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**KERALA STATE POLLUTION CONTROL BOARD**

കേരള സംസ്ഥാന മലിനീകരണ നിയന്ത്രണ ബോർഡ്

Pattom P.O., Thiruvananthapuram – 695 004

പട്ടം പി.ഒ., തിരുവനന്തപുരം - 695 004



File No. PCB/HO/EE3/CERTFN-1/2023

Date: 06/02/2024

**Certificate No: PCB/HO/PE/CERTFN/01/2024 dated 06.02.2024.**

To

M/s Green Sign,  
Bosco Road, Nalammile,  
Erumathala, Aluva  
Pin Code-683112

Sub: Certificate to Distributor - M/s Green Sign, Bosco Road, Nalammile,  
Erumathala, Aluva for certification of material for banner and hoarding.

Ref: 1. Your application no: Nil dated 3/11/2023

2. Report no. CIPET: IPT- Kochi/Testing/2023-24/TC -05/2912 dated 08.01.2024  
received from CIPET. (Copy enclosed).

3. GO No. 639/2023/LSGD dated 17.03.2023

4. GO No. 111/2019/LSGD dated 29.08.2019

5. SOP for certification of material for banner and hoarding issued by Kerala  
State Pollution Control Board


With reference to the application received from M/s Green Sign, whose registered address is at Bosco Road, Nalammile, Erumathala, Aluva, Pin Code-683112 is fulfilling the standard stipulated in GOs and SOP referred above.

Certificate to M/s Green Sign, Bosco Road, Nalammile, Erumathala, Aluva: 683112 for distributing *polyethylene material* for banner and hoarding material is subject to following conditions.

1. Each material shall have the information related to name and certificate number printed in English.

2. A QR code to the Certificate issued by the Board shall be prepared by M/s. Green Sign, which on scanning has to be lead detailing the contents of this Certificate. The distributor shall provide this QR code to and printer units also.
3. The details of the QR code (email/password, Name, plant address, KSPCB certificate no. etc.) shall be shared with the printer units and KSPCB (Head Office).
4. If the certified distributor is found non-complying any conditions, the Certificate shall stand cancelled.
5. The distributor shall provide six-monthly report, giving details of material sale viz. name of printing unit, district, date of issue etc.
6. PCB may cancel or suspend the certificate of the distributor, in case the distributor fails to comply with any of the conditions of this certificate.



  
**ISSUING AUTHORITY**  
**(Environmental Engineer,**  
**Plastic Section, Head Office)**

**Copy to:**

- 1) All ROs & DOs, KSPCB
- 2) IT cell
- 3) CA to Chairperson/ Member Secretary/ Chief Environmental Engineer



केंद्रीय पेट्रोरसायन अभियांत्रिकी एवं  
प्रौद्योगिकी संस्थान (सिपेट)

(पूर्व में सेन्दल इंस्टिट्यूट ऑफ प्लास्टिक्स इंजीनियरिंग एण्ड टेक्नोलॉजी)

इंस्टिट्यूट ऑफ पेट्रोकेमिकल्स टेक्नोलॉजी (आई.पी.टी.)

रसायन एवं पेट्रोरसायन विभाग

रसायन एवं उर्वरक मंत्रालय, भारत सरकार

एच. आई.एल. कॉलोनी, एडयार रोड, Nr. पातालम्

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ई-मेल: kochi@cipet.gov.in, cipetkochi@gmail.com

वेबसाइट : www.cipet.gov.in

मुख्यालय : गिण्डी, चेन्नई - 600 032



सिपेट CIPET



**CENTRAL INSTITUTE OF PETROCHEMICALS  
ENGINEERING & TECHNOLOGY (CIPET)**

(Formerly Central Institute of Plastics Engineering & Technology)

**INSTITUTE OF PETROCHEMICALS TECHNOLOGY (IPT)**

Department of Chemicals & Petrochemicals

Ministry of Chemicals & Fertilizers, Govt. of India

HIL Colony, Edayar Road, Nr. Pathalam

Udyogamandal P.O., Kochi, Kerala-683 501

Ph: 0484-2547741

E-mail:kochi@cipet.gov.in, cipetkochi@gmail.com

Web : www.cipet.gov.in

Head Office: Guindy, Chennai-600 032

CIPET: IPT-Kochi /Testing/2023-24/TC-05/2912

Date: 08.01.2024

To

**M/s.KERALA STATE POLLUTION CONTROL BOARD  
PATTOM P.O, THIRUVANANTHAPURAM – 695 004**

Dear Sir,

**Sub.: Report on Recyclability Assessment – Reg.**

**Ref.: Letter FILE No.PCB/HO/EE3/CERTN- 1/2023 Dated 15.11.2023.**

We are enclosing herewith consultancy report CIPET/KOCHI/CONS. /2023-24/TC-05 dated 08.01.2024 on pertaining to the samples submitted to our laboratory.

Please find enclosed herewith the feedback form. Kindly fill and send it back to us.

Thanking you and assuring you our best services.

Yours sincerely,

  
Joint Director & Head

Encl. as above.

केन्द्र : अहमदाबाद, अमृतसर, औरंगाबाद, अमरतला, बदी, बालासोर, बेंगलूरु, भोपाल, भुवनेश्वर, चंद्रपुर, चेन्नई, देहरादून, गुवाहाटी, ग्वालियर, हैदराबाद, हाजीपुर, हल्दिया, इम्फाल, जयपुर, कोच्चि, कोरवा, लखनऊ, मदुरै, मुरथल, मैसूरु, रायपूर, राँची, वलसाड, वाराणसी, एवं विजयवाडा

Centres : Ahmedabad, Amritsar, Aurangabad, Agartala, Baddi, Balasore, Bengaluru, Bhopal, Bhubaneswar, Chandrapur, Chennai, Dehradun, Guwahati, Gwalior, Hyderabad, Hajipur, Haldia, Imphal, Jaipur, Kochi, Korba, Lucknow, Madurai, Murthal, Mysuru, Raipur, Ranchi, Valsad, Varanasi & Vijayawada

केंद्रीय पेट्रोरसायन अभियांत्रिकी एवं  
प्रौद्योगिकी संस्थान (सिपेट)

(पूर्व में सेंट्रल इंस्टिट्यूट ऑफ प्लास्टिक्स इंजीनियरिंग एण्ड टेक्नोलॉजी)

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रसायन एवं पेट्रोरसायन विभाग

रसायन एवं उर्वरक मंत्रालय, भारत सरकार

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सिपेट CIPET



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Web : www.cipet.gov.in

Head Office: Guindy, Chennai-600 032

CIPET/KOCHI/CONS. /2023-24/TC-05

8<sup>th</sup> January 2024

To

**KERALA STATE POLLUTION CONTROL BOARD**

**Pattom P.O., Thiruvananthapuram- 685 004**

**CERTIFICATE OF ANALYSIS**

Sample Details (As stated by party)	: Material for banner and hoarding
Brand Name	: ZEROW
Quantity of sample submitted	: 2 kg
Sampling	: By the party

Test results Obtained:

Sample Details	Test details	Recycling Category as per IS 14534 : 2016
		Material Recovery
		Mechanical Recycling
Material for banner and hoarding (As stated by party)	Assessment of recyclability of Film and certify its category as per IS:14534 (2016)	Suitable in the existing format

Detailed technical analysis on the above results is enclosed as Annexure.

  
**Dr. K.P. Bhuvana**  
Authorized Signatory

  
**Dr. S. Anbudayanidhi**  
Authorized Signatory

केन्द्र : अहमदाबाद, अमृतसर, औरंगाबाद, अगरतला, बही, बालासोर, बेंगलूरु, भोपाल, भुवनेश्वर, चंद्रपुर, चेन्नई, देहरादून, गुवाहाटी, ग्वालियर, हैदराबाद, हाजीपुर, हल्दिया, इम्फाल, जयपुर, कोच्चि, कोरबा, लखनऊ, मदुरै, मुरथल, मैसूरु, रायपूर, राँची, वलसाड, वाराणसी, एवं विजयवाडा

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REPORT  
ON  
RECYCLABILITY ASSESSMENT

Submitted  
By



**Central Institute of Petrochemicals Engineering and  
Technology (CIPET): Institute of Petrochemicals  
Technology (IPT)**

HIL Colony, Edayar Road,  
Pathalam, Eloor, Udyogamandal P.O.,  
Kochi-683 501

Web: [www.cipet.gov.in](http://www.cipet.gov.in), E-mail: [kochi@cipet.gov.in](mailto:kochi@cipet.gov.in)

Submitted  
to



**KERALA STATE POLLUTION CONTROL BOARD**  
Pattom P.O., Thiruvananthapuram



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## DETAILED TECHNICAL ANALYSIS REPORT

### 1. PROJECT OUTLINE:

The scope of the work is to evaluate the suitability of the submitted sample for recycling / energy recovery. The sample was subjected to analytical characterization like Differential Scanning Calorimeter (DSC)/ Fourier Transformed Infrared Spectroscopy (FTIR) to identify the materials and further assessments to study the flow behavior of the sample for recycling and the suitability for energy recovery. The samples were subjected to mechanical recycling and the properties of the recyclates were estimated.

### 2. DEFINITIONS AS PER IS 14534: 2016

**Recycling:** Processing of plastics waste materials for the original purpose or for other purposes excluding energy recovery.

**Material Recovery:** Material processing operations including mechanical recycling, feedstock (Chemical) recycling and organic recycling, but excluding energy recovery.

**Mechanical Recycling:** Processing of plastics waste into secondary raw material or products without significantly changing the chemical structure of the material.

**Organic Recycling:** Controlled microbiological treatment of biodegradable plastics waste under aerobic and anaerobic conditions.

**Feedstock Recycling:** Conversion to monomer or production of new raw materials by changing the chemical structure of plastics waste through cracking, gasification, or depolymerization, excluding energy recovery and incineration.

**Biological recycling:** Aerobic (composting) or anaerobic (digestion) treatment of biodegradable plastics waste under controlled conditions using microorganisms to produce, in the presence of oxygen, stabilized organic residues, carbon dioxide, and water or in the absence of oxygen, stabilized organic residues, methane, carbon dioxide, and water.



### 3. EXPERIMENTAL:

The submitted sample was subjected to the following preliminary analysis in order to assess the recyclability of film.

- Visual Examination
- Separation of Layers
- Identification of Materials by DSC& FTIR
- Recycling through Melt Processing
- Evaluation of Properties of recyclates

### 4. RESULTS ANALYSIS

#### 4.1 Visual Examination

S. No.	Test	Test Method / Test Standard	Observations
1.	Visual Examination	-	<ul style="list-style-type: none"><li>• The submitted sample is in the form of sheet.</li><li>• Sample does not have any printed contents</li><li>• The submitted sample is white in colour.</li><li>• Observed a layer of coating on one side of the sheet.</li></ul>
2.	Overall Mass (GSM)	IS 1964	251 g/m <sup>2</sup>

#### 4.2 Separation of layers

S. No.	Test	Test Method / Test Standard	Observations
1.	Separation of Layers	5 strips of size 25 mm x 100 were Immersed in Ethyl acetate for 24 hrs	No layers were separated





### 4.3 Material Identification

The submitted sample was subjected to DSC and FTIR analysis in order to identify the material of construction in the sample.

#### 4.3.1 Differential Scanning Calorimetry (DSC):

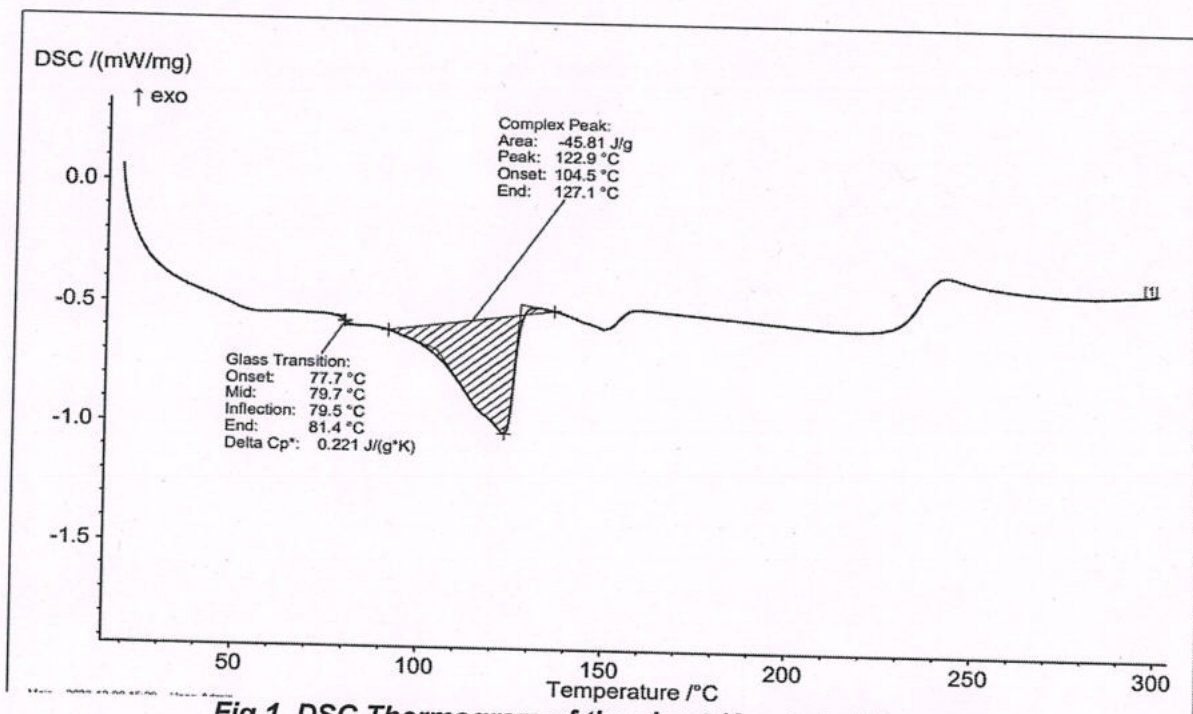


Fig.1. DSC Thermogram of the sheet (As stated by party)

The sample was subjected to DSC analysis in the temperature range of ambient to 300°C at the heating rate of 10°C / min. Fig. 1 depicts the DSC thermo gram of the sample. The endothermic peak at 122.9°C reveals the melting temperature of Linear Low Density Polyethylene (LLDPE).



S. No.	Test	Test Method	Test results	Inference
1.	Differential Scanning Calorimetry (DSC)	ASTM D 3418	An endothermic Peak at 122.9°C	Melting temperature of Linear Low Density Polyethylene (LLDPE)

### 4.3.2 Fourier Transformed Infrared Spectrum

The sheet sample was subjected to Fourier Transformed Infrared (FTIR) studies on both sides of the sheets.

#### Layer 1 (Uncoated)

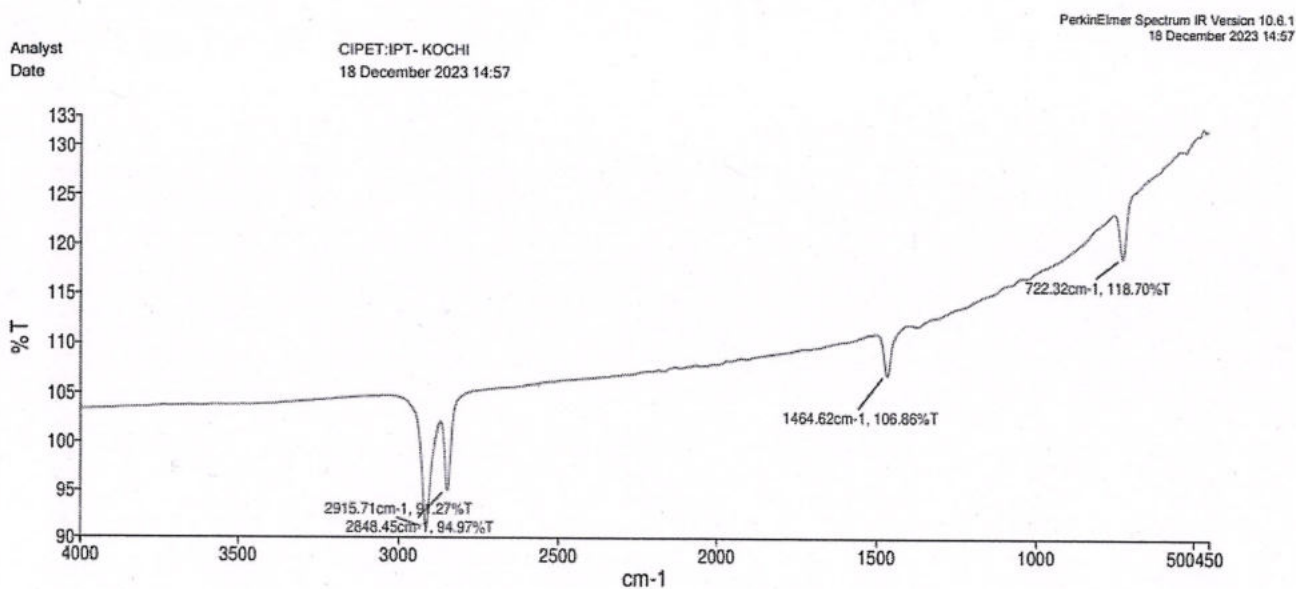


Fig. 2: FTIR spectrum of the submitted sheet (Uncoated side)





### Inference:

Fig. 2 shows the FTIR spectrum observed at the surface of the sheet (Uncoated side). From the above FTIR spectrum the peaks observed at  $2915.71\text{ cm}^{-1}$  ( $\text{CH}_2$  asymmetric C-H stretching),  $2848.45\text{ cm}^{-1}$  ( $\text{CH}_2$  symmetric C-H stretching),  $1464.62\text{ cm}^{-1}$  ( $\text{CH}_2$  deformation),  $722.32\text{ cm}^{-1}$  ( $\text{CH}_2$  rocking) corresponds to the functional groups of polyethylene. Hence, it is inferred that the submitted sheet sample consist of Polyethylene. Further, no peak corresponds to chlorine is observed. Hence, it is inferred that the sample does not contains PVC.

### Layer 2 (Coated)

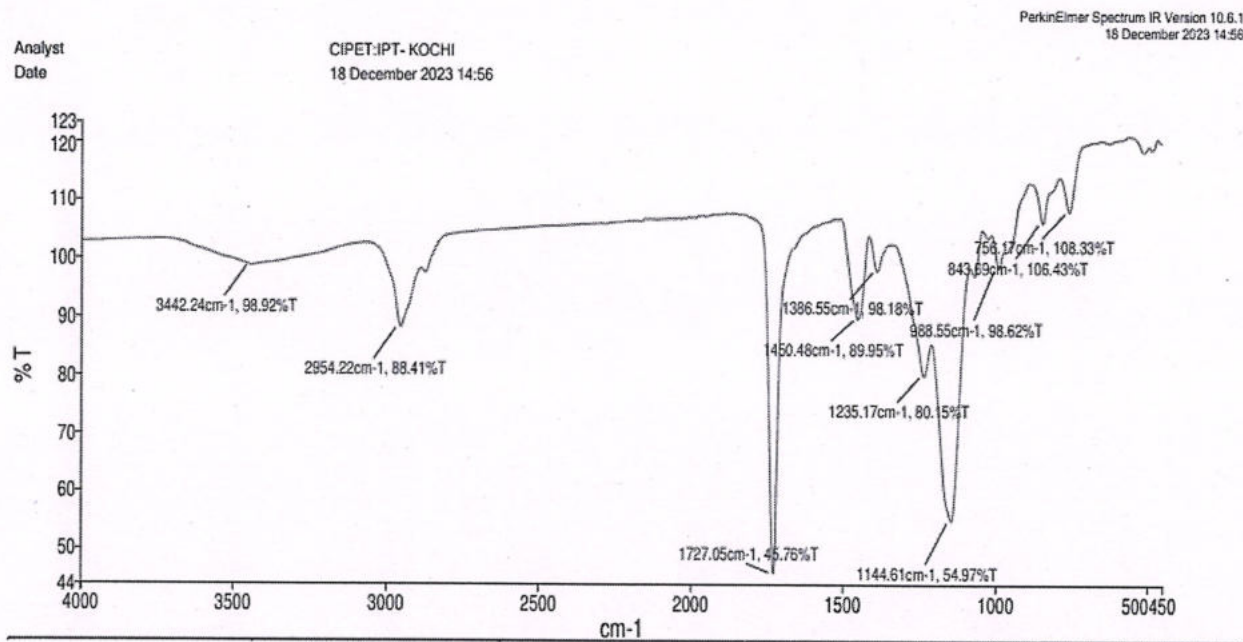


Fig. 3: FTIR spectrum of the submitted sheet (Coated side)

### Inference:

Fig. 3 shows the FTIR spectrum observed at the surface of the sheet (Coated side). The two major peaks observed at  $1727.05\text{ cm}^{-1}$  and  $1144.61\text{ cm}^{-1}$  are attributed to C=O stretching and C-O-C asymmetrical stretching, which confirms the presence of acrylic emulsion as coating. Further, no peak corresponds to chlorine is observed. Hence, it is inferred that the sample does not contains PVC.



#### 4.4. Mechanical Recycling:

##### 4.4.1 Melt processing and granulation

The submitted sample was subjected to mechanical recycling through melt processing technique. The sheet sample in the existing format was fed into the feed zone of the twin screw extruder. The optimal temperature was set in each heating zone of the extruder. The molten extruder was subjected to cutting for further conversion to granules. Fig. 4 shows the conversion of submitted sheet sample to recycled granules through mechanical recycling.

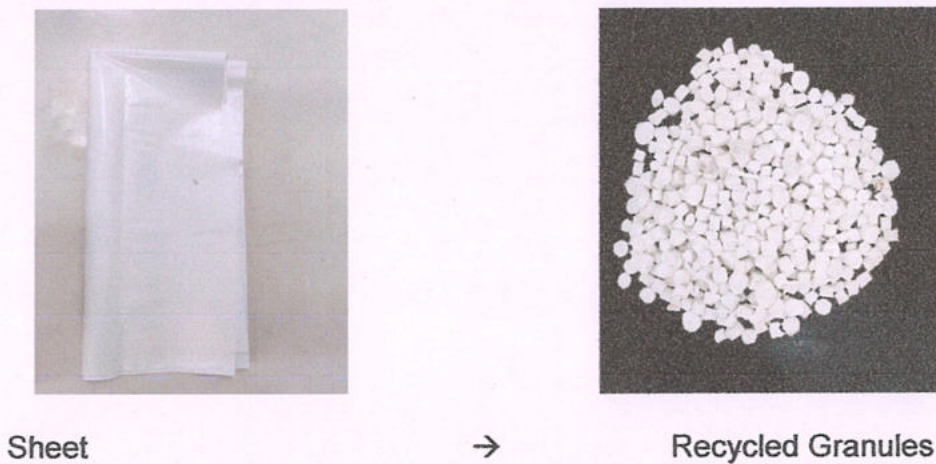


Fig. 4: Recycled Granules from sheet sample

##### 4.4.2 Specimen Preparation

The recycled granules were converted into test specimens using Injection moulding process in order to determine the properties of the recyclates. Fig. 5 shows the molded test specimen from the recycled granules.

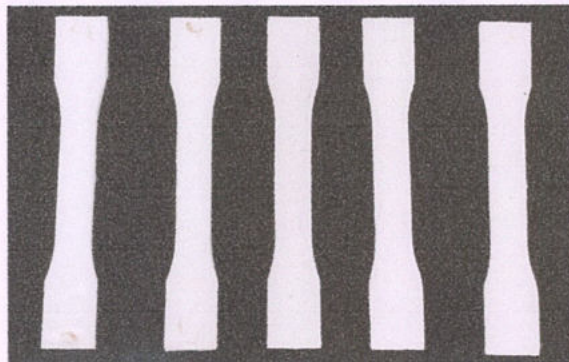


Fig. 5: Molded test specimen from Recycled Granules






The following properties were determined on the recyclate obtained from mechanical recycling of submitted sample of sheet used for banner and hording.


Sl. No	Name of test	Testing Method	Unit	Test value obtained
01	Tensile strength	ASTM D638	MPa	10.91
02	Elongation at break	ASTM D638	%	359
03	Flexural strength	ASTM D790	MPa	11.03

#### 5. SUMMARY AND CONCLUSION:

- Visual examination confirms that the submitted sample in sheet form, does not contains any printing and the sheet is white in colour.
- FTIR and DSC reveal that the sheet sample is made of Linear Low density Polyethylene (LLDPE) with a thin layer of acrylic emulsion coating.
- Further, there is no evidence of chlorine in the sample, confirming the absence of PVC.
- The melt processing confirms the feasibility of mechanical recycling of the submitted sample of sheet in the existing format.

Hence, it is concluded that the submitted sample of "Material for banner and hoarding" (*as stated by party*) comprises of Linear Low Density Polyethylene (LLDPE) and a thin coating layer of acrylic emulsion is suitable for Mechanical recycling (in the existing format) as per IS:14534-2016.

  
**Dr. K.P. Bhuvana**  
 Authorized Signatory

  
**Dr. S. Anbudayanidhi**  
 Authorized Signatory

\*\*\*\*\*End of the report\*\*\*\*\*

