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Experimental study on eco-friendly tar

Mrs.Jayanthi.V[1], Mrs.M.Mahalakshmi[2], Meiyarasu.N[3], Abhirami.MR[4], Kiruba Shankar.M[5]

[1]Assistant Professor, Department of Civil Engineering, Bannari Amman Institute of Technology,Sathyamangalam

[2,3,4,5]AssistantProfessor, Department of Civil Engineering, Bannari Amman Institute of Technology, Sathyamangalam

E – Mail: jayanthiv@bitsathy.ac.in

Abstract—**The world has become increasingly concerned over the global climate change thought to be caused by greenhouse gases, chief among them anthropogenic carbon dioxide which is released into the atmosphere from burning carbon fuels. In order to reduce the carbon emission content, non toxic material added with the bitumen. Such a material is molasses, which is the residue in sugar manufacturing process. Non-petroleum based binders can be made light-coloured bitumen so that it reduces the urban heat island effect. Superplasticizers are an essential component of self compactness to provide necessary workability such as viscosity modifying agents (VMA) for stability. The carbon content and viscosity of the bitumen is reduced by adding these ingredients into the bitumen and thus will increase self compactness and eco friendly.**

Keywords: ***Molasses; viscosity grade; bitumen; stability; ductility; durability; Eco friendly.***

I. INTRODUCTION

Bitumen is a mixture of organic liquids that are highly viscous, black, sticky, entirely soluble in carbon disulfide, and composed primarily of highly condensed polycyclic aromatic hydrocarbons. Naturally occurring or crude bitumen is a sticky, tar-like form of petroleum which is so thick and heavy that it must be heated or diluted before it will flow. At the room temperature, it is much like cold molasses. Refined bitumen is the residual (bottom) fraction obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with the highest boiling point, boiling at 525°C (997°F).

There are some current issues globally associated with the bitumen which are threatening the environment

1. Bitumen's release huge amount of carbon dioxide,
2. There will be 8 to 37 % of carbons in one-gallon oil bitumen.
3. The surfaces of asphalt roads made from normal bitumen have a tendency of becoming "greasy" in wet road conditions; this is due to oil content of residue bitumen.
4. Black road surfaces made from bitumen absorb so much heat that heavy vehicles have been known to "lift" the road surface creating road safety hazards for the public and also for the motor vehicles.
5. Huge amount of heat is required to melt the bitumen during transportation and application 6. Aggregate and bitumen bond is attacked by the water reaction.

In order to reduce these types of problem, the bitumen was replaced with waste materials. This material is the one thought that took life from reading the startling things about decaying of environment because of cement.

II. BITUMEN PROPERTIES

1. Bitumen Adheres
2. Bitumen is Elastic
3. Bitumen is Plastic
4. Bitumen is Viscoelastic
5. Bitumen Ages
6. Bitumen Hardens

III. VISCOSITY GRADES

Bitumen's shall be classified into four types, based on viscosity,asgivenbelow:

a)VG-10
b)VG-20
c)VG-30
d)VG-40

IV. REQUIREMENTS

The paving bitumen binder shall be homogeneous and shall not foam when heated to 175°C. The various grades of bitumen shall conform to the requirements prescribed in Table 1 of IS 73-2013

IS 73 : 2013

Table 1 Requirements for Paving Bitumen
(*Clause* 6.2)

Sl No.	Characteristics	Paving Grades				Method of Test, Ref to
		VG10	VG20	VG30	VG40	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Penetration at 25°C, 100 g, 5 s, 0.1 mm, *Min*	80	60	45	35	IS 1203
ii)	Absolute viscosity at 60°C, Poises	800-1 200	1 600-2400	2 400-3 600	3 200-4 800	IS 1206 (Part 2)
iii)	Kinematic viscosity at 135°C, cSt, *Min*	250	300	350	400	IS 1206 (Part 3)
iv)	Flash point (Cleveland open cup), °C, *Min*	220	220	220	220	IS 1448 [P : 69]
v)	Solubility in trichloroethylene, percent, *Min*	99.0	99.0	99.0	99.0	IS 1216
vi)	Softening point (R&B), °C, *Min*	40	45	47	50	IS 1205
vii)	Tests on residue from rolling thin film oven test:					
	a) Viscosity ratio at 60°C, *Max*	4.0	4.0	4.0	4.0	IS 1206 (Part 2)
	b) Ductility at 25°C, cm, *Min*	75	50	40	25	IS 1208

Fig .1 Requirements of paving bitumen

V. MOLASSES

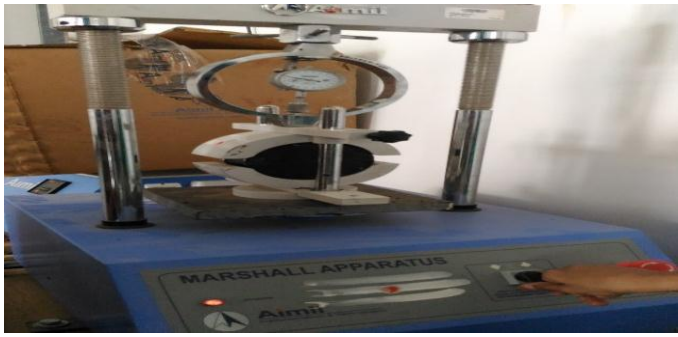
Molasses is a byproduct of the sugar-making process, resulting in the brown syrupy liquid left over after boiling once the sugar crystals have been removed. There are several types of molasses; variations depend on how many times the syrup was boiled and what may be added to it.

- Light Molasses
- Dark Molasses
- Black Strap Molasses
- Sulfured vs. Unsulfured Molasses

Fig.2 Black strap molasses

A. Light Molasses:
This is the syrup left over after the first boiling cycle of sugarcane juice.This molasses is the lightest in colour, has the highest sugar content, and the least viscous.
B.Dark Molasses:
Dark molasses is the byproduct of the second boiling cycle of sugarcane. This molasses is darker and more viscous than light molasses, and contains less sugar.

C.Black Strap Molasses:



This is the final by product of the third boiling cycle in the sugar making process. This variety of molasses contains the least sugar and has the highest concentration of vitamins and minerals. Black strap molasses has a very dark colour and is extremely viscous intexture. Because this type of molasses is highly concentrated, it has a deep, spicyflavour.
D.Sulfured vs. Unsulfured Molasses:
Sulfured molasses refers to molasses that has been treated with sulfur dioxide as a preservative. Generally, only young sugarcane requires this treatment. Therefore, molasses made from mature sugarcane is often unsulfured. Unsulfured molasses may have a lighter,cleaner sugar flavor.

VI. USES OF MOLASSESBAKED GOODS:

In the United States, molasses is a common sweetener and flavoringgoods such as gingerbread, Boston brown bread, and shoofly pie. Molasses is also responsible for theclassic, sweet, rich flavor of baked beans.

A. Alcohol:
Molasses is the sugar used to make rum. Rum is therefore common in regions of the world where sugarcane or sugar beets are heavily cultivated because of the abundance of molasses. Molasses is also sometimes used to brew dark ales like stout.
B.Brown Sugar:
Molasses is responsible for the dark, rich flavor and texture of brown sugar. Brown sugar is produced by combining refined white sugar with approximately 5% molasses.
C.Tobacco:
Molasses is added to some tobacco products for flavor. Tobacco flavored with molasses is particularly popular in the Middle East for use in hookahs.

VII. USES OF MOLASSESBAKED GOODS:

The tests are as follows,
1. The Marshall stability of bituminous mixture.

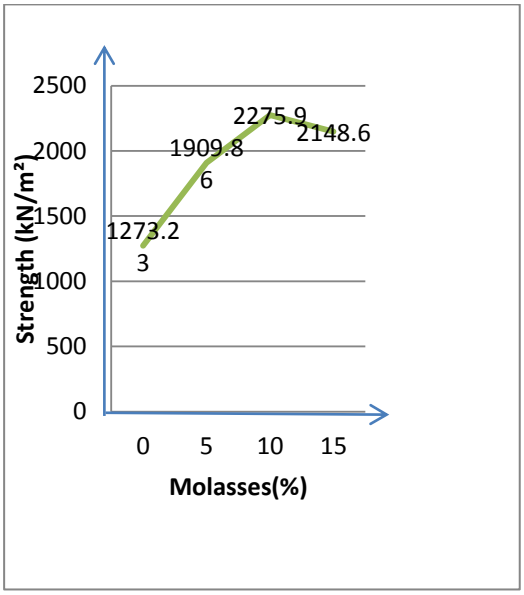
This test is done to determine the Marshall stability of bituminous mixture as per ASTM D 1559. The principle of this test is that Marshall Stability is the resistance to plastic flow of cylindrical specimens of a bituminous mixture loaded on the lateral surface.
The process of MarshallStability is,
Heat the weighed bituminous mixture upto 170^{o}C and 163^{o}C respectively.Mix them thoroughly, transfer the mixed

material to the compaction mould arranged on the compaction pedestal.

Give 75 blows on the top side of the specimen mix with a standard hammer. Take the mould with the specimen and cool it for a few minutes.Remove the specimen from the mould by gentle pushing. Mark the specimen and cure it at room temperature, overnight.Before testing of the mould, keeps the mould in the water bath having a temperature of 60^{o}C for half an hour Check the stability of the mould on the Marshall Stability apparatus.

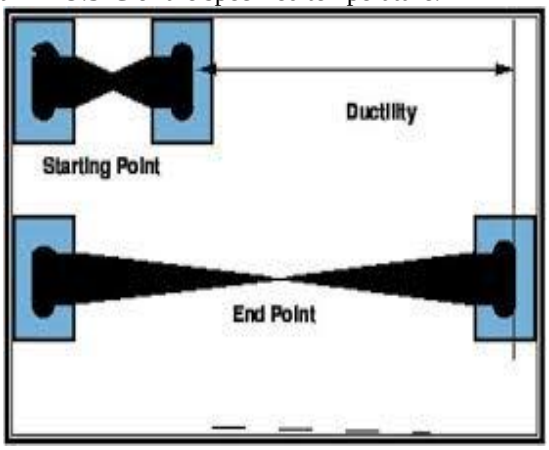
Z

Sample weight (gm)	Bitumen Content (ml)	Molasses Content (%)	Weight Of Sample (Air) (kg)	Weight of Sample (water) (kg)
1200	50	5	1.22	1.22
		5	1.28	1.24
1200	50	10	1.18	1.18
		10	1.24	1.28
1200	50	15	1.28	1.26
		15	1.30	1.30



2. Ductility of bitumen

Pour the material in a thin stream back and forth from end to end of the mould until it is more than level full. Leave it to cool at the room temperature for 30 to 40 min, and then place in a water bath maintained at the specified temperature for 30 min after which cut off the excess bitumen by means of a hot, straight-edged putty knife or spatula so that the mould shall be just level full.Place the brass plate and mould with briquette specimen, in the water bath and keep at the specified temperature for about 85 to 95 minutes. Then remove the briquette from the plate, detach the side pieces, and test the briquette immediately. Attach the rings at each end of the clips to the pins or hooks in the resting machine and pull the two clips apart horizontally at a uniform speed as specified until the briquette ruptures. Measure the distance in centimetres through which the clips have been pulled to produce rupture. While the test is being made, make sure that the water in the tank of the testing machine covers the specimen both above and below it by at least 25 mm and is maintained continuously within ±O.5°C of the specified temperature.



Description	Ductility value(cm)
Molasses 10%	39.6
Molasses 10%	42.2
Molasses 10%	43
AVG	41.6

3. Penetration of bitumen

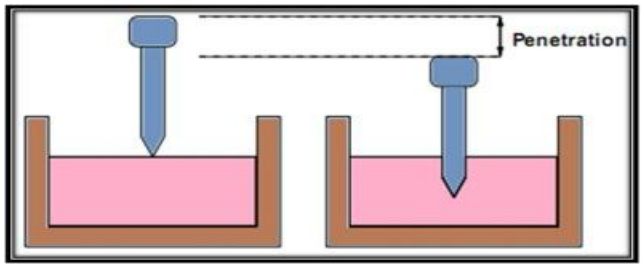
Pour the melt(sample) into the container to a depth at least 10 mm in excess of the expected penetration allow it to cool in an atmosphere at a temperature between 15 to 30°C for l 1/2 to 2 h for 45 mm deep container and 1 to l 1/2 h when the container of 35 mm depth is used.

Fill the transfer dish with water from the water bath to a depthsufficient to cover the container completely; place the sample in it andput it upon the stand of the penetration apparatus.

Adjust the needleto make contact with the surface of the sample.

Note the reading of the dial or bring the pointer to zero. Release the needle and adjust the points, if necessary to measure the distance penetrated.

Make at least three determinations at points on the surface of the sample not less than 10 mm apart and not less than 10 mm from the side of the dish.



VIII. CONCLUSION

From this study the behaviour of bitumen modified with molasses improves ductility, penetration and Marshall Characteristics. Investigation not only utilizes beneficially, the solid waste molasses but also provides us improved pavement characteristics such as road safety, visibility, long life, strength, recycling, workability and another one that is environment.By using molasses to the bituminous mix amount of release of carbon dioxide decreases and also products of molasses also decreases which are very harmful to human health. The road can withstand heavy traffic and better service. This modification not only adds value to molasses but will also develop technology which is eco-friendly.

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