IF : 4.547 | IC Value 80.26 Volume-6, Issue-4, April - 2017 • ISSN No 2277 - 8160

Original Research Paper Engineering

AN EXPERIMENTAL APPROACH USING MARSHALL APPARATUS TO DESIGN BITUMINOUS MIX BY ADDING CRUMB RUBBER IN BITUMEN PERCENTAGE

Vikram Patel	Assistant Professor, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur
Priyanka Patil	UG Student, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur
Shweta Shah	UG Student, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur
Vedashree Shinde	UG Student, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur
Hitesh Ahirrao	UG Student, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur
Rajendra Patil	UG Student, Civil Engineering Dept., R. C. Patel Institute of Technology, Nimzari Naka, Shirpur

ABSTRACT Solid waste is a major problem as far as environment is concerned. Crumb rubber is a waste from Industrial corporation. It is available in large quantity as a waste in Industries. It is smart innovation to utilize Crumb rubber in Road Pavement. Bitumen percent is reduced as crumb rubber is added in it. The mixture of crumb rubber in bitumen is the best solution to re-use the industrial waste. The main aim of present research is to determine optimum binder content by adding 5% crumb rubber in bitumen content and design the bituminous mix. The optimum binder content so obtained from lab tests is considered to be the best mix design.

KEYWORDS : crumb rubber, utilization, waste, bitumen, Pavement etc.

INTRODUCTION

- Crumb rubber is the term usually applied to recycled rubber from automotive and truck scrap tires. During the recycling process steel and fluff is removed leaving tire rubber with a granular consistency. Continued processing with a granulator and/or cracker mill, possibly with the aid of cryogenics or mechanical means, reduces the size of the particles. From physical and chemical interaction of crumb rubber with conventional bitumen Crumb Rubber Modified Bitumen (CRMB) is made. Its advantages are: Lower susceptibility to daily & seasonal temperature variations, higher resistance to deformation at elevated pavement temperature, better age resistance properties, higher fatigue life of mixes, Better adhesion between aggregate & binder,

Prevention of cracking & reflective cracking, and Overall improved performance in extreme climatic conditions & under heavy traffic condition.

The Marshall Stability and flow test provides the performance prediction measure for the Marshall Mix design method. The stability portion of the test measures the maximum load supported by the test specimen at a loading rate of 50.8 mm/minute. Load is applied to the specimen till failure, and the maximum load is designated as stability. During the loading, an attached dial gauge measures the specimen's plastic flow (deformation) due to the loading. The flow value is recorded in 0.25 mm (0.01 inch) increments at the same time when the maximum load is recorded.

Figure 1: Marshall Apparatus

OBJECTIVES OF RESEARCH

- To utilize waste materials as a pavement (in surface course) ingredients.
- To check the sustainability of waste materials in asphalt mixture.
- To Optimize of pavement design with waste materials.
- To compare the cost of modified bitumen with conventional bitumen.
- To study the effect of crumb rubber powder on propeties of 60/70 penetration grade bitumen & their indicative doses.
- To study & compare the effect of modified bitumen in the bituminous concrete mix design with conventional bitumen.

BITUMINOUS MIX DESIGN:

PROCEDURE:

- Approximately 1200gm of aggregates and filler is heated to a 175o C -190o C temperature.
- Bitumen is heated to a temperature of 1210C -1250C with the first trial percentage of bitumen (say 3.5 or 4% by weight of the mineral aggregates).
- The heated aggregates and bitumen are thoroughly mixed at a temperature of 154C -160C.
- The mix is placed in a preheated mould and
- compacted by a rammer with 50 blows on either side at temperature of 1380C to 1490C.
- The weight of mixed aggregates taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/-3 mm. Vary the bitumen content in the next trial by +0.5% and repeat the above procedure.
- Number of trials are predetermined.

Figure 2: Sieve Analysis of Aggregates

Figure 3: Crumb Rubber

EXPERIMENTAL WORK AND RESULTS:

CALCULATION FOR 5 % CRUMB RUBBER IN BITUMEN ARE TABULATED BELOW:

Table 1: Results of 5 % Crumb Rubber in Bitumen

	4.50%	5.00%	5.50%	6.00%	6.50%
Weight of sample in air (WA)	1250	1258	1266	1270	1277
Weight of sample in water (Ww)	631	632.8	634.3	636.3	640.4
Weight of coarse aggregate(W1)	468	468	468	468	468
Weight of fine aggregate (W2)	204	204	204	204	204
Weight of filler material(W3)	480	480	480	480	480
Weight of bitumen(Wb)	54	60	66	72	78
Weight of crumb rubber (W)	2.7	3	3.63	4.32	5.07
Specific gravity of coarse aggregate (G1)	2.6	2.6	2.6	2.6	2.6
Specific gravity of fineaggregate (G2)	2.03	2.03	2.03	2.03	2.03
Specific gravity of filler material (G3)	1.78	1.78	1.78	1.78	1.78
Specific gravity of bitumen (Gb)	0.99	0.99	0.99	0.99	0.99
Bulk specific gravity (Gm)= Wm/Wm-Ww	2.019	2.012	2.004	2.004	2.006
Specific Gravity without considering Air Voids (Gt)	1.476	1.969	1.98	1.97	1.96
Air voids (Vv)	2.02	2.16	1.21	1.72	2.34
% Volume of bitumen (Vb)	8.432	10.03	10.93	11.86	12.79
Voids in mineral aggregate (VMA)	10.452	12.196	12.14	13.58	15.13
Voids filled with bitumen (VFB)	80.67	82.28	90.03	98.64	84.53
Stability Value	337 kg	342 kg	450 kg	556 kg	701 kg
Flow Value	2.1	3.25	2.73	3.02	3.87

GRAPHS:

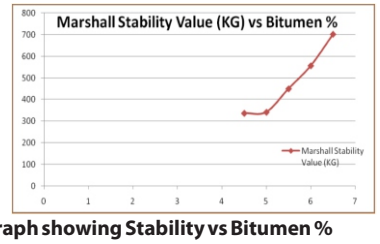

Figure 4: Graph showing Stability vs Bitumen %

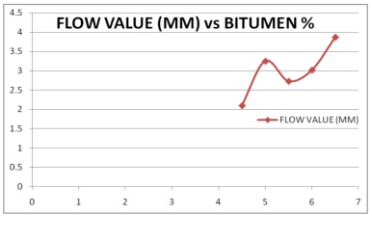

Figure 5: Graph showing Flow vs Bitumen %

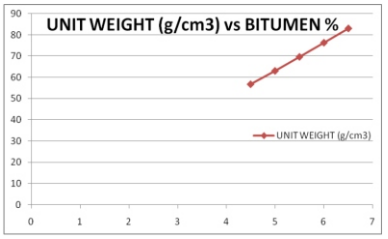

Figure 6: Graph showing Unit Weight of Bitumen vs Bitumen %

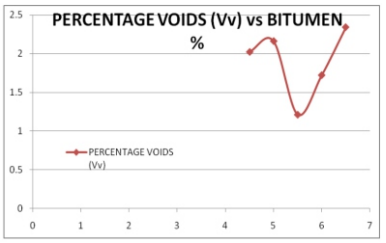

Figure 7: Graph showing Percentage Voids(Vv) vs Bitumen %

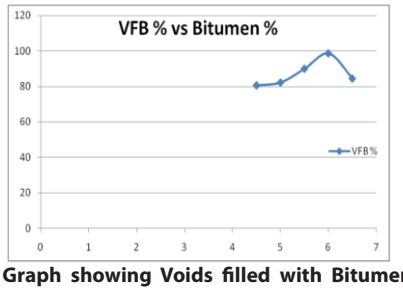

Figure 8: Graph showing Voids filled with Bitumen(VFB) vs Bitumen %

CONCLUSION

Such Crumb Rubber is a waste in tyre industry & mixing it in a bitumen is giving the best strength & the property of Re-using it is worth noting. By using this waste rubber ,the cost also going to decrease moderately. Bituminous Mix Design of 5% addition of crumb rubber in bitumen gave good results. By Adding this 5% Crumb rubber, a bitumen quantity is saved and strength criteria is achieved It saves environment too, because rubber is that material which is not decay in soil & when the rubber is going to be burn then it create poisonous gases and by that it affect environment. It causes health problems too. By using this property, Consistency of Bitumen is greatly achieved.

CONCLUSIONS

We can say that for 1m3M20 grade of concrete consumption of fine aggregate is 775.96 kg. Here in specimen M-3 we replace fine aggregate by 24.62 kg of crumb rubber for 1m3M20 grades of concrete. So, we can say that up to 15% foundry sand utilized for economical and sustainable development of concrete.Uses of crumb rubberin concrete can reduce the harmfulness to the environment and produce a 'greener' concrete for construction. An innovative supplementary Construction Material is formed through this study.

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