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EVALUATION THE PROPERTIES OF VG 10 BITUMEN MODIFIED WITH WASTE THERMOCOL

Speaker Name: Supriya Mahida
Designation: PhD Research Scholar
Organization: IITRAM, Ahmedabad
Email Address: supriyamahida@gmail.com

CONTENTS

- INTRODUCTION
- OBJECTIVES OF STUDY
- LITERATURE REVIEW
- MATERIALS AND METHODOLOGY
- MORPHOLOGICAL ANALYSIS
- CONCLUSIONS
- FUTURE SCOPE
- REFERENCES

INTRODUCTION

- The plastic production industry has grown from INR 35,000 Cr. in year 2005 to INR 100,000 Cr. in year 2015.
- The polymer modified bitumen used globally includes 75% elastomeric modified binder, 15% plastomeric and remaining 10% either rubber or other modification.
- A review study on applications of waste and virgin polymers in pavement has shown that waste polymers also improved the properties of pavement similar to that of using virgin polymers.

OBJECTIVES OF STUDY

- Evaluating the properties of WTMB (Waste Thermocol Modified Binders) prepared by mixing 0.5%, 1% and 2% (by weight of bitumen) with VG 10 bitumen
- To prepare and study WTMB containing 0.5% to 2% thermocol waste.
- To assess the extent of modification in the physical and rheological (viscosity) properties of base bitumen (VG-10).
- To assess the compatibility of bitumen with thermocol and to study the morphological changes in the modified binder containing optimum thermocol quantity using Field emission scanning electron microscopy (FESEM).

LITERATURE STUDY

- **Title:** Effect of thermoplastic copolymers on microstructure and viscoelastic behaviour of bitumen
- **Authors:** Noor Zainab Habib, Ibrahim Kamaruddin, Madzlan Napiah and Isa Mohd Tan
- **Journal, Year:** Malaysian Universities Transportation Research Forum and Conference (MUTRFC) 2010
- **Materials:** 80/100, HDPE, LLDPE, PP
- **Dosages:** 1%, 2%, 3% and 5%
- **Speed:** 120 rpm
- **Temperature:** 160-170 °C

LITERATURE STUDY

- **Empirical Tests:** Penetration, Softening and Viscosity Test
- **Morphological Analysis:** FESEM
- PP offer better homogenous blend in comparison to LLDPE and HDPE.
- The best results were obtained when polymer concentration was kept below 3% for HDPE and LLDPE.
- FESEM of PMBs up to 3% shows better blended mix, which reflects that lower the concentration of polymer in mix, better the blends can be achieved.

LITERATURE STUDY

- **Title:** Evaluation of the effect of waste polystyrene on performance of asphalt binder
- **Authors:** I.M. Nassar, K.I. Kabel and I.M. Ibrahim
- **Journal, Year:** ARPN Journal of Science and Technology, 2012
- **Materials:** Binder: 60/70, Polystyrene
- **Dosages:** 2%, 3%, 4%, 5% and 6%
- **Speed:** 600 rpm
- **Experiments:** Penetration, Softening , Viscosity Test, Marshall Test, TFOT, FT-IR, TGA and DTA.

LITERATURE STUDY

- **Morphological Analysis:** Optical microscope.
- All modified binders gave higher stability values, increase in air voids and slightly decrease in flow.
- FT-IR shows that asphalt has no change in the functional groups before and after modification.
- Morphological analysis characterize the distribution and the fineness of polymer in the asphalt matrix.

MATERIALS AND METHODOLOGY

- **BITUMEN:** Physical properties of VG 10 bitumen are described in Table 1.

TABLE 1: Physical Properties of VG 10 Bitumen

Properties	Values	Limit as per IS 73:2013	Code
Penetration (dmm),	75	80-100	IS 1203
Softening point (°C)	46	Min. 40	IS 1205
Ductility (cm)	75+	Min. 75	IS 1208
Absolute Viscosity, 60 °C, Poise	976	Min 800	IS 1206 (Part 2)
Kinematic Viscosity, 135 °C, cSt	323	Min 250	IS 1206 (Part 3)

MATERIALS AND METHODOLOGY

- **WASTE THERMOCOL:** Waste thermocol is a Polystyrene (PS) which is made of styrene monomers obtained from the liquid petrochemical.

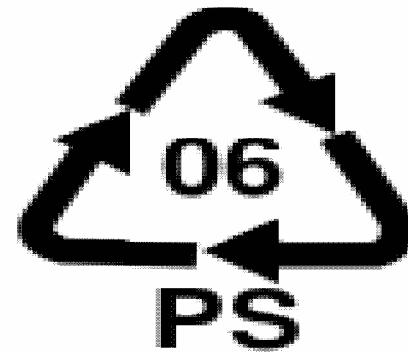
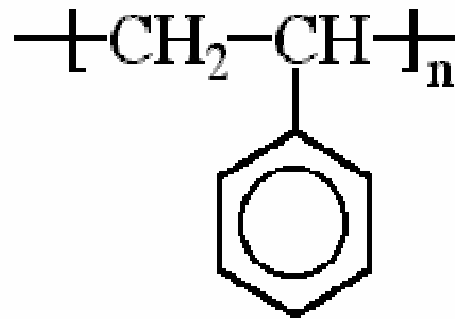


FIGURE 1: Chemical Structure and ISI Code of Polystyrene.

PREPARATION OF MODIFIED BITUMEN

- **Bitumen** = 500gm
- **Thermocol Waste** = 0.5%, 1.0% and 2.0% by weight of bitumen
- **Time** = 2-3 hours
- **Temperature** = 160-180 °C
- **RPM** = 250-300

CHARACTERIZATION OF VG-10 AND MODIFIED BINDERS

- The binder properties were found to be improved on addition of waste thermocol to VG 10.
- The results of penetration, softening point and viscosity of thermocol modified bitumen with different percentages of thermocol are presented in Figure 2, Figure 3 and Figure 4 respectively.

CHARACTERIZATION OF VG-10 AND MODIFIED BINDERS

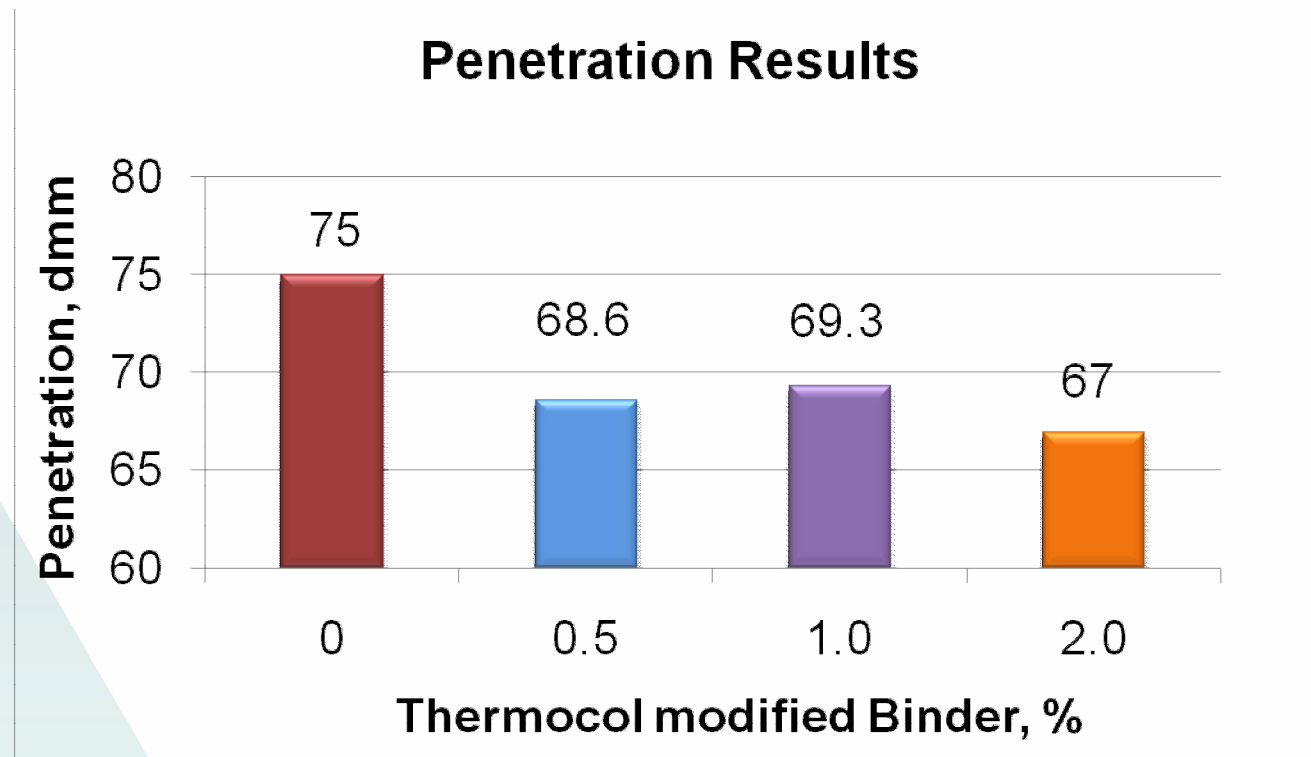


FIGURE 2: Penetration of VG-10 and Thermocol Modified Binder.

CHARACTERIZATION OF VG-10 AND MODIFIED BINDERS

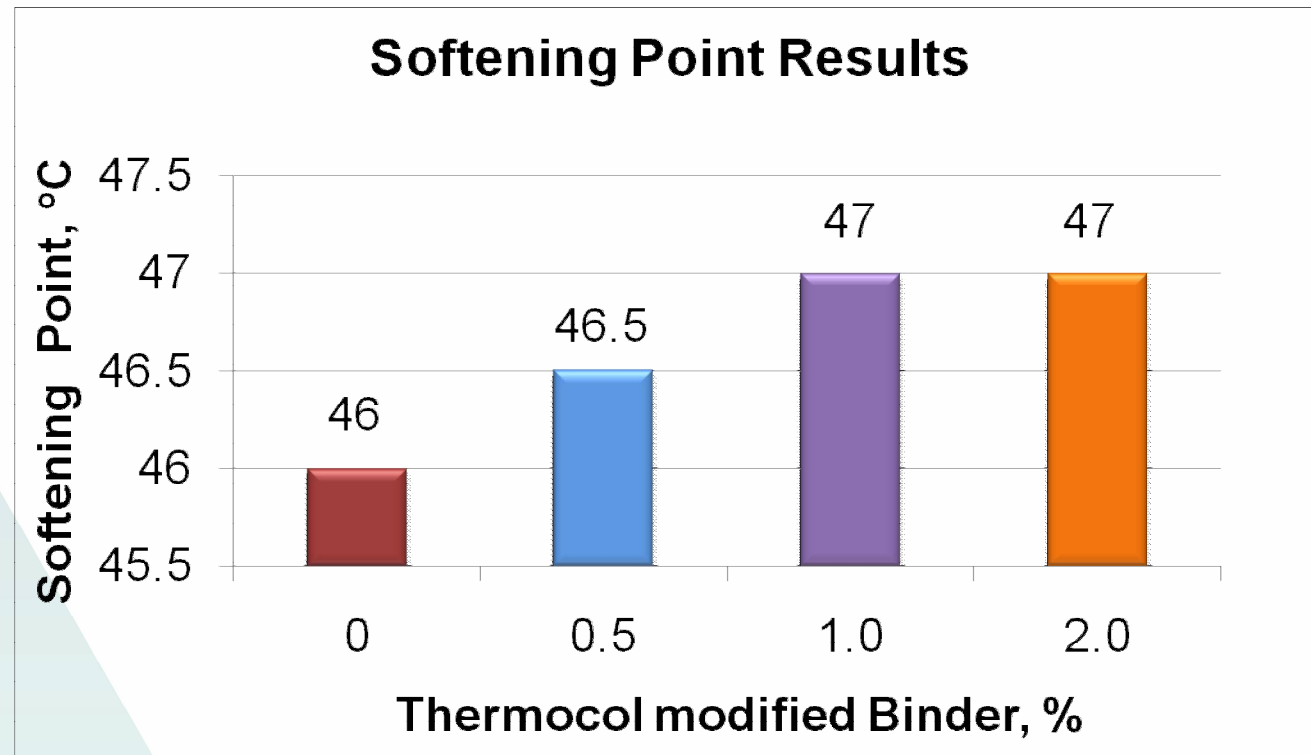


FIGURE 3: Softening Point of VG-10 and Thermocol Modified Binder.

CHARACTERIZATION OF VG-10 AND MODIFIED BINDERS

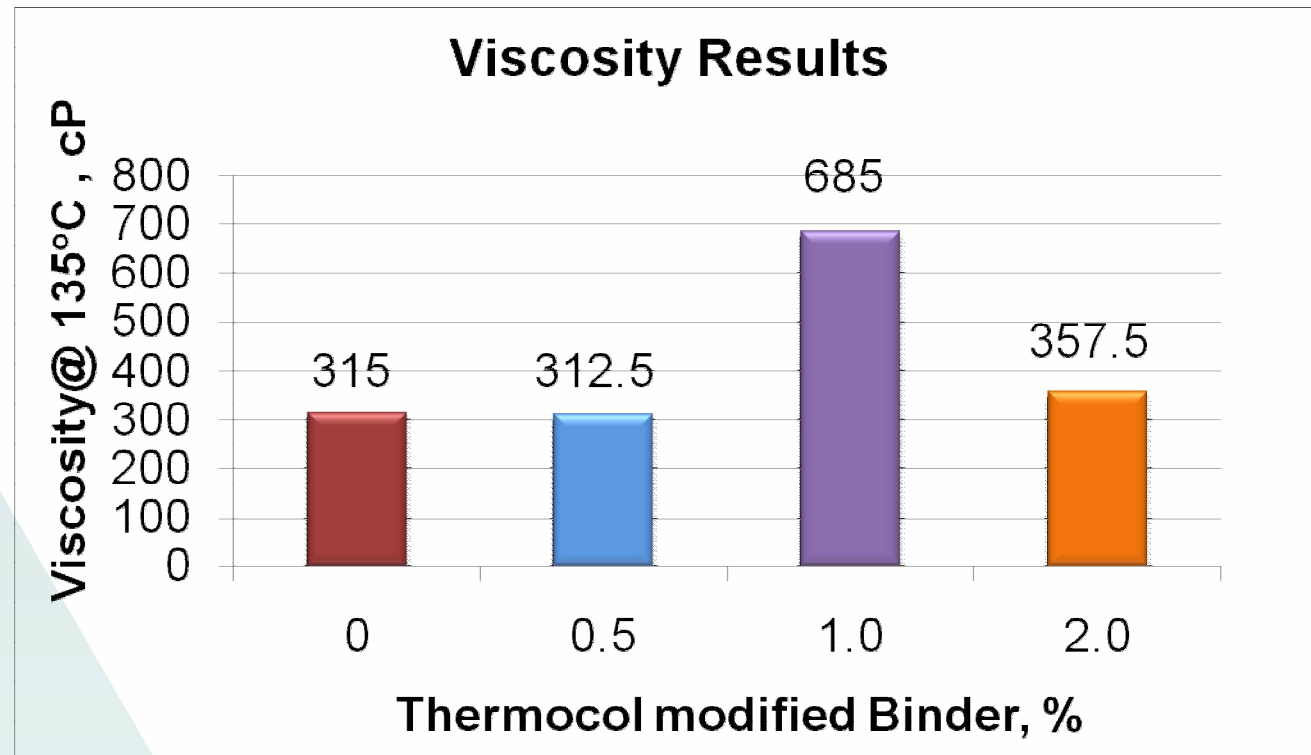


FIGURE 4: Viscosity of VG-10 and Thermocol Modified Binder.

MORPHOLOGICAL ANALYSIS

- Field emission scanning electron microscope (FESEM) instrument was used for the study of the microscopic structure of VG 10 bitumen and 1% thermocol modified bitumen with a magnification of 500x.
- Figure 5 presents the FESEM image of VG 10 bitumen and Figure 6 presents FESEM image of bitumen modified with 1% thermocol.

MORPHOLOGICAL ANALYSIS

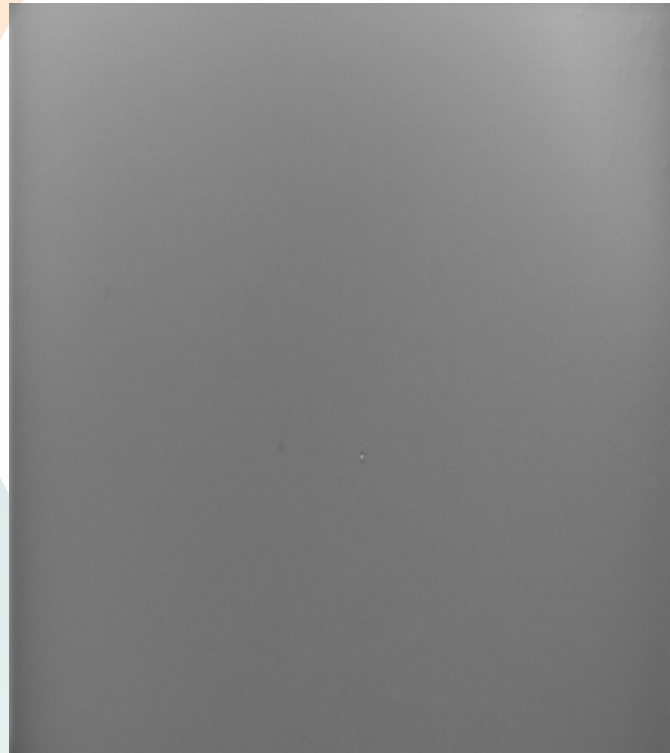
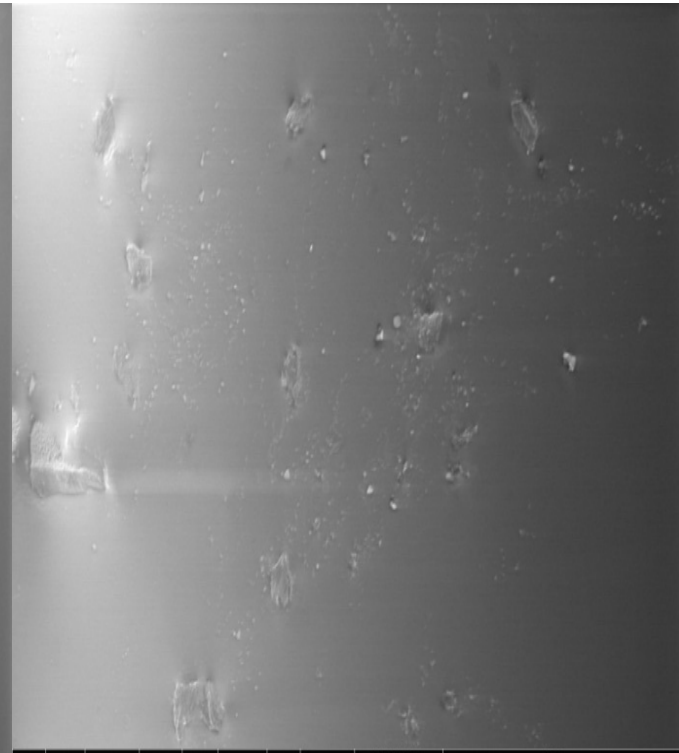


FIGURE 5: FE-SEM of VG10.



**FIGURE 6: FE-SEM of
1% Thermocol Modified
Bitumen.**

CONCLUSIONS

- Based on the preliminary laboratory studies, it can be concluded that thermocol waste can be successfully used in preparing modified binder.
- The addition of thermocol wastes to virgin bitumen improved the binder properties.
- Optimum dose of waste thermocol to be blended with VG-10 is 1 % .

CONCLUSIONS

- This study also indicates a solution to safe disposal of thermocol waste through development of modified binders which carries great promise as an alternative to recycle the thermocol waste for waste management.
- Apart from this the problem of environment pollution caused by burning and thermal processing of thermocol wastes picked by rag pickers from municipal solid waste stream will be resolved by using thermocol waste in road construction industry.

FUTURE SCOPE

- Further studies to investigate rheological behavior, long term performance of thermocol modified binders and Stripping, rutting, fatigue properties and resilient modulus of modified bituminous mixes are in progress.

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- **THANK YOU**