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CHARACTERISTICS OF FLY ASH-BASED GEOPOLYMER MORTAR WITH VARIATION OF TYPES AND DOSAGES OF ADMIXTURE AND CURING SYSTEMS

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ABSTRACT

Geopolymer concrete is the concrete of the future because, in its manufacture, it does not cause environmental problems; instead, it can prevent air pollution and environmental pollution. Geopolymer concrete has several advantages: suitable mechanical properties, high early strength, stable heat, and fire resistance. In the mixture, fly ash, a silicate and aluminum source, is reacted with an alkaline solution as an activator to make a polymerization reaction. To carry out the polymerization reaction, it is necessary to use Sodium Hydroxide or NaOH, which has strong basic properties as an alkaline reactant, and sodium silicate or Na_2SiO_3 as a catalyst.

This study aims to determine the effect of using admixture on the compressive strength of 50x50x50 mm geopolymer mortar cubes. This study's ratio of the alkaline solution was 1/1, while the balance between fly ash/solution was 60/40. Planning a mixture of mortar composition, namely fine aggregate/paste of 65/35. The admixture used is Sikament LN and Sika Viscocrete 1050 HE with a curing system that is humid temperature and at room temperature. Sikament LN content is 0,3%, 1%, 1,5%, and 2% by weight of fly ash, while the Sika Viscocrete 1050 HE content is 0,8%, 1%, 1,5% and 2% by weight of fly ash. Mortar compressive strength test was carried out at 7 days, 14 days, and 28 days.

In this study, the optimum grade for each use of admixture in geopolymer mortar was Sikament LN 0,3% and Sika Viscocrete 1050 HE 0,8% at humid temperature curing, which produced the highest compressive strength of 37,65 MPa and 21,26 MPa at 28 days of age. Increasing the percentage level of the amount of admixture used decreases the results of the mortar compressive strength test. The curing system shows that the mortar with the humid temperature curing system produces a higher compressive strength compared to the room temperature curing system.

Keywords: Geopolymer, Fly ash, Admixture, Curing System

1. INTRODUCTION

Geopolymer concrete is the concrete of the future because in its manufacture it does not cause problems for the environment, instead it can prevent air pollution and environmental pollution (Achmad, 2015). Geopolymer concrete has several advantages, namely having good mechanical properties, high early strength, stable heat resistance and fire resistance. In the mixture, fly ash which is a source of silicate and aluminum is reacted with an alkaline solution as an activator to make a polymerization reaction. To carry out

the polymerization reaction, it is necessary to use Sodium Hydroxide or NaOH which has strong basic properties as an alkaline reactant and sodium silicate or Na_2SiO_3 as a catalyst. The molarity of NaOH and the ratio between Na_2SiO_3/NaOH (alkali) is one of the parameters that affect the strength of geopolymer concrete (Mariamah, 2021).

Furthermore, there have been no studies that have compared different types of admixtures for geopolymer mortars. What is meant in this study is Sikament LN and Sika Viscocrete 1050 HE which are admixtures type F High Range Water Reducer. As for the variation of the curing that is done is the humidity temperature and room temperature tested at the age of 7, 14, and 28 days. Differences in admixture and curing used will be compared to get an overview of the effect of using additives and curing on geopolymer mortar with fly ash from PLTU Asam-asam so that it is known how significant the effect is on the strength of geopolymer mortar and can get the optimum mixture. Geopolymer concrete is the concrete of the future because, in its manufacture, it does not cause problems for the environment, instead, it can prevent air pollution and environmental pollution (Achmad, 2015).

2. THEORETICAL STUDY

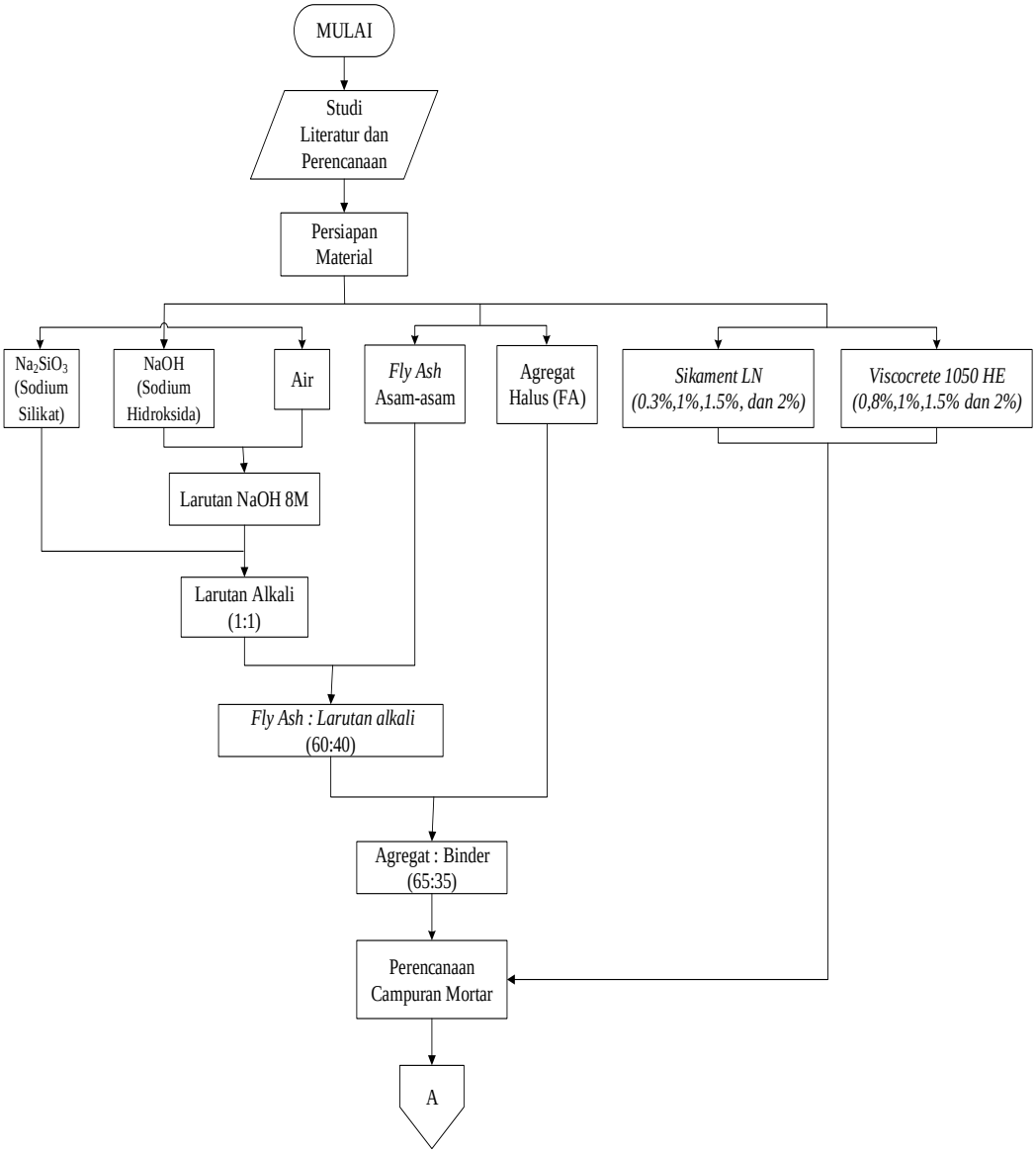
Fly ash is one of the waste materials industries that can be used to make binders in geopolymer concrete. Binder is a binder in a geopolymer concrete mixture consisting of fly ash, excellent in size, and very good for filling cavities in concrete (Achmad, 2015). So far, there have been several studies related to the effect of using additives in geopolymer mortar and yielding different results depending on the composition and mortar additives used, so further research is still needed.

In one of the studies conducted by Ika et al. (2014) regarding the addition of Sikament LN additives to mortar. The results of this study for the compressive strength value of mortar characteristics aged 28 days using Sikament LN with a percentage of 0,6%, 1,0%, and 1,5%. Each variation of the test object aged 28 days respectively reached 28,51 MPa, 26,77 MPa, and 26,55 MPa, while the compressive strength of the characteristics of the mortar without additives was 27,66 MPa. Whereas in research conducted by Dewi et al. (2016) regarding the addition of Sika Viscocrete-10 with percentage variations of 0,5%, 1%, 1,5%, and 2% in concrete. The maximum concrete compressive strength value is obtained by adding Sika Viscocrete-10 with a percentage of 0,5% of 13,68 MPa. From

this, it can be concluded that the smaller the percentage of added material added, the greater the compressive strength value obtained. On the other hand, research on curing for pastes and mortars Prasetyo has been done (2021). Among them are putting in the oven (temperature 900C for 24 hours), room temperature, humid temperature, and wrapping from the results obtained, curing humid temperatures a better compressive strength than other curing methods.

3. METHOD

The form of the flowchart in this Final Project is shown in Figure 3.1.



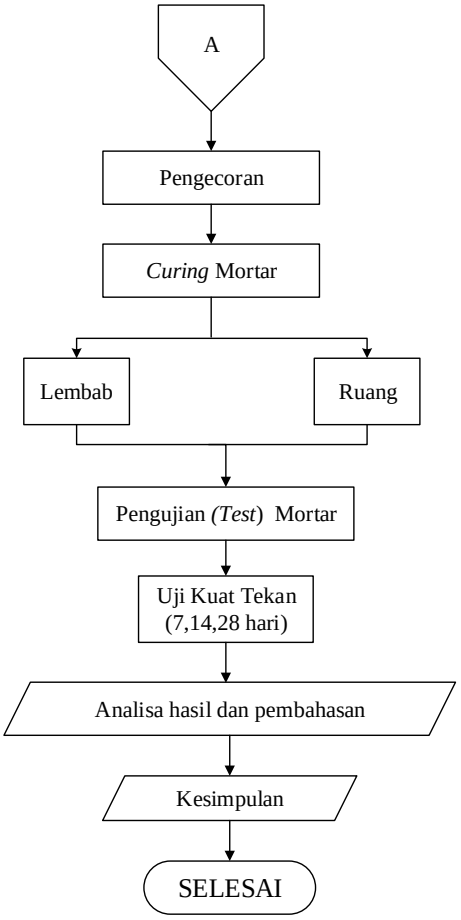


Figure 3. 1 Research Flowchart

4. RESULT AND DISCUSSION

In the geopolymer mortar using Sikament LN, the highest average compressive strength value was obtained with the use of Sikament LN with a percentage of 0,3%, namely at 28 days of age at curing humidity at 32,96 MPa. In comparison, the lowest average compressive strength at 28 days was found in the use of Sikament LN with a percentage of 2% at the curing of 12,6 MPa. From the results obtained, it was seen that there was a decrease in compressive strength of 61,77% in the mortar using Sikament LN with a percentage of 2% at curing room temperature and Sikament LN with a percentage of 0,3% at curing humid temperature. The effect of Sikament LN at 28 days of age with curing humid temperature and room temperature can be seen in Figure 4.1.

Then for the geopolymer mortar using Sika Viscocrete 1050 HE, the highest average compressive strength value was obtained using Sika Viscocrete 1050 HE with a percentage of 0,8%, namely at 28 days of age at curing humid temperature at 19,55 MPa.

In comparison, the lowest average compressive strength at 28 days was found in the use of Sika Viscocrete 1050 HE with a percentage of 2% at the curing of 11,95 MPa. From the results obtained, it can be seen that there was a decrease in compressive strength of 38,87% in the mortar using Sika Viscocrete 1050 HE with a percentage of 2% at curing room temperature Sika Viscocrete 1050 HE with a percentage of 0,8% curing humid temperature. The effect of Sika Viscocrete 1050 HE at 28 days of age with curing humidity and room temperature can be seen in Figure 4.2.

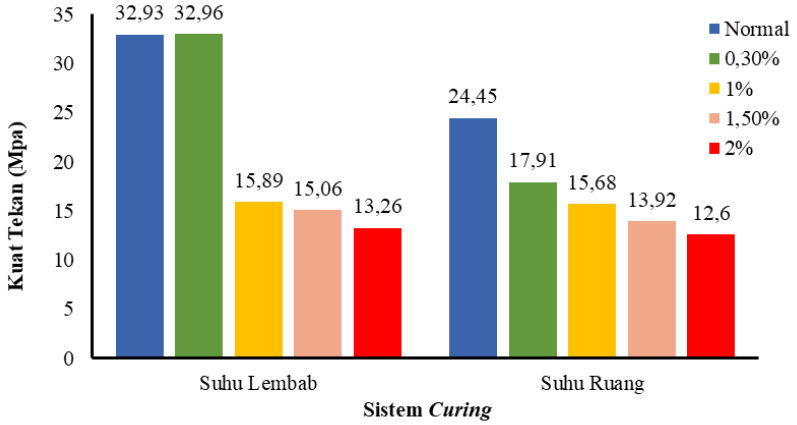


Figure 4.1 Effect Sikament LN at 28 Days of Age with Curing Humid Temperature and Room Temperature

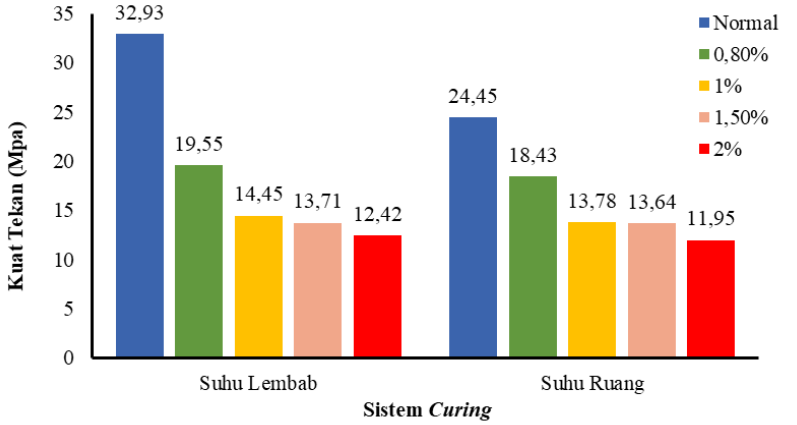


Figure 4.2 Effect Sika Viscocrete 1050 HE at 28 Days of Age with Curing Humid Temperature and Room Temperature

The overall maximum compressive strength results are obtained by using Sikament LN. In addition, the percentage of added materials used, both Sikament LN and Sika Viscocrete 1050 HE , also affects the compressive strength of the geopolymer mortar. This is in line with research conducted by Ika et al. (2014), Dewi et al. (2016) and Andika et al. (2021). If the smaller the percentage of added material is added, the greater the compressive strength value obtained. The study's results also show that using excess additives can reduce the compressive strength of concrete.

The effect of the use of the humidity and room temperature curing methods on the compressive strength of the geopolymer mortar, for maximum results overall, is obtained with the humid curing temperature, both mortars using Sikament LN and Sika Viscocrete 1050 HE. This is also in line with research conducted by Prasetyo (2021) that curing humid temperatures better compressive strength than other treatment methods.

5. CONCLUSION

From the results of research conducted at the Laboratory of Structures and Materials, Faculty of Engineering, the University of Lambung Mangkurat regarding " Characteristics of Fly ash Based Geopolymer Mortar with Variation of Types and Dosages of Admixture and Curing Systems", several conclusions can be drawn as follows.

1. For geopolymer mortar, using Sikament LN has a higher compressive strength than geopolymer mortar using Sika Viscocrete 1050 HE added material. The highest mortar compressive strength test was found in the mortar with Sikament LN 0,3% curing humid temperature. Meanwhile, the lowest mortar compressive strength test was found in the mortar with Sika Viscocrete 1050 HE at a percentage of 2% at curing room temperature.
2. The more percentage of added material used for both Sikament LN and Sika Viscocrete 1050 HE, the lower the compressive strength test results. In this study, the highest yield for the compressive strength test was using Sikament LN at a percentage level of 0,3% with a humid curing temperature, which was 37,65 MPa. Then, for the compressive strength test, the highest results were used with Sikament Viscocrete 1050 HE at a percentage level of 0,8% with a humid temperature curing of 21,26 MPa.

3. For geopolymer mortar with added Sikament LN at curing humid temperature has the highest compressive strength of 37,65 MPa. As for the mortar with the addition of Sika Viscocrete 1050 HE at curing humid temperature, the highest compressive strength of 21,26 MPa.

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