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Experimental Investigation of Modified Bitumen using Crumb Rubber

Shekhar kumar Gupta[1*], Narendra Dudhe[2], S.K.Soni[3]

[1]Department of Civil Engineering, Rabindranath Tagore University,Bhopal ,India

[2]Associate Professor,Department of Civil Engineering, RNTU, Bopal

[3]HOD & Associate Professor, Department of Civil Engineering, RNTU,Bhopal

*Email-1991shekhar992@gmail.com

1.INTRODUCTION

Activity and action power in the street spread. It is estimated that over 36,000km of trails are available in India, and about 40% of these trails are extensively paved and maintained. Road transport occupies an important and high rank among the few current methods of transport planning because it is more convenient, easier to use, more reliable and faster. Concerning 90% of entire traffic in district is road & 70% is goods. As a result, the road reserve capacity must be expanded. There are 2 types of roads: malleable asphalt (bitumen roads) &inflexible asphalt (rigid roads). Conformable asphalt (bituminous road) contains the essential elements of all paved roads. In India, many roads are made of bitumen because of its low cost when tolls are charged and the underlying cost of inflexible asphalt, which is composite concrete. Domestic and foreign studies have revealed that the properties that affect the properties of bitumen mixtures have been improved, and the asphalt requirements have been collected by the inclusion of inducing additives or the convergence of additives. These additive substances can be referred to as bitumen modifiers & bitumen mixed through these modifiers is considered modified bitumen. Conditioned bitumen may give a dominant surface finish (upon 100%) depend on the amount of modification and category of material added and the growth of modification used. Modifiers that can be use are polymers, ordinary rubber, as well as rubber granules.

2. LITERATURE REVIEW

According to Justo et al [1] An experiment was conducted at Center for Transport Engineering at Bangalore University to investigate the potential make use of of engineered synthetic bags as a stabilizer in bituminous material mixtures. The property of customized bitumen were comparing with normal bitumen. It has been experimental that the penetration and ductility criteria of tailored bitumen decrease as the amount of plastic stabilizer increases up to 12 wt%. The softening point of the modified bitumen was increased by up to 8.0 wt% with the addition of plastic additives. A study was conducted on bituminous actual mixes using 80/100 rating bitumen with a nominal Marshall strength value of 1100 kg the best bitumen content of 5.0% by mass of the mix. The use of modified bitumen reinforced with treated plastics, which is about 8.0% by weight of bitumen, contributes to and impacts significant improvements in durability or strength.

Vasudevan, et al [2] It has been found that the bitumen mixed with the polymer improves the modified bitumen mixture. In the wet process, mixing was done by directly mixing ground polymer with burning bitumen at 160 degrees. C. The arid construction method used a new technology to increase the proportion of plastic waste in road construction, and an alternative construction method using this technology was adopted. In this process, waste polymer was fed into hot (170°C) aggregate. A polymer was applied over the aggregate. Spreads were easy here. The thermal aggregate was uniformly coated with polymer. Then bitumen was added.

Vasudevanet. [3] A modified method was developed in which stone aggregates were covered with melt plastic and these scrap coated aggregates, PCA, were use as raw materials for flexible manufacturing. PCA showed improved binding properties. Low wettability. There is a small amount of voids. The sample showed a high Marshall stability score. The PCA-built road performed well.

Mohammad T. Awwad et al [4] He investigated the use of polyethylene as a polymer that can be used to study potential predictions for improving asphalt combination property. Research objective also included formative the optimal type and percentage of polyethylene to use. Two categories of polyethylene were additional to cover agglomerates: soaring density polyethylene (HDPE) and low thickness polyethylene (LDPE). The polymer was added to the blend in two forms, milled and unmilled. The Marshall Mix plan was used to study the contented of the most beneficial bituminous binders and to further test the properties of custom mixes. The results show that the milled HDPE polyethylene modifier has excellent technical properties.

Aslam et al [5] Developed a modified technique for creating flexible category passages. In constructing flexible covers, plastic-coated aggregates showed improved bonding properties. Less wettability and less voids. Plastic-contaminated blend bitumen showed that the adding of scrap plastic to the bitumen increased the known soften point, decreased infiltration rate and ductility, improved flash , ignition points, increased Marshall constancy, Anti-stripping property have also been shown to be restored. This procedure has personal limitations. The production of such improved bitumen requires powerful agitators with thermostatic devices to preserve the temperature at 160°C. An amplify in temperature can influence the property of bitumen. Proper storage space of such polymer-blended bitumen's is very significant. Store in freezer and stable at 180°C for 6 hours.

SheiknaLebbaiet. al.[6] I read about recycling plastic waste and mixing it with bitumen to build roads. The technology is simple but revolutionary and for the road he has to mix 8% plastic and 92% bitumen. Shredded plastic misuse acts as a strong binder for tar, manufacture it waterproof and making long-lasting asphalt. A normal road surface has a lifespan of 3-4 years, while a road made from plastic waste has a lifespan of at least 7-8 years.

Sabina et al [7] describes the relative concert of property of bituminous concrete mixes contain plastic polymers (8 wt% and 15 wt% bitumen) and conformist bituminous concrete mixes made with 60/70 diffusion mesh bitumen. Significant improvements in property such as residual stability, not direct tensile strength, Marshall stability and rutting were experimental in the pp-modified bituminous material mixtures.
Overall, it can be concluded that coating the aggregates with plastic (LDPE) improved their quality in terms of moisture containment, porosity and strength. Plastic covers help reduce porosity, an important characteristic, and improve its display in aggregate classes and flexible pavements. But it also induces stiffness. To compensate for the stiffness introduced by using LDPE as a modifier, search the literature for other modifiers.

Yuqiao Yang et al [1] 3 types of customized asphalt were equipped by adding desecrate rubber crumbs (WCR), waste polyethylene (WPE) and WCR/WPE to the bottom asphalt. The viscosities at 135°C, 165°C were investigated, and the adjustment mechanism of the customized asphalt was investigated because the 135°C thickness of the mixed modified asphalt is superior to that of the WPE and WCR customized asphalts. In adding, the waterproof performance of composite customized asphalt with waterproof resources is superior to that of conventional waterproof resources.

C.Prasanna kumar et al [2] We looked at scrap rubber, reclaimed rubber from scrap cars and truck tires. Throughout the recycle process, the steel and fluff are detached and the rubber of the tire becomes rough. Tires and other rubber materials taken from vehicles are available at the location. Today there are many cars around the world and in India it is also very important to reduce bitumen consumption and research in this direction is important. We are investigating. Various tests are performed.

Neutaget. al [3] Bituminous mixtures were shown to exhibit large variations depending on the added mass (5%, 10%, 15%) and origin of the rubber granules. The softening point increases and the penetration decreases. Furthermore, when the softening point is plotted against the penetration of various rubber agglomerates, there is an almost linear relationship. , with up to 40% increase in softening point and up to 30% decrease in penetration, relative to unmodified bitumen. Conventional bitumen can be refined into high-quality binders by adding old tire rubber (recycled material), and various properties (fatigue strength, low and high temperature behavior, viscosity, elasticity, etc.) can be directly modified and optimized.

Shankar et al [4] The investigated crumb rubber modified bitumen (CRMB 55) be mixed at a specific temperature. The design of the Marshall compound varied the content of the improved bitumen while maintaining the content of the sympathetic rubber and was used to decide the dissimilar design individuality of the compound and the conservative bitumen (60/70). Approved by the following tests: This mixed design provides significantly improved properties compared to straight run bitumen. This occurs when the optimal modified binder content (5.67%) is reduced. A ductility from 80 cm to 47 cm was also noted, indicating an improvement in individual properties of bitumen. A Marshall mix design implemented in crumb-modified bituminous concrete yielded a Marshall stable value (600 °C - 30 min 1437 kg), 3.2 mm flow value (range 2-4 mm), 14.05 VMA (range 13-15), 74.2 VFB (range 65-75), and 3.88% volume (air void range) design).

3.RESEARCH METHODOLOGY AND EXPERIMENTAL

3.1. Methodology

Laboratory tests were performed on standard bitumen (60/70) and customized bitumen tests. entity properties of the case (diffusion, soften point, ductility, flash and ignition, precise gravity) were particular. A representation of the standard bitumen mix (60/70) of the semi-thick bitumen mix (SDBC) was created using the Marshall mix layout and connections for the standard bitumen mix properties including the modified bitumen were created. Following the selection of the problematic sections for the detection of modified bitumen in asphalt mixtures, another preparation of the test program (test preparation and test procedure) was delivered.

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test

5. Flash and fire point test
6. Marshal stability test

The over test were performed on the subsequent conventional/customized bitumen sample (grade 60/70 bitumen, bitumen and CRMB, bitumen and CRMB samples combined) as shown in Table 3.1. Details of the materials used and sample preparation describe in the next section.

TABLE 3.1 DETAILS OF SAMPLE CONSTITUTION AND PERCENT CONSTITUENT BY WEIGHT OF BITUMEN

Sample Constitution	Sample Preparation	% Constituent by Weight of Bitumen
Bitumen + CRMB	Wet process	CRMB: 3%
		CRMB: 6%
		CRMB: 9%
		CRMB: 12%

4.RESULTS AND DISCUSSIONS

TABLE 4.6:Marshall Stability Mix Design Results for SDBC Using 60/70 Class Bitumen

S. No	Bitumen %	Marshal stability (kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	4.00	830	2.70	2.234	4.86	13.82	60.23
2	4.50	870	3.00	2.246	4.32	13.90	71.12
3	5.00	967	3.12	2.262	3.76	13.92	73.58
4	5.50	872	3.53	2.248	3.24	14.08	74.14
5	6.00	840	3.94	2.231	3.07	14.33	76.24

The following graphs are plotted to find out the Optimum Binder Content.

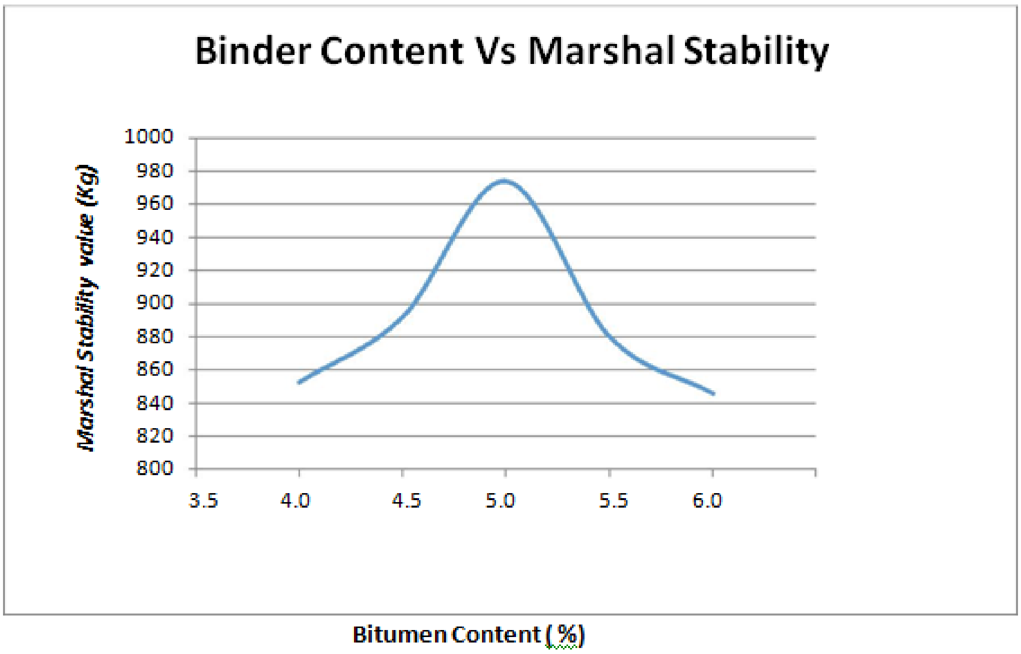

Figure 4.1 Bitumen % Vs Marshal Stability Value

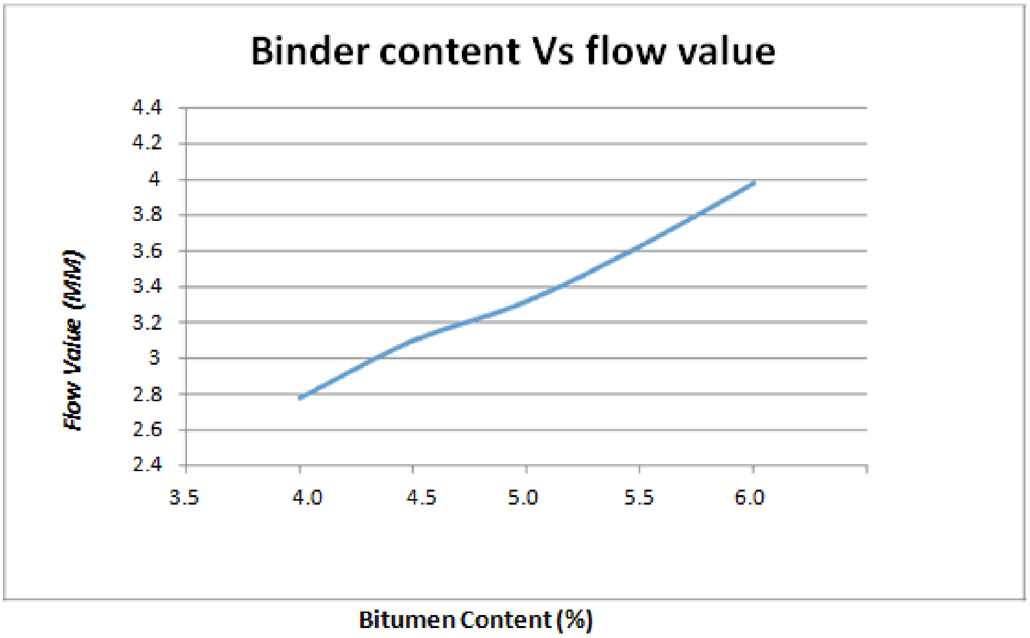

Figure 4.2 Bitumen %Vs Flow value

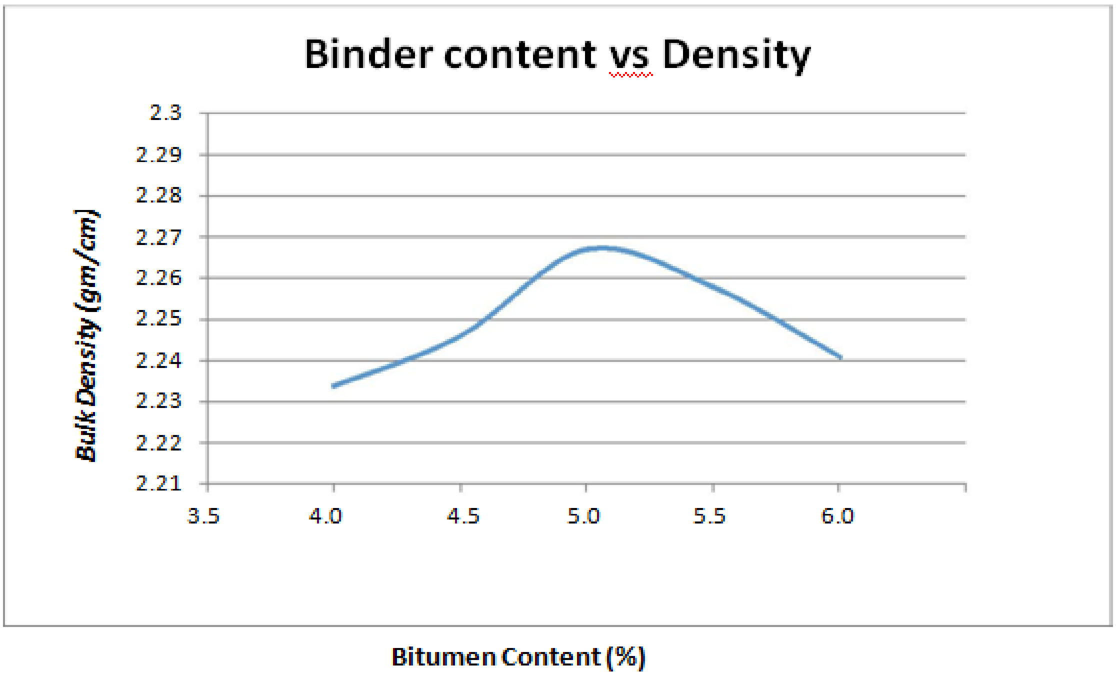

Figure 4.3 Bitumen % Vs density

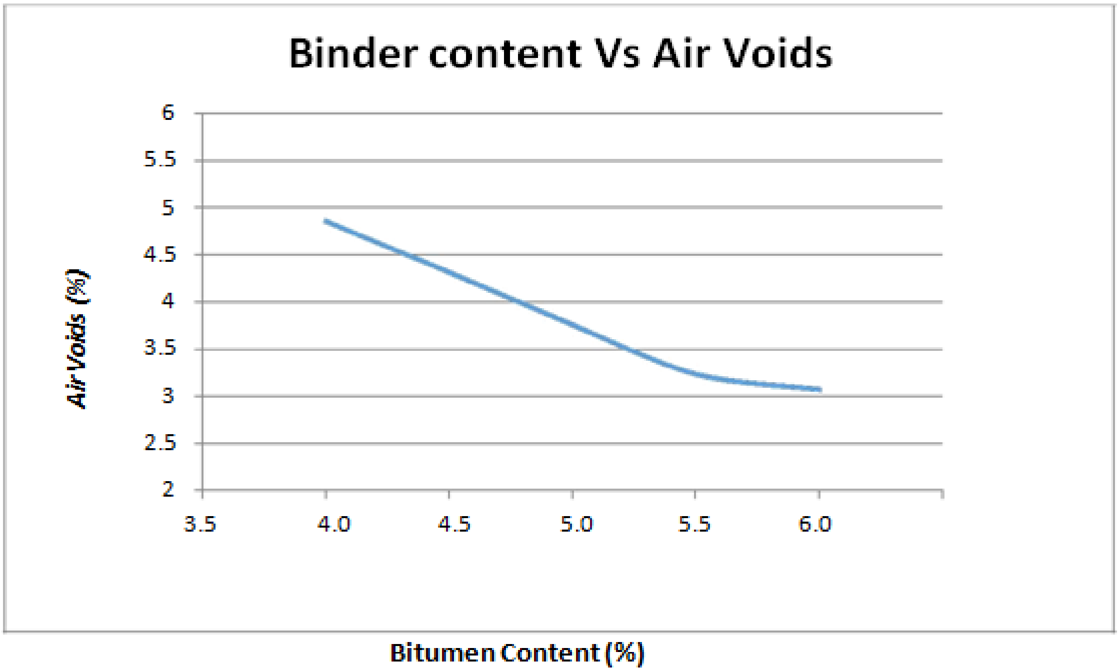

Figure 4.4 Bitumen % Vs Air voids %

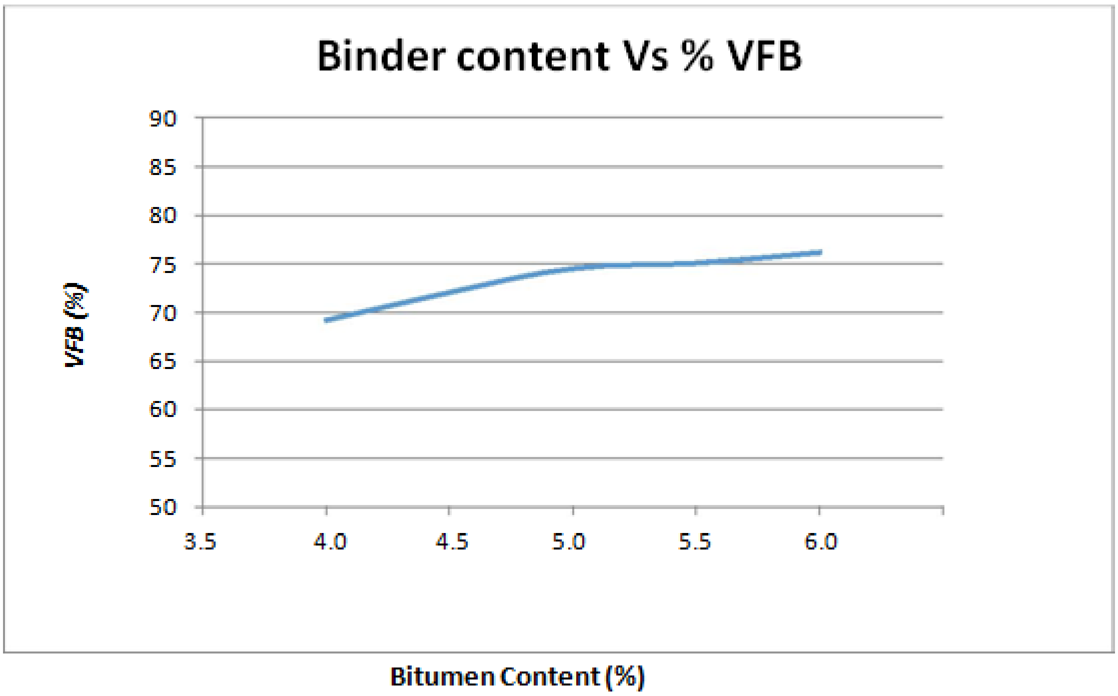

Figure 4.5 Bitumen % Vs Voids filled with bitumen%(VFB)

As of the figure above we can bring to a close that the optimum binder contented is 5.0% bitumen.

4.3.5Results with use of CRMB in SDBC

In this section, property such as B. Marshall constancy Value, Yield Value, Bulk thickness, % Air Entrainment, VMA, VFB of Modified Bitumen (CRMB) is 6.0% Bitumen Content and Properties and Results are known below (Table 4.7).

TABLE 4.7: RESULTS OBTAINED FFOM MARSHAL STABILITY MIX DESIGN FOR

SDBC WITH CRMB MODIFIED BITUMEN

S. No	CRMB %	Bitumen %	Marshal stability (kg)	Flow value (mm)	Bulk Density (gm/cc)	Air voids % Vv	VMA	VFB %
1	3	6.0	1063	3.52	2.24	3.80	14.97	74.13
2	6	6.0	1191	3.63	2.26	3.82	15.07	73.85
3	9	6.0	1284	3.67	2.30	3.87	15.11	73.73
4	12	6.0	1213	3.74	2.28	3.85	15.14	73.20

As of the above results, it is experimental that when the modifier (CRMB) proportion varies from 3% to 12%, the Marshal stability statistic increases to 9% and then the Marshal stability statistic decreases. It is also experimental that the flow value increase and the VFB decrease. Furthermore, the highest Marshall stability value is achieved at 9% CRMB.

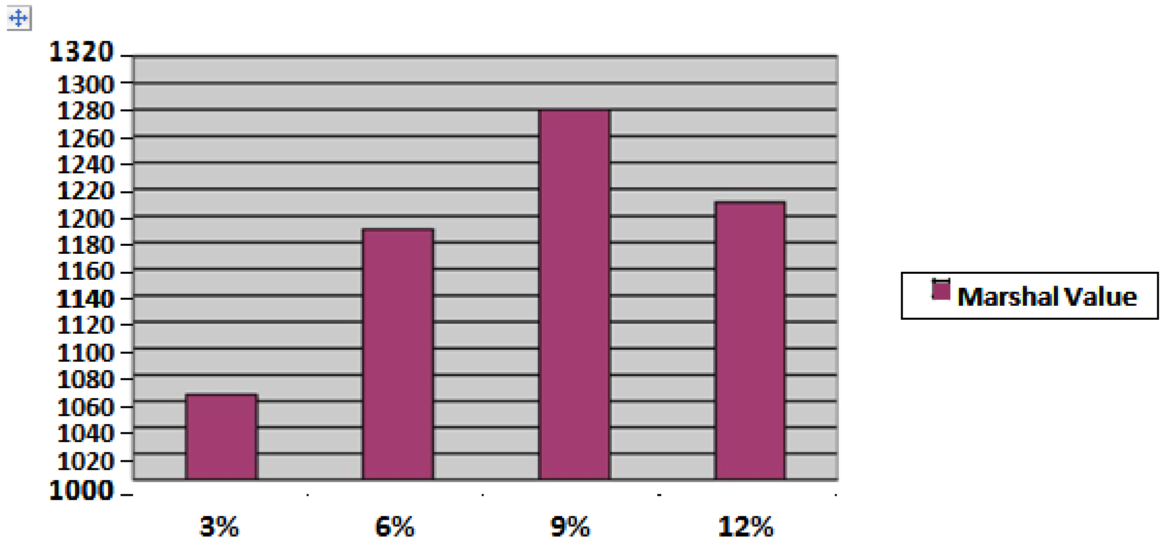

Figure 4.6 CRMB %vs Mrshal Value

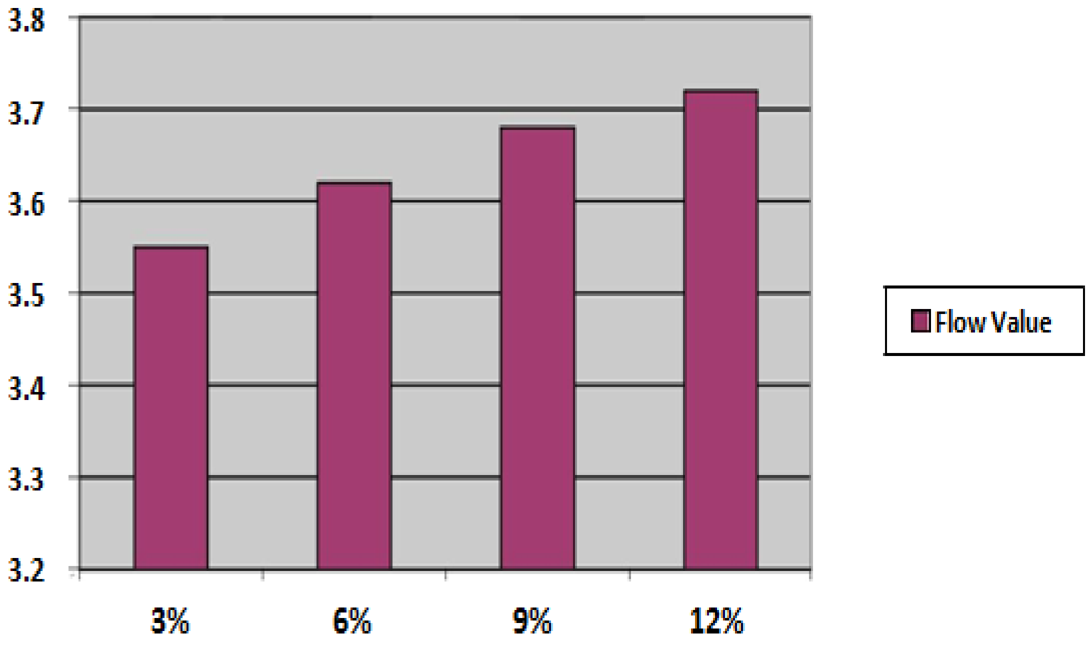

Figure 4.7 CRMB %vsFlow Value

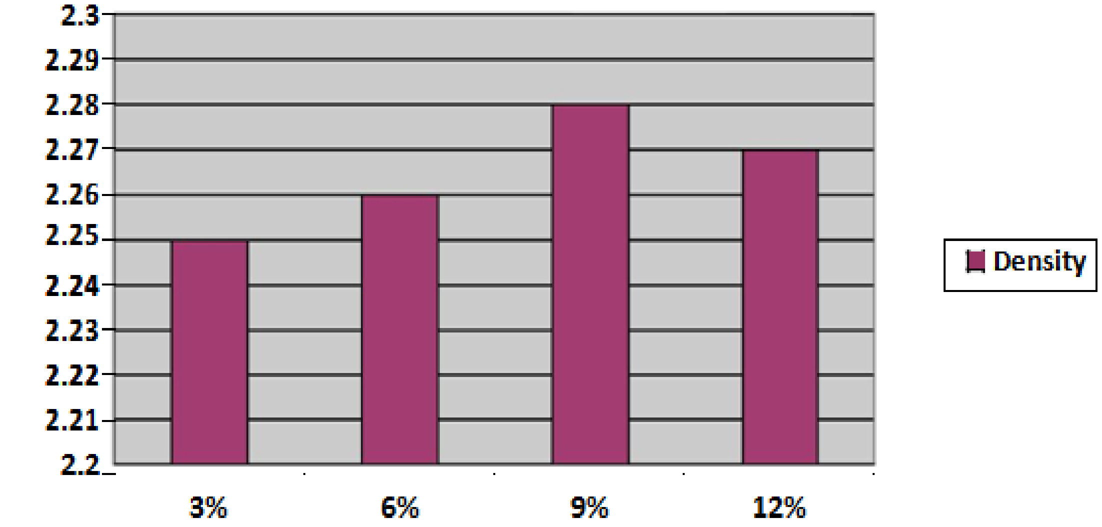

Figure 4.8 CRMB %vs Density

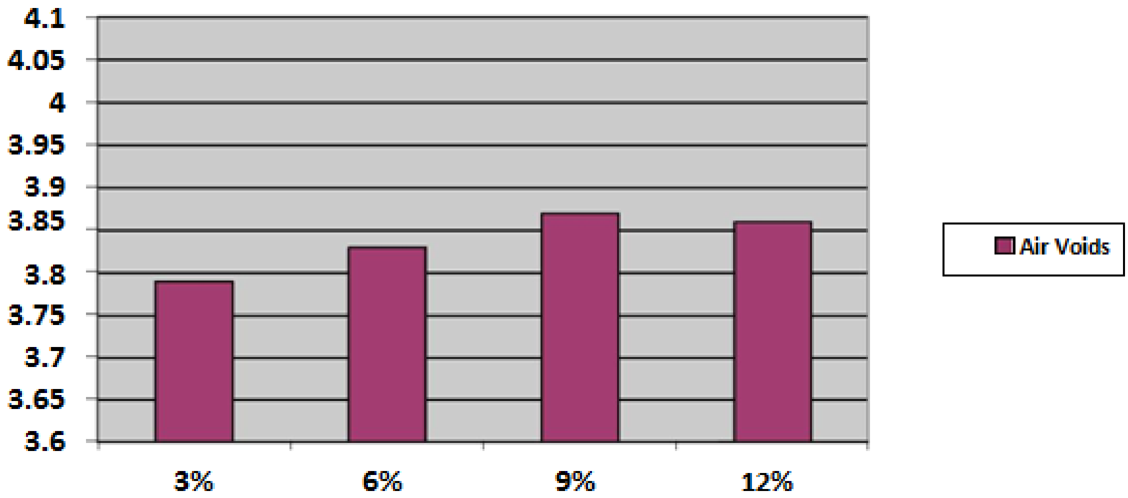

Figure 4.9 CRMB %vsAir Voids

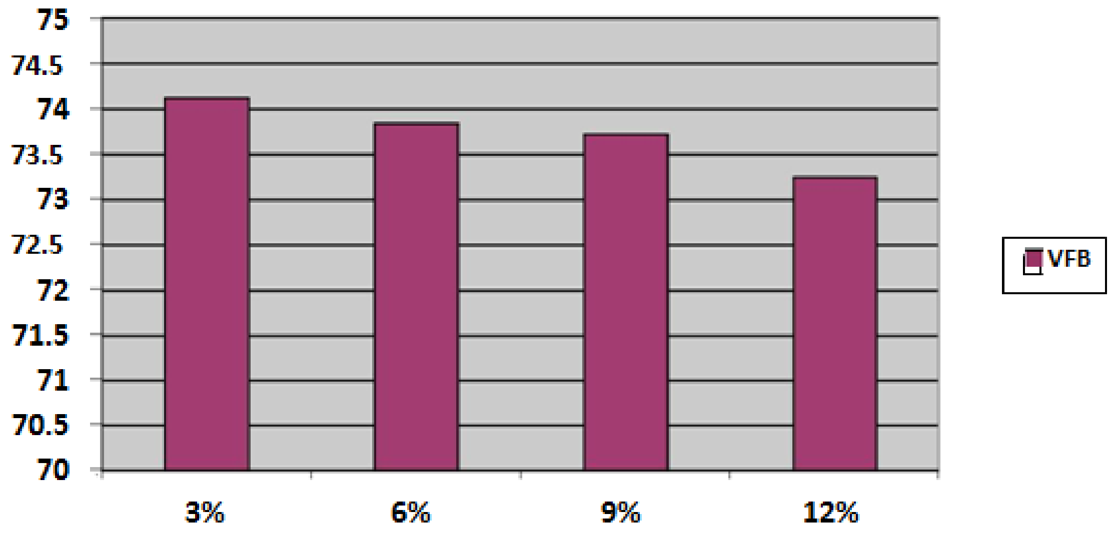

Figure 4.10 CRMB %vsVFB

5.CONCLUSIONS & SCOPE

When crumb rubber was mixed with various (3, 6, 9, and 12)% grade 60/70 bitumen, changes in penetration, ductility, flame and flame, precise gravity and soften point were observed. As already discuss in Chapter 4, all experiment show that infiltration, ductility decreases and soften point and precise gravity values increase. As the percentage of CRMB enlarge, the infiltration and ductility further decrease and the soften point,precise gravity value increase further. Contrast, flash point & fire point values initial increase and then decrease with rising CRMB percentage. The subsequent conclusion are drawn from this research.

1. Analyzes in this research showed that addition of CRMB increased the Marshall constancy and flow values of bituminous mixture.

2. Addition of 9% of His CRMB to the mixture results in CRMB modified bitumen with higher Marshall stability value.

3.CRMB customized bitumen blend show a improved Marshal stability evaluation (1284 kg) than regular (60/70) bitumen blend (967 kg).

4. Marshal constancy Value increase by 22.17%, 31.42% and 24.22% for CRMB 6%, 9% and 12% respectively at 6.00% bitumen grade (60/70).

5. It is also experimental that the void is reduced, the strength and durability of the road are increased, and the VFB (bitumen full cavities) is enlarged.

6. The most favorable binder contented decreased to 5% at the most favorable CRMB dosage (9%) compared to the normal bituminous mixture (6%).

Future Scope

In this study, semi-rigid bituminous concrete was used for 60/70 rated bitumen and modified by adding a variety of percentages of CRMB. In the future, modifiers will change to:

1. Possible HDPE additives to modify natural rubber, latex powder, polymer waste and bitumen.

2. The utilize of CRMB, LDPE and CRMB + LDPE and HDPE + CRMB can also be use for high density bituminous solid and bituminous solid.

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