K2O, and FeO, where silica is the most dominant content [7]. The studies presented above provide an illustration that each sand or natural material has different characteristics both in terms of the elements of its formation and the place where it comes from. For this reason, it is very important for each type of sand to first study its characteristics before being used for certain purposes.

Based on the background above, the purpose of this study was to determine the surface topography and elements of the sand from the flash flood in North Luwu Regency using SEM-EDX. The output target of this research is that it can be published in national and international journals which are expected later as a reference for the community or local government that the sand from the flash flood is feasible or not to be used as other more useful materials, and also as learning how to utilize a resource. abundant local nature which is an environmental problem. The technology developed is the application of material physics, especially advanced materials by utilizing abundant local resources.

2 Research Methods

2.1 Research Place

The sand collection was carried out in three places affected by flash floods at random in North Luwu Regency, South Sulawesi Province. The SEM-EDX test was carried out at the Serpong Advanced Characterization Laboratory, National Research and Innovation Agency, South Tangerang, Banten Province, Indonesia.

2.2 Research Materials and Tools

The material and tools used in this research were sand from the flash flood in North Luwu, and SEM-EDX (SEM Hitachi SU 3500). SEM (Scanning Electron Microscope) is used to analyze the surface shape or topography of the sand sample under study. EDX (Energy Dispersive X-Ray Spectroscopy) or commonly written as EDS or EDAX is an additional tool in SEM that is used to identify and analyze the elemental content of the sand sample under study.

2.3 Measurement Condition/Testing Parameters

a. Sample preparation = with coating Au
b. Room temperature = 18-250C
c. Room humidity = < 65%
d. Tilting = -deg
e. Vacc = 20 kV
f. Spot intensity = 50
g. Vacc EDS = 20 kV
h. Spot intensity EDS = 63
i. Magnification = 1000X, 2500X, 5000X, 10000X
j. Magnification EDS = 1000X
k. Type image = SE dan BSE
l. Vacuum = High
m. Sample = Sand

3 Result and Discussion

The results of this study can be seen in figure below:

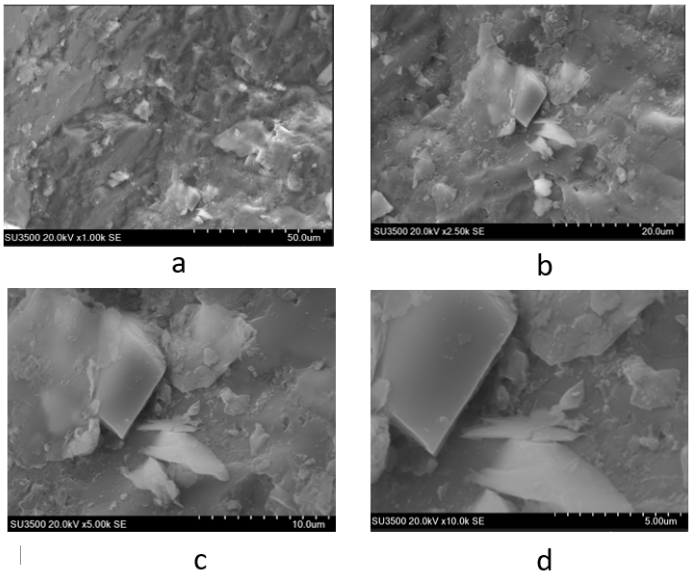

Fig 1. Sand sample surface image using SEM with (a) 1000X, (b) 2500X, (c) 5000X, and (d) 10000X magnification

Based on Figure 1 above, it is clear that the surface of the sand sample that has been studied has a rough and sharp surface contour and is not porous when referring to Djokrodimuljo (1996), that sand with such characteristics when used as a mixture of mortar or concrete, then the bonding power between sand as fine aggregate and cement paste becomes very good which has an impact on the strength of the concrete which is getting better as well.

Table 1. Elemental content in the sand sample

Element	Weight (%)	Atomic (%)
C	6.05	9.86
O	49.90	61.00
Na	0.94	0.80
Al	8.37	6.07
Si	25.14	17.51
K	9.39	4.70
Fe	0.21	0.07
Total	100	100

Referring to the EDX results, it can be seen that the sand is an oxide compound with O (weight 49.90% and atomic 61.00%) and Si (weight 25.14% and atomic 17.51%) are the largest elements contained in this sand. This indicates that most likely the sand is a type of silica sand (SiO2) with a mixture of various impurities contained such as K (weight 9.39% and atomic 4.70%), Al (weight 8.37% and atomic 6.07%), C (weight 6.05% and atomic 9.86%), Na (weight 0.94% and atomic 0.80%), Fe (weight 0.21% and atomic 0.07%).

The graph of the spectrum of this sand content can be seen in Figure 2 below:

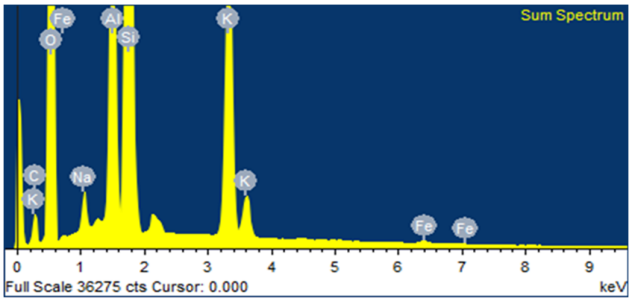

Fig 2. Spectrum of the elemental content of sand

Elemental analysis in EDX is done by comparing the ratio of the X-ray intensity of the elements contained in the sand sample with the same element from the standard sample. The characterization of the X-rays generated from each element is proportional to the basic concentration of the element, the probability of X-ray production or the ionization cross-section of the element, and the path length of the electrons.

4 Conclusion

Based on the data that has been obtained above, it can be said that:

a. From the surface texture of the sand that looks rough and non-porous, it indicates that the sand resulting from the banjir bandang in North Luwu has good adhesion with cement when used as fine aggregate for mortar or concrete.
b. The most dominant elements possessed by sand from the flash flood in North Luwu Regency are O and Si which have the potential to be used for the manufacture of ceramics, glass, or other useful silica materials.

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