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OPTIMIZATION OF COIR FIBER CONTENTS AND LENGTHS FOR THE AGGREGATE BASES STABILIZED WITH CEMENT AND BITUMEN EMULSION

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ABSTRACT:

The scarcity of natural aggregates is one of the severe concerns to the global population. To overcome this problem, the stabilized bases/subbases were evolved. Generally, Emulsified Asphalt Stabilized Bases (EASB) are related to the bitumen stabilized materials. These bases are composed of emulsified asphalt, aggregates, active filler like lime/cement and pre-mixing water. As the bases treated with emulsified asphalt possessed low-early strength, the addition of lime or cement is adopted for better strength in early stages [1-10]. In addition to the cement, the fibers are also used for improving the strength properties of the emulsified asphalt treated mixes [11]. The research works related to the performance of coir fiber reinforced emulsified asphalt treated mixes are limited. Hence, the present study is aimed to focus on performance of evaluation of Emulsified Asphalt Treated Mixes with Coir Fibers. This research work includes the optimization of mechanical characteristics of Coir Fiber Reinforced Emulsified Asphalt Stabilized Bases with different coir fiber contents (0, 0.3, 0.6 and 0.9% by weight of dry aggregates) and lengths (10, 15 and 20mm). Initially, the optimum fluid contents are determined based on the procedure given in IRC: 37-2012. Later, the optimum coir fiber contents and lengths are determined based on maximum Indirect Tensile Strength. Finally, the results are discussed and conclusions are drawn.

Keywords: ***Emulsified Asphalt Stabilized Bases (EASB); Coir Fiber Content (CFC); Coir Fiber Length (CFL);***

I. STUDY OBJECTIVES:

1. To determine the Optimum Fluid Contents for the cement treated mixes with different proportions of coir fibers (0.3, 0.6,and 0.9% by weight of dry aggregates), cement (2,3,4,5,6%) and different coir fiber lengths (10, 15 and 20mm)
2. To determine the optimum coir fiber contents and lengths based on the maximum values of Unconfined Compressive Strength and Indirect tensile Strengths.

II. RESEARCH APPROACH:

The present research work includes a series of laboratory tests to investigate the mechanical properties of the mixes with coir fibers. Initially, the literature review and the summary of previous studies on cement treated bases/subbases, coir fiber reinforced concrete mixtures is discussed. Later, the required materials are collected and basic properties are determined. The step by step methodology is shown in the following chart.***(figure 1)***

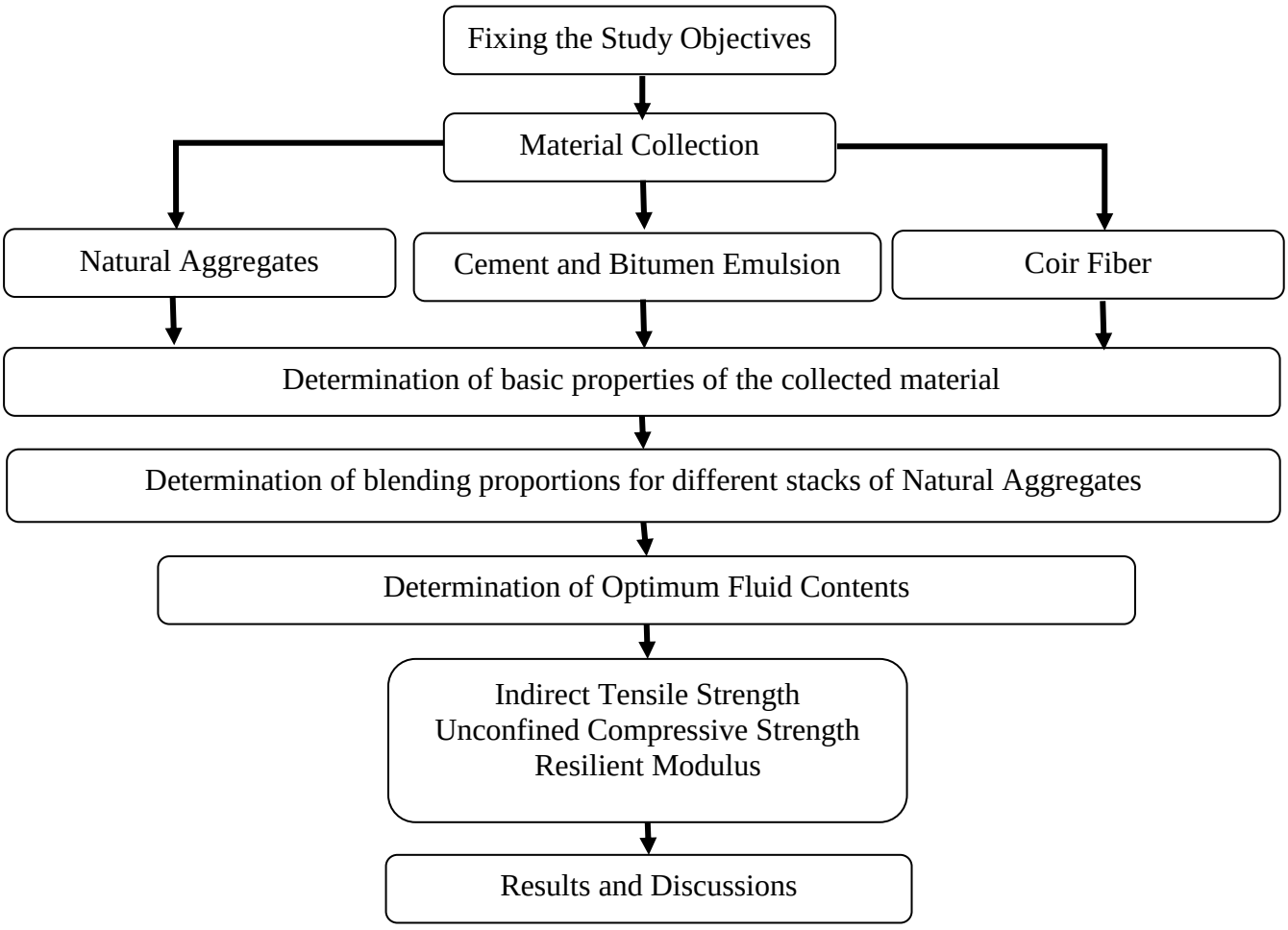

Figure 1. The research methodology

III. RESULTS AND DISCUSSIONS:

Initially, the materials are collected and basic properties are evaluated. The results of basic properties of bitumen-emulsion are shown in following ***Table 1.*** The conventional aggregates are blended as per the gradation given in Asphalt Academy, TG-2. To the blended dry aggregates (1100grams), 1% of cement was added and mixed until the mix has become homogenous. Later, bitumen-emulsion (i.e., Cationic Slow Setting-2) was diluted with 50% of water and the diluted emulsion was added at a dosage of 4, 6, 8, 10 and 12% by weight of dry aggregates. The samples are compacted using Marshall Compacting hammer with 50 number of blows on either side of the specimen. The bulk and dry densities were estimated for each sample and optimum fluid content was determined***(Table 2 and figure 2).***From, the results it was found that 6% was taken as optimum fluid content corresponding to the maximum dry-density of 2.32 g/cc. Later, the samples were prepared with 2% water, 6% bitumen emulsion and various dosages of coir fiber contents and lengths. Then, the optimum fiber contents were determined for different fiber lengths. The results are shown in ***figure 3.***

Table 1. The conventional Properties of Bitumen Emulsion

Characteristic	**Specification**	**Test Result**	**Test Method**
	IS 8887-2018		
Residue on 0.6 mm IS Sieve, % by mass, Max	0.05	0.04	IS 8887
Viscosity (sayboltfurol viscometer), seconds, (At 25°C)	30-150	42	IS 3117
Particle charge	Positive	Positive	IS 8887
Stability to mix with cement (% coagulation), Max	2	1.23	IS 8887
Penetration, 25°C/ 100g/5, sec	60-100	81	IS 1203
Residue by evaporation, percent, *Min*	60	60.27	IS 8887
Ductility, 27 °C/cm, Min	50	64	IS 1208

Table 2. Density Results of Compacted Specimens

S. No	**Fluid Content (%)**	**Bulk Density (g/cc)**	**Dry Density (g/cc)**
1	4	2.21	2.125
2	6	2.46	2.320755
3	8	2.48	2.296296
4	10	2.51	2.281818
5	12	2.53	2.258929

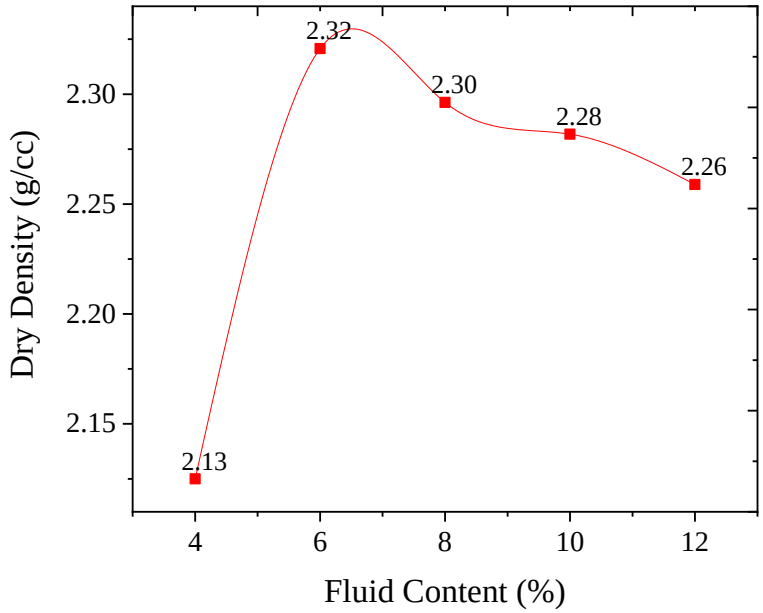

Figure 2. The plot between density andtotal fluid content

The results showed that the higher ITS for higher fiber length up to fiber contents of 0.6% by weight of dry aggregates. The maximum observed ITS values are 247, 261 and 214kPa (at 0.6, 0.6 and 0.3% of fiber contents) for the fiber lengths of 10, 15 and 20mm respectively.

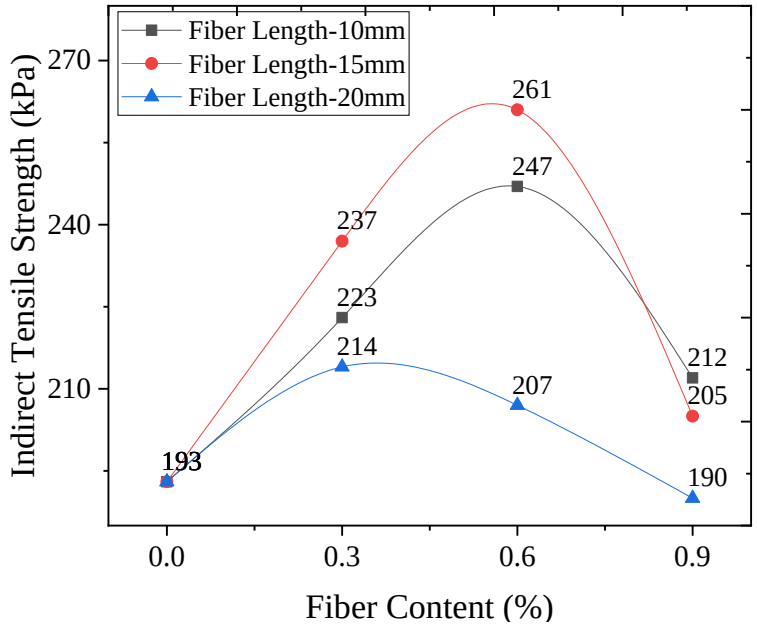

Figure 3. The plot between fiber content and indirect tensile strength

IV. CONCLUSIONS

The following conclusions are drawn from the current study.

- The optimum fluid content was found at a dosage of 6% total fluid content with corresponding maximum dry density of 2.32 g/cc.
- The addition of Coir Fibers resulted an increase in ITS by 28, 35 and 11% for 10, 15 and 20mm fiber lengths respectively.
- The addition of coir fibers resulted in improved strength of the stabilized bases, hence the coir fibers can be successfully implemented up to a percentage of 0.6%

V. REFERENCES:

[1] Lim, S., & Zollinger, D. G. (2003). Estimation of the compressive strength and modulus of elasticity of cement-treated aggregate base materials. *Transportation research record*, *1837*(1), 30-38.

[2] Pérez, P., Agrela, F., Herrador, R., &Ordoñez, J. (2013). Application of cement-treated recycled materials in the construction of a section of road in Malaga, Spain. *Construction and Building Materials*, *44*, 593-599.

[3] Behiry, A. E. A. E. M. (2013). Utilization of cement treated recycled concrete aggregates as base or subbase layer in Egypt. *Ain Shams Engineering Journal*, *4*(4), 661-673.

[4] Hoyos, L. R., Puppala, A. J., & Ordonez, C. A. (2011). Characterization of cement-fiber-treated reclaimed asphalt pavement aggregates: preliminary investigation. *Journal of Materials in Civil Engineering*, *23*(7), 977-989.

[5] Fedrigo, W., Núñez, W. P., López, M. A. C., Kleinert, T. R., &Ceratti, J. A. P. (2018). A study on the resilient modulus of cement-treated mixtures of RAP and aggregates using indirect tensile, triaxial and flexural tests. *Construction and Building Materials*, *171*, 161-169.

[6] Sounthararajah, A., Bui, H. H., Nguyen, N., Jitsangiam, P., &Kodikara, J. (2018). Early-age fatigue damage assessment of cement-treated bases under repetitive heavy traffic loading. *Journal of Materials in Civil Engineering*, *30*(6), 04018079.

[7] Yalley, P. P., & Kwan, A. S. K. (2009). Use of coconut fibre as an enhancement of concrete. *Journal of Engineering and Technology*, *3*, 54-73.

[8] Achudhan, A. M., Sankar, S. S., &Saikumar, K. (2018). Experimental study on coir fibre mixed concrete. *Int J Pure Appl Math*, *118*(20), 2913-2929.

[9] Abiola, O. S., Kupolati, W. K., Sadiku, E. R., &Ndambuki, J. M. (2014). Utilisation of natural fibre as modifier in bituminous mixes: A review. *Construction and Building Materials*, *54*, 305-312.

[10] Slebi-Acevedo, C. J., Lastra-González, P., Pascual-Muñoz, P., & Castro-Fresno, D. (2019). Mechanical performance of fibers in hot mix asphalt: A review. *Construction and Building Materials*, *200*, 756-769.

[11] Shanbara, H. K., Ruddock, F., & Atherton, W. (2017, August). Improving the Mechanical Properties of Cold Mix Asphalt Mixtures Reinforced by Natural and Synthetic Fibers. In *International Conference on Highway Pavements & airfield Technology* (pp. 102-111).