

# Use of Waste Polyhtene in Bituminous Concrete Mix

Sreena<sup>1</sup>, V. K. Ahuja<sup>2</sup>

<sup>1</sup> M. Tech. Civil, SBMNEC, MDU, Rohtak

<sup>2</sup> HOD, Civil, SBMNEC, MDU, Rohtak

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## ABSTRACT

Also considering the environmental approach, due to excessive use of polythene in day to day business, the pollution to the environment is enormous. Since the polythene are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes. This paper presents a research conducted to study the behavior of BC mix modified with waste polythene. Various percentages of polythene are used for preparation of mixes with a selected aggregate grading as given in the IRC Code. The role of polythene in the mix is studied for various engineering properties by preparing Marshall samples of BC mixtures with and without polymer. Marshall properties such as stability, flow value, unit weight, air voids are used to determine optimum polythene content for the given grade of bitumen (80/100).

**Key words:** Bituminous Concrete (BC), Marshall stability, Flow value, Optimum Polythene Content.

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## INTRODUCTION

Bituminous binders are widely used by paving industry. A pavement has different layers. The main constituents of bituminous concrete (BC) are aggregate and bitumen. Generally, all the hard surfaced pavement types are categorized into 2 groups, i.e. flexible and rigid.

**i. Flexible Pavement:** If the surface course of a pavement is bitumen then it is called "flexible" since the total pavement structure can bend or deflect due to traffic loads.

**ii. Rigid Pavement:** If the surface course of a pavement is PCC then it is called "rigid" since the total pavement structure can't bend or deflect due to traffic loads. Such pavements are much stiffer than the flexible pavements due to the high modulus of elasticity of the Plain Cement Concrete material. Importantly, we can use reinforcing steel in the rigid pavements, to decrease or eliminate the joints.

### Role of plastic or polymer in pavement

Modification of BC, with the synthetic polymer binder can be considered as a solution to overcome the problems, arising because of the rapid increase in wheel loads and change in climatic conditions. Polymer modification can be considered as one of the solution to improvise the fatigue life, reduce the rutting & thermal cracking in the pavement. Asphalt, when blended or mixed with the polymer, forms a multiphase system, containing abundant asphaltenes which are not absorbed by the polymer. This increases the viscosity of the mix by the formation of a more internal complex structure.

## MATERIAL USED

### Aggregate

Aggregate constitutes the granular part in bituminous concrete mixtures which contributes up to 90-95 % of the mixture weight and contributes to most of the load bearing & strength characteristics of the mixture. Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement.

### **Bitumen**

Asphalt binder 60/70 and 80/100 are used in this research. The bitumen used should have the following properties.

- a) Grade of bitumen used in the pavements should be selected on the basis of climatic conditions and their performance in past.
- b) It is recommended that the bitumen should be accepted on certification by the supplier (along with the testing results) and the State project, verification samples. The procedures for acceptance should provide information, on the physical properties of the bitumen in timely manner.

### **Mineral Filler**

Mineral filler consists of, very fine, inert mineral matter that is added to the hot mix asphalt, to increase the density and enhance strength of the mixture. These fillers should pass through 75 $\mu$ m IS Sieve. The fillers may be cement or fly ash.

### **Polythene**

The polythene used in milk packets was used as raw material for preparation of the samples. These polythene packets were collected; they were washed and cleaned by putting them in hot water for 3-4 hours. They were then dried. Specific Gravity of polythene = 0.905

## **REVIEW OF LITERATURE**

### **Evolution of mix design concepts**

I. During 1900's, the technique, of using bitumen in pavements, was first used on rural roads in order to prevent rapid removal of the fine particles such as dust, from Water Bound Macadam, which was caused due to fast growth of automobiles [Roberts et al. 2002]. At initial stages, heavy oils were used as dust palliative. An eye estimation process which is called pat test, was used to estimate the required quantities of the heavy oil, in the mix.

II. The 1st formal method of mix design was Habbard field method, which was actually developed on sand-bitumen mixture. Mixtures with larger sized aggregate particles could not be handled in this method. This was one limitation of this procedure.

III. Fransis Hveem, 1942; who was a project engineer of California Department of Highways, has developed the Hveem stabilometer in 1927. He did not have any previous experience on judging, the required mix from its colour, hence he decided to measure various mixture parameters to find the optimum quantity of bitumen [Vallerga and Lovering 1985]. He had used the surface area calculation concept, (which was already in use, at that time for the cement concrete mix design), to estimate the quantity of bitumen actually required.

IV. Bruce Marshall developed the Marshall testing machine just before the World War-II. It was adopted in the US Army Corpes of Engineers in 1930's and subsequently modified in 1940's and 50's.

### **Advantages & Disadvantages**

#### **Advantages:**

- 1) Better binding property ,Higher Softening point; withstands high temp.
- 2) Lower penetration value; withstands higher load. No stripping – Resists the permeation of water.
- 3) Higher Marshall Stability–increased strength of road. Cost less compared to bitumen road.
- 4) Better disposal of waste plastics. Ten lakhs or one ton carry bags in one kilometre road.
- 5) The polymer coating also reduces the voids. This has resulted in reduced rutting , reveling, there is no formation of pot hole. The road can withstand heavy traffic & show better durability.

#### **Disadvantages:**

- 1) The burning of plastic waste creates air pollution and also health hazards.

## CONCLUSIONS

From the study of the behaviour of polythene modified BC it was found that the modified mix possesses improved Marshall Characteristics as mentioned below. It is observed that Marshall stability value increases with polyethylene content up to 4% and thereafter decreases. we observe that the marshall flow value decreases upon addition of polythene i.e the resistance to deformations under heavy wheel loads increases. Also the values of the parameters like VMA, VA, VFB are within the required specifications. Considering these factors we can assure that we can obtain a more stable and durable mix for the pavements by polymer modifications. This small investigation not only utilizes beneficially, the waste non-degradable plastics but also provides us an improved pavement with better strength and longer life period.

## REFERENCES

- [1]. Annual Book of ASTM Standards, 1999. ASTM D-6373, Standard Specification for Performance Graded Asphalt Binder, pp: 1102-1136.
- [2]. Aslam Shahan-ur-Rahman "Use of Waste Plastic in Construction of Flexible Pavement", New Building Materials & Construction World, 2009.
- [3]. Bahia, H.U. and Anderson, D.A., Strategic highway research program binder rheological parameters: Background and comparison with conventional properties. Transport. Res. Rec. 1488, 1995, 32, 39.
- [4]. Vasudevan R., Nigam S.K., Velkennedy R., Ramalinga Chandra Sekar A., Sundarakannan B. Utilization of Waste Polymers for Flexible Pavement and Easy Disposal of Waste Polymers, International Conference on Sustainable Solid Waste Management, 5 - 7, Chennai, India pp-105-111, 2007.
- [5]. Baker, R.E., Polymer modified bitumen. Indian Highways, 1998, 1, 85-94.
- [6]. Button, J.W. and Little, D.N., Additives Have Potential to Improve Pavement Life, 1998 (Roads and Bridges: USA).
- [7]. Collins, J.H., Bouldin, M.G., Gelles, R. and Berker, A., Improved performance of paving asphalt by polymer modification. Proc. Assoc. Asphalt Paving Technol., 1991, 60.
- [8]. Das, A., (1998). Analytical design of bituminous pavements based on field performance, unpublished PhD thesis, Civil Engg. Dept., IIT, Kharagpur.
- [9]. Denning, J.H. and Carswell, J., Improvement in rolled asphalt surfacing by the addition of organic polymers, Report LR 989, TRRL, Crowthorne 1981.
- [10]. Justo C.E.G. and Veeraragavan A "Utilization of Waste Plastic Bags in Bituminous Mix for Improved Performance of Roads", Centre for Transportation Engineering, Bangalore University, Bangalore, India, 2002.
- [11]. Palit, S.K., Reddy, M.A., Reddy, K.S. and Pandey, B.B., Performance evaluation of crumb rubber modified bituminous mixes. Proceedings of National Seminar on Road Transportation in India: Emerging Trends and Techniques, 2002 September 12-13 (IIT Kharagpur: India).
- [12]. Pandey, B. B., "Bituminous Mix Design", A Two Day Workshop on Design of Flexible Pavement with Emphasis on the New IRC:37-2001 Guidelines, 9-10 February, IIT Kanpur, 2002.