The effect of adding visocrete - 1003 on compressive strength of concrete using electric pole waste as a partial replacement of coarse aggregate

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Abstract. The use of aggregate from electric pole waste material is expected to produce concrete with economic value. The study was conducted by an experimental method in the laboratory, utilizing waste electricity poles broken down to the size of coarse aggregates. The use of waste in the concrete mixture is 20% of the weight of the coarse aggregate and to increase the quality of the concrete, the visocrete-1003 admixture is used in the mixture. The variation of the admixture used was 0.5%, 1.0%, and 1.5% by weight of cement. Mixed planning using the SNI-03-2847-2002 method. The specimen for compressive strength is cylindrical with a diameter of 150 mm and a height of 300 mm. Compressive strength testing is done on 28 days. The results of the study for normal concrete compressive strength on 28 days were 397.71 kg/cm². Concrete compressive strength using 20% waste aggregate and the addition of visocrete-1003 of 0.5%, 1.0% and 1.5% is 427.25 kg/cm², 469.30 kg/cm², 506.79 kg/cm². In general, the higher the percentage of visocrete-1003, the higher the compressive strength of concrete with a mixture of waste. The admixture of visocrete-1003 can improve workability, make concrete more flow, and accelerate hardening.

1. Introduction
Concrete is the building material that is most needed in the world of construction. One material that contributes strength to concrete is coarse aggregate. This material can be obtained naturally, by a stone crusher or artificial production. Currently, the use of concrete waste is being processed into new material so that it can be reused. There is one way to turn waste products into a useful resource on the environment recycling construction waste [1]. Recycling using waste materials to produce new materials with similar characteristics that can be applied to the structure will provide high material use efficiency [2]. Recycled concrete which is crushed and used as aggregate to produce concrete is an alternative that minimizes concrete waste and helps conserve abiotic resources. The use of waste is generally in the form of coarse aggregate. If the aggregate is fine, the quality of the concrete tends to decline [3]. The replacement of natural aggregate with recycled aggregate will give new characteristic values of concrete. Concrete using recycled aggregate will generally provide low strength [4]. To obtain the desired strength and workability when varying the use of recycled aggregate from waste concrete can add a high-performance superplasticizer [5]. Recycled concrete containing crushed rock aggregate strength and elastic modulus is lower, whereas recycled concrete that uses gravel has a higher strength [6]. The workability of concrete that uses a greater content of recycled aggregate will give a lower slump value but a higher
slump flow value. The use of recycled aggregate with a coarse and angular texture will increase the strength of the concrete and improve the slump and slump flow values in the mixture [7].

2. Research methodology

This research is a laboratory experiment that utilizes electric pole waste as a partial replacement of coarse aggregate and adding viscocrete-1003 admixture. The study begins by conducting property tests on coarse and fine aggregates to be used. Property results are used as a basis for making the job mix. Concrete mix planning is the first step that must be done before making the concrete mixture. Currently, there are many methods that can be used as a reference for making self-compacting concrete [8].

2.1. Concrete waste

Concrete waste in large quantities will produce environmental problems and require a fairly large area as a piling place. To overcome this problem, innovation is needed to utilize the waste. This study uses electric waste concrete poles derived from the remainder of the flexural testing carried out every 500 electricity poles production. As a result of this test, the pole will be destroyed and become a waste. Quality of waste concrete electric pole K 500, crushed then sieved to obtain granules of coarse aggregate retained in a sieve of 40 mm. The utilization of recycled aggregates is a new innovation in sustainable development. Recycled aggregate which is used in the concrete mixture is an alternative to help sustain the aggregate reserves contained in nature [9]. Recycled coarse aggregates have relatively finer particles than natural coarse aggregates [10].

2.2. Admixture

Admixture is the material that is added during the mixing process of concrete, cement binding to modify the properties of fresh concrete or concrete hard. The admixture used is sika viscocrete-1003, which has the function of increasing the compressive strength of the concrete mix flows, thus improving workability. Viscocrete-1003 includes the added material admixture type F [11], SCC concrete using coarse aggregate is said to have a good performance if it flows in a compact layer during the SF testing process. The circle diameter in the SF test is based on the horizontal projection of the average diameter of the coarse aggregate, the empty space between aggregates, and the thickness of the mortar layer [12].

2.3. Compressive strength

The strength of the concrete is the result of a compressive strength machine which is applied pressure in the form of a load force on the test object until it breaks [13].

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concrete\ compressive\ strength = \frac{P}{A}
\]  

(1)

P = maximum load (kg); A= sectional area of the specimen (cm²).

The greater the amount of recycled aggregate used in SCC type concrete, the lower the compressive strength, flexural strength and split tensile strength [14].

2.4. Slump test

The slump test equipment is mainly used for measuring concrete in a plastic state and is used in the concrete mixture which is very dry or wet, as well as for the maximum aggregated value of 25.4 mm with a slump test plan of 75-100 mm [15].

3. Results and discussion

3.1. The result of fine aggregate properties

The results of fine aggregate testing are presented in Table 1.
Table 1. Properties of fine aggregates.

| Type of testing     | Result | Unit | Standard SNI   |
|---------------------|--------|------|---------------|
| Fineness modulus    | 3.78   | -    | 1.5-3.8       |
| Sludge levels       | 1.210  | %    | < 5%          |
| Bulk Density        | 1.699  | Kg/ltr | 1400-1900     |
| Specific Gravity    | 1.555  | gram | 2.58-2.83     |
| Water Absorption    | 2.041  | %    | 2-7%          |
| Water content       | 3.26   | %    | 3-5%          |

Visible results in Table 1 the fine aggregate properties have met the Indonesian National Standard (SNI), except the specific gravity and this will affect the weight of the plan for fine aggregates in concrete mixtures.

3.2. The results of the coarse aggregate properties

Table 2. Properties of coarse aggregate.

| Type of testing     | Result | Unit | Standard SNI   |
|---------------------|--------|------|---------------|
| Fineness Modulus    | 5.80   | -    | 5-8           |
| Bulk density        | 1.729  | kg/ltr | 1400-1900     |
| Specific Gravity    | 2.539  | gram | 2.58-2.83     |
| Water Absorption    | 2.652  | %    | 2-7%          |
| Water Content       | 0.79   | %    | 3-5%          |
| Abrasion Value      | 25     | %    | Max <50%      |

The results of the coarse aggregate properties already meet the Indonesian National Standard (SNI) except water content. The coarse aggregate used is splits with a maximum size of 30 mm. The water content will affect the amount of water used to make the mixture.

3.3. Material composition

The results of the properties of coarse aggregate and fine aggregate used to make concrete mix design. Mixed planning refers to SNI-03-2834-2000 with a compressive strength of 400 kg/cm². The composition for 1 m³ of concrete is presented in Table 3.

Table 3. Composition for 1 m³ of concrete.

| Types of concrete     | Cement (kg) | Water (liter) | Fine Aggregate (kg) | Coarse Aggregate (kg) | Waste Electric Pole (kg) | Viscocrete 1003 (liter) |
|-----------------------|-------------|---------------|---------------------|-----------------------|--------------------------|--------------------------|
| Concrete              | 485.71      | 182.82        | 664.51              | 1,096.96              | -                        | -                        |
| 20% Waste Concrete +  | 485.71      | 182.82        | 664.51              | 877.57                | 219.39                   | 2.42                     |
| admixture viscocrete 0.5% |            |               |                     |                       |                          |                          |
| 20% Waste Concrete +  | 485.71      | 182.82        | 664.51              | 877.57                | 219.39                   | 4.84                     |
| admixture viscocrete 1% |            |               |                     |                       |                          |                          |
| 20% Waste Concrete +  | 485.71      | 182.82        | 664.51              | 877.57                | 219.39                   | 7.28                     |
| admixture viscocrete 1.5% |            |               |                     |                       |                          |                          |
3.4. Slump test
The slump test results for the addition of viscocrete-1003 are presented in Figure 1 and water usage in Figure 2.

![Figure 1. Relationship between slump value and viscocrete addition.](image1)

![Figure 2. Relationship of water use to the addition of viscocrete.](image2)

In Figure 1, the greater the viscocrete-1003 levels added, the higher the slump value obtained so that the workability is easier. Conversely, the less amount of water used for mixing, this can be seen in Figure 2.

3.5. Compressive strength test
Compressive strength performed on day 28, the result of normal concrete compressive strength of concrete with mixed waste and 20% and the addition of admixture viscocrete 1003 with a variation of 0.5%, 1% and 1.5% can be obtained is shown in Figure 3.
The compressive strength result in Figure 3 shows that the use of aggregate electric pole waste as much as 20% does not affect the planned compressive strength. The higher the percentage of viscocrete-1003 added, the greater the compressive strength produced.

4. Conclusion
Based on the data and the results of the sample testing conducted, it can be concluded that the results of the compressive strength test of concrete samples on 28 days 397.71 kg/cm² are correct. Testing by partially replacing the coarse aggregate from waste electrical poles with 20% and a variation of viscocrete-1003 admixture of 0.5%, 1% and 1.5% by weight of cement on 28 days in a row is 427.25 kg/cm², 469.30 kg/cm² and 506.79 kg/cm². Admixture viscocrete-1003 can improve the workability and make more concrete mixture flow, and it quickly hardens.

Acknowledgment
The authors thank the Chairman of the Sekolah Tinggi Teknologi Pekanbaru and Head of laboratory materials/concrete that has been granted permission to use the laboratory facilities for conducting this research.

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