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ANALYSIS OF THE INFLUENCE OF SNAKEFRUIT SKIN ASH ON THE COMPRESSIVE STRENGTH OF K-175 CONCRETE

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ABSTRACT

Research has been carried out on K-175 concrete with a mixture of snakefruit bark ash with the aim of determining the effect of snakefruit bark ash on the mechanical properties of K-175 concrete. The test object used was a cube measuring 15 cm x 15 cm x 15 cm with standardization SNI-7394-2008 with quality K-175 with a cement ratio of 1: 2.3: 3.1 with FAS 0.6. The mechanical properties testing carried out was compressive strength testing and determining the crystal structure and filler phases of the concrete after soaking for 28 days and drying for 24 hours. Based on the research results with a mixture of snake fruit ash (0%, 0.5%, 1%, 2%, 4%) the average compressive strength test results were 18.11 Mpa, 17.21 Mpa, 17.02 Mpa, 20, respectively. 23 Mpa, and 16.80 Mpa. Where the test is carried out after the concrete is 28 days old. From the results of the compressive strength test, the concrete experienced an insignificant decrease in compressive strength with each addition of snakefruit bark ash, but the compressive strength increased with the percentage of snakefruit bark ash (2%). The maximum compressive strength result with a mixture of snakefruit bark ash was 20.23 Mpa. Based on the test results and X-Ray Diffraction analysis results, it shows that the concrete samples containing silica are mostly amorphous, it can be seen in the graphic image that there is only a very small amount of X-ray diffraction which has sharp and angular peaks, this shows that the crystalline SiO_2 content is getting smaller thus most of the SiO_2contained in the sample is amorphous

Keywords: Compressive Strength of Concrete, Snakefruit Bark Ash, X-Ray Diffraction.

INTRODUCTION

Concrete is a construction material with a composition consisting of several mixtures, namely cement, fine and coarse aggregate, water, using additional materials if necessary or not using additional materials. Crushed stone and marble which act as coarse aggregates in making concrete and sand which act as fine aggregates are the main components in making concrete and also act as reinforcements, while the mixed material in the form of cement and water functions as a binder between the other components (Simanjuntak, 2021) .

Factors that have a big influence on concrete strength are cement quality, mix ratio, strong and clean aggregate, good mixing process, compaction and concrete maintenance. Apart from that, the compressive strength of concrete is also an important thing in determining the quality of concrete structures. Another important role that influences the strength and structure of

concrete is the mixture and quality of the materials used. Generally, concrete is used in various fields of construction such as columns, foundations, plates, beams, bending, and so on. Therefore, it is important to ensure that the mixture and quality of concrete materials comply with the established standards which we can see in SNI 03-2847-2002. Concrete compressive strength is a very important indicator for estimating the quality of a structure. The composition and quality of the materials used in mixing concrete will have a significant influence on the strength and quality of the concrete structure itself (Sani, 2021)

In this day and age, the need for concrete is increasing due to the ongoing development in the construction sector which requires several materials, especially concrete, as well as the need for other materials to form it. The more concrete and its constituent materials such as river rock and sand are used, the more mining will cause environmental damage. Therefore, it is necessary to look for alternative materials as a substitute for some concrete mixtures, in particular we can use agricultural waste and industrial waste as a substitute for coarse aggregate in the concrete mixture without reducing the compressive strength of the concrete, and this is also an effort to preserve the environment by reducing river rock mining. carried out continuously until coarse aggregate is obtained (Riyono, et al., 2022).

Most areas in Indonesia can grow snake fruit, whether preserved or growing wild. Many snake fruit processing industries produce snake fruit skin waste. Central Java is one of the regions in Indonesia that still prioritizes agricultural development. Based on data from the Central Statistics Agency (BPS), Central Java is the largest snakefruit producing region in Indonesia with production of around 718,734 tons or the equivalent of 51.2% of the total national snakefruit production last year. The Central Statistics Agency (BPS) also reported that snake fruit production in Indonesia continued to increase by 25.4% compared to the previous year, reaching production of 1.4 million tons. The large yield of snake fruit plants also increases waste from snake fruit, one of which is snake fruit skin. Snakefruit skin that is still fresh or has just been removed usually contains water, carbohydrates, protein and minerals. This content can be converted into activated charcoal because it contains carbon (cellulose). The added ingredient to the powder concrete mixture is made from carbonized snake fruit bark waste. This added ingredient contains cellulose which can increase the compressive strength value of the concrete (Rahayu, 2018).

Snakefruit skin has a fairly high SiO_2 content which can result in an increase in the quality of the mixture. According to research conducted by Fauziah Sulaiman (2019), snake fruit skin contains quite high levels of silica, generally snake fruit skin contains 65% silica and small amounts of alkali and metal impurities. The high silica content in snake fruit ash can be used as an alternative source of silica in making concrete mixes. Snakefruit skin has a silica content of 39.67% in snakefruit seeds (Dyah, et al, 2019). Snakefruit fronds also contain silica reaching 42.45% (Rahmah, 2017)

Based on previous research regarding silica and cellulose content, snake fruit skin shows the highest proportion of all parts of the snake fruit plant that contain silica and cellulose. Therefore, snake fruit bark can be used as research with new innovations and developments from previous research, by innovating concrete mixtures with snake fruit ash. This is done because snake fruit skin has a silica content of 65%. Seeing the large amount of waste from snake fruit production every year that has not been utilized by the community.

Therefore, this research also aims to identify the potential for utilizing snake fruit skin waste with new innovations to optimize the economic value of this waste. It is hoped that this research can make a positive contribution to reducing waste and reducing mining which can damage nature.

Table 1. Snakefruit peel composition

Number	Compound	Amount
1	Water	74,67%
2	Carbohydrates	5,8%
3	Proteins	0,565%

In snake fruit skin there is activated carbon which contains aliphatic -OH, C-H, C-O, Si.O, C-C alkyl compounds. And in the EDS spectra a peak will appear indicating the element Si or what is usually called silicon. Snakefruit skin contains cellulose which can be read via FTIR because of the -OH compound found in snake fruit skin.

Figure 1. Pressure Test Equipment

RESEARCH METHOD

Research Location and Time

This concrete manufacturing research was carried out at the Physics Laboratory of FMIPA Medan State University and the Civil Engineering Concrete Laboratory of Medan State University which are located on Jl. Williem Iskandar Pasar V Medan Estate, Medan 20221.

Research Tools and Materials

Table 2. Research tools used

Number	Tool Name	Spesification	Quantity
1	Scales	5 kg and 15 kg	1 piece
2	Measuring cup	1000 ml and 100 ml	1 piece
3	Soaking Tub	-	1 piece
4	Oven	-	1 piece
5	Cement spoon	-	3 pieces
6	Colander or sieve	-	11 pieces
7	Concrete mold (mold steel)	Cube(15 cm x 15 cm x 15 cm)	1 piece
8	Bucket		3 pieces
9	XRD		1 piece

Table 3. Materials used in research

Number	Material Name	Specifications
1	Fine aggregate	Ordinary Sand
2	Coarse aggregate	Crushed Stone 3/4
3	Cement (3 wheel brand)	Cement 3 Wheel
4	Water (UNIMED Physics Lab)	PAM
5	Dried Snakefruit Skin	Snakefruit
6	Oil	-

Research Analysis

This research aims to find alternative materials that can improve the quality and performance of concrete. The method used is experimental, which involves material inspection and feasibility testing of the materials to be used in making K-175 concrete. After that, mixing (mix design) and mixture trials are carried out to create high quality concrete. Concrete mix planning is an important theoretical process for determining the proportions of materials required to comply with standards. In this research, mix design is based on the standard method SNI 7394-2008.

The planned test object is in the shape of a cube with dimensions of 15 cm x 15 cm x 15 cm consisting of high quality concrete with the substitution of cement, coarse aggregate, fine aggregate, water, snake fruit ash.

Concrete compressive strength is the ability of concrete to withstand or accept compressive forces per unit area (Balsala, et al., 2018). Compressive strength can be calculated by dividing the maximum load that can be

supported by the object to be tested by the cross-sectional area when the test object experiences structural failure. The compressive strength parameter will indicate the magnitude of the load per unit area which can cause the test object to crumble with a certain compressive force. During the pressure test, a tool called *Universal Testing Machine* (UTM) is used. The concrete compressive strength test is carried out after the maintenance process and the maintenance period after 28 days with reference to SNI 1974: 2011. The concrete compressive strength test is calculated based on SNI 1974: 2011 (BSN 2011) with the equation:

$$\sigma = \frac{P}{A}$$

XRD (X-Ray Diffraction) is one of the oldest characterization methods that is often used today. XRD using X-ray diffraction is an analysis method that uses X-rays with atoms arranged in a crystal system. There are 3 possibilities that will occur if an X-ray beam interacts with a material, these 3 possibilities are absorption, scattering (diffraction), and re-emission (fluorescence) of X-rays with lower energy. The three phenomena above will become the basis for analyzing X-ray techniques (Setiabudi., 2012).

Monochromatic This pattern will later be used to analyze the crystal structure and lattice parameters of the sample. The emitted X-rays will not diffract coherently if the crystalline and amorphous structures are disordered, but will experience Compton scattering. Compton scattering will occur when X-rays interact with free electrons in the sample and experience a change in energy and change in direction.

RESULT AND DISCUSSION

Concrete is made from a mixture of snakefruit bark ash which has been made with a mixture of cement, coarse aggregate, fine aggregate and also water. Mixing the concrete with a cube-shaped specimen measuring 15 cm x 15 cm x 15 cm was carried out by molding, soaking the sample and then removing it from the soaking tub after 28 days, after which the sample was placed in the curing room until the sample was dry. Then the mechanical and structural properties of the concrete samples were tested. The composition of the concrete mixture in this study is based on SNI-7394-2008 with quality K-175, namely with a ratio of cement: fine aggregate: coarse aggregate of 1: 2.3: 3.1 with FAS 0.6. The ratio of the composition of the concrete mixture, including cement, sand, snake fruit pulp ash, greatly influences the characteristics of the concrete. The mechanical properties tests carried out include the compressive strength of the concrete, and an XRD test will be carried out.

Compressive Strength Test Results

Concrete compressive strength testing is carried out to measure the compression strength of concrete, especially concrete consisting of a mixture of snake fruit ash. This test uses a Universal Testing Machine (UTM) testing machine to apply pressure gradually to the concrete sample. Concrete pressure is the amount of force applied per unit area, which causes the concrete sample to crumble when exposed to a certain load from the machine.

Based on Figure 2, it can be seen that variations in the bark ash mixture show an influence on the compressive strength of the concrete. Concrete mixed with snake fruit ash experienced an increase in compressive strength with a variation of 2% so that it had a maximum average compressive strength of 20.23 MPa, while the minimum average compressive strength of concrete with a mixture of snake fruit ash had a variation of 4%, namely 16.8 Mpa.

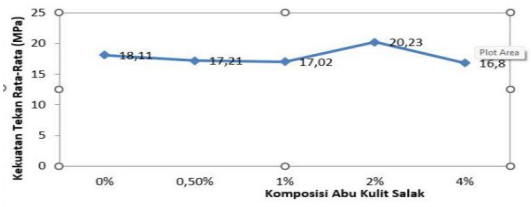

Figure 2. Overall Average Compressive Strength Graph of Concrete

This irregular pressure drop is caused by uneven mixing, causing many pores or cavities in the concrete, causing the concrete to not be unified or homogeneous in the mixture. The

addition of a large mixture of snakefruit bark ash composition can trigger water absorption in making concrete.

X-Ray Diffraction Test Results

XRD testing aims to determine the phase and crystal structure contained in the sample. The results of the XRD sample analysis can be seen in Figure 3

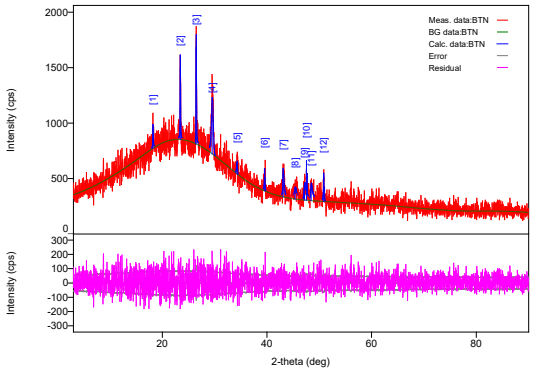

Figure 3. XRD Analysis Chart

Based on the test results and analysis results, it shows that the concrete samples containing silica are mostly amorphous, it can be seen in the graphic image that there is only a very small amount of X-ray diffraction with sharp peaks and angles, this shows that the crystalline SiO_2 content is getting smaller and thus the majority The SiO_2 contained in the sample is amorphous.

CONCLUSION AND SUGGESTION

Conclusion

From the results of the research that has been carried out, the following conclusions can be drawn:

1. From the results of the snakefruit bark ash mixture, the compressive strength of the concrete decreased with each addition of mixed ingredients but the compressive strength of the concrete increased, namely 20.23 Mpa with the percentage of snakefruit bark ash (2%). This exceeds the pressure strength set by the Indonesian National Standards Agency (14.5 MPa).
2. From the results of the XRD analysis there are elements of Si (Silica). The diffractogram of the concrete sample shows the presence of silica phases in amorphous and crystalline form

Suggestion

1. It needs to be done again by adding a composition of various snake bark ash in order to improve the quality of the concrete because the decrease and increase are not significant
2. It is necessary to retest with snakefruit peel ash used as an additional ingredient, not a substitute ingredient.
3. Further researchers need to pay more attention to sample care and making better samples to achieve homogeneity of the mixture in order to improve the quality of concrete.

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