Improving Asphalt Binder Properties for Cold Regions Using Waste Plastic

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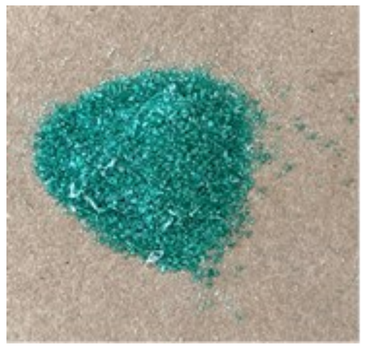
Background

- The generation of waste plastics has been a serious environmental concern on a global scale impacting human health, landfills, groundwater etc.
- Due to low recycling rate of the plastics (<10%), the need for alternate recycling paths is been anticipated by industry particularly through infrastructure.
- Asphalt industry is one of the predominant construction sector which is continuously exploring the potential of waste plastic as a performance enhancer.
- Commonly available waste plastics include Polyethylene, Polystyrene, Polyethylene Terephthalate (PET)



Polyethylene **Polystyrene** **PET Plastic**

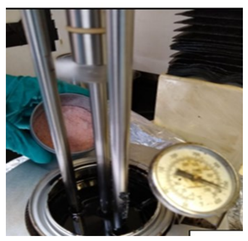
- Could waste plastic serve as a sustainable polymer to enhance the performance of asphalt mixtures, particularly in low temperatures?

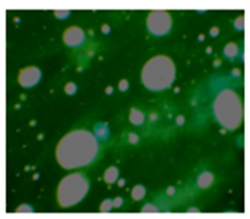
Goal and Objectives

To evaluate the feasibility of using waste plastic modifiers in asphalt pavements specifically in cold regions.

Objectives

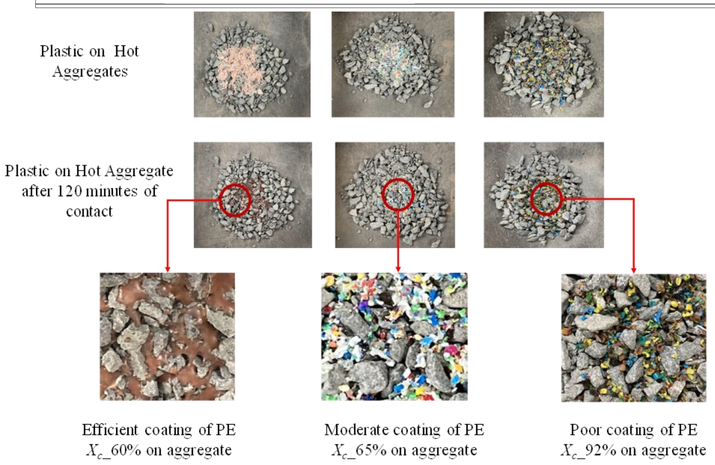
- Establishing a selection procedure for best compatibility of plastic with asphalt binder.
- Quantify the phase separation between asphalt and plastic modifiers.
- Characterizing the plastic in terms of their fundamental properties.
- Correlating the performance characteristics of plastic modified asphalt mixtures with their fundamental (viscosity and crystallinity) properties.
- Evaluate the capability of plastic modified asphalt mixture to resist the impact of permafrost (fracture energy and stress relaxation).





Significant findings of the study

Sample	Source	Density (g/cc)	T_m (°C)	Enthalpy (J/g)	X_c (%)	η at 165 °C (Pa.sec)
PE-1	Postal carts	0.937	133.60	161.18	55.01	1091.00
PE-2	Roof panels	0.911	125.32	176.57	60.26	1334.00
PE-3	Packaging waste	0.926	132.02	192.09	65.56	4019.00
PE-4	Injected moulds	0.945	136.39	210.00	71.67	1112.60
PE-5	Commercial PE	0.923	130.16	268.35	91.59	7733.80



Characterizing plastics in terms of crystallinity and viscosity rather than source.

Coating ability of plastics which has impact on mixture performance

Conclusions

- ***Crystallinity and viscosity*** of plastic were identified as useful classification parameters for waste plastic.
- Reduction in the use of virgin asphalt binder; ***approx. 2200lb per mile considering 1.5% replacement of plastic.***
- Improvement in the moisture resistance ***(up to 10% higher),*** rutting resistance ***(up to 2 times)***.

Impact of the research

- ***Extended service life of pavements*** *due to improved performance of plastic modified asphalt mixtures.*
- ***Cost savings*** in producing polymer modified binders due to the usage of waste plastics.
- ***Sustainable pavements*** due to low carbon emissions & better performance.

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