Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 7, July 2021: 2313 – 2322

Partial Replacement of Bitumen with Molasses

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ABSTRACT

Bituminous cement is a composite material which comprises of mineral totals, bitumen as a cover and air voids. With the expansion in energy cost and necessity of bitumen and other petrol increments around the world, and furthermore the prerequisite of a superior nature of asphalts just as stress over the contamination. The bitumen discharges carbon dioxide when warmed, which is exceptionally unsafe to human wellbeing. We need to add some non-poisonous material into the bitumen folio to decrease contamination. In this way, elective folios are needed to adjust, halfway substitution or absolutely substitution of bitumen fastener. A particularly elective cover is Molasses. Molasses is a buildup of sugar stick acquired during the way toward assembling of sugar. This exploration is planned for fractional supplanting of bitumen cover with molasses.

The examination thinks about the after effects of regular bitumen and bitumen containing molasses utilizing research facility tests. The tests which we performed are – infiltration, pliability, mellowing point, Marshall soundness tests. We arranged examples having various rates of bitumen and various rates of molasses to track down the ideal rate. Level of bitumen (4%, 6% and 8%) and level of molasses by weight of bitumen (4%,8%,10%,12% and 16%).

The examination study reasons that the fractional supplanting of bitumen with molasses improves the Marshall attributes, and furthermore the strength and security increments at 6% bitumen content and 8% molasses content. Adjusted bitumen builds infiltration and mellowing point. The particular gravity stays as before however malleability diminishes. Arrival of carbon dioxide lessens as the measure of the bitumen diminishes. Generally, research reason that the ideal worth of altered bitumen is 8% which is plausible to incomplete supplant bitumen with molasses.

Keywords- Bitumen, Binder, Molasses, Marshall Stability, Replacement, Carbon dioxide

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General

Energy assumes an essential part in the blast of developing countries like India. Inside the setting of low accessibility of non-environmentally friendly power assets combined with the requirements of huge amounts of energy for materials like bitumen, the

meaning of the utilization of business squander can't be overlooked. At the hour of assembling of bitumen from the unrefined petroleum huge measure of benzene, Sulfur dioxide and nitrogen oxide are delivered. The organization can handle these delivered gases somewhat, however the bitumen is warmed to the over the top temperatures during the transportation and application measure, the carbon dioxide gas is delivered into the climate which is extremely destructive and causes lung illnesses and genuine danger to the environment.

Problem Statement

It has been important to track down an elective fastener to supplant bitumen folio. The world is dealing with a significant issue of environmental change, and an Earth-wide temperature boost which is our worried as an architect, it is brought about by ozone depleting substances. Copying of carbon fills releases into the environment discharges carbon dioxide gas. Molasses is utilized in different sort of enterprises in light of its limiting and non-dirtying attributes. No creation of harmful gases on warming which is a lot of safe for the climate. It is extremely simple to convey and utilized in different cycles. It is essential because of a lot of Carbon dioxide delivered by bitumen, in one-gallon of bitumen having around 8-37 percent of carbons. Because of the oil substance of bitumen surfaces of the bitumen streets in wet conditions become oily.

Another issue is engrossing of warmth as the outside of the street is dark and the substantial vehicles lift the outside of the street, which is hazardous for people in general and for engine vehicles too. Street security is our first inclination over anything. One of the fundamental issues is the liquefying of bitumen requires a lot of warmth during transportation and application. Water response tears the connection between the total and bitumen. These all are the serious issues which ought to be defeated quickly to make eco-accommodating streets for example less dirtying street. Arrival of carbon dioxide is the enormous issue which ought to be settled utilizing the elective folio like we use molasses. Thus, utilization of close by accessible material like molasses as an option replacer of the bitumen folio.

Adding or incomplete substitution of molasses was an old thought in the ventures of development. There were a few investigations showed the substitution and one examination showed completely supplanting of bitumen folio with some material produced using molasses and absolutely non-oil based. The result was that the new blend is non-harmful, having dry-granulated structure, no hot stockpiling is required, 50% more noteworthy solidness, protection from weakness, wear and tear, less breaking, less blurring and solvents, less unpredictable deliveries, and make a non-tricky street, and more secure to travel, much preferred execution over bitumen.

Aim of the study

To investigation the impact of sugarcane molasses in bituminous cement.

To select the ideal level of sugarcane molasses in bituminous cement.

To analyze the pertinent designing properties of altered blend in with ordinary bitumen.

Scope of the Study

Determining of ideal sugarcane molasses in bituminous cement by changing the molasses content.

The characteristics communicated in SI units are to be seen as the norm. The same units of assessment are joined into this norm.

LITERATURE REVIEW

Introduction

Asphalt includes various layers of various material upheld by a layer known as sub-grade. Generally, the asphalt has 3 layers for example unbending asphalt, adaptable asphalt and composite asphalt. The unbending highlights of the asphalt are identified with the inflexibility or flexural strength or chunk activity, so the circulation of burden is on the subgrade of the dirt over a wide region. Adaptable asphalt comprises of bituminous substantial blend situated over the granular base layer upheld by the compacted soil, alluded to as the subgrade. Adaptable asphalt incorporates subgrade, sub-base, base coarse and surface coarse. While composite asphalt is the blend of both the asphalts (unbending asphalt and adaptable asphalt).

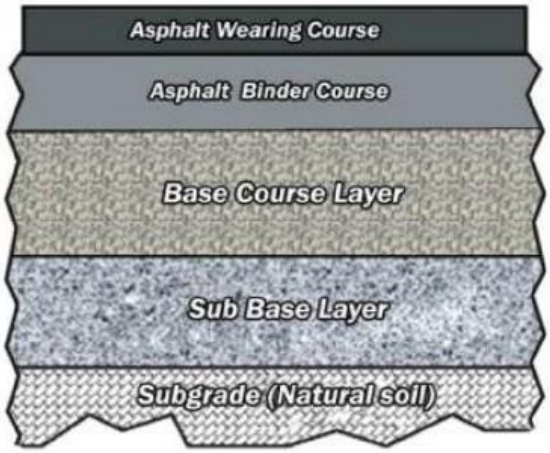

Figure2.1 Typical flexible pavement vertical section structure (Mohammed, 2013)

Summary of reviews

For the most part, the bitumen and totals are the essential materials to whom the test are performed. Presently a day, change of bitumen or incomplete or full substitution of bitumen was introduced and the principle center behind it. This exploration is mostly for using waste materials in street development, one of the waste material is molasses. In this examination, we use molasses as an incomplete substitution of bitumen. Molasses is utilized as an elective cover in numerous nations, so it is useful for our nation as well. In the wake of considering past research papers incomplete supplanting of bitumen with molasses is advantageous for our country. We arranged the examples for research center tests.

Material Properties

Materials required for this examination are Aggregates, Bitumen and Molasses.

Tests on Aggregates

AggregatesCrushing Test

This test is performed in accordance with IS 2386 Part IV. Aggregate Crushing Value is the percentage by weight of crushed aggregates when subjected to specified loading. Thistest is done in order to find the resistance of aggregates against crushing due to wheel loads. Crushing Value of aggregates demonstrates its quality. Lower Crushing Value is suggested for pavement construction as it shows a lower crushed part under the application of wheel load and would give a longer life to the pavement. The test comprises of oppressing the sample of aggregate in the standard mould to a pressure test under standard load conditions for this aggregate passing through 12.5mm and retaining on 10 mm is taken. These aggregate are then put in a cylindrical measure of the diameter of 115 mm and height of 180mm in three layers. Each layer is tamped for 25 times with the help of a tamping rod.

$$Aggregate\ Crushing\ Value = \frac{W_1}{W_2} \times 100$$

Where,

W_1= Weight of material passed through 2.36 mm sieveW_2 = Total weight of Aggregates taken

Marshall Stability Test

This test is used to determine the optimum binder content. The stability of the testestimates the most extreme burden upheld by the test sample at a loading rate of 5.08 cm/minute. .Marshall Stability is the maximum value of the load at which the test specimen fails. During loading, the flow value that is the deformation of the test sample with the load is also measured.

Preparation of the sample

- About 1200 gm of aggregate is taken and is heated to a temperature of 175°C-190°C.
- Modified Bitumen is heated to a temperature of 120°C-140°C starting with thetrailing percentage of 4% of the weight of the mineral aggregates.
- The heated aggregates and modified bitumen is blended at a temperature of154°C-160 °C.
- The blend is put in a mould and compacted by a rammer with 75 blows on eitherside at temperature.
- Keep the mix in the mould for 24 hours and after that expel the sample from themould with the help of test extractor.
- The weight of the sample is measured in the air as well as in water.

RESULTS AND DISCUSSIONS

General

This part displays the impact on the binder property due to the addition of molasses in bitumen. The tests results are utilized to make compare the properties of the binder through bargraphs and linegraphs.

Softnening Poin

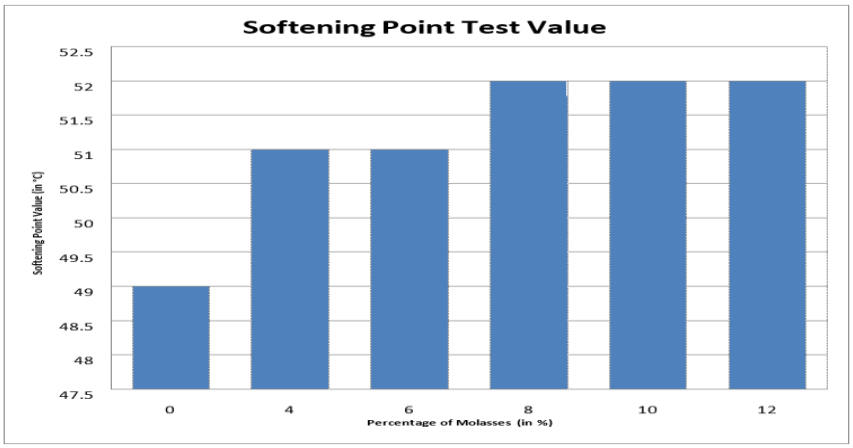

Figure 4.1 Bar Graph between Softening Point v/s Different Molasses % (Modified Bitumen)

From the given Figure 4.1, it can be seen that the softening point is increasing with an increase in molasses content. Although, the values have not increased much still this will help in sustaining against higher temperature and will have a longer service life.

Penetration Test

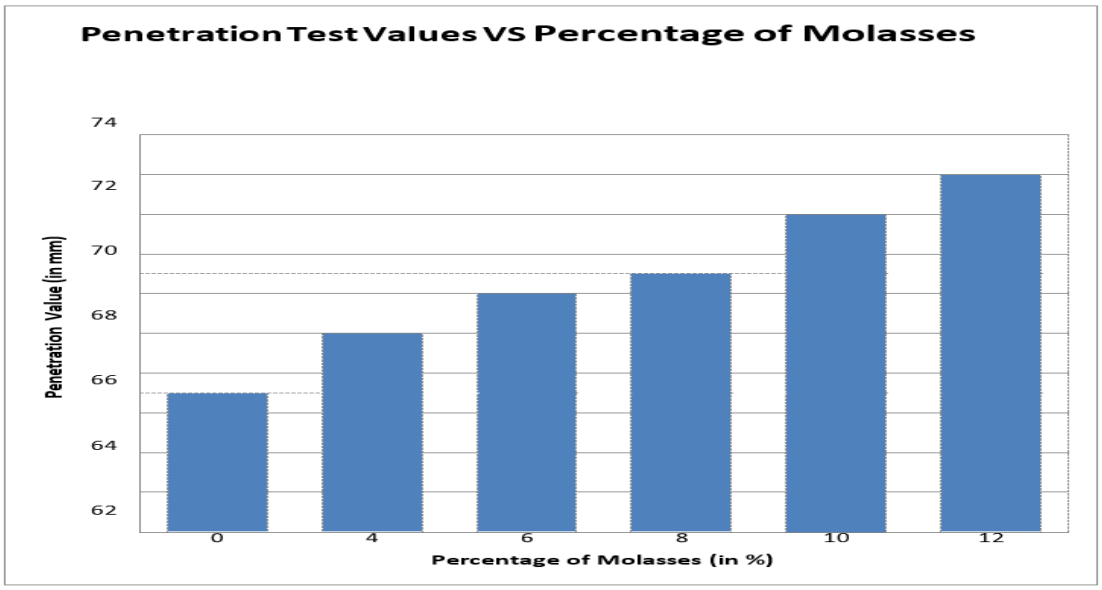

Figure 4.2 Bar Graph between Penetration value v/s Different Molasses % (Modified Bitumen)

From the Figure 4.2, it can be seen that on increasing the molasses content, the penetration valueis increasing. This shows that molasses have a great impact on the penetration value of the bitumen. Thus the addition of molasses on bitumen is making it soft leading to increased resistantagainst temperature variation. This can be due to decrease in viscosity of the bitumen due to increasing in the molasses content. Thus, the increase in molasses content in bitumen makes it softer and more resistant to temperature variation.

Ductility Test

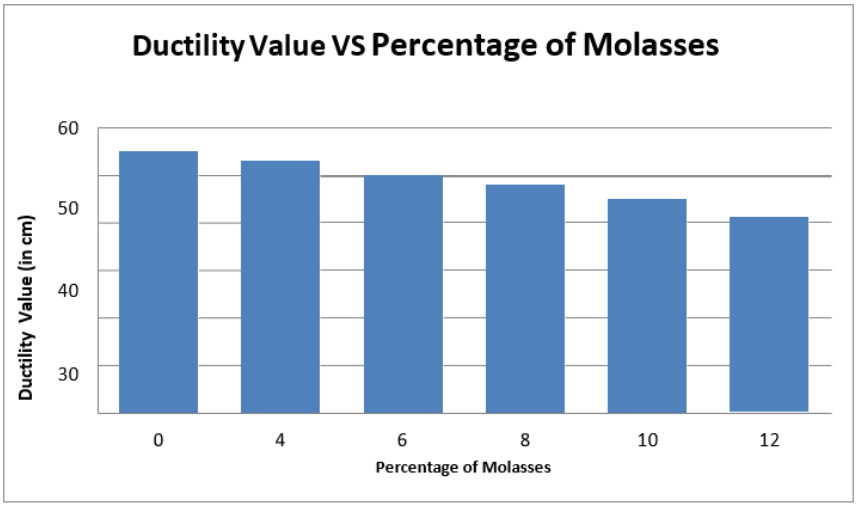

Figure 4.3 Bar Graph between Ductility value v/s Different Molasses % (Modified Bitumen)

From the Figure 4.3, it can be seen that with an increase in molasses content, ductility value is decreasing. The decrease in ductility value shows that the breaking of the binder bond due to the presence of molasses in a binder. The decrease in the ductility value is somewhat lesser.

Specific Gravity

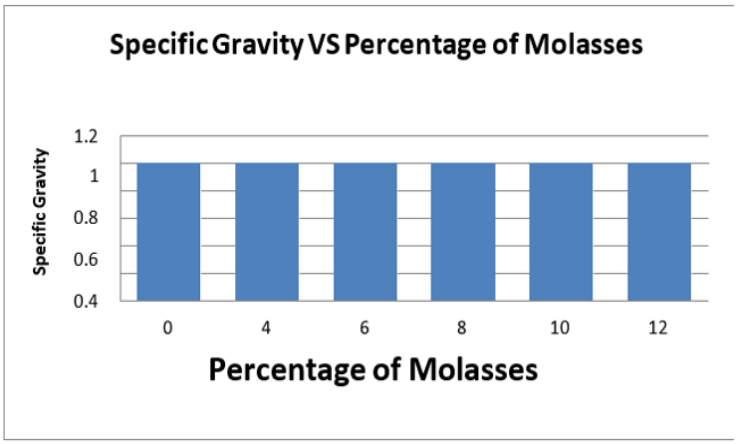

Figure 4.4 Bar Graph between Specific Gravity v/s Different Molasses% (Modified Bitumen)

From the Figure 4.4, it can be seen that there is no much variation in specific gravity of binder with an increase in binder content. This can be justified as the specific gravity of sugarcane molasses is comparable to that of a molasses.

Marshall Mix Design

Marshall Stability VS Binder Content

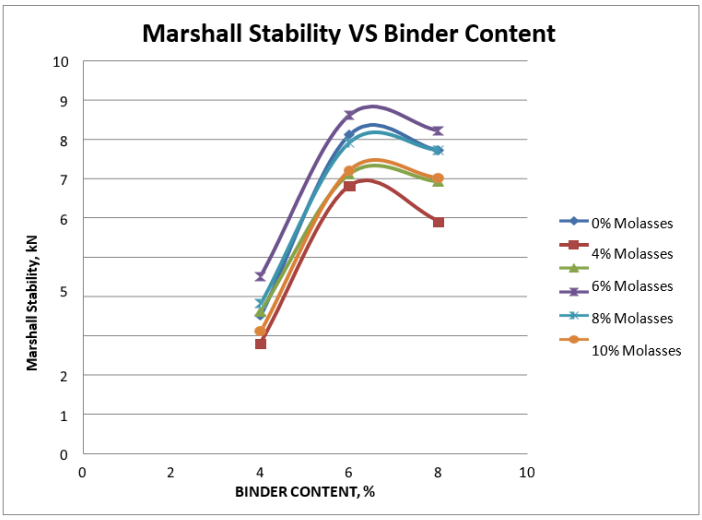

Figure 4.5 Graph between Marshall Stability v/s Binder Content (different % of bitumen& molasses)

As appeared in Figure 4.5., with increment in bitumen content Marshall Stability increments however up to certain content after it begins diminishing. This pattern is observed because firstly the binder fills the voids in the mineral aggregate but after a certain point when all the voids get filled up this extra binder create extra space which cannot take any load. The Marshall Stability is

found to highest in 8% Molasses replacement and at a total binder content of 6%. As the Molasses content is increased beyond this decrease in Stability value is observed due to the decrease in the ductility value of the binder.

Flow Value VS Binder Content

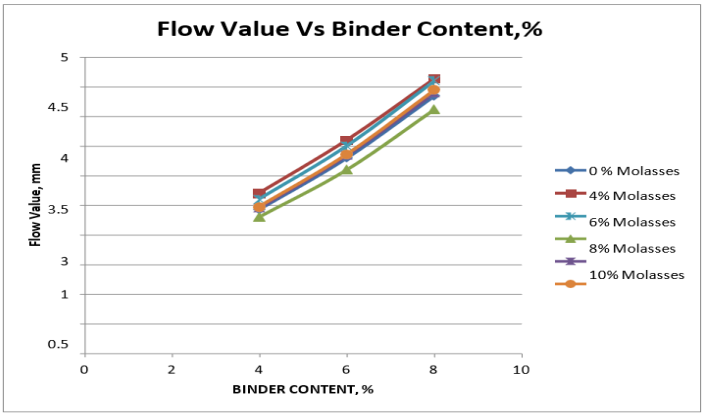

Figure 4.6 Graph between Flow value v/s Binder Content % (Different % of bitumen & molasses)

As shown in the Figure 4.6, due to improper binding Flow value is highest at 4% partialreplacement of bitumen with molasses. At the 8% partial replacement of bitumen with sugarcane molasses, the flow value is minimum. This is justified because at 8% partial replacement of bitumen with bitumen maximum Marshall Stability Value is observed. At 12% partial replacement of bitumen with molasses a flow value is increasing due to a decrease in ductility of the binder due to sugarcane molasses.

Voids Filled with Bitumen Vs Binder Content

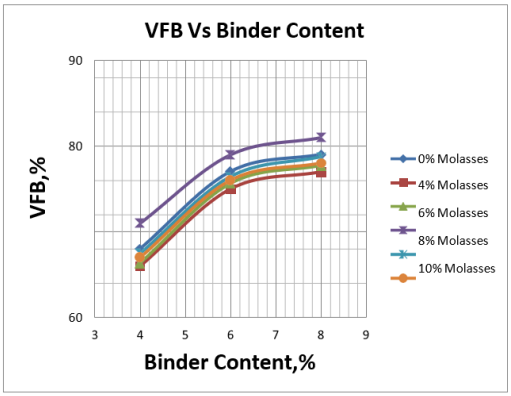

Figure 4.7 Graph between VFB% v/s Binder Content % (Different % of bitumen & molasses)

As appeared in the Figure 4.7 , as the binder content is increasing the voids filled with the bitumen is also increasing reaching a maximum value, then becoming almost constant value. At the partial replacement of bitumen with 8% Molasses Content, voids filled is maximum as justified by the maximum stability value at this content.

Air Voids Vs Binder Content

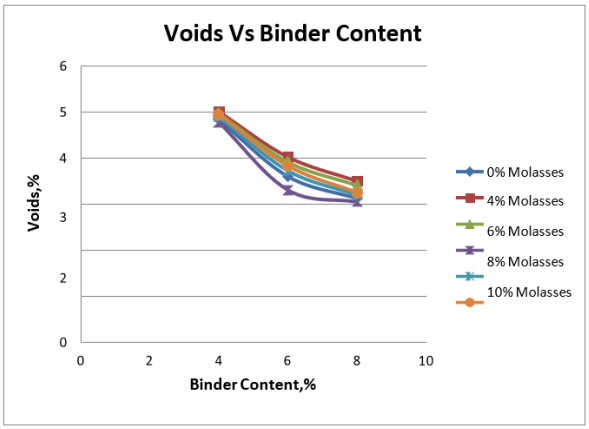

Figure 4.8 Graph between Voids % v/s Binder Content % (Different % of bitumen & molasses)

As shown in the Figure 4.8, as the binder content is increasing, the percentage of the volume of voids is decreasing. We are getting a minimum percentage of the volume of voids at 8% partial replacement of bitumen with sugarcane molasses.

Bulk Unit Weight Vs Binder Content

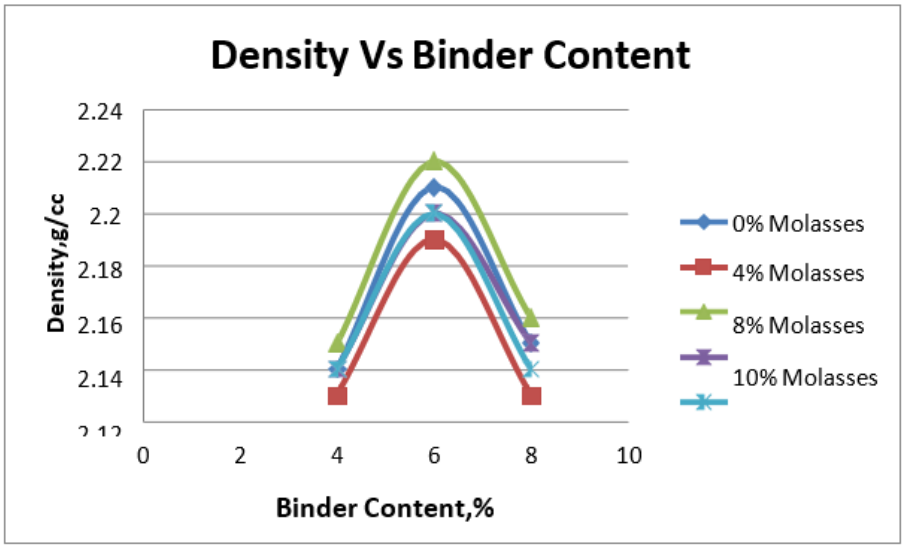

Figure 4.9 Graph between Density v/s Binder Content % (Different % of bitumen & molasses)

As shown in the Figure 4.9, the Bulk Unit Weight of the specimen increases up to optimum binder content. Beyond optimum binder content, the bulk unit weight starts decreasing as now binder starts replacing aggregate thus reducing bulk unit weight. The maximum Bulk Unit weightis obtained at the partial replacement of bitumen with molasses by 8%

CONCLUSION

Expansion of sugarcane molasses has expanded certain properties of the fastener like Marshall Stability, infiltration esteem, mellowing point, mass unit weight and so on at a specific substance for a specific evaluation of bitumen. This can help in expanding the strength of the asphalt just as will help in making street protection from temperature variety and keeping a long assistance life that also utilizing the waste sugarcane molasses. To get ideal substance of sugarcane molasses, factors, for example, the mixing time, temperature, characteristics, and wellspring of the Sugarcane Molasses and bitumen type should be considered since these are the factors that direct the ensuing presentation of bitumen mixes.

Conclusion

Based on the results of the experiment following remarks can be derived

Mixing of Sugarcane Molasses shows a great impact on the properties of the Bitumen likeMarshall Stability, penetration, ductility, softening Point etc.

Marshall Stability is maximum at the binder content of 6 % with partial replacement ofbitumen of 8 %.

Penetration Value and Softening Point is increasing withanincrease in the content ofsugarcane molasses.

Ductility Value is decreasing with increase in Molasses Content.

Change in Molasses Content has not shown an impact on Specific Gravity of Binder

Recommendations

Thereare following recommendations on the base of the results that are –

Molasses can be used as a partial replacer of bitumen.

It may be likely to use lower bitumen when molasses is used.

8% molasses with 6% of bitumen can be used to replace partially bitumen binder with molasses. For more resistance to moisture, we may add adhesive agents in the mixture.

Future study

There is always a possibility for future research in the area of bitumen binders. So future researchstudy may consider: -

Further studies are required to test different grades of bitumen with different percentages of molasses.

Further research is required to describe the chemistry of binders including molasses and bitumen binder.

Like this study determines the optimum value of molasses as 8% and the optimum value of bitumen as 6%. Therefore, further research is required to determine Optimum MolassesContent and also Optimum Bitumen Content.

Life cycle cost analysis should be considered for the construction of roads using molasseswith comparison to the conventional bitumen roads.

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