RECYCLEING OF PLASTIC WASTE

A SUMMER INTERNSHIP REPORT

Seminar submitted in partial fulfilment of the
requirements for the award of the degree of B.Tech. in
CHHOTUBHAI GOPALBHAI PATEL INSTITUTE OF
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an autonomous institution of
UKA TARSADIA UNIVERSITY

By

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JULY 2023

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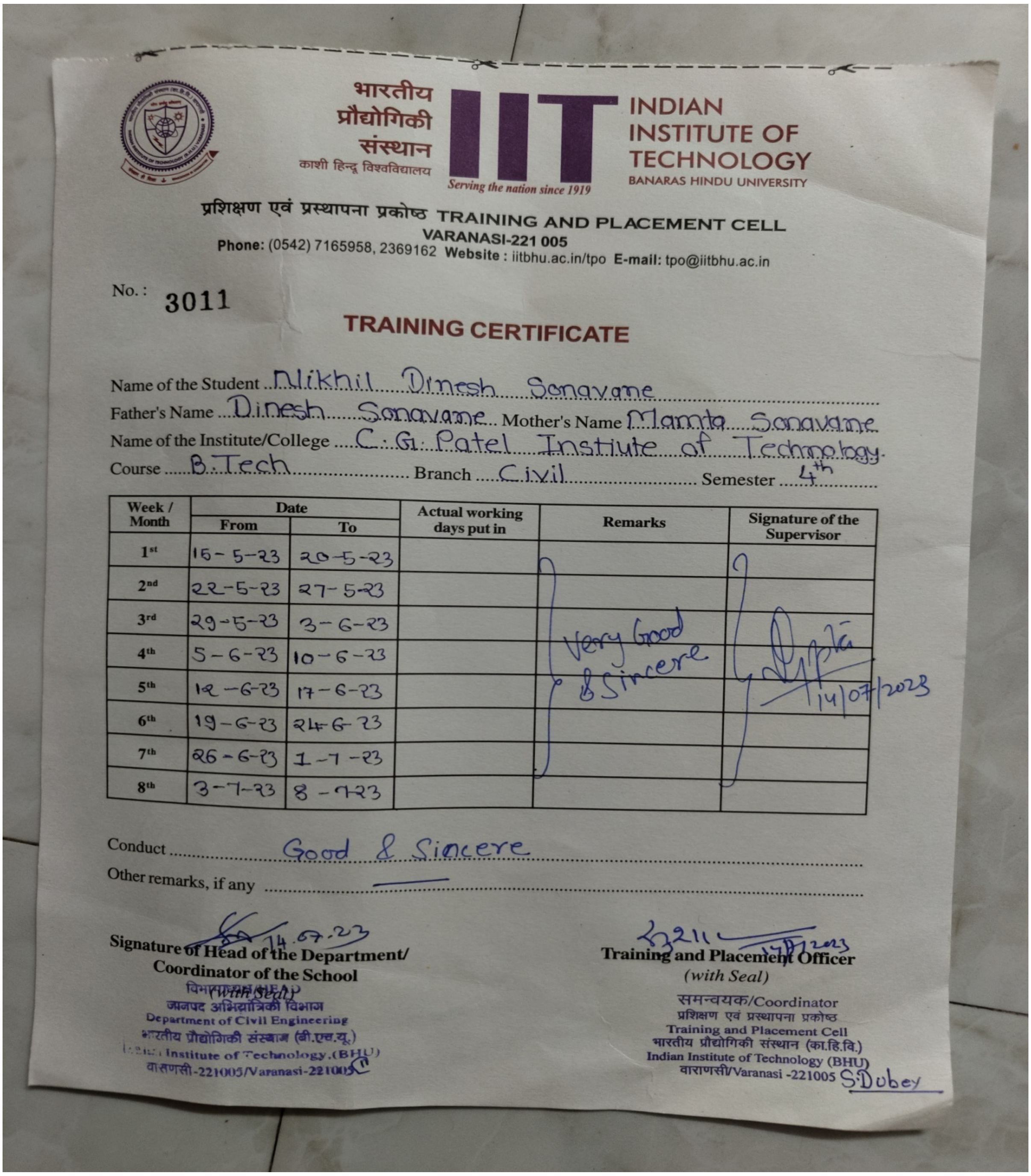

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2nd	22-5-23	27-5-23			
3rd	29-5-23	3-6-23			
4th	5-6-23	10-6-23			
5th	12-6-23	17-6-23			
6th	19-6-23	24-6-23			
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Above all, to the Great Almighty, the author of knowledge and wisdom, for his countless love.

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Abstract

This summer internship report focuses on recycling plastic waste, particularly low-density polymers (LDPE), to create modified binders for civil engineering applications. It provides an overview of the materials used, the process of making polymers modified binders, and the various types of binders produced. The report also discusses other performed practices, such as the Hamburg Wheel Load Test and the Semi-Circular Bending Test, for evaluating asphalt mixtures' performance. Additionally, essential tests for assessing bitumen properties, such as the penetration test, softening point test, and rotational viscometer test, are covered. The report emphasizes the importance of problem-solving skills in the field of civil engineering and the potential of recycling plastic waste to address environmental concerns. Overall, this internship report offers valuable insights for civil engineering professionals and other disciplines.

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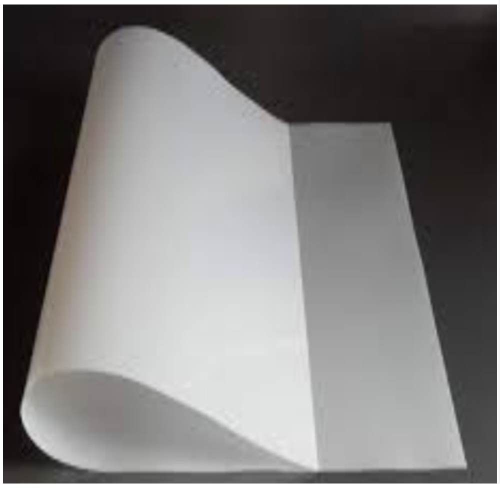
Table of Contents

1.INTRODUCTION

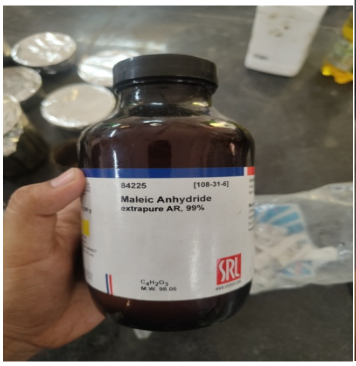
- Low-density polymers, also known as LDPE (Low-Density Polyethylene), are a type of thermoplastic polymer with a relatively low density compared to other plastic materials
- LDPE is produced through the polymerization of ethylene monomers, which are derived from crude oil or natural gas. The polymerization process results in a chain-like structure with numerous branches, giving LDPE its characteristic low density and high flexibility. The density of LDPE typically ranges from 0.910 to 0.940 g/cm³, making it one of the least dense polymers.
- One of the key characteristics of LDPE is its excellent flexibility and toughness. It is highly resistant to impact and can withstand repetitive bending and stretching without breaking. This property makes LDPE ideal for applications such as packaging films, plastic bags, and squeeze bottles, where flexibility and durability are required.
- Despite its advantageous properties, LDPE has a relatively low melting point, typically around 105-115°C (221-239°F). This low melting point restricts its use in high-temperature applications. LDPE also has lower tensile strength and stiffness compared to other polymers, such as high-density polyethylene (HDPE) or polypropylene (PP)
- In summary, low-density polymers, or LDPE, are versatile thermoplastics with excellent flexibility, toughness, chemical resistance, and electrical insulating properties. Their low density and high flexibility make them suitable for applications requiring durability, such as packaging, bags, and bottles. LDPE's resistance to chemicals and moisture expands its use in the chemical industry and outdoor applications. However, it should be noted that LDPE has limitations in terms of temperature resistance and mechanical strength compared to other polymers.
- NOTE: LDPE Are non recycleble

2.POLYMERS AND MATERIALS

PELLETS PURE



FLEX SHREDS



MELEIC SULFUR

3.PROCESS OF MAKEING POLYMERS MODIFIED BINDERS

- Oven heat the virgin binder for 1 hour at 163*C
- Put the binder on heater ,set temp.@ 165*C & mix the binder at low shear for 15 min.
- When temp. Goes above 165*C then add polymer
- Mix the binder at medium shear for next 15 min.
- After that start high shear mixing for next 30 min.
- Reduce the temp. Of heater & mix binder at low shear
- Then add cross linkers (if any)
- Mix it on medium shear for 10 min
- Mix it on high for next 15 min
- Mix it on low shear for 10 min
- After that oven heat the binder for 1 hour at 165*C

4 TOTAL TYPS OF BINDER MAKE

1.PURE

- 2%Pure
- 4% Pure
- 6% Pure
-
- 2%Pure w /s
- 4% Pure w/s
- 6% Pure w/s
-
- 2%Pure w/m
- 4% Pure w/m
- 6% Pure w/m

2.PELLETS

- 2%Pellets
- 4% Pellets
- 6% Pellets
-
- 2%Pellets w/s
- 4% Pellets w/s
- 6% Pellets w/s
-
- 2%Pellets w/m
- 4% Pellets w/m
- 6% Pellets w/m

3.SHREDS

- 2%Shreds
- 4% Shreds
- 6% Shreds

- 2%Shreds w/s
- 4% Shreds w/s
- 6% Shreds w/s

- 2%Shreds w/m
- 4% Shreds w/m
- 6% Shreds w/m

4.Flex

- 2%flex
- 4% flex
- 6% flex

- 2% flex w/s
- 4% flex w/s
- 6% flex w/s

- 2% flex w/m
- 4% flex w/m
- 6% flex w/m

5.OUTHER PERFORMED PRACTICES

5.1 HAMBUR WHEEL LOAD TEST FOR RUTING

5.2 SEMI-CIRCULAR BENDING TEST FOR FUTIGUE

- # HAMBUR WHEEL LOAD TEST PROCESS

The general steps in the Hamburg Wheel Tracking Test process are as follows:

1. Preparation of Specimens: Cylindrical specimens are prepared from the asphalt mixture according to specific standards or requirements.
2. Conditioning: The specimens are usually conditioned in a water bath or oven at a specified temperature to achieve the desired testing temperature.
3. Placing Specimen in the Testing Machine: The conditioned specimen is placed horizontally in the Hamburg Wheel Tracking Test machine.
4. Applying Load: The circular steel wheel applies a vertical load on the specimen.
5. Immersion in Water: The specimen is submerged in water to simulate the effect of moisture on the pavement.
6. Wheel Tracking: The wheel is rotated and traverses the length of the specimen, applying the load and creating the rutting effect.
7. Measuring Rut Depth: The rut depth is measured at regular intervals (e.g., after a specific number of wheel passes) to assess the rutting resistance of the asphalt mixture.
8. Test Evaluation: The data obtained from the test is analyzed to determine the resistance of the asphalt mixture to rutting.

It's important to note that specific testing procedures may vary depending on the standards or protocols used by different organizations or countries. The Hamburg Wheel Tracking Test is just one of several tests used to evaluate the performance of asphalt mixtures in the laboratory before they are used in real road construction.

For up-to-date and detailed information on the Hamburg Wheel Tracking Test process, it's best to refer to the relevant standards or guidelines issued by recognized organizations in the field of pavement engineering and asphalt technology.

SEMI-CIRCULAR BENDING TEST PROCESS

The process of the Semi-Circular Bending Test typically involves the following steps:

1. Sample Preparation: Cylindrical asphalt specimens are prepared according to specific standards or project requirements. These specimens are then notched to create a semi-circular shape. The notched region is where the crack initiation and propagation will occur during the test.
2. Conditioning: The prepared specimens may be conditioned in a temperature-controlled environment to reach the desired test temperature. This is crucial as the test evaluates the low-temperature cracking performance of the asphalt material.
3. Placing Specimen in the Test Fixture: The conditioned semi-circular asphalt specimen is placed in the test fixture, which consists of two support rollers and a loading pin located at the center of the specimen.
4. Applying Load: A loading device or hydraulic actuator applies a controlled force on the loading pin, inducing bending stresses on the semi-circular specimen. The load is increased at a constant rate until the specimen fractures.
5. Crack Initiation and Propagation: As the load is applied, a crack starts to form at the notch of the specimen. The crack then propagates along the length of the specimen until it reaches the other side.
6. Data Collection: Throughout the test, various parameters are measured, such as the load applied and the corresponding crack mouth opening displacement (CMOD). These data are used to determine the fracture toughness and cracking resistance of the asphalt material.
7. Test Evaluation: The collected data is analyzed to calculate important fracture properties, such as critical stress intensity factor (K_IC) and critical crack tip opening displacement (CTODc). These properties provide insights into the material's susceptibility to cracking under bending loads.

The Semi-Circular Bending Test is a valuable tool for assessing the performance of asphalt mixtures, especially in regions with low temperatures, where the risk of cracking due to thermal stresses is higher. As with any test method, it is essential to follow the relevant standards and guidelines to ensure accurate and consistent results.

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- PENETRATION TEST
- SOFTENING POINT TEST
- ROTATIONAL VISCOMETER TEST

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• PENETRATION TEST

The penetration test is carried out as follows:

1. A sample of bitumen is taken and conditioned to a specified temperature (usually 25°C or 25°C ± 0.1°C).
2. A standard needle with a specified weight (usually 100 grams) is allowed to penetrate the bitumen sample for a specific duration (usually 5 seconds).
3. The depth of penetration of the needle is recorded in tenths of a millimeter, and this value represents the penetration value of the bitumen sample.

The penetration test provides valuable information about the hardness or consistency of bitumen, which is essential for assessing its suitability for various applications. Different grades of bitumen are used for different purposes, and the penetration test helps in classifying bitumen into different penetration grade categories.

It's important to note that the penetration test is just one of several tests conducted to evaluate bitumen properties, and additional tests like softening point, flash point, and ductility are also performed to understand the overall behavior and characteristics of the bitumen.

If you are looking for specific information related to the penetration test of bitumen, I would recommend referring to the relevant ASTM (American Society for Testing and Materials) standards, as they provide detailed procedures and guidelines for conducting the test.

• SOFTENING POINT TEST

Apparatus:

- Softening point apparatus: It consists of a ring and ball assembly. The ring is a brass ring with a groove that supports the ball. The ball is a steel ball that rests on the bitumen sample.

Sample Preparation:

1. A representative sample of bitumen is taken for testing. The sample is usually in the form of pellets or small pieces.

Test Procedure:

1. The ring and ball assembly is heated in a water bath to a temperature of 5°C above the expected softening point.
2. The bitumen sample is placed in a metal cup, and the cup is placed on a heat-resistant plate.
3. The heated ring and ball assembly are placed on top of the bitumen sample in the cup.
4. The temperature is gradually increased at a specified rate (typically 5°C per minute).
5. As the temperature rises, the bitumen softens and allows the ball to sink into the sample.
6. The softening point is determined as the temperature at which the bitumen sample has sufficiently softened, and the ball touches the bottom of the metal cup.

Calculation: The softening point is reported in degrees Celsius (°C) as the average of duplicate or triplicate determinations.

It's important to note that the softening point of bitumen is affected by factors such as the source of crude oil, the type of refining processes, and the presence of additives. Different applications may require bitumen with specific softening points to ensure adequate performance under different environmental conditions.

The softening point test is just one of several tests conducted on bitumen to assess its properties and suitability for various applications. Other tests, such as penetration test, ductility test, and specific gravity test, are also performed to comprehensively evaluate the characteristics of bitumen.

• ROTATIONAL VISCOMETER TEST

Apparatus:

- Rotational viscometer: The viscometer consists of a spindle or rotor that is rotated at a constant speed by a motor.
- Sample container: The fluid sample is placed in a container or cup, and the spindle is immersed in the fluid.
- Temperature control: Some viscometers have temperature control capabilities to test the viscosity at different temperatures.

Test Procedure:

1. The fluid sample is prepared by ensuring it is homogeneous and free from air bubbles or any contaminants that could affect the results.
2. The viscometer is set up, and the spindle is placed in the sample container with the fluid.
3. The rotational speed of the spindle is set, and the test begins.
4. The spindle starts rotating in the fluid, and the viscometer measures the torque required to maintain the rotational motion at the preset speed.
5. The viscometer displays the viscosity value, usually in units of centipoise (cP) or millipascal-seconds (mPa·s), depending on the instrument's configuration.

6.CONCLUSION

In this summer internship report, the focus was on recycling plastic waste, particularly low-density polymers (LDPE), to create modified binders for civil engineering applications. The report provided a comprehensive overview of the materials used in the process, the methods of making the polymers modified binders, and the various types of binders produced, such as pure, pellets, shreds, and flex, with different percentages of additives.

The report also discussed other performed practices, including the Hamburg Wheel Load Test for rutting and the Semi-Circular Bending Test for fatigue. These tests are essential for evaluating the performance and suitability of asphalt mixtures for road construction under different conditions. Additionally, penetration test, softening point test, and rotational viscometer test were mentioned as crucial methods for assessing the properties of bitumen.

As the report concludes, it becomes evident that recycling plastic waste for creating modified binders can be a promising approach to address environmental concerns and reduce plastic pollution. The knowledge and methodologies shared in this report could be beneficial not only in the field of civil engineering but also in other disciplines.

In conclusion, this summer internship report provides valuable insights into the recycling of plastic waste for civil engineering applications and the importance of problem-solving skills for engineering professionals. The knowledge gained from this internship will undoubtedly contribute to the author's academic and professional growth in the field of civil engineering.