International Journal of Applied Engineering Research
ISSN 0973-4562 Volume 10, Number 6 (2015) pp. 14637-14644

http://www.ripublication.com

Influence of Virgin Material on Cement Treated Recycling Base (CTRB) Construction

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Abstract

Natural resources such as natural material such as stone, sand, asphalt which has long been used by humans for road construction because of the limited experience any material taken will collide with the preservation of the environment so that the construction work of road infrastructure obstacles and ultimately can lead to the work stalled road infrastructure. To overcome these problems it is necessary to the implementation of the technology development of road infrastructure by using recycled. The purpose of this study to determine the effect of cement and virgin material as a mixture of construction of Cement Treated Recycling Base (CTRB). This study uses an experimental method in the laboratory with a cylindrical specimen diameter of 15 cm height of 30 cm made of Reclaimed Asphalt Pavement (RAP) Kudus-Demak roads with cement content 7% is used for testing the uncondifined compressive strength (UCS) at the age of 7 days. The results show that the addition of virgin material will increase the uncondifined compressive strength (UCS) and added material from these laboratory experiments can increase the carrying capacity CTRB construction.

Keywords: recycling, uncondifined compressive strenght, virgin material.

Introduction

Techique of Recycling Road Construction (recycling) pavement is processing and using of the old pavement re-construction (existing), either with or without the addition of new material, for the purposes of maintenance, repair or improvement of pavement construction [8].

[3, 12] Lario R., stating that the recycling of construction work done on the pavement / insitu more ffectively and efficiently.

From the research laboratory explained that the recycled materials are stabilized with cement and asphalt foam produce a compressive strength of 14.4 MPa, unconfined compressive strength (UCS) test results a mixture of recycled materials produce compressive strength of 1400 kPa to 2300 kPa and the results of testing the direct tensile strength produce a tensile strength of 40 kPa to 120 kPa.

Construction recycled pavement has the toughness to prevent reflective cracking in pavement wear layers so that the occurrence of holes in the road can be minimized.

[5, 13] Okafor FO, said the strength of concrete made of RAP depends on the bond strength of mortar asphalt (asphalt binder - sand as filler) coating of the aggregate cannot produce concrete with compressive strength above 25 MPa. However, for medium and low quality concrete, RAP material used should be comparable with natural gravel aggregate.

Recycled asphalt concrete containing 40 % RAP can be used as a road surface layer , from the same study showed that the performance of laboratories and test pavement experimental results . Instead of recycling containing RAP 70 % is not recommended strength is lower than with the construction of the road with a mix of new material [7, 10].

RAP mix to 50% is recommended to use for road construction under Superpave standards, but RAP gradation and aggregate quality should be good. In general, an increase in RAP contents of the mixture increases rigidity and lowers its shear strain, and increases resistance to deformation.

To generate a strong superpave with recycled materials asphalt pavement (RAP) is required right method in the mixing process from choosing the RAP, examines the nature and composition of the gradation [4].

The use of waste materials highway can save natural resources and cost about 20 to 40 percent, saving fuel oil and faster process 30 to 40 percent compared with the construction work with new material old pavement layer carded and processed according to specific requirements to become construction new pavement strong and stable [2].

[8, 9] Wirtgen G. (2004), states recycled materials use cement pavement has a rigid nature but watertight, while the recycled pavement material that uses asphalt stabilizer material is flexible but not waterproof. For material recycling pavement already contains asphalt (RAP) when stabilized with cement will produce pavement that has semi flexible nature.

Materials used in the construction of Cement Treated Recycling Base (CTRB) consists of material scratching the old pavement, new aggregates, Portland cement, water. Construction recycling / CTRB produces solid material used as a foundation on (base) and shaped like concrete (concrete soil) but is flexible because it contains asphalt, so often called semi-rigid pavement construction. RAP usage of 14%; 20%; 28% to 40% can be recycled for road pavement layers, using RAP is a way to reduce the cost of new asphalt [6, 11].

The addition of additives such as water and cement in recycled asphalt pavement material produces a particular strength. Strength mixture of recycled materials is

affected by factors of cement water, if water-cement factor improved in the material mixture, its power decreases and vice versa if the water-cement factor reduced the strength of the mixture increases but would have difficulty in mixing process. Factors effective water cement used in the mixture of recycled pavement material between 0.45 to 0.5 and can generate a certain compressive strength in 28-day treatment period [1, 13].

Material and Methods

Preparation of Material

a) Virgin material (crushed stone) is used as a mixture of recycled aggregate to be printed into the specimen.
b) Reclaimed Asphalt Pavement (RAP) as recycled aggregate which became the principal material in a mixture of the test object.
c) Portland cement is used to unify the aggregate and increase the strength of the test specimen.
d) Water is used as a cement mixture to bind the material so that it becomes an integral and strong and has a particular value of compressive strength.

Figure 1: Virgin material and Reclaimed Asphalt Pavement (RAP)

Methods

Experimental design of this research is to conduct experiments in the laboratory using a cylindrical test specimen diameter 15 cm, height 30 cm and used cement water factor of 0.5. The first study was filter performed virgin material and RAP for known gradation.

Furthermore, considering the proportion of virgin material to be mixed with waste materials asphalt pavement (RAP).

The next process makes things much as 20 pieces with interventions that RAP mixes with water, cement and virgin materials (crushed stone) in the group of test specimens and performed treatment for 7 days, after the test so that the press can know the strengths of each. The main objective of the study was to determine the compressive strength of the test specimen and the influence of the proportion of virgin materials (crushed stone) on Cement Treated Recycling Base (CTRB) construction.

Table 1: Gradient scratching mixture

Sieve size (ASTM)	The percentage that passed the filter	
	Foundation Layer	Bottom Foundation Layer
2” (50,0 mm)		
1 1/2” (37,5 mm)	100	88 – 95
1” (25,0 mm)	79– 85	70 – 85
3/8” (9,50 mm)	44– 58	30 – 65
No.4 (4,75 mm)	29– 44	25 – 55
No.10 (2,0 mm)	17– 30	15 – 40
No.40 (0,425 mm)	7– 17	8 – 20
No.200 (0,075 mm)	2- 8	2 – 8

To get the voltage magnitude of the crushed specimen is done by calculating:

$$f'c = \frac{P}{A} \quad \text{.....} \quad (1)$$

with f'c = Unconfined Compressive Strength Values (MPa),
P = Maximum load (KN),
A = Surface area of the test specimen depressed (cm^2)

Figure 2: Proses Uji Tekan Sampel CTRB

Results and Discussion

Table 2: RAP gradation sieve analysis results

Sieve Number		Requirements of sieve passing	% cumulative retained	% passing
ASTM	mm			
1 ½ “	37.5	100	0	100
1”	25	79 – 85	21.97	78.03
3/8”	9.5	44 – 58	42.45	57.55
No.4	4.8	29 – 44	60.88	39.12
No.10	2	17 – 30	81.83	18.17
No.40	0.425	7 – 17	90.77	9.23
No.200	0.075	2 – 8	97.13	2.87
Pan		0	100.	0.00

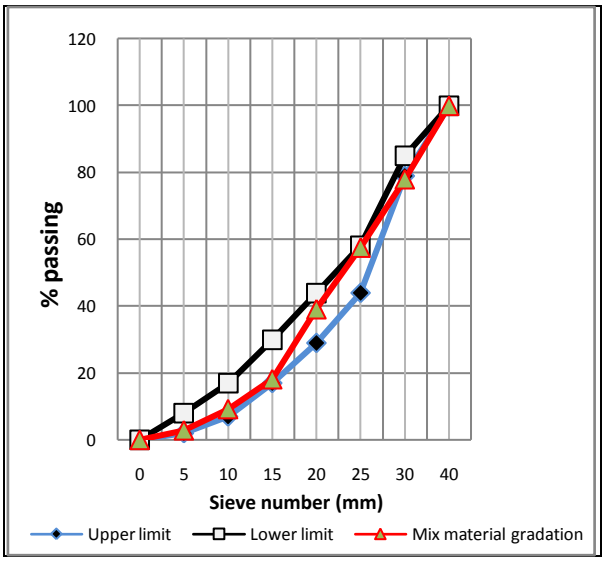

Figure 3: Graph of The Sieve Analysis Results

Table 2: Hasil perhitungan KTB berbagai variasicampuran agregat baru dan RAP

No.	Perbandingan Campuran (%)	Kadar semen (%)	Kuat tekan bebas	
			Kg/cm^2	Mpa
1	Vm 10:Rap 90	7	13,66	1,366
2	Vm 20:Rap 80	7	16,33	1,633
3	Vm 30:Rap 70	7	25,29	2,529
4	Vm 40:Rap 60	7	29,22	2,922
5	Vm 50:Rap 50	7	37,67	3,767
6	Vm 60:Rap 40	7	41,21	4,121

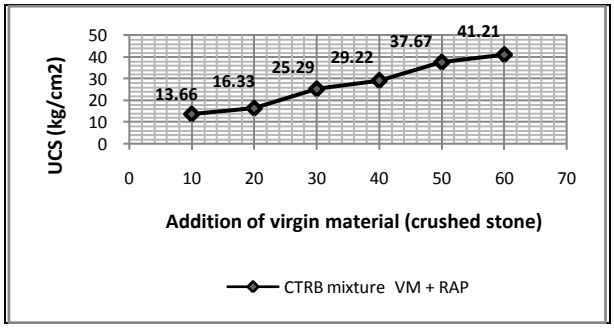

Figure 4: Graph the relationship between the addition of virgin material with UCS

Based on the research results of mixing the new aggregate and asphalt pavement waste materials described in Figure 4 shows the virgin material mixture 10% yield UCS 13.66 kg/cm^2, the virgin material mixture 20% increase to 16.33 kg/cm^2, the new aggregate mixture 30 % increase to 25.29 kg/cm^2, the virgin material mixture 40% increase to 29.22 kg/cm^2, the virgin material mixture 50% increase to 37.67 kg/cm^2, the virgin material mixture 60% increase to 41.21 kg/cm^2, the greater the addition of virgin material, the resulting increased UCS.

Conclusion

a) The results show that the addition of virgin material will increase the unconfined compressive strength (UCS) and added material from these laboratory experiments can increase the carrying capacity CTRB construction.

b) Further research is needed for additional proportion of virgin material in order that it can be seen the maximum compressive strength of the test specimen to decrease the compressive strength of the test specimen.

Acknowledgement

Beasiswa Unggulan 2014 DIKTI, Kementrian Pendidikan dan Kebudayaan, INDONESIA.

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