Characteristics of Asphalt Concrete-Wearing Course (AC-WC) mixtures using concrete waste as rought agregate and addition of Wetfix-Be

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Abstract. Aggregates are important in the construction and improvement of roads but their numbers are limited due to deep river dredging and it is therefore necessary to find other materials that can be used instead of easily and cheaply obtained aggregates. This study, using concrete waste and the disadvantage is having a high absorption because it needs to be added an additive, namely Wetfix-Be so that the use of concrete can be applied in the field. The method used in this study is an experimental method using a laboratory scale. Tests conducted in this study are concrete waste as coarse aggregate. With variations with coarse aggregates of 40 and 60, 80 and 20, 100 and 0, and the results of comparison of Wetfix-Be material used are 0, 15%, 0.25%, 0.35%, 0.45% by weight of asphalt. The results of this study proved to be able to increase the value with an optimal Wetfix-Be of 0.25% of asphalt weight and asphalt weight of 6.3% The benefit of this research is to determine the characteristics of concrete waste by using Wetfix-Be added material on the flexible pavement in the AC-WC mixture and can reduce construction waste in Indonesia.

1. Introduction
The phenomenon of transportation infrastructure development is the increase in road infrastructure that is built, the need for material and other materials that form a large amount of reinforcement structure [1]. The main ingredients that make up the pavement structure are aggregates and adhesives, approved by aggregates to be very important [2]. Because more material is agreed because it is more limited, because mining aggregate material in river areas or in hilly areas has a detrimental effect on the environment [3]. Then it needs to be done new to find alternative aggregate materials that are easily available and relatively inexpensive. In this study, using concrete waste as a substitute for coarse aggregate. However, the weakness of concrete waste has a high absorption [4] so that additional substances need to be added, namely Wetfix-Be. Waste generated from compressive strength testing results of concrete in the laboratory is very much supported by 35 Mpa f’c quality [5]. Wetfix-Be is a chemical produced by Akzo Nobel Surface Chemical produced as an anti-stripping / peel that can increase bonding and stabilize the aggregate mixture that is paved due to adhesion promoter substances for hot and warm asphalt mixtures, cut-back [6]. Besides Wetfix-Be also functions as an anti-aging and resistant to water [7]. Water resistance is needed to reduce damage during the Rainy Season [8]. The benefit of this research is to study some of the benefits of concrete and Wetfix-Be waste as a mixture of aggregate and asphalt AC-WC and can be used in Indonesia so that it can be reused with a higher structural value [9].
2. Research methods
This research method using experimental methods to test specimens of asphalt used as a binder layer of asphalt concrete (laston) compared to other binder materials namely bitumen 60/70 and Wetfix-Be pertamina pen and aggregate used is concrete waste.

2.1. Waste aggregates and concrete properties
Testing was conducted to determine the characteristics of the aggregates and concrete waste to be used as a mixture laston.

2.2. Properties asphalt and Wetfix-Be laston
This test is used to determine the characteristics of bitumen and Wetfix-Be to mix laston. Making the Job Mix This test is used to determine the characteristics of bitumen and Wetfix-Be to mix laston [10].

2.3. Making the job mix design
Making the job mix designs using coarse aggregate with a variation of crushed stone aggregates and concrete waste 0/100, 40/60, 80/20 and 100/0 to get the value of Optimum Asphalt Content.

2.4. Preparation of the test object
Preparation of the specimen using Optimum Levels Waste Asphalt Concrete and Asphalt mix + Wetfix-be. Levels Preparation of the specimen using Optimum Levels Waste Asphalt Concrete and Asphalt mix + Wetfix-be. Levels Preparation of the specimen using Optimum Levels Waste Asphalt Concrete and Asphalt mix + Wetfix-be. Levels Wetfix-Be used were 0,15, 0,25, 0,35, and 0,45 of heavy bitumen.

3. Results and discussion

3.1. Test results

3.1.1. Waste aggregates and concrete properties. From the test results broke and waste concrete aggregate obtained the following characteristics Table 1:

| No | Types of Tests | Method          | Requirements | Result | Information |
|----|----------------|-----------------|--------------|--------|-------------|
| A  | Coarse Aggregates |                |              |        |             |
| 1  | Specific gravity | SNI 1970:1990  | Min 2,5      | 2,67   | OK          |
| 2  | Absorption      | SNI 1969:1990  | Max 3%       | 2,27   | OK          |
| 3  | Abrasion (500 rounds) | SNI 2417:2008 | Max 40%      | 14,01  | OK          |
| 4  | Abrasion (100 rounds) | SNI 2417:2008 | Max 6%       | 2,61%  | OK          |
| 5  | Passed Sieve No. 200 | SNI 03-4142-1996 | Max 2% | 0,77  | OK          |
| 6  | Oval Flat Index  | ASTM D4791     | Max 10%      | 10%    | OK          |
| B  | Aggregate Fine  |                |              |        |             |
| 1  | Specific gravity | SNI 1969:1990  | Min 2,5      | 2,64   | OK          |
| 2  | Absorption      | SNI 1969:1990  | Max 3%       | 3,0    | OK          |
| 3  | Passed Sieve 200 | SNI ASTM C117:2012 | Max 10% | 8,29  | OK          |
| 4  | Sand equivalent | SNI 03-4428-1997 | Min 60% | 95,6  | OK          |
| C  | Aggregate Average |              |              |        |             |
| 1  | Specific gravity | SNI 1970:1990  | Min 2,5      | 2,67   | OK          |
| 2  | Absorption      | SNI 1969:1990  | Max 3%       | 2,15   | OK          |
| 3  | Passed Sieve No. 200 | SNI 03-4142-1996 | Max 2% | 0,58  | OK          |
Table 1. Cont.

| D. Waste Concrete |                  | SNI 1969:1990 | Min 2.5 | 2.60 | OK  |
|-------------------|------------------|---------------|---------|------|-----|
| 1 Specific gravity|                  |               |         |      |     |
| 2 Absorption      | SNI 1969:1990    |               | Max 3%  | 3.98 | Not OK|
| 3 Abrasion (500 rounds) | SNI 2417:2008   | Max 30%       | 28.52   | OK   |
| 4 Abrasion (100 rounds) |            | Max 6%        | 5.35    | OK   |
| 5 Oval flattened Index | ASTM D4791     | Max 10%       | 0       | OK   |

3.1.2. *Properties asphalt.* Here are the results from testing the properties of asphalt to be used, attached in the following Table 2:

Table 2. Properties of asphalt.

| Characteristic       | Unit | Result | Specification | Information |
|----------------------|------|--------|---------------|-------------|
| Specific gravity     |      | 1,032  | >1,0          | OK          |
| Viscosity            | Cst  | 360    | >300          | OK          |
| Flabby point         | °C   | 49     | >48           | OK          |
| Flash point          | °C   | 241,50 | >200          | OK          |
| Penetration          | Cm   | 66,83  | 60-70         | OK          |
| Ductility            |      | >106   | 100           | OK          |
| The solubility of TCE |  | 99,25  | 99            | OK          |

3.1.3. *Preparation of test objects using concrete waste.* From the results, optimum asphalt normal levels of 6.33% seen in Figure 1:

![Figure 1. Normal optimum asphalt content.](image-url)


**Figure 2.** Levels of Concrete Waste Optimum 100%.

**Figure 3.** Results Marshall parameters using Wetfix-Be content 0.25% by weight of the asphalt.
3.2. Discussion

Based on the results of testing the characteristics of aggregates, concrete and asphalt waste, that the aggregate are chemicals that are useful to improve bonding and stabilizing mixture aggregates and asphalt, especially in the rainy season. Therefore this research using Queued stripping Wetfix-Be this as a mixture of laston.

The results of the testing of concrete waste approaching normal value is 100% waste concrete with the optimum bitumen content to 6.58% and the results of the use of Wetfix-Be Optimum is on content of 0.25% by weight of the asphalt. This research is evident from the results of the pore volume in concrete asphalt solid (VIM) entry Highways specification that is equal to 3-5%. So this research can recommends the use of concrete waste can improve the structure of the flexible pavement mix AC-WC and can reduce construction waste in Indonesia.

4. Conclusion

Based on the results of research on the use of concrete waste as coarse aggregate and the use of Wetfix-Be as an additive can be concluded as follows:

- Optimum levels of value that is 6.33% asphalt and concrete waste optimum level of 100%. While Wetfix-Be content value is 0.25%.
- The use of waste concrete as coarse aggregate to improve the characteristics concrete mix asphalt wearing course that is the stability. Value stability continues to increase along with increasing the amount of waste concrete as coarse aggregate. Highest stability 100% waste concrete with stability value of 1533.1 kg.
- Proven to increase the value of stability. the highest stability value is at the Wetfix-Be level of 0.25% of the weight of asphalt.
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