

EXPERIMENTAL INVESTIGATION ON BITUMEN WITH PARTIAL REPLACEMENT OF SUGARCANE WASTE MOLASSES

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Abstract: 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. The benefits of using alternative binders are that they can save the natural resources and reduce energy consumption, while maintaining, and in some cases improving pavement performance. The objective of this research is investigating the effect of cane molasses on performance of the base bitumen. Sugar cane molasses is an organic waste material obtained from raw sugar during the refining process at sugar refineries. The effects of cane molasses percentage replacement on bitumen were examined by means of a various laboratory tests. While adding molasses ductility decreases.

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

Introduction

The word road defines that there is often difference between the common understanding of what a road is, and the wider, legal definition that is used in enforcing the large that control the use of motor vehicles and the behavior of drivers, cyclists, pedestrians other road users. It is used for the enforcement purposes, including the enforcement of requirements relating to the use of motor vehicles, has been widened from the traditional view of what is a road.

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.

Molasses is the material that is used to reduce the bitumen content also to reduce the carbon from the pavement to make the global warming reduced to the rest of the time. Molasses is so much good in binding the aggregates with bitumen and also used in hot zones to reduce the little amount of heat in the pavement surface. The molasses is also soil stabilizing ingredient and make

them more bond in hilly areas and make them more denser.

MATERIALS USED

BITUMEN

- Bitumen is a black or dark-coloured (solid, semi-solid, viscous) amorphous, cementitious material that can be found in different forms, such as rock asphalt, natural bitumen, tar and bitumen derived from oil, which is referred to as petroleum bitumen. The specific gravity is 0.97 to 1.02.
- Currently most of the roads globally are paved with bitumen. Today the world's demand for bitumen accounts for more than 100 million tons per year which is approximately 700 million barrels of bitumen consumed annually.

PROPERTIES OF BITUMEN

- Bitumen's main property is that of a very strong and durable adhesive that binds together a very wide variety of other materials without affecting their properties.
- Its durability is essential to major engineering projects such as roads and waterways where it must do its job for 20 years or more.
- Bitumen is insoluble in water but is soluble in numerous organic solvents. As it is highly waterproof, it can act as an effective sealant.
- It also resists action by most acids, alkalis and salts. It does not contaminate water so it can be used to line watercourses.

MOLASSES

Molasses is the dark, sweet, syrupy by-product made during the extraction of sugars from sugarcane and sugar beets. Molasses can vary in colour, sweetness, and nutritional content depending on the variety or how much sugar has been extracted.

Molasses has a rich history in the Caribbean and Southern United States, where sugarcane and sugar beets are heavily cultivated. Molasses was also a popular sweetener throughout the United States in the early 20th century.

MANUFACTURING OF MOLASSES

During the sugar making process, juice extracted from sugarcane or sugar beets is boiled down until the sugars crystallize and precipitate out. The syrup left over after crystallization is referred to as molasses. Typically, sugar cane juice undergoes three cycles of boiling and crystallization to extract as much sugar as possible. With

each successive cycle, the left over molasses contains less sugar.

ENVIRONMENTAL PROTECTION

Molasses that remain unused can be led into wastewater drains and find its way into natural drainages sometimes without being sufficiently treated. If that happens it may become a source of environmental pollution especially in the rivers. The use of this material in road construction can most likely ensure such an eventuality does not take place because the added usage will ensure that all the molasses produced by factories is wholly taken care of in road constructions. The use of molasses in treatment of soil to improve its engineering properties will most probably bring about a considerable saving on the current expenditure on repairs for damaged structures. In that aspect it will immensely contribute to sustainable development of infrastructure.

TYPES OF MOLASSES

- 1) Light molasses
- 2) Dark molasses
- 3) Black strap molasses
- 4) Sulfured vs. Unsulfured molasses

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. Texture

Dark Molasses: Dark molasses is the by-product of the second boiling cycle of sugarcane. This molasses is darker and more viscous than light molasses, and contains less sugar.

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 in texture. Because this type of molasses is highly concentrated, it has a deep, spicy flavour.

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 flavour.

USES OF MOLASSES

Baked Goods: In the United States, molasses is a common sweetener and flavouring in many baked goods

such as gingerbread, Boston brown bread, and shoofly pie. Molasses is also responsible for the classic, sweet, rich flavour of baked beans.

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.

Brown Sugar: Molasses is responsible for the dark, rich flavour and texture of brown sugar. Brown sugar is produced by combining refined white sugar with approximately 5% molasses. **Tobacco:** Molasses is added to some tobacco products for flavour. Tobacco flavoured with molasses is particularly popular in the Middle East for use in hookahs.

FEATURES OF MOLASSES

- Due to the low sugar content it increases the strength of the expansive soil
- It can be used as a dust palliative as well as binder for granular soil that are structurally stable
- It is waste minimization
- It is pollution prevention and green productivity

MERITS

- Low cost material
- Easily available material
- High binding property between aggregate and bitumen
- It is eco-friendly material

MATERIAL TEST

TESTS ON BITUMEN

TEST	BITUMEN VALUE
Specific Gravity	1.0
Penetration	130mm
Softening Point	49 °C
Viscosity	4mins 20secs
Ductility	85cm

TESTS ON AGGREGATE

TEST	AGGREGATE VALUE
Specific Gravity	2.42
Water Absorption	0.013kg
Impact value	35%
Crushing value	13.10%
Abrasion value	3.15%

TESTS ON BITUMEN WITH MOLASSES

TEST	BITUMEN VALUE
Specific Gravity	1.0
Penetration	190mm
Softening Point	55 °C
Viscosity	3mins
Ductility	52cm

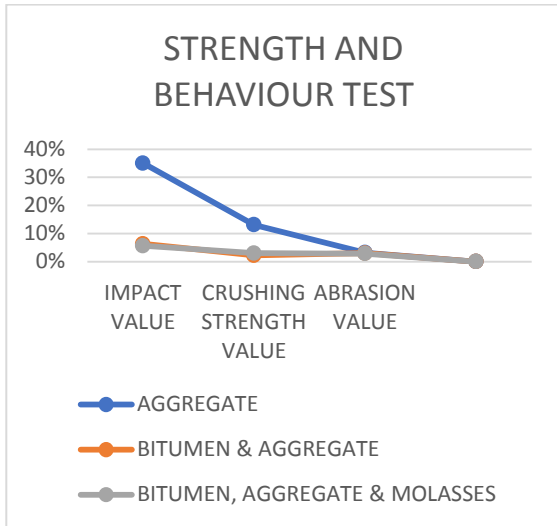
DETERMINATION OF STRENGTH AND BEHAVIOUR TEST (BITUMEN)

TEST	VALUE OBTAINED
Impact value	6.3%
Abrasion value	3%
Crushing value	2.2%
Binder extractor	22g

DETERMINATION OF STRENGTH AND BEHAVIOUR TEST (BITUMEN WITH MOLASSES)

TEST	VALUE OBTAINED
Impact value	5.6%
Abrasion value	2.8%
Crushing value	3%
Binder extractor	25g

GRAPH 1.1 - STRENGTH AND BEHAVIOUR TEST OF (AGGREGATE,BITUMEN WITH AGGREGATE , BITUMEN WITH AGGREGATE AND MOLASSES)



TESTS ON BITUMEN WITH MOLASSES(0.10%)

TRIAL	PERCNTAGE (%)	STABILITY VALUE	FLOW VALUE
1	6	1919.25	2.679
2	6	1803.561	2.25
3	6	1693.78	1.987

TESTS ON BITUMEN WITH MOLASSES(0.15%)

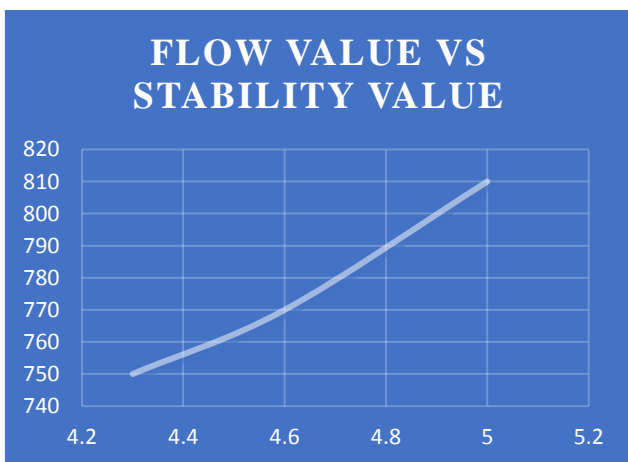
TRIAL	PERCNTAGE (%)	STABILITY VALUE	FLOW VALUE
1	6	1766.648	2.135
2	6	1601.732	1.956
3	6	1524.43	1.890

MARSHALL STABILITY TEST - (BITUMEN)

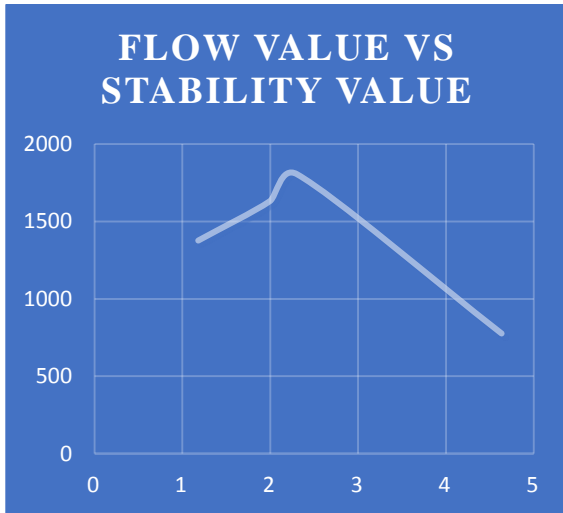
TRIAL	PERCNTAGE (%)	STABILITY VALUE	FLOW VALUE
1	6	750	4.3
2	6	770	4.6
3	6	810	5.0

TESTS ON BITUMEN WITH MOLASSES(0.20%)

TRIAL	PERCNTAGE (%)	STABILITY VALUE	FLOW VALUE
1	6	1463.34	1.775
2	6	1376.146	1.014
3	6	1291.55	0.751



**COMPARISON RESULTS
STABILITY VALUE VS FLOW VALUE**



- The addition of molasses as an additive with VG-10(80/100) grade bitumen shows there is decrease in penetration value. It shows that stiffness is increased therefore enhance the condition of temperature susceptibility resulting in increase of workability of bituminous mix.
- The softening point increases with the increment of molasses percentage shows increase of resistance of bitumen to the heat and it shows the decrease in tendency to soften in hot weather hence increases the rutting resistance, load taking capacity, stability and durability.

REFERENCE

Shakeel Abid, Assistant Professor, Kakatiya institute of technology &science, (2015) Construction and subsequent maintenance of pavements in good condition

Sandra Lawson et al.,(Melbourne -July 5) An Australian research and development company has developed non-petroleum based, asphalt bitumen substitute for roads.

Damien johnson et al., (Melbourne-December 21, 2005) Eco pave Australia GE0320 Technology Improves Shell Bitumen.

Sandhya Dixit (2013) concluded that From the Marshall test results, it is concluded that the Marshall stability value increases with an increase in bitumen content from 5% to 5.5% then it decreases.

COMPARISON BETWEEN BITUMEN AND BITUMEN WITH MOLASSES ROAD

- The durability of the roads laid out with molasses is much more greater than the conventional bitumen road.
- Roads laid with sugarcane waste molasses are found to be better than the conventional ones.
- The binding property of molasses makes the road last longer besides giving added strength to withstand more loads.
- While a normal bitumen road lasts four to five years it is claimed that molasses bitumen roads can last up to 10 years. But the little amount of rainwater will seep through it because of molasses-bitumen road.
- This can give more life in the hotter regions like deserts. Its more suitable for this kind of places than the colder and rainy regions. On that conventional bitumen road is more suitable.

CONCLUSION

- Molasses coating of aggregates increases abrasion and impact resistance of aggregates thus improving strength and wear resistance properties of the treated aggregates. More over molasses coating reduces its affinity for water and may improve stripping susceptibility.
- Mixture modification using 0.10%, 0.15%, 0.20% molasses in binder content improves the Marshall Stability of the mixture and thus increasing its rutting resistance and load carrying capability.