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Modification of Cold Mix

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Abstract
Cold mix asphalt (CMA) stands as a pivotal material in road construction and maintenance, especially in areas with colder climates or limited access to hot mix facilities. While lauded for its ease of application and cost-effectiveness, traditional CMA formulations often fall short in terms of strength, durability, and resilience to environmental pressures. In response, researchers and practitioners have increasingly explored modification techniques leveraging plastic and crumb rubber additives. This review provides a comprehensive overview of recent advancements in bolstering CMA performance via plastic and crumb rubber modifiers. Plastic additives, encompassing waste plastics like polyethylene (PE) and polypropylene (PP), along with recycled plastics, present avenues for enhancing the cohesion, flexibility, and fatigue resistance of CMA. Similarly, crumb rubber sourced from discarded tires offers a sustainable avenue for augmenting CMA properties. The synergistic integration of plastic and crumb rubber modifiers holds significant potential in elevating CMA's performance and sustainability, offering avenues to enhance pavement durability, mitigate environmental impact, and elevate the overall quality of transportation infrastructure.

Keywords: **Cold mix asphalt (CMA), polyethylene (PE), polypropylene (PP), Hot mix asphalt (HMA), Warm mix asphalt (WMA), High-density polyethylene (HDPE)**

I. INTRODUCTION

Increasing Road construction is resulting in proportional increase in the production of greenhouse gases which causes global warming. In order to cut down the production of greenhouse gases, different industries are adopting different measures. Similarly, road construction industry is also trying to control its carbon footprint. For this a number of measures are being adopted and Cold mix asphalt (CMA) is one of such measures which is used in road construction to reduce the production of greenhouse gases. the increasing rate of road construction has led to a proportional rise in greenhouse gas emissions, exacerbating global warming. In response, various industries, including the road construction sector, are adopting measures to mitigate their carbon footprint. Cold mix asphalt (CMA) emerges as one such measure, aimed at reducing greenhouse gas emissions during road construction. Unlike hot asphalt, CMA does not require heat for application, making it a more environmentally friendly option. Produced by mixing emulsified bitumen, cutback, or foamed bitumen with unheated aggregates, CMA offers economic benefits and minimal pollution due to the absence of aggregate heating. Asphalt mixtures are broadly categorized into hot mix asphalt (HMA), warm mix asphalt (WMA), and CMA based on production temperature. While HMA boasts superior performance, its high manufacturing temperature contributes significantly to greenhouse gas emissions. WMA, with lower manufacturing temperatures, has gained popularity for its environmental friendliness and comparable performance to HMA. CMA, however, stands out for its cost-effectiveness, energy efficiency, and environmental sustainability, with manufacturing temperatures ranging from 0 to 40°C. This paper aims to investigate the utilization and necessity of modified CMA in the road construction industry, offering a sustainable and cost-effective solution to enhance performance and durability. By incorporating plastics and crumb rubber as modifiers, this research seeks to contribute to safer, more resilient, and environmentally friendly road infrastructure. With growing concerns about environmental sustainability and waste management, exploring alternative materials and recycling methods for road construction becomes imperative. Plastics and crumb rubber, as waste products, hold promise for modifying CMA while reducing the environmental impact of plastic and rubber waste. Ultimately, this research aims to optimize the formulation of modified CMA, assess its performance, evaluate environmental impacts, and determine economic viability, thus advancing sustainable practices in road construction. The preparation of CMA involves selecting aggregates, bitumen emulsion, and additives, followed by mix design formulation to determine optimal proportions. CMA offers several advantages over HMA, including lower energy consumption, reduced emissions, extended paving seasons, and stockpiling capability. Despite its benefits, CMA presents challenges such as slower curing times and susceptibility to moisture damage. These challenges can be addressed through proper design, construction practices, and the use of additives or modifiers. Overall, CMA serves as a versatile solution for emergency repairs, seasonal constraints, remote locations, temporary pavements, and low-traffic areas, contributing to efficient and sustainable road infrastructure management.

II MATERIALS AND METHODS

MATERIALS

1. PLASTICS

Plastics, like polyethylene (PE) and polypropylene (PP), are added to cold mix asphalt to boost its resistance to cracking, rutting, and moisture damage. They enhance the stiffness and elastic rebound of the asphalt, lessening deformation under traffic and prolonging pavement life. PE offers flexibility, improving elasticity and durability, while PP provides strength, bolstering resistance to rutting and fatigue cracking. High-density polyethylene (HDPE)

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or polyethylene terephthalate (PET) are commonly chosen for their durability and compatibility. Initially, plastic waste is shredded into small particles and integrated into the asphalt mix. During mixing, plastic particles are blended with aggregate and bitumen in varying proportions to meet specific pavement requirements. Thorough mixing ensures uniform distribution. The benefits include enhanced durability, reduced cracking, and environmental advantages through plastic recycling.

Fig. 1 Plastics

2. CRUMB RUBBER

Crumb rubber, made from recycled tires by shredding or grinding, enhances cold mix asphalt by improving its elasticity, flexibility, and resistance to fatigue. Ranging from fine powder to larger granules, crumb rubber production repurposes old tires into valuable asphalt modifiers. In mix design, it's blended with aggregate and asphalt binder in specific ratios tailored to pavement needs. This integration enhances asphalt's elasticity, flexibility, and resistance to cracking and deformation. Moreover, it promotes sustainability by recycling tires, reducing waste, and providing an eco-friendly alternative. Rubber-modified asphalt also reduces noise, creating quieter roads. Its versatility suits various pavement projects, especially in high-traffic areas. However, ongoing research is vital to assess long-term durability across different environments.

Fig. 2 Crumb Rubber

METHODOLOGY

Sample preparation for modifying cold mix asphalt with plastics and crumb rubber involves several crucial steps. 1/4th,1/6th 1/12th portion of sample specimen replace by plastics and crub rubbber.Plastics and crumb rubber are initially processed by shredding or granulating them into small, uniform particles, with the size varying based on project specifications. Similarly, crumb rubber derived from recycled tires undergoes shredding or grinding to achieve the desired particle size distribution, tailored to project requirements and desired performance characteristics. Pre-treatment of plastics and crumb rubber may be necessary, such as shredding or grinding, to reduce particle size and increase surface area for improved adhesion with the asphalt binder. Quantities of plastics and crumb rubber required to achieve the target dosage levels are calculated, accounting for the volume of the cold mix asphalt to be modified. The mixing equipment is preheated to ensure proper blending and adhesion of additives with the asphalt binder. The pre-made cold mix asphalt is then added into the mixer, and mixing commences at a low speed to guarantee uniform distribution of aggregates and binder, effectively incorporating the plastics and crumb rubber additive.

TESTS

1. MARSHALL STABILITY

Stability of modified cold mix is tested by Marshall stability test

Fig.3 Load testing apparatus

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Table 1. Modification of Cold Mix by Plastics

Sl No:	Maximum load (kN)	Flow value(mm)	Stability (kN)
Sample 1	15	1.5	11.311
Sample 2	18	2	12.06
Sample 3	16	2.1	9.857

Table 2. Modification of Cold Mix by Crumb Rubber

Sl No:	Maximum load (kN)	Flow value(mm)	Stability (kN)
Sample 1	3	5	4.5
Sample 2	4.6	3.8	5.06
Sample 3	7.8	2.6	6.942

2. MOISTURE SUSCEPTIBILITY TEST

Moisture absorption of modified cold mix is tested by moisture susceptibility test

Fig.4 Water bath

Table 3. Moisture susceptibility test on Plastics and Crumb Rubber

Sample	Marshall stability (kN)	Flow value (mm)
Cold mix modified by plastics	16.33	2.17
Cold mix modified by plastics	5.13	3.8

The analysis of results indicates distinct characteristics between the plastics and crumb rubber samples. Plastics samples exhibits superior resistance to deformation under load compared to crumb rubber samples. Depending on project requirements, if prioritizing high strength and deformation resistance, plastics samples may be preferable. Ultimately, the selection between plastics and crumb rubber should consider specific project needs, performance objectives, and cost considerations.

III STUDIES AND FINDINGS

Marshall stability test, moisture susceptibility test provides, Stability and Strength: Conventional cold mix asphalt typically exhibits lower stability and strength due to reduced compaction at lower temperatures, whereas modified cold mix asphalt can achieve higher stability and strength, resulting in improved resistance to deformation.

Rutting Resistance: While conventional cold mix asphalt is prone to low rutting and permanent deformation under heavy traffic loads, modified cold mix asphalt often shows enhanced rutting resistance, contributing to its improved performance under traffic stress.

Moisture Susceptibility: Conventional cold mix asphalt is susceptible to moisture damage, whereas modified cold mix asphalt tends to exhibit improved moisture susceptibility resistance, indicating its potential for better performance in wet conditions.

Durability: Conventional cold mix asphalt typically has limited durability compared to hot mix asphalt, whereas modified cold mix asphalt provides enhanced durability, offering improved longevity and resistance to deterioration over time.

Environmental Impact: Conventional cold mix asphalt may utilize asphalt binders and aggregates with higher environmental impacts. However, utilizing recycled materials such as plastics or crumb rubber in modified cold mix asphalt can reduce overall environmental impacts and promote sustainability.

IV. CONCLUSION

The modification of cold mix asphalt with crumb rubber and plastic offers a comprehensive solution to the challenges encountered in road construction and maintenance. Through the integration of these recycled materials, substantial improvements in road durability are achievable, as both crumb rubber and plastic additives enhance the asphalt mixture's flexibility and resistance to cracking. Various proportions of these additives were studied, revealing that the inclusion of plastics surpassed crumb rubber in enhancing the strength and stability of the modified cold mix. Key assessments, including the Marshall stability test and water susceptibility test, shed light on crucial aspects of the modified mix's behavior, while analysis of specific gravity and void ratio provided further understanding of its performance characteristics. Overall, the study highlights the potential of using plastics to modify cold mix asphalt, offering sustainable and resilient pavement solutions. Further research aimed at optimizing the proportions of plastics and crumb rubber could lead to even greater enhancements in cold mix performance, contributing to advancements in civil engineering infrastructure materials and practices.

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REFERENCES

[1] Swayam Siddha, DashAnush K, Design and performance cold mix asphalt 2021
[2] Pejoohan TavassotiMans our SolaimanianXu a Chen. Characterization on of fatigue performance of cold mix at 2022
[3] Manu Sasidharan Micheal, P.N. Burrow, using waste plastics in road construction leads,2019
[4] Raheb Hafezzadeh, Federico Autelitano, Felice, Performance-related methods for the characterization of cold mix patching materials used in asphalt pavements maintenance at 21 October 2023
[5] Hayder Kamil Shanbara, Anmar Dulaimi, Talaat Abdel-Wahed, The future of eco-friendly cold mix asphalt at 17 June 2021
[6] Shobhit Jain, Bhupendra Singh Cold mix asphalt, An overview at 28 September 2020