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INFLUENCE OF FIBER PLASTIC SACKS ON CEMENT TREATED RECYCLING BASE

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ABSTRACT
Pavement recycling technology has several advantages such as to restore and maintain the geometric pavement strength and over come the dependence on new material. The purpose of this study is to determine the cement effect, fiber plastic sacks polypropylene as a mixture forthe construction of Cement Treated Recycling Base(CTRB). The addition of cement affects the average UCS of the CTRB. Selected cement content and meets the requirements of UCS for construction CTRB is 7%. CTRB mixed fiber plastic sacks produce tensile strength tends to increase is abaout 5.76%..

Keywords: Cement, CTRB, Fiber Plastic Sacks, Tensile Strength,UCS

I. INTRODUCTION
Mechanical recycling pavement construction is processing and reusing waste materials from old pavement (existing), either with or without the addition of new material, for maintenance purposes, repair and improvement of road pavement construction [3].

Types of recycling in road construction can be divided into two kinds:
a. Cold mix recycling.
Cold mix recycling by adding cement can be used as a Cement Treated Recycling Base (CTRB), Cement Treated Recycling sub base (CTRSB) and asphalt binder emulsion or foam bitumen binders which commonly called Cold Mix Recycling by Foam Bitumen Base (CMRFB).
b. Hot mix recycling.
Recycling of waste materials through pavement recycle uses heating machines.
The addition of cement content will increase the dry unit weight but it will increase the unconfined compressive strength (UCS) with quite significant value and the optimum water content, then the lower water content is used, the higher UCS. The realtively small increase of the optimum water content will reduce the value of UCS quite large [5, 6]. Unconfined Compressive Strength(UCS) is the maximum voltage magnitude at the testing time until the specimen sample collapse[2, 4].

Cement Treated Recycling Base(CTRB) is the foundation stabilization of highway technology system with the existing pavement material recycled with a mixture of cement. Recycled material with a mixture of cement is commonly used existing material in the old pavement which usually used as abase course for construction above named Cement Treated Recycling Base(CTRB) or for the sub-base layer construction called Cement Treated Recycling Sub Base(CTRSB). Recycling technology to repair the road from economic considerations requires relatively lower cost because of processing the old material only. [8].

Composite manufacturing mixed with fiber polypropylene plastic can increase its tensile strength [10]. Fiber plastic polypropylene can be used as a stabilizer of pavement construction. The method used is a mix of fiber plastic polypropylene sacks at 0.3% aggregate of the total mixture.It should be noted that the process of road construction stabilized by polypropylene fibers has a specific requirement that the heating temperature of the asphalt material should not exceed 146 ° C because if it exceeds the temperature limit, then it will cause plastic melting so that the value of tensile strength polypropylene plastic material will be lost [7].

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II. MATERIALS AND METHODS

The material used in the work of the Cement Treated Recycling Base (CTRB) is demolished waste materials old pavement consisting of aggregates and asphalt. Pavement that has been damaged scratched with hot milling, cold milling and graders.

Fiber polypropylene plastic sacks were taken from the plastic bags of rice wrappers and port land cement that used is a cement type I asshown in the figure below:

Figure 1. Fiber plastic sacks polypropylene and aggregates

Compressive and tensile strength are achieved when a stabilized material with cement which are largely determined by the amount of cement added, the type of material and thedensity of the mixedmaterial. Determination of the percentage of cement is determined by weight and volume.

Table 1. Criteria for the strength of recycled pavements mixture with cement

Allotment	Unconfidined compressive strength at the age of 7 days (Kg/cm^2)	
	UCS (diameter 70 mm x 140 mm)	Compressive strength of concretecylinders (diameter 150 mm x 300 mm)
The base foundation layer	Min 30	15 – 30
Sub base foundation layer	Min 20	7,5-15

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

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

f'c = Unconfined Compressive Strength Values (Kg/cm^2), P = Maximum load (Kg),
A = surface area of the test specimen depressed (cm^2)

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The formula used in the calculation of the tensile strength that occurs in the test cylinder object according to [12] is:

$$ft = \frac{2xP}{LxDx\pi} \qquad (2)$$

Where ft = tensile strength (kg/ cm^2), P = destroyed load (Kg), D = diameter of the cylinder and L = Length of cylinder.

Density of mixed material has a major role in determining the ultimate strength while temperature directly affects the level of strength, andthen theimportance in this process is the placement and compaction acceleration after recycling to achieve maximum density and to obtain the strength of the mixed materials.

The density of the material will greatly affect the strength of the stabilized material. Generally, the density is expressed in dry weight unit(γd)[5, 13].

Unconfined compressive strength test (UCS) using a cylinder with a diameter of 7 cm and height 14 cm according to [14] and number of specimens test of 10 pieces for each variation of cement content according to the procedure of [19].

Table 2. 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

This research is an experimental research by conducting experiments in the laboratory to obtain the desired data. The study was conducted to determine the condition of the specimen with a group of interventionssuch as mixing the specimen with water, cement and fiber plastic sacks are varied in the object group tests so that the strength of each specimen group can be known. The main objective of the study was to determine the compressive and tensile strength of the specimen test made of a waste materials mixture of stabilized cement and asphalt pavement (Cement Treated Recycling Base) which can be briefly described in the diagram below.

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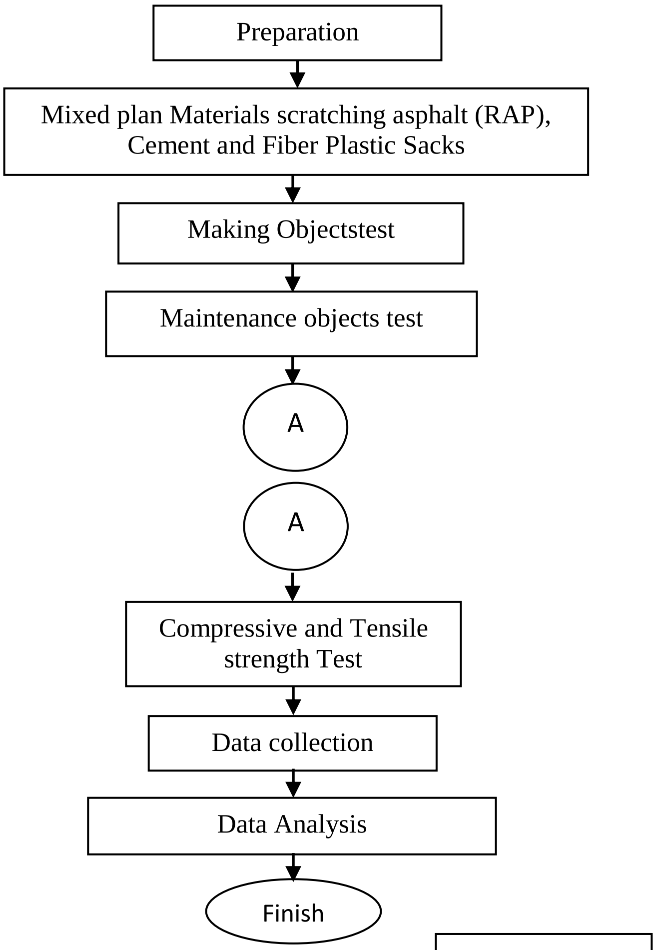

Figure 2, Flow diagram of the research stag

III. RESULTS AND DISCUSSION

Implementation of a mixture of recycled asphalt pavement to be compacted then carried out under optimum moisture content. Optimum moisture content obtained by the value of the maximum density achieved with heavy density testing [13, 16,] is to make 5 mixes with 6 variations in water levels and variations of cement that has been planned to determine the optimum water content graphed the relationship between water levels with the maximum dry unit weight (γd). This compaction results in Plot into a graph of compaction water content with a dry density produces. From the graph based on the maximum dry unit weight (γd) can be determined optimum moisture content required.

The optimumwater content(w opt) anddry unit weight (γd) research has beenconductedonthe material making Kudus-Demak road pavementcan be seen inthe table below:

Table 3. Examination results and optimum moisture content of dry unit weight (γd) Mix cement treated recycling base (CTRB)

cement content	Maximum dry unit weight (γd)	Optimum moisture content (%)
0%	1,615	6,9
1,5%	1,63	6,8

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3%	1,653	6,6
4,5%	1,674	6,4
6%	1,686	6,3
7,5%	1,69	6,2

The specimen test of Cement Treated Recycling Base (CTRB) includes Unconfined Compressive Strength (UCS). Making the specimen test is first carried out using 100% RAP without the addition of new aggregate. Compressive strength test using the specimen test diameter of 7 cm and height 14 cm is done at the specimen timeof 7 days, 14 days, 21 days and 28 days. RAP mixture for further test conducted after the cement formula known. Compressive strength of the material used to evaluate the mixed cement [1, 4]. The test is performed to determine the ability of the test object to the imposition of the vertical direction. In this study, compressive strength testing using tests equipment UTM (Universal Testing Machine). RAP diameter used in the manufacture of compressive

strength test object is the aggregate 19 mm sieve [15]. Obtained from the testing burden vertical direction capable retained by the specimen test is expressed in units of kg / cm^2 or with units of MPa.

a. Effect of cement content on compressive strength of test specimens

The main functions of cement in the mix Cement Treated Base is for stabilization, the mixture strength is largely determined by the amount of cement is added, the type of material and density of the material that is mixed [8,14,18].

The influence of the amount of cement on the compressive strength at the age of maintenance 7 days, 14 days, 21 days and 28 days can be seen in the table and the graph below.

Table 4. Testing results UCS of the cement content, dry unit weight and moisture content of the age of 7 days

Cement content	Maximum dry unit weight (γd)	Optimum moisture content (%)	Unconfined Compressive Strength/ UCS Kg/cm^2
0%	1.615	6.9	0
1,5%	1.63	6.8	12,23
3%	1.653	6.6	15,46
4,5%	1.674	6.4	20,07
6%	1.686	6.3	24,83
7,5%	1.69	6.2	33,12

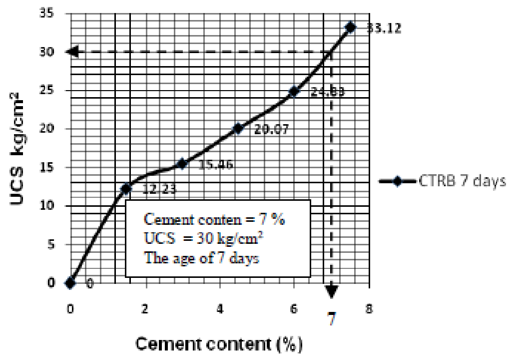

Figure 3.Graph of the relationship between the UCS with cement content.

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Technical directive [4], to look for levels of cement that will be used in the mix design test specimen CTRB conducted experiments with 5 variations cement mixture that can be described as in Figure 3 above.

Terms of compressive strength of cylindrical test specimen is diameter 7cm and thickness of 14cm in the age of 7 days. The experimental results of the test specimen with 5 variations produce compressive strength of cement content of each are 12,23kg / cm^2; 15.46 kg/cm^2; 20.07 kg/cm^2; 24.83 kg/cm^2; 33.12 kg/cm^2, the required compressive strength 30kg /cm^2 shows the cement content of 7 % of the weight of the test object so that it can be used as a guideline CTRB mixture.

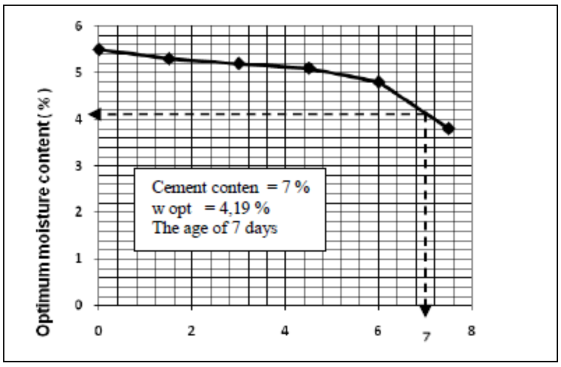

Figure 4.Graph of the relationship between cement content with optimummoisture content.

From **figure 4**, it is known that optimum moisture content of 4.19 % to 7 % cement content so that the mixture of water CTRB using 4.197 % by weight of material used.

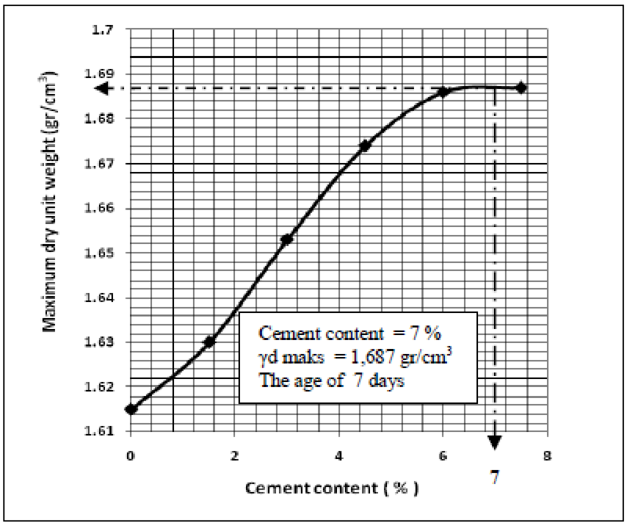

Figure 5 . Graph of the relationship between cement content with maksimum dry unit weight

When the cement content is known as the **figure 5**, dry unit weight can be determined dry unit weight (γd) used in the experiment using the tool proctor density to determine the optimum moisture content and used as the basis for the use of water to mix the specimen.

In the age of the object test 14 days treatment with cement content 0 % compressive strength value of 0.00 kg/cm^2, 1.5 % cement content increased to 14.96 kg/cm^2, 3 % cement content of the compressive strength increased to 19, 63 kg/cm^2, 4.5 % cement content compressive strength value increased to 24.54 kg/cm^2, 6 % cement content compressive strength value increased to 32.31 kg/cm^2, 7.5 % cement content of the compressive strength increased to 42.25 kg/cm^2.

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In the age of the object test 21 days treatment with cement content 0 % compressive strength value of 0.00 kg/cm^2, 1.5 % cement content increased to 16.51 kg / cm^2, 3 % cement content compressive strength value increased to 22, 19 kg/cm^2, 4.5 % cement content compressive strength value increased to 27.70 kg/cm^2, 6 % cement content compressive strength value increased to 35.55 kg/cm^2, 7.5 % cement content of the compressive strength increased to 46.43 kg/cm^2.

Likewise at age test object 28 days treatment with cement content 0 % compressive strength value of 0.00 kg / cm^2, 1.5 % cement content increased to 18.85 kg/cm^2, 3 % cement content compressive strength value increased to 24.38 kg/cm^2, 4.5 % cement content compressive strength value increased to 31.28 kg/cm^2, 6 % cement content compressive strength value increased to 39.61 kg/cm^2, 7.5 % cement content compressive strength value increased to 51, 69 kg/cm^2.

Under the terms of the strength of recycled mix old pavement with the added ingredient of cement for the foundation layer over the age of 7 days treatment (Technical Guidelines -08-2005 - B Department of Public Works) for the cylindrical test specimen with a diameter of 7 cm and height 14 cm is 15 kg/cm^2 to 30 kg / cm^2 or 1.5 up to 3 MPa . In this study, the compressive strength of cement content of 0 %, 1.5 %, 3 %, 4.5 % do not meet the requirements of the technical guidelines [4, 17].

3.2. Effect of fiber plastic sacks of tensile strength divided specimen

Compressive strength and modulus elasticity of concrete is influenced by the characteristics of the constituent materials, if the aggregate used has a high modulus of elasticity that it will a high compressive strength too and if aggregate used has low modulus elsticity that compressive strength tends to decrease.

Aggregate has an important role in the concrete mix, especially affects bond between cement with micro cracks on concrete mass [11].

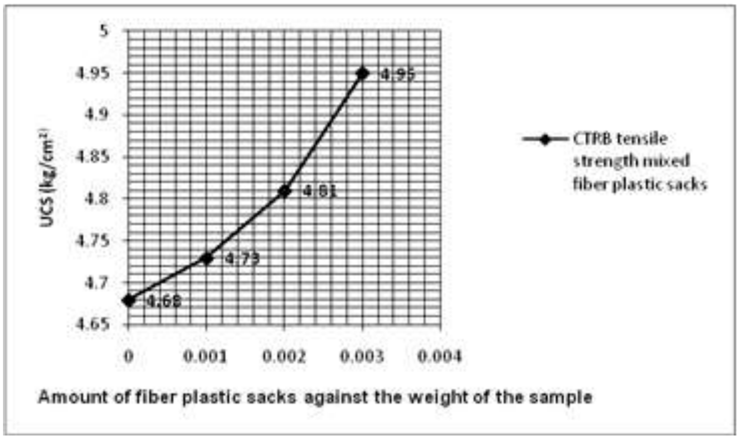

Figure 6. Graph of the relationship between fiber plastic sacks with tensile strength

Effect fiber plastic sacks of tensile strength against the sides of the test specimen CTRB as in Figure 7 above shows that the specimen CTRB without plastic sack fiber mixture produces tensile strength of 4.68 kg/cm^2 , the test object CTRB fiber mixed plastic sacks strong 0.1 % yield press of 4.73 kg/cm^2 , the test object CTRB fiber mixed plastic bag compressive strength 0.2 % yield 4.81 kg/cm^2 and the subsequent test object CTRB plastic sack fiber mixture 0.3 % yield compressive strength of 4.95 kg/cm^2 . The increase in tensile strength is about 5.76 %.

The properties can be improved by polypropylene, among others:
(i) Ductility : relates to the ability to absorb energy ; (ii) The resistance to shock loads (impact resistance) ;
(iii) ability to withstand tensile and bending moments ; (iv) The resistance to fatigue ; (v) Resistance of shrinkage effect (shrinkage) ; (vi) Security Aus ; (vii) spilling resistance [1, 12] .

Polypropylene plastic can be used as stabilizers pavement construction. The method used is a mix of polypropylene fibers at 0.3 % of the total mixture of aggregate and to note that the process of road construction stabilized polypropylene fibers have a specific requirement that is when it is used to hot mix asphalt material heating temperature is not exceed 146 ° C because if the temperature exceeds the melting plastic will experience so that the value of tensile strength polypropylene plastic material is lost [7].

Manufacture of composite plastic bags mixed with polypropylene fibers can increase its tensile strength. The increase in tensile strength of the composite depends on composition of the mixture in it. In comparison 60/40 composite strain improvement reached its peak of 63.71 % [9].

IV. CONCLUSION

Addition of cement content on CTRB increases the value of the dry unit weight 1,687gr/cm^3 but resulted in a significant increase in compressive strength 33,12kg/cm^2 at the age of 7 days and the dry weight of 1,687 g/cm^3 used jobmix formula produces compressive strength 49.65 kg/cm^2 at 28 days. The addition of cement affects the average UnconfinedCompressiveStrength (UCS) of the CTRB. Selected cement content and meets the requirements of UCS for construction (CTRB) is 7%. Cement content results of this study can be used in CTRB work in the field.

CTRB mixed fiber plastic sacks produce tensile strength tends to increase compared with CTRB without a mixture of fibers plastic sacks and after the calculated a happen increase on tensile strength of about 5.76%.

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