Environmental Benefits of Using the Warm Mix Asphalt (WMA) in Road Construction

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Abstract: In India Road Transportation Sectore expande in the last few year after independence. Conventionally Indian roads are paved with Hot Mix Asphalt,which is invented almost 150-170°C aggregate and bitumen mixed together. During Production of the Hot Mix Asphalt,Generate Large Amount of Emission gases mainly Greenhouse Gases which are directly impact on Environment. So elucidation is using Warm mix Asphalt Technology.Warm mix Asphalt concede Generate asphalt material lower temperature and Due to low temperature less amount of energy required of the producing bitumen. So, that directly benefits on Environment Impact. This study carry out about of the Warm mix Ashphalt Technologies and other Environmental Benefits over hot mix Asphalt.

Index Terms **– Warm mix Asphalt, Environment, Greenhouse gases**

I.INTRODUCTION OF WARM MIX ASPHALT

A Number of new process and products have become available that have the capability of reducing the temperature at which hot mix asphalt is mixed and compaction without compromising the performance of the pavement. Warm mix asphalt technologies can reducing air emission and environment impact. These new technologies many kind of the process which make easily reducing temperature, but in this paper using Forming Technologies.

Forming technologies in binding aggregate with bitumen via steam. This technology mainly entails the insert of small amounts of water, either injected into the hot binder or directly into the mixing chamber. When the water is mixed with the hot bitumen, high temperatures cause it to evaporate and the steam is entrapped. This generates a large volume of foam, which temporarily increases the volume of the binder and reduces mix viscosity. In this Foaming technologies, hot binder mixing with a limited amount of water (steam) typically 1.5-2% by weight of the binder.

II.DATA COLLECTION & MEASUREMENT

Reducing emissions through the use of WMA is dependent upon several condition. First, type and level of emission reduction will vary according to the degree of temperature reduction and other operational factors such as type of fuel used. In this work fuel using a furnace oil. The plant's design and operation, aggregate moisture content. Generally speaking, less fuel use translates directly to lower emissions at the plant, since the largest part of gaseous emissions is the result of fuel combustion during the drying and heating processes.

In conventionally hot mix Asphalt mixing temperature arrange different proportional to making mixture with aggregate and bitumen. The Producing Asphalt having binder temperature, aggregate temperature mixture temperature and compaction temperature properties allow to heat making properly binding and mixing. So, that below table indicate all the properties required temperature in both technologies.

Table 1 Temperature Comparison

Mixture	Binder (VG40) Temperature (˚c)	Aggregate Temperature (˚c)	Mixture Temperature (˚c)	Compaction Temperature (˚c)
Hot Mix Asphalt (HMA)	160	160-185	60-165	Min 100
Warm Mix Asphalt (WMA)	181	135-140	135	Min 100

CO_2 emissions for each of the mixes tested during the project. Similar fuel usage reported in Table CO_2 production is reduced for WMA mixed compared to their corresponding HMA mixture.CO_2 emission result from fuel combustion during mixing aggregate and bitumen .In WMA reported fuel saving avg. 8.24 %.N_2O emission result from fuel combustion during firing on mixing in WMA reported fuel saving avg.8.12 %. CH_4 emission result from fuel combustion during firing on mixing in WMA reported fuel saving avg.8.11 %.Emission Factor including in Intergovernmental Panel on Climate Change (IPCC) vol.2.

Measuring fuel usage reported table no. show quantity usage in mixing material in plant. Table 3 indicated avg. fuel mixing at temperature are 60-165 ˚c and 135 ˚c corresponding HMA and WMA.

Table 2 Emission Factor

Green House Gases	Emission Factor (Kg of GHG/Kg of Fuel oil)
CO_2	3.120000
N_2O	0.000120
CH_4	0.000024

Fuel Consumption to both the cases use kilogram per tonne of mixture. Actual quantity use in 63 km Stretch in per tonne 5.40 to 5.80 kg of mixture. Here use of quantity is 5.28 kg per tonne.avg of actual consumption of hot mix Asphalt and Warm mix Asphalt using quantity is 4.79 kg per tonne of mixture of total consumption.

Table 3 Fuel Consumption

Mixture	Quantity (Kg/Ton. Of Mixture)	Actual Consumption
Hot Mix Asphalt (HMA)	5.28	5.40 to 5.80
Warm Mix Asphalt (WMA)	4.79	4.10 to 5.50

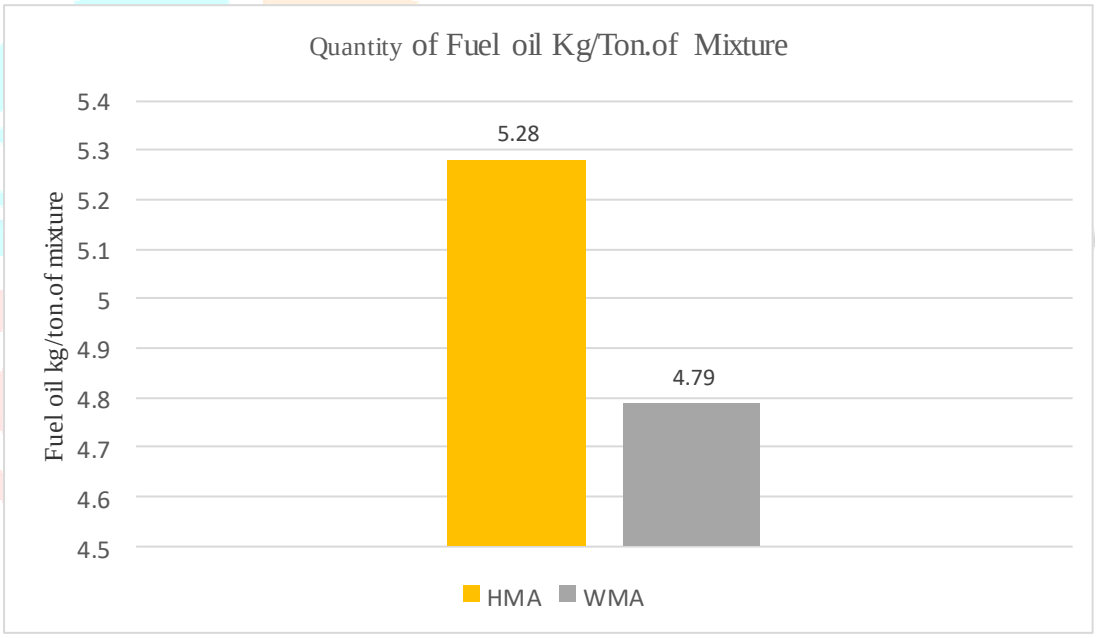

Figure 1 Comparision fuel consumption with HMA and WMA

Emission from evaluated mix is lower of hot mix asphalt compare to warm mix asphalt. Greenhouse gas emission reducing for the using warm mix asphalt. Total about of 9 % reduction show using of the warm mix asphalt.it can be environment benefits and reducing impact of the other environmental factor.

Table 4 Emission from Evaluated mixes

Greenhouse Gases	HMA	WMA
CO_2	16.4736	14.9448
N_2O	0.0160	0.0147
CH_4	0.0382	0.0351
Total	16.7241 kg of GHG/ton.	15.3445 kg of GHG/ton.

In this study other environment parameter like SOx, NOx, $PM_{2.5}$, and PM_{10} are measured. Measurement data are using Improvement West and Gaeke Method for Sox, Jacob & Hochheiser modified NOx and Particulate matter are measured by gravimetric matter. Also sampling and measuring data use IS: 5182 various part. In Plant Site various process could be running out. Batching plant, mixing plant, Place in Aggregate Bitumen and supply of the material. These are activity conduct through produce

particular matter which has harmful labor and living organism.so these are must be required measuring parameter. In this Study conduct on the site determination parameter like Sox, NOx, $PM_{2.5}$, PM_{10}. Result show measuring parameter are about Particulate matter is high indicated and SO_2, NO_2 are in the range. All of the result on site are 24 hour and during producing of the material had checked on site.SO_2 and NO_2 parameter are in permissible limit given National Ambient Air Quality Standard (2009) Industrila,Resudential,Rural and other Areas. Other particular matter are out of range. During mixing of material bitumen and aggregate generated particulate matter.

Table 5 Ambient air quality

Parameter	Result from Site plant for 24 hour ($\mu g/m^3$)	National Ambient Air Quality Standard (2009)
SO_2	54	80
NO_2	26.8	80
$PM_{2.5}$	150	100
PM_{10}	70	60

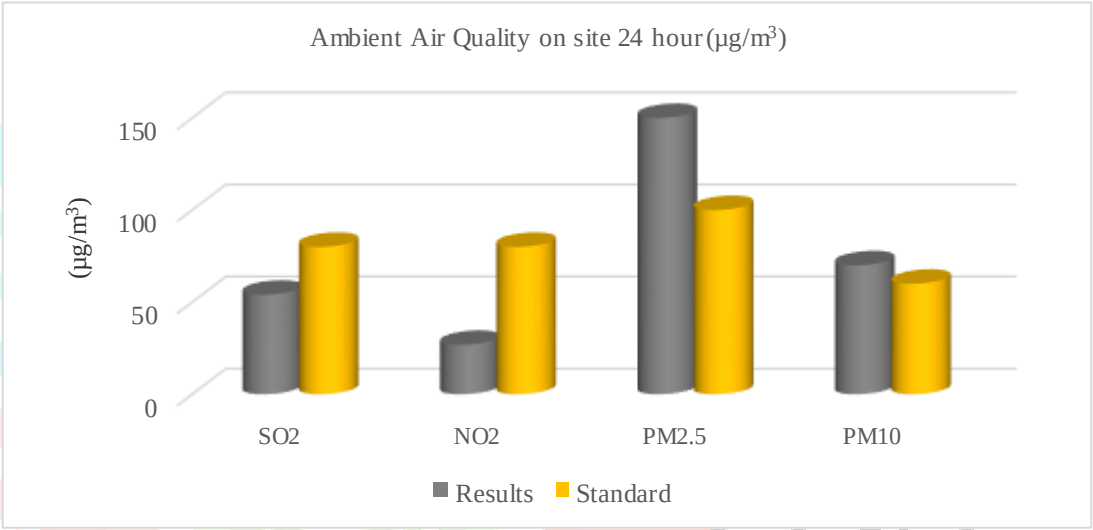

Figure 2 Ambient air quality comparison with standard

III.DATA ASSESSMENT

Data determination of using a Life Cycle Assessment (LCA). The amount of GHGs output/input in body life cycle of the compound has to be calculating and count. Life cycle includes all the stages involved for a compound such as its production right from source of raw material to final packaging, distribution, and to the final stages of disposal. Life cycle assessment (LCA) produces complete picture of inputs and outputs with respect to generation of air pollutants, water use and wastewater generation, energy consumption, GHGs emitted, or any other similar parameter of interest and cost–benefit initiatives.
This assessment is often called as environmental LCA. LCA estimates the GHGs output/input at each identified step of the product's life cycle, technically known as GHG measurement.

Each Stages of the LCA connecting overall system. Start to end of production to analyse and selection data should be done appropriate depending of objective or available data.

IV. CONCLUSION

Using of the Warm mix Asphalt in production of the bitumen show reducing emission and environmental benefits.

- Energy consumption, thus lowering the fuel/energy cost: it has been observed about 9 % reduction of energy in plant mix it means 0.45 kg/ton of fuel per tonne of materials saving.
- Decreased emission from mixing plant: the warm mix asphalt practice has been observed that there is average reduction of Green House Gases about 8.25 %.
- Ambient air quality in particulate show in more than permissible limit

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