Volume 6, Issue 7, pp. 6-9, 2022

*International Journal of Scientific Engineering and Science*
*ISSN (Online): 2456-7361*

# Utilization of Sidoarjo Hot Mud for the Production of Low-Strength Concrete

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***Abstract***— *The idea of this research departs from two problems; Sidoarjo hot mud eruption disaster in Renokenongo Village, Porong District, Sidoarjo Regency which until now requires handling solutions, as well as the increasing need for concrete for the construction of various infrastructures which is increasing – which is accompanied by limited resources. The resources needed for the manufacture of concrete include sand, cement, and split stone. Sand is a material that comes from nature and cannot be renewed, so its abundance is decreasing. This study seeks to actualize the idea of using Sidoarjo (Lusi) hot mud as a substitute for sand for the manufacture of low strength concrete. One of these types of concrete is needed for the construction of domestic sewers. This community service research is a development of previous research conducted by researchers related to the potential of Sidoarjo hot mud for the production of irrigation lining concrete, where a feasibility test of concrete produced has met the criteria for compressive strength of concrete according to national standards.*

***Keywords***— *Low-strength concrete, Sidoarjo hot mud, sand substitution, drainage, domestic wastewater.*

## I. Introduction

Nowadays, the need for concrete production is increasing along with the increase in development. This means that the need for sand resources also continues to increase and one day it will have an impact on the scarcity of sand itself. Sand is one of the main materials in the manufacture of concrete, where its availability comes from nature and cannot be renewed. Sand is a granular material measuring between 0.0625 to 5 mm, mostly formed from silicon dioxide but some is formed from limestone. In the world of concrete (mortar), sand is referred to as fine aggregate. Sand in this context is defined as a granular material derived from rock that is formed either naturally or by the disintegration process by the stone crusher industry, which has the largest grain size of 5 mm. Sand which is included in the criteria for making concrete is sand that has a grain size of 5 mm. Sand whose grain size is > 5 mm will be filtered in the sieving process and fall into the category of coarse aggregate.

Sand quality is an important variable in concrete production. In other words, the type of concrete produced has its own designation and adjusts to the specifications of the raw materials used. The results of previous studies indicate that Sidoarjo hot mud material has the potential to be used as an additive material in concrete production to reduce the use of sand (Wulandari et al., 2022). However, it is known that Lusi's material has different specifications from concrete sand which is generally volcanic sand or the result of sand mining in rivers. Volcanic sand is a type of sand that has the highest silica (SiO) content. High silica content is characterized by a pointed grain shape. This morphology makes this type of sand very suitable for making concrete because it will easily bond with cement. In addition to the silica content, volcanic sand also contains iron (FeO) which can increase the durability of concrete and make the concrete porous level low. The iron content in volcanic sand is usually inversely proportional to the silt content. The higher the iron content, the lower the mud content because the mud comes from the rock weathering process. On the other hand, river sand has grains that tend to be round because it has undergone a friction process with water for a long time. In other words, the silica and iron content of river sand is lower than that of volcanic sand.

The use of Lusi material – which is basically mud – of course cannot replace the use of sand as a whole, because both have different specifications. Mud is synonymous with high mud content, so the quality of the processing results as fine aggregate still cannot match sand. Therefore, the use of Lusi is limited to help reduce the use of sand in the production of concrete. In addition, in this community service research, the specification of the concrete produced with the Lusi mixture is low strength concrete. According to SNI 03-6468-2000, low-strength concrete is divided into two, namely low-strength concrete which has a compressive strength of 10-15 MPa and is generally used as a work floor, and low-strength concrete which has a compressive strength of 16-20 MPa and is generally used for unreinforced structures (cyclops, pavements and masonry blanks filled with mortar).

This research is basically an actualization of previous research (Wulandari et al., 2022) which is outlined in community service. Production of low-quality concrete is carried out by utilizing ready-to-use Lusi materials, for the manufacture of domestic sewers in housing complexes. The housing complex selected as the beneficiary of this low-strength concrete production is Pondok Harapan Indah (Poharin), located in Malang City, East Java. Poharin is a housing complex that has existed since 1981 which has now undergone regional expansion; represents an increase in population. As one of the oldest housing complexes, Poharin also bears hope from the Mayor of Malang to become a model for other villages or housing complexes (Malangtimes, 2021). The increasing number of housing complexes indicates that daily wastewater production is also high. Thus, domestic sewerage continues to require repairs so that it is always channeled properly. Domestic wastewater that flows directly through waterways is greywater waste. Greywater is wastewater that comes from bathing and washing activities, and does not come into contact with dirt (Wulandari, 2019).

Based on the description of the background, it can be underlined that this study aims to actualize the production of low-strength concrete by utilizing Sidoarjo (Lusi) hot mud material to improve the sewerage in the housing complex of Pondok Harapan Indah (Poharin) Malang City. The research results are also expected to provide an overview for future research related to the development of low-strength concrete production and the use of Lusi itself.

## II. METHOD

This research applies a quantitative approach to test the feasibility of concrete produced with a mixture of Lusi materials through a compressive strength test, as well as a qualitative approach to examine the application or use of low-strength concrete in the field. The concrete quality test was carried out at the Civil Engineering Laboratory, National Institute of Technology, Malang City. The location of the application of the research results is in the housing complex of Pondok Harapan Indah (Poharin) Malang City, East Java, Indonesia. The expected concrete specifications from the production carried out are low-strength concrete (SNI 03-6468-2000) which is used for domestic wastewater (greywater). Lusi's material was obtained directly from the Lapindo Mud Eruption Center in Sidoarjo, East Java, Indonesia (See Figure 1).

Fig. 1. The eruption of hot mud in Lapindo area, Sidoarjo, East Java, Indonesia
Source: Sindonews.net (2022)

Fig. 2. The initial condition of drainage in Poharin housing complex
Source: Research Documentation (2022)

The materials used in this research are concrete building blocks; broken stone (split stone), sand, cement, water, and Lusi material. The use of Lusi material that has been dried is expected to reduce the use of sand. The percentage of use of Lusi (comparison with sand) is 5%. The use of this percentage refers to the results of previous research (Wulandari et al., 2022), where this percentage still allows the concrete to have a low quality category in accordance with the 1971 Indonesian Concrete Regulations, as well as the national standard SNI 03-6468-2000. The concrete will be applied at the location of the implementation of the development results, namely to repair a drainage channel in the Poharin housing complex which is in need of repair. The drainage channel to be replaced with low-strength concrete has a length of 200 meters. The condition of the drainage channel can be seen in the following photo:

## III. RESULT AND DISCUSSION

Concrete for drainage channels for domestic wastewater disposal is made in accordance with the specifications for low-strength concrete according to the 1971 Indonesian Concrete Regulations, as well as the national standard SNI 03-6468-2000. The design of the sewer or drainage channel is made as visualized in Figure 3, while the finished concrete results are shown in Figure 4. Drainage channel is one of the complementary buildings on the road segment in fulfilling one of the technical requirements of road infrastructure. Road drainage channels function to drain water that can interfere with road users, so that the road body remains dry. In general, road drainage channels are open channels using gravity to drain water to the outlet. The distribution of flow in the drainage channel to this outlet follows the contours of the highway, so that surface water will flow more easily by gravity.

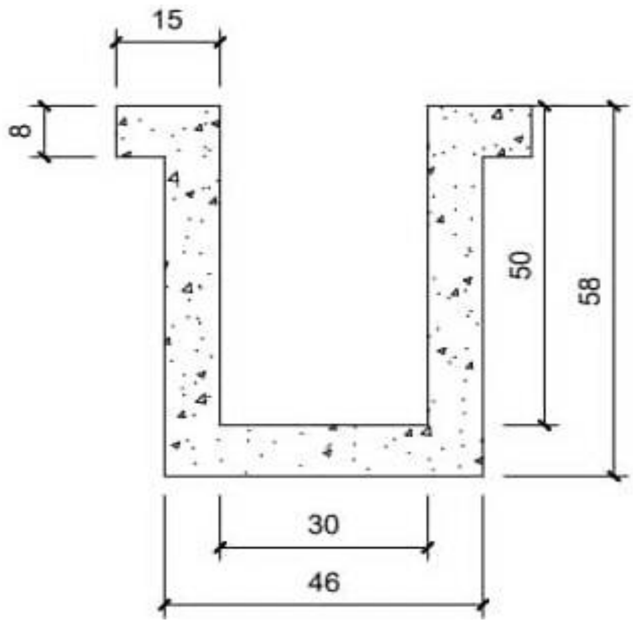


Fig. 3. The design of concrete drainage on the scale 1:10
Source: Research Data (2022)

Fig. 4. The result of low-strength concrete production with the addition of Lusi material
Source: Research Documentation (2022)

The Poharin housing complex is inhabited by an increasing number of residents, so the availability of vacant land is increasingly limited. The more developed an area, the vacant land to absorb water naturally will decrease. The ground surface is covered by concrete and asphalt. This will add to the excess water that is not wasted. If this excess water cannot be drained, it will cause puddles. In planning the drainage channel, it is necessary to pay attention to the land use of the catchment area of the drainage channel which aims to keep the road section dry even though there is excess water, so that surface water is controlled and does not interfere with road users. The condition of the drainage channel in the Poharin residential complex with this description requires constant improvement, which will trigger the high use of sand resources. For this reason, the use of Lusi material is expected to reduce the need for sand for the manufacture of concrete drainage channels, as well as reduce the production costs of repairing drainage channels for the housing complex itself. In this case, the quality of the concrete produced itself needs to be re-measured before the concrete is installed in the drainage channel. Table I below presents the results of the measurement of important parameters related to the quality of low-strength concrete that has been developed in this study.

TABLE I. The result of compressive strength of concrete produced with the addition of Lusi

| Unit Number | Weight (Kg) | Weight (PkN) | Compressive Strength (kg/cm2) | Converted Compressive Strength (kg/cm2) |
|---|---|---|---|---|
| 1 | 10.74 | 109.00 | 62.94 | 75.83 |
| 2 | 11,41 | 169.00 | 97.59 | 117.57 |
| 3 | 8,84 | 13.00 | 7.51 | 9.04 |
| 4 | 9,68 | 18.00 | 10.39 | 12.52 |
| 5 | 9,74 | 16.00 | 9.24 | 11.13 |
| 6 | 8,74 | 10.00 | 5.77 | 6.96 |
| 7 | 9,36 | 13.00 | 7.51 | 9.04 |
| 8 | 8,58 | 9.00 | 5.20 | 6.26 |
| 9 | 8,82 | 13.00 | 7.51 | 9.04 |
| 10 | 8,97 | 18.00 | 10.39 | 12.52 |
| 11 | 8,66 | 10.00 | 5.77 | 6.96 |
| 12 | 8,67 | 9.00 | 5.20 | 6.26 |

Source: Data analysis (2022)

The compressive strength of the concrete is the ability of the concrete to withstand the magnitude of the load -per unit area- which causes the concrete to crumble when loaded with a certain compressive force. The compressive strength of concrete describes the quality of a structure because the higher the level of strength of the desired structure, the higher the quality of the concrete that must be produced (Mulyono, 2004). Concrete was made on April 15, 2022, while the measurement of the parameters above was carried out on May 13, 2022. In other words, the concrete measured (or will be applied in the field) is lining concrete with a pavement age of 28 days. The compressive strength of concrete will increase with increasing age of the concrete. The compressive strength of concrete will increase rapidly during the drying period since the concrete begins to be molded, but over time it will slow down again, ie if it has reached the optimal compressive strength. 28 days is the standard age for concrete ready to be tested or used according to its designation (Simanjuntak, 2015).

Based on the results of the measurement of the compressive strength parameters, it can be seen that the quality of the drainage channel concrete is in accordance with the concrete in the low quality category according to the 1971 Indonesian Concrete Regulation, as well as the national standard SNI 03-6468-2000. These findings indicate that the treatment or manufacture of low-strength concrete for drainage channels in urban housing complexes can be applied widely for long-term programs.

## IV. Conclusion

This research has proven that low-strength concrete made with a mixture of Lusi materials can be applied in the field, namely as a drainage channel in housing complexes in urban areas. This idea can be widely applied to other housing complexes, with the hope that the use of sand material for concrete production can be reduced, while on the other hand of course it can increase the utilization of Sidoarjo hot mud whose overflow is still ongoing to this day; reduce the effects of hot mud pollution in the local area. In addition, this research also needs further development by modifying the treatment of Lusi material before it is used as a mixture for making concrete. It is hoped that the use of Lusi's material can be more but the resulting concrete has a better quality than the current development achievement. Concrete with better quality will have the potential to be used as a building structure and not only as a drainage channel.

## References

[1]. ASTM C 128-78, Standard Test Method for Density, Relative Density (Spesific Gravity), and Absorbtion of Fine Aggregate.
[2]. ASTM C 128-93, Standard Test Method for Density, Relative Density (Spesific Gravity), and Absorbtion of Fine Aggregate.
[3]. Dibiantara, D. Pustaka. (2013). Pemanfaatan Lumpur Bakar Sidoarjo Untuk Beton Ringan dengan Campuran *Fly Ash,* Foam, dan Serat Kenaf. Surabaya: ITS Library, RSS 620.136.
[4]. Febrian, Lericta. (2012) Pemanfaatan Lumpur Oven Sidoarjo Sebagai Bahan Campuran Pembuatan Beton Ringan dengan Tambahan Pasta Foam. Undergraduate Thesis. Institut Teknologi Sepuluh November, Surabaya.
[5]. Mulyono Tri, 2004. *Teknologi Beton*. Penerbit Andi, Yogyakarta.

[6]. Simanjuntak, J. Oberlyn, & Saragi, T. Elita. (2015). Hubungan Perawatan Beton dengan Kuat Tekan (Pengujian Laboratorium). Lembaga Penelitian Universitas HKBP Nommensen. Medan.
[7]. Wulandari, L. Kurniawati, Munasih, & E. Prikasari. (2019). The Modification of Communal Wastewater Treatment Plant (IPAL) Tlogomas Malang Using Sand Filter. *Int. J. Sci. Eng. Sci.*, Vol. 3, No. 7, pp. 30–35. http://eprints.itn.ac.id/5337/
[8]. Wulandari, L. Kurniawati, Mundra, I Wayan, & Wijayaningtyas, Maranatha. (2022). The Promising Potential of Sidoarjo Hot Mud As Additional Material For Concrete Lining Production. International Journal of GEOMATE, Vol.23, Issue 95, pp.37-44. https://doi.org/10.21660/2022.95.568