

BEFORE THE HONOURABLE NATIONAL GREEN TRIBUNAL

CHENNAI

**Original Application No.262 of 2017 (SZ) &
M A No. 215 of 2017 (SZ)**

Appellant : K K Muhammed Iqbal

Versus

Respondents : The Kerala State Pollution Control Board & Others

**ADDITIONAL REPORT FILED BY THE COMMITTEE CONSTITUTED BY THE
HON'BLE TRIBUNAL AS PER THE ORDER DATED 20.01.2020 IN THE ORIGINAL
APPLICATION NO.262 OF 2017**

Standing counsel for the 1st respondent

**Rema Smrithi. V. K., Advocate
Additional Standing Counsel,
National Green Tribunal, (SZ), CHENNAI**

**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
SOUTH ZONE, CHENNAI**

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Dated this the 7th day of July, 2021.

**Rema Smrithi. V. K., Advocate
Standing Counsel for the 1st Respondent**

BEFORE THE HONOURABLE NATIONAL GREEN TRIBUNAL

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Original Application No.262 of 2017 (SZ) &

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THE HON'BLE TRIBUNAL AS PER THE ORDER DATED 20.01.2020 IN
THE ABOVE APPLICATION**

We the Committee constituted by the Hon'ble National Green Tribunal vide order dated 20.01.2020 in O.A.No.262 of 2017. We know the facts and circumstances of the case. The factual submission made here under is true and correct to the best of our knowledge, information and belief. In these circumstances, it is just and necessary that this Hon'ble Tribunal may be pleased to accept the accompanying status report as submitted by the committee constituted by the Hon'ble Tribunal and it is so humbly prayed in the interests of justice in this case.



- 1) On 19-02-2021 the joint committee inspected the site and collected soil samples from the cleared plastic waste dump site of M/s. Sreesakthi Paper Mills from which plastic waste was segregate and submitted to The Central Institute of Plastic Engineering and Technology (CIPET) Cochin on 20-02-2021 for analysis of the samples using Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC) for the characterization of plastic waste. The status of the field inspections and sampling activities were submitted to the Hon'ble tribunal as an interim report on 22-02-2021 for the hearing on 24-02-2021 for which the next hearing was posted on 31-03-2021. Since the analysis results were not received until then, the committee made submission dated 24-03-2021, seeking extension of time for the hearing on 31-03-2021, which was adjourned to 23-04-2021, 04-06-2021 and further to 09-07-2021.
- 2) The analysis report of the samples submitted to CIPET was received on 19th April 2021. The results of the analysis are tabulated below. A copy of the original analysis report produced by CIPET is attached as Annexure R1(A).

S. No	Sample ID	Aim	Test Method	Result
01	SR-1 (Coarse Particles)	Identification of Type of Plastic	ASTM D 3418 & ASTM E1252	Polyethylene (PE) Polypropylene (PP) Polyethylene Terephthalate
02	SR-1 (Fine Particles)	Identification of Type of Plastic	ASTM D 3418 & ASTM E1252	Polyethylene Terephthalate



- 3) It was submitted to the Hon'ble tribunal in the earlier interim report dated 24-03-2021, that the joint committee's next visit to be scheduled in the second week of March, 2021. Unfortunately, due to the second wave of pandemic, starting mid-march 2021, followed by strict curfews and lockdowns imposed by the government restricted free movement. Hence scheduled committee meetings were postponed on several occasions. Upon abatement of covid case by the end of June 2021, followed by relaxations to travel, the committee members immediately assembled to conduct further inspection on 06th July 2021.
- 4) The committee visited the site on the forenoon of 06th June 2021 and it was understood that the cleared plastic waste dump yard of M/s. Cella Space Ltd (formerly Shree Shakthi Paper Mills Ltd), is presently under construction of concrete parking yard for the leased out warehouses.
- 5) The joint committee in its interim report dated 22-02-2021 recommended to undertake a technical study from a reputed consultant/institution for remediation/containment on anticipation of possible transport of microplastics from the plastic contaminated soil to the river in near future. In reference to that, M/s. Cella Space Ltd (formerly Shree Shakthi Paper Mills Ltd) have entrusted NIIST (National Institute for Interdisciplinary Science and Technology), Trivandrum for carrying out a study titled "Assessment of Plastic Contaminated Soil vis-a-vis recommendations for its reuse at Cella Space Ltd, Ernakulam." A copy of the report was handed over to the joint committee during the site inspection on 06-07-2021.
- 6) The study recommends that the excavated plastic containing material to be used for plinth filling or construction fills and further recommends capping of the contaminated site with impermeable cover



on top and sides as a suitable option to prevent transport of microplastics to the adjacent river. The study further proposes that by implementing the above recommendations the waste dump site remains undisturbed. Further the site can be used for parking with suitable impermeable and structurally strong pavement that can resist any possible flooding by Periyar River. The study had also performed toxicity characteristic leaching procedure (TCLP) tests and had confirmed no heavy metals beyond standard limit. A copy of the third party report is attached as Annexure-R1(B).

- 7) The committee had observed manganese concentration from the TCLP study performed in the third party report, exceeding remarkably.
- 8) M/s. Cella Space Ltd, had initiated earth levelling activities followed by gravel/ aggregate topping as a preparatory work for the construction of concrete parking yard. Further M/s. Cella Space Ltd had informed the committee during the visit, about its consultations with third party consultants for plantation of trees along borders of its premises to increase stability and prevent any erosion of non-concreted areas due to any possible flooding by the Periyar river.
- 9) The joint committee also suggested in its earlier interim report for construction of dyke walls along the river front. Accordingly, M/s. Cella Space Ltd has reported its approach to the District Industrial Central (DIC), Ernakulam seeking permission for construction of boundary wall. The copy of the letter is attached as Annexure R1(C). However the committee opines to go with the construction of a proper dyke wall along the boundary of its premises bordering the river to avoid any possible risk of anticipated microplastic transport to river in the long run.



- 10) The joint committee during its inspection observed the exposed slopes of the under construction concrete parking yard and is of the view that the slope needs to be properly covered/ concreted to create a complete capped structure to avoid any anticipated transport of microplastics into the river.
- 11) After inspection, the committee conducted second phase sampling in the low lying areas adjacent to river where site preparation is yet to start. Soil samples were collected upto 3 feet depth at 5 different locations using powered Earth Auger Driller. The soil samples shall be assessed to quantify plastic contamination in the specific spot. The representative images of the field inspections and sampling activities are attached as Annexure R1(4). The collected soil samples were transported to the KSPCB lab for analysis of bulk density and to quantify plastic contamination.
- 12) Upon generation of analysis report, the joint committee shall further review the analysis outcome to calculate the environmental damage caused due to the alleged dumping and storage of plastic waste in the site.
- 13) The committee prays a period of 3 weeks to complete the analysis and to finalize the assessment of environmental damages.

Dated this the 07th day of July, 2021.

Dr. Deepesh V.
Scientist 'C', CPCB

Jowin Joseph
Scientist, NEERI

Vinaya K.S
Senior Environmental Engineer



**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
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Dated this the 7th day of July, 2021.

Rema Smrithi. V. K., Advocate
Standing Counsel for the 1st Respondent



CIPET सिपेट
proba perform practice Plastics



CENTRAL INSTITUTE OF PETROCHEMICALS
ENGINEERING & TECHNOLOGY (CIPET)
(Formerly Central Institute of Plastics Engineering & Technology)
INSTITUTE OF PETROCHEMICALS TECHNOLOGY (IPT)
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Web www.cipet.gov.in
Head Office: Gundy, Chennai-600 032

सिपेट:आई पी टी-कोच्ची /परीक्षण/२०२१-२२

दिनांक : १९.०४.२०२१

CIPET: IPT-Kochi/Testing/2021-22/ 2016

Date : 19.04.2021

सेवा में To

The Senior Environmental Engineer,
Kerala State Pollution Control Board
Environmental Surveillance Centre
FACT-Qr No.S-5,Udyogamandal P.O.,Ernakulam-683501

प्रिय महोदय Dear Sir,

विषय : नमूनों की परीक्षण - संदर्भ में।

Sub.: Testing of samples – Reg.

Ref.:PCB/ESC/LAB-2/07 dt. 20.02.2021

हम इसके साथ परीक्षण के लिए प्रस्तुत नमूने से संबंधित टेस्ट रिपोर्ट क्रमांक 21013 दिनांकित 19.04.2021 संलग्न कर रहे हैं।

We are enclosing herewith Test Report No.21013 dt. 19.04.2021 pertaining to the samples submitted for testing.

कृपया संलग्न कस्टमर फीडबैक फॉर्म भरकर वापस भेजने का कष्ट करें।

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

धन्यवाद तथा सबसे अच्छी सेवा देने का आश्वासन के साथ,

Thanking you and assuring you our best services,

सादर, / Yours sincerely,

प्रबंधक एवं प्रभारी, सिपेट : आई पी टी-कोच्ची
Manager & In-Charge, CIPET: IPT-Kochi

संलग्न यथोक्त / Encl. as above

केंद्र Ahmedabad, Amritsar, Aurangabad, Ayazkhana, Barhi, Bikaner, Bongaon, Bongaon, Bongaon, Chandrapur, Chennai, Dehradun, Gurugram, Guwahati, Hyderabad, Jaipur, Kolkata, Lucknow, Madurai, Murthal, Mysuru, Raipur, Ranchi, Valsad, Varanasi & Vijayawada

Centres Ahmedabad, Amritsar, Aurangabad, Agartala, Baddi, Balasore, Bongaon, Bhopal, Bhubaneswar, Chandrapur, Chennai, Dehradun, Gurugram, Guwahati, Gwalior, Hyderabad, Jaipur, Kolkata, Lucknow, Madurai, Murthal, Mysuru, Raipur, Ranchi, Valsad, Varanasi & Vijayawada

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फोन : 0484-2547741, 2546740
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वेबसाइट : www.cipet.gov.in



PP

CIPET सिपेट

परीक्षण रिपोर्ट

TEST REPORT

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
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Ph. 0484-2546740
E-mail: kochi@cipet.gov.in, cipetkochi@gmail.com
Web : www.cipet.gov.in

क्र.सं. / SI.No. 8015
Test Report No : 21013
Date : 19.04.2021

Issued to :
The Senior Environmental Engineer,
Kerala State Pollution Control Board
Environmental Surveillance Centre
FACT-Qr No.S-5,Udyogamandal P.O.,Ernakulam-683501

Page 1 of 2

Ref No: Your letter PCB/ESC LAB-2/07 dt. 30.02.2021

PART A: PARTICULARS OF SAMPLE SUBMITTED

Nature of Sample : Soil samples as stated by party
Grade Variety type / Size / Class etc : Nil
Brand name, if any : Nil
Declared values, if any : Nil
Code No. : 1)SR-1(coarse particles)
2)SR-1(fine Particles)
Batch No. and date of manufacture : Nil
Quantity : 1 Packet each
Mode of Packing : Not Packed
Date of receipt of sample : 20.02.2021
Date of commencement of test : 25.03.2021
Date of completion of test : 30.03.2021
Sealed or not : Not Sealed
Any other information : Nil

PART B: SUPPLEMENTARY INFORMATION

a) Reference to sampling procedure : Supplied by the party
b) Supporting documents for the measurements taken and results derived like graphs, tables, sketches and / or photographs as appropriate to test report, if any (to be attached) : Nil
c) Deviation from the test methods as prescribed in relevant ISS / Work instructions, if any : Nil

S. Anjali

Devi



CIPET सिपेट
Centre for Petrochemicals & Plastics Technology

Continuation Sheet

CENTRAL INSTITUTE OF PETROCHEMICALS
ENGINEERING & TECHNOLOGY (CIPET)

(Formerly Central Institute of Plastics Engineering & Technology)

INSTITUTE OF PETROCHEMICALS TECHNOLOGY (IPT)

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केन्द्रीय पेट्रोकेमिकल इंजीनियरिंग एंड टेक्नॉलॉजी (सिपेट)
केन्द्रीय पेट्रोकेमिकल टेक्नॉलॉजी (आई.पी.टी.)
पेट्रोकेमिकल विभाग
राज्य उद्योग मंत्रालय, भारत सरकार
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वेबसाइट : www.cipet.gov.in



Test Report No :21013

Date :19.04.2021

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PART C : TEST RESULTS

Sl. No.	Test	Test Method	Unit	Results obtained
1	Identification of Plastic	ASTM D 3418 & ASTM E1252	--	Sample ID:SR-1 (coarse particles) Polyethylene (PE), Poly Propylene (PP) & Polyethylene terephthalate(PET)

Sl. No.	Test	Test Method	Unit	Results obtained
1	Identification of Plastic	ASTM D 3418 & ASTM E 1252	--	Sample ID:SR-1 (fine particles) Polyethylene terephthalate(PET)

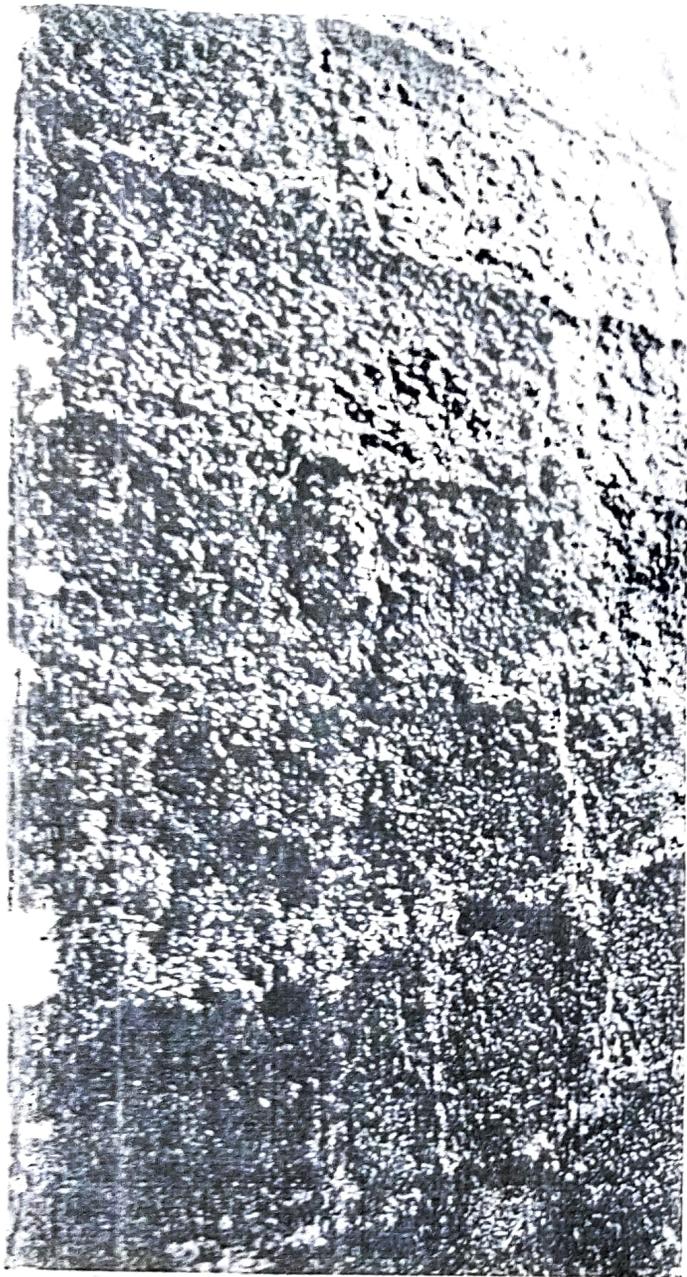
PART D: REMARKS

- NB: i. This Test Report / Certificate is issued only for the samples submitted to CIPET.
ii. The results stated above related only to the items tested.
iii. The quality of the subsequent production lot has to be ensured by the purchaser
iv. This Test Certificate shall not be reproduced except in full without the written approval.
v. Details of test subcontracted - Nil.

S. Anil K.
Sr. Technical Officer

Manager (Technical)
Authorized Signatory

End of the Report



Assessment of plastic
contaminated soil
vis-à-vis
recommendations for its
reuse at Cella Space
Limited, Ernakulam

Sponsor
M/s Cella Space Limited, Ernakulam



CSIR-NIIST

MARCH 2021

Environmental Technology Division (ETD),
CSIR-National Institute for Interdisciplinary
Science and Technology, Thiruvananthapuram,
Kerala 695 019

Ernakulam's proximity to the equator and the Arabian Sea provides a moderate equatorial climate with an annual temperature range between 23 to 31° C and moderate to high humidity levels. During the months of June-September, the south-west monsoon brings in heavy rains as it lies on the Western Ghats' windward side. The average annual rainfall is nearly 2978.00 mm, with a yearly average of 125 rainy days (<https://en.wikipedia.org/wiki/Kochin>). The base map of the study area is shown in Figure 2. The dump yard at M/s Cella Space Limited is shown in Figure 2 with the maroon colour and has an area of approximately 0.4 ha. The study site is located in the industrial area, and the river Periyar's bank is about 35 meters from the south boundary of the dump yard. The study site lies between latitude 10°4'30" N to 10°5'30" N and longitude 76°18'30" E to 76°19'00" E.

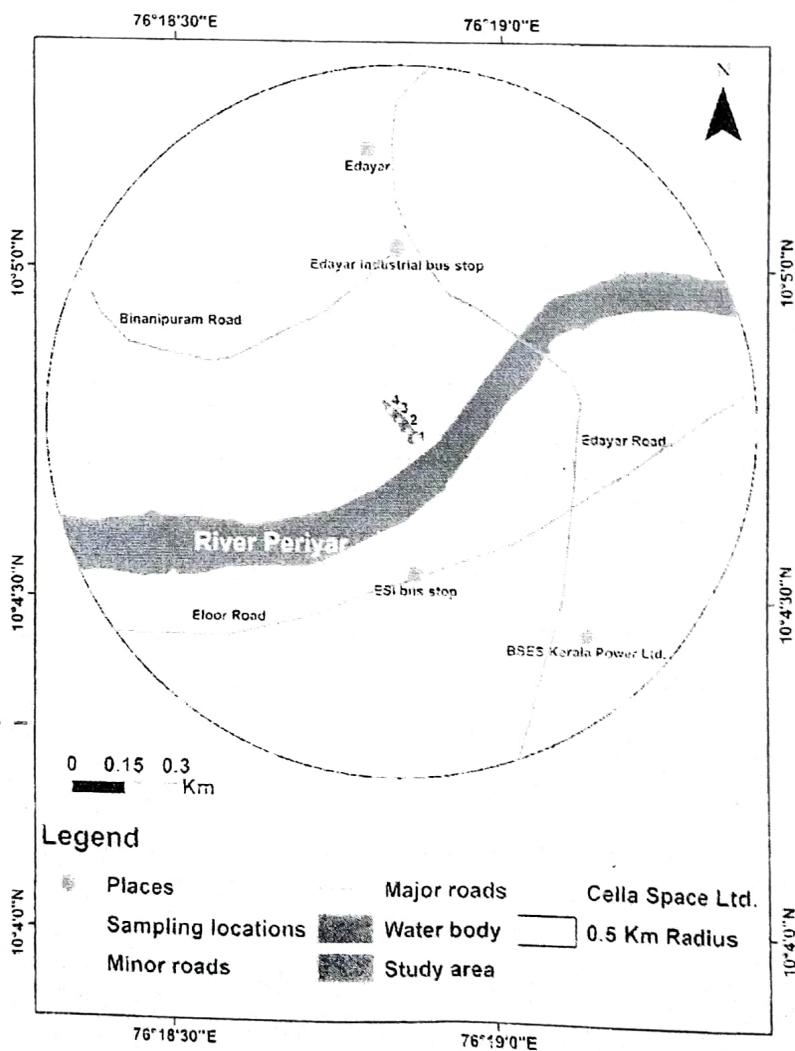


Figure 2: Base map for 0.5 Km radius around the study area (M/s Cella Space Limited, Ernakulam Limited)

M/s Cella Space Limited was previously known as "Sree Sakti Paper Mills Limited" and is based in Ernakulam in the state of Kerala. The Kraft mill was established in the year 1992 with a manufacturing capacity of 15 Tonnes/day. The capacity was later increased to 150 Tonnes/day in the year 2007. The principal raw material used in the manufacturing of paper was old cartons and waste paper. The waste paper and old cartons were fed into the pulper machine, and waste from the same was segregated viz. steel clips, stapler pins, plastic waste. The steel clips and stapler pins were sold to the scrap dealer, and plastic waste was burned in an incinerator in accordance with the directives of the Kerala State Pollution Control Board (KSPCB). However, due to certain local issues, the incinerator's operation could not be continued after the year 2012. As a result, plastic waste was dumped on land having an area of approximately 1 acre possessed by Sree Sakti Paper Mills Limited. This resulted in the accumulation of plastic waste on the land. Consequently, as per the Honorable court's order, M/s Cella Space Limited removed a total of 6664.26 Tonnes of plastic waste from their premises by hiring Kerala Enviro Infrastructure Limited. A team comprising of experts from Kerala State Pollution Control Board (KSPCB), Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute (NEERI), and Environmental Surveillance Centre visited the site of M/s Cella Space Limited in February 2020 for inspection and suggested to carry out the testing of soil from the premise to assess the plastic content.

Subsequently, M/s Cella Space Limited approached CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram, to provide technical assistance for assessing plastic contaminated soil vis-à-vis recommendations, if any. CSIR-NIIST is a constituent laboratory of the Council of Scientific and Industrial Research (CSIR), Ministry of Science and Technology, New Delhi, and has certification from the National Accreditation Board for Testing and Calibration Laboratories (NABL) and National Accreditation Board for Education and Training (NABET).

Accordingly, this report outlines the overall concept and approach to quantify the plastic waste at the M/s Cella Space limited and includes the following scope of work.

CSIR-NIIST, Thiruvananthapuram

26.96 ± 4.89, 22.80 ± 3.82 %, respectively. This data is indicative of the fact that plastic pieces of different sizes are dumped at the site in the past.

Heavy metal concentrations (Li- Lithium, Be-Beryllium, Mg-Magnesium, Ca-Calcium, V-Vanadium, Cr-Chromium, Mn-Manganese, Fe-Iron, Co-Cobalt, Ni-Nickel, Cu-Copper, Zn-Zinc, As-Arsenic, Se-Selenium, Mo-Molybdenum, Cd-Cadmium, Sb-Antimony, Tl-Thallium, Pb-Lead, Hg-Mercury) were analyzed in all four samples. None of the heavy metals concentration is in significant quantity. The maximum leachable concentration of heavy metals in all the four samples was less than the (Toxicity Characteristic leachability Procedure) TCLP limits as recommended by the United States Environmental Protection Agency (USEPA) and schedule 2 of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in India.

Based upon the detailed characterization of the waste, including sieve analysis, moisture content, fixed and volatile solids determination, heavy metals concentration (mg/Kg), maximum leachable concentration (mg/L), it is recommended that any superstructure/ construction activities that will disturb the underlying waste materials shall not be carried out. It is recommended that the entire area be covered with impervious concrete lining, and the same can be used only for vehicle parking or as an open storage yard. This suggestion is subject to detailed geotechnical investigation of the site to check the load-bearing capacity and other relevant geotechnical parameters and the expert advice by the structural/geotechnical engineers. Due care shall also be taken to protect the site by considering the flood levels of the River Periyar.

In case, if any material is to be removed from the dump, the excavated materials shall be mixed with the soil in the ratio of 1:5. This will ensure the plastic content of less than 5 % as recommended in CPCB's guidelines to use such waste for plinth filling. The resultant mixture of waste and soil can then be used for plinth filling for the in-house construction activities, such as the construction of warehouses. Plinth filling ensures containment in the impervious layers, reduction in plinth filling cost, reduction in risk due to spillage while transportation, and may prove a techno-economic and environmentally sustainable option. At the end of the property's life, the construction and demolition waste may be managed as per the relevant regulations covered under Construction and Demolition Waste Management Rules, 2016, as amended from time to time.

Executive Summary

M/s Cella Space Limited was previously known as "Sree Sakti Paper Mills Limited" and is based in Ernakulam in the state of Kerala. The principal raw material used in the manufacturing of paper was old cartons and waste paper. The plastic waste from the paper mill was burned in an incinerator in accordance with the directives of the Kerala State Pollution Control Board (KSPCB). However, due to certain local pollution issues, the incinerator's operation could not be continued after the year 2012. As a result, the plastic waste was dumped on land having an area of approximately 1 acre possessed by Sree Sakti Paper Mills Limited. This resulted in the accumulation of plastic waste on the land. Consequently, as per the Honorable court's order, M/s Cella Space Limited removed a total of 6664.26 Tonnes of plastic waste from their premises by hiring Kerala Enviro Infrastructure Limited. A team comprising of experts from Kerala State Pollution Control Board (KSPCB), Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute (NEERI), and Environmental Surveillance Centre visited the site of M/s Cella Space Limited in February 2020 for inspection and suggested to carry out the testing of soil from the premise.

Subsequently, M/s Cella Space Limited approached CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram, to provide technical assistance for assessing plastic contaminated soil vis-à-vis recommendations, if any. CSIR-NIIST chocked out the detailed methodology to conduct the sampling and collected samples from the four sampling locations on the plastic contaminated soil. The dimension of the test pits was 1.5 X 1.5 X 1.5 m. The samples were collected by employing the coning and quartering method. All the samples were sun-dried and analyzed for moisture content, percentage retained for various sieve/mesh sizes (5, 2.3, 1.4, 0.4, and 0.1 cms), fixed solids (FS) and volatile solids (VS), heavy metals concentration (mg/Kg), maximum leachable heavy metals concentration (mg/L), etc. The detailed analysis revealed that the waste material from the study site has different size gradations. The average percentage retained of 5, 2.3, 1.4, 0.4, and 0.1 cms were 11.62 ± 4.03 , 16.33 ± 6.10 , 10.43 ± 3.03 , 19.08 ± 1.41 , 19.96 ± 3.34 % respectively. The percentage finer than 0.1 cm was 22.55 ± 10.09 %. Moreover, the average percentage VS of the contents retained on the sieves/mesh of 5, 2.3, 1.4, 0.4, and 0.1 cms were 34.48 ± 16.76 , 21.58 ± 6.54 , 18.89 ± 1.71 ,

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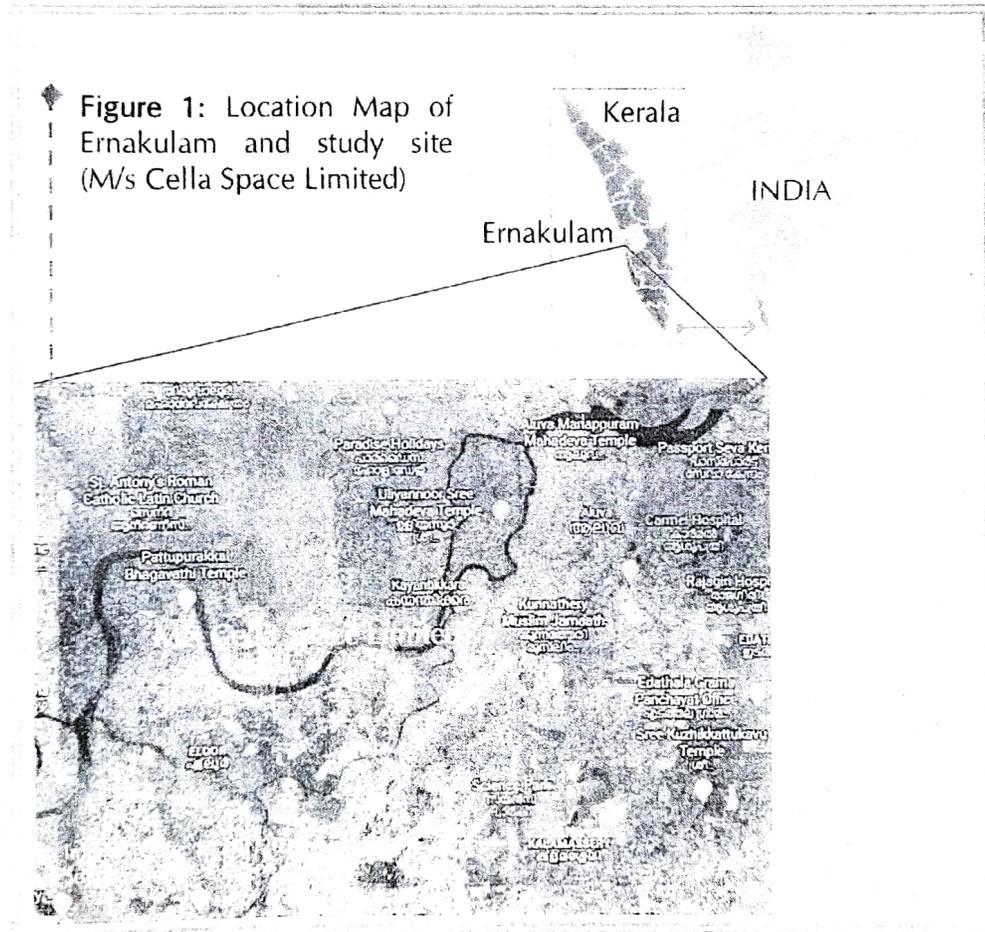
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- Secondary data collection with respect to contaminated soil at M/s Cella Space Limited viz. dimensions, drawing if any, nature of waste being dumped, numbers of years the site was operational, etc.
- Site investigation and sample collection from the contaminated land.
- Detailed physico-chemical characterization of the sample.
- Recommendation of techno-economic and environmentally sustainable measures for the reuse of contaminated soil based on physico-chemical characterization.
- Submission of the draft and final report.

Site Description

The study site is located in the district of Ernakulam in the State of Kerala. It is well connected to the rest of India by air (International airports with regular flights to major cities in India), by train (Ernakulam Junction, Ernakulam Town, and Cochin Harbor Terminus), and by road (NH 47, NH 17, and NH 49). Figure 1 shows the location map of Ernakulam and the study site.



M/s Cella Space Limited also conducted the soil testing in March 2020 by hiring Envirodesigns Eco Labs, Kochi 682025, which is a NABL accredited and Ministry of Environment and Forest and Climate Change (MoEF&CC) approved laboratory (Source: <https://www.envirodesigns.in/>). The test was conducted by collecting 1 Kg of the soil sample from five different test pits. The analysis data showed that the plastic content in all the five samples was less than 0.65 % on a weight to weight basis (w/w).

4.1.2.1.2. Fieldwork approach and Methodology

CSIR-NIIST team comprising a Scientist and Technical Officer visited M/s Cella Space Limited on June 09, 2020, to inspect and gather the relevant secondary data. The site has been filled and covered with soil to an average height of 1 to 2 meters above datum. No plastic waste was visible at the site, except for scattered small plastic pieces. In order to check whether plastic waste has been covered with soil, sample test pits were dug and the samples were analyzed by M/s Cella Space, as mentioned before. However, the test pits and sample sizes are considered too small for representative sampling. Representative soil sampling up to the fill depth of 1 to 2 meters is required to better assess the soil characteristics and the extent of plastic content in the soil vertically. Subsequently, the CSIR-NIIST team visited M/s Cella Space Limited, Ernakulam, to carry out the sampling work on September 10-11, 2020. The methodology is presented below with original photographs during the fieldwork:

1. Based upon the shape of the plastic dump yard at M/s Cella Space Limited, Ernakulam; Four test pits are identified (marked in yellow color) as shown in Figure
2. The exact location of all the four test pits is presented in Table 1.

Table 1: Location of Test pits in the study area

Test Pit	Latitude	Longitude
1	10° 4'44.65"N	76°18'52.25"E
2	10° 4'45.20"N	76°18'51.62"E
3	10° 4'46.27"N	76°18'50.79"E
4	10° 4'47.14"N	76°18'49.94"E

2. The site was excavated with the help of an Excavator at the marked location up to the bottom of the overburden. The dimension of the test pits was 1.5 X 1.5 X 1.5 m. Excavated material from each of the test pits was heaped and thoroughly mixed.

◆ Figure 3: Excavation of sample from the test pits (1.5 X 1.5 X 1.5 m)



◆ Figure 4: Heaped to form the cone



3. By employing the coning and quartering method several times, a representative sample of approximately 30 to 50 Kg was collected for each sampling pit. The leftover/discarded excavated materials are refilled in the test pits to avoid ponding or any other hazards.



Figure 5: Coning and quartering in progress

4. 30 to 50 kg samples from each test pit were taken to CSIR-NIIST to further analyze relevant parameters like moisture content, volatile matters, inorganic content, and plastic content. All the parameters can be expressed in percentage (weight by weight basis). The samples are sun-dried for three weeks to remove the moisture. All the samples were overturned twice a day.



Figure 6: The sample from the study site after drying

5. The sun-dried samples (4 Kgs) are then sieved using sieve/mesh size of 5, 2.3, 1.4, 0.4, and 0.1 cms. It is essential to mention here that all the mesh used in the study has square openings. It is common to report the opening size equal to the square's side (IS: 460 (Part 1) – 1985). However, in this study, the opening size is reported as the square's diagonal length. This is due to the fact that the plastic pieces will tend to pass through the square sieve through its diagonal, which is the largest path in the square sieve.

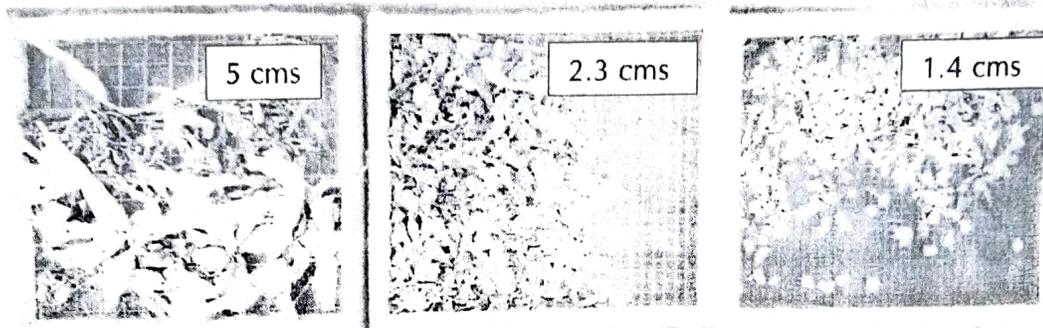


Figure 7: The contents retained on each sieve/mesh having different opening

6. It is imperative to mention that the moisture content determination by method ASTM: E871-82, 2014 (or IS:2720:PartII), involves drying the sample at 105°C. However, the same was not practicable in the present study due to plastic presence, which may likely burn at temperatures greater than 60 to 70°C, thus giving erroneous results.
7. Additionally, the contents retained on the sieves were again analyzed for volatile solids (VS) and fixed solids (FS) and are expressed in percentage on a dry weight basis.
8. It is important to note here that a homogenized sample must be taken to determine the volatile solids. However, during the experiments, it was observed that the homogenized sample collection from the sieve is not possible because of the uneven size of the plastic and stones. Hence, the entire content retained on the respective sieves was kept in a furnace at 550°C to analyze the VS and FS.
9. For heavy metals analysis, the fraction finer than 0.1 cms obtained at the end of the sieving experiment were sampled. The sample was drawn by following the coning and quartering method. The samples were digested by taking approximately 0.1 grams of the sample and dissolving it in a mixture of 3 ml of nitric acid (HNO₃) and 2 mL of hydrogen peroxide (H₂O₂) and digesting it in a

microwave digester at 180°C for 30 minutes. The digested samples were then analyzed in an Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) (Thermo iCAP RQ). Merck multi-element Standard solution XVI (21 elements in dilute nitric acid) and LGC make custom standard 1728: Hg were taken as reference standards for the analysis.

3. Characterization of the waste materials

3.1 Sieve analysis

The sieve analysis results showed that the waste material from the study site has different size gradations, as shown in figure 8. The percentage retained on 5.0 cms sieve varied between 6.34% to 17.03 %, and the percentage finer than 0.1 cm (1 mm) ranged between 11.75% to 34.51 %. A minimal variation was observed in the percentage retained on a 0.4 cm sieve, which was between 17.33% to 21.23 %. The samples collected from all four test pits showed more or less a similar trend in terms of particle size for the sieve opening of 1.4, 0.4, and 0.1 cms. More than 80 % of the waste material passed through the 5.0 cms opening of the sieve, as shown in figure 9. The cumulative percentage retained on 0.1 cm (1 mm) sieve varied between 65.49 to 88.26 %, as shown in figure 10. The detailed analysis results of the sieve experiments for all four samples are presented in Table 2 for reference. In order to further characterize the contents retained on each sieve, the volatile and fixed solids of the retained contents from the respective sieves were analyzed and are discussed in the subsequent section.

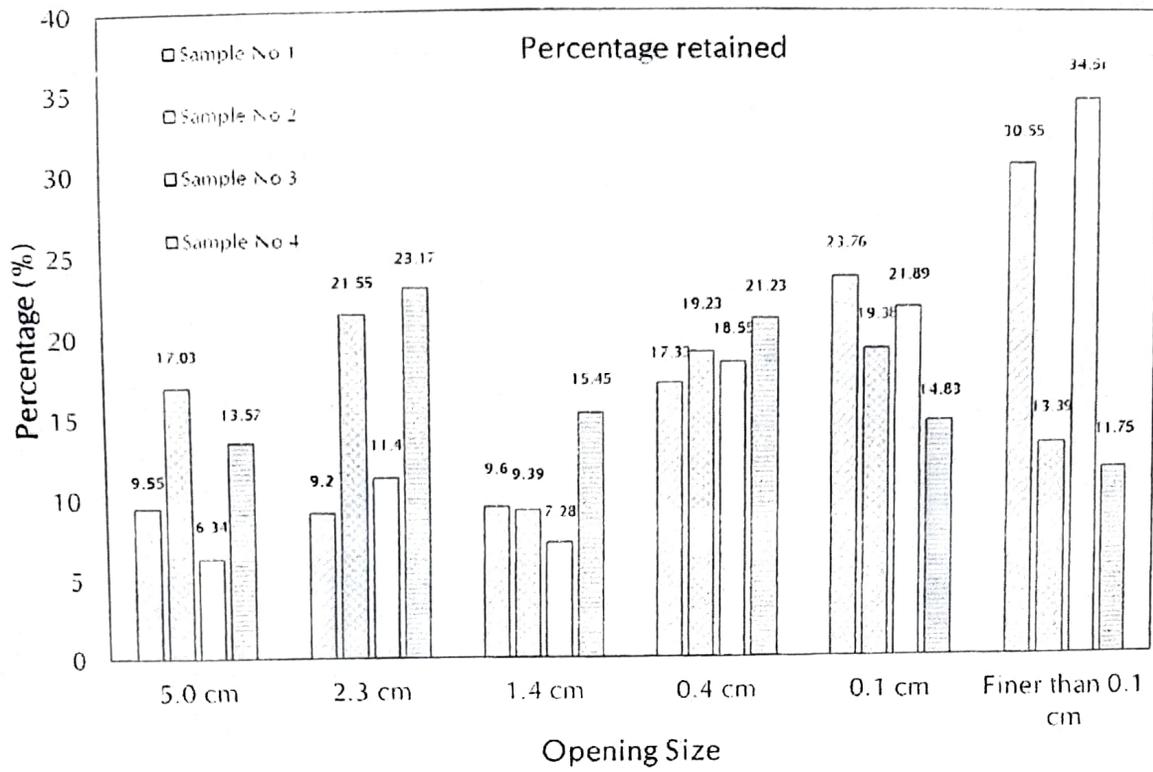


Figure 8: Sieve analysis results (Percentage retained on each sieve)

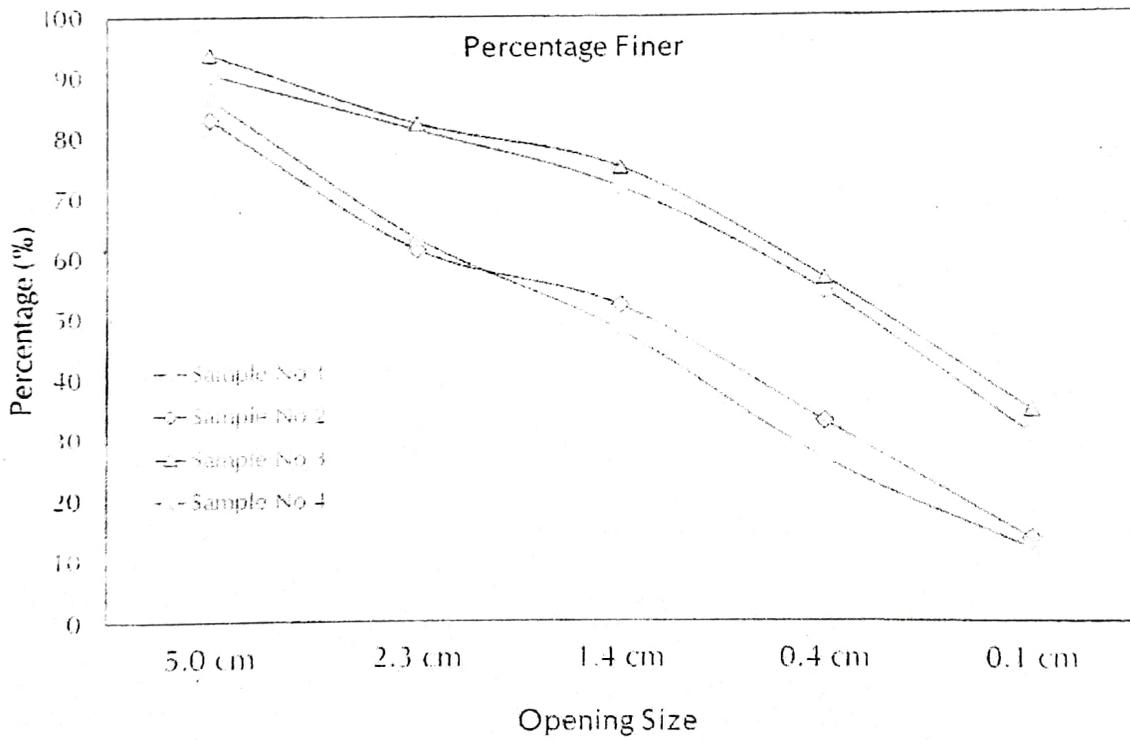


Figure 9: Sieve analysis results (Percentage finer)

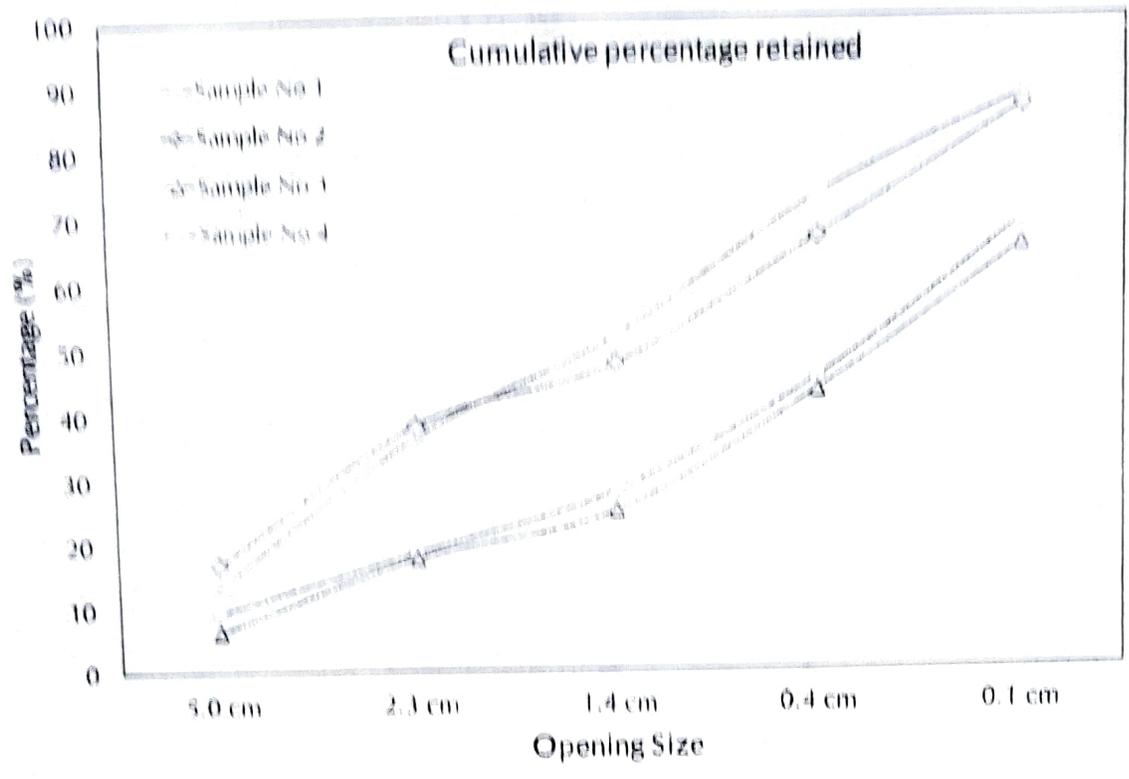


Figure 10: Sieve analysis results (Cumulative percentage retained)

Table 2: Results of the sieve analysis

Opening Size	Sample No 1			Sample No 2		
	Percentage retained	Cumulative retained in percentage	Percentage finer/passing	Percentage retained	Cumulative retained in percentage	Percentage finer/passing
5.0 cm	9.55	9.55	90.44	17.03	17.03	82.97
2.3 cm	9.2	18.76	81.23	21.55	38.59	61.4
1.4 cm	9.6	28.36	71.63	9.39	47.98	52.01
0.4 cm	17.33	45.69	54.3	19.23	67.21	32.78
0.1 cm	23.76	69.45	30.54	19.38	86.6	13.4
Finer than 0.1 cm*	30.55	100	-	13.39	100	-
Opening Size	Sample No 3			Sample No 4		
	Percentage retained	Cumulative retained in percentage	Percentage finer/passing	Percentage retained	Cumulative retained in percentage	Percentage finer/passing
5.0 cm	6.34	6.34	93.65	13.57	13.57	86.42
2.3 cm	11.4	17.74	82.25	23.17	36.74	63.25
1.4 cm	7.28	25.03	74.96	15.45	52.196	47.8
0.4 cm	18.55	43.59	43.59	21.23	73.43	26.56
0.1 cm	21.89	65.49	65.49	14.83	88.26	11.73
Finer than 0.1 cm*	34.51	100	-	11.75	100	-

*represents final mass (residue) remained after sieving

3.2 Moisture Content, Fixed and Volatile solids

The moisture content of the samples is presented in Table 3. The moisture content of the samples showed wide variation, i.e., 15.84% to 31.2 %. The moisture content varies with particle size, particle size distribution, porosity, weather conditions, etc. The average moisture content of all the four samples was found to be 25.40 ± 6.49 %.

Table 3: Moisture content of the samples on a wet weight basis

Sample No.	Moisture Content in percentage (%)
1	23.03
2	15.84
3	31.55
4	31.2

The volatile solids (VS) and the fixed solids (FS) retained on each sieve for each sample are shown in Figures 11 to 14. The percentage of the FS and VS are presented on a dry basis. It was found that the dirt/soil/ash adheres strongly on the surface of plastic retained on different sieves and is difficult to remove it by dusting or washing with water. Moreover, the stones/gravels are also retained on the sieves, which contributes to the FS. The VS is contributed by plastic and biological organic matter. The waste dumped at M/s Cella Space Limited is principally the mixture of ash from the incinerator and plastic of different types and sizes.

The VS of the contents retained on the sieves of 1.4, 0.4, and 0.1 cms ranged from 16.76% to 34.36 % on a dry basis. On the other hand, the VS of the contents retained on the 5.0 cms sieve was 15.10 % for sample no. 2 and 59.31 % for sample no. 3. This indicates that larger sized plastic pieces are present in some locations at the site (e.g., Sample No.3).

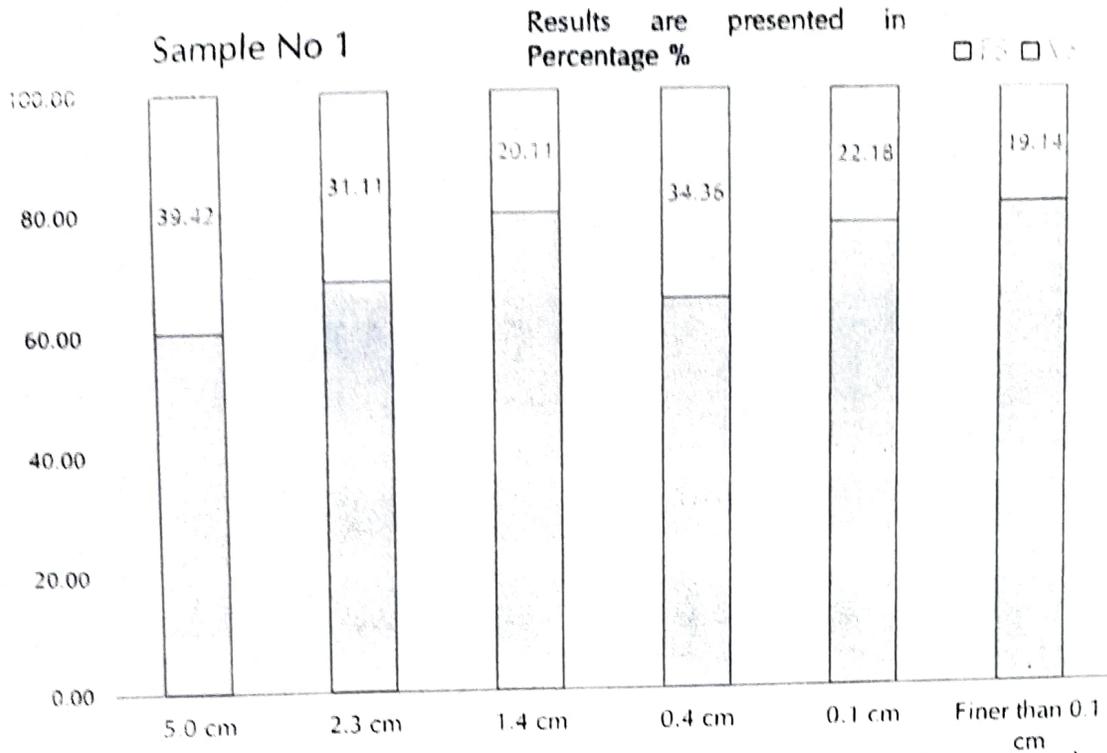


Figure 11: Fixed and volatile solids of Sample 1 retained on different sieves on a dry basis

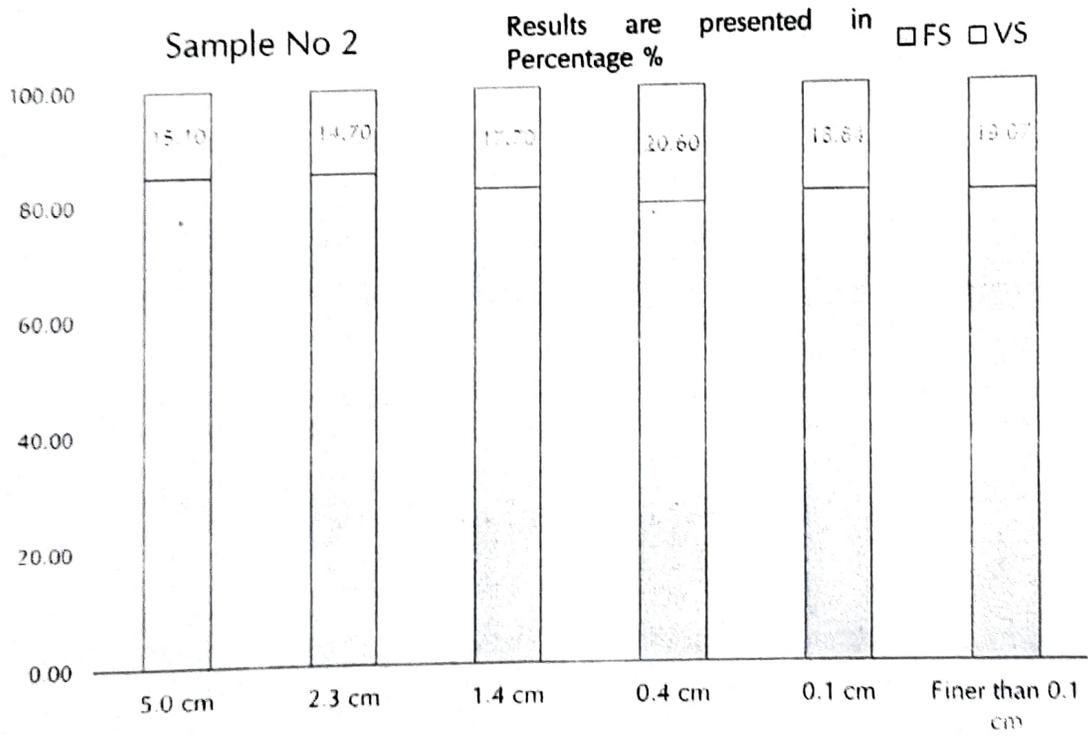


Figure 12: Fixed and volatile solids of Sample 2 retained on different sieves on a dry basis

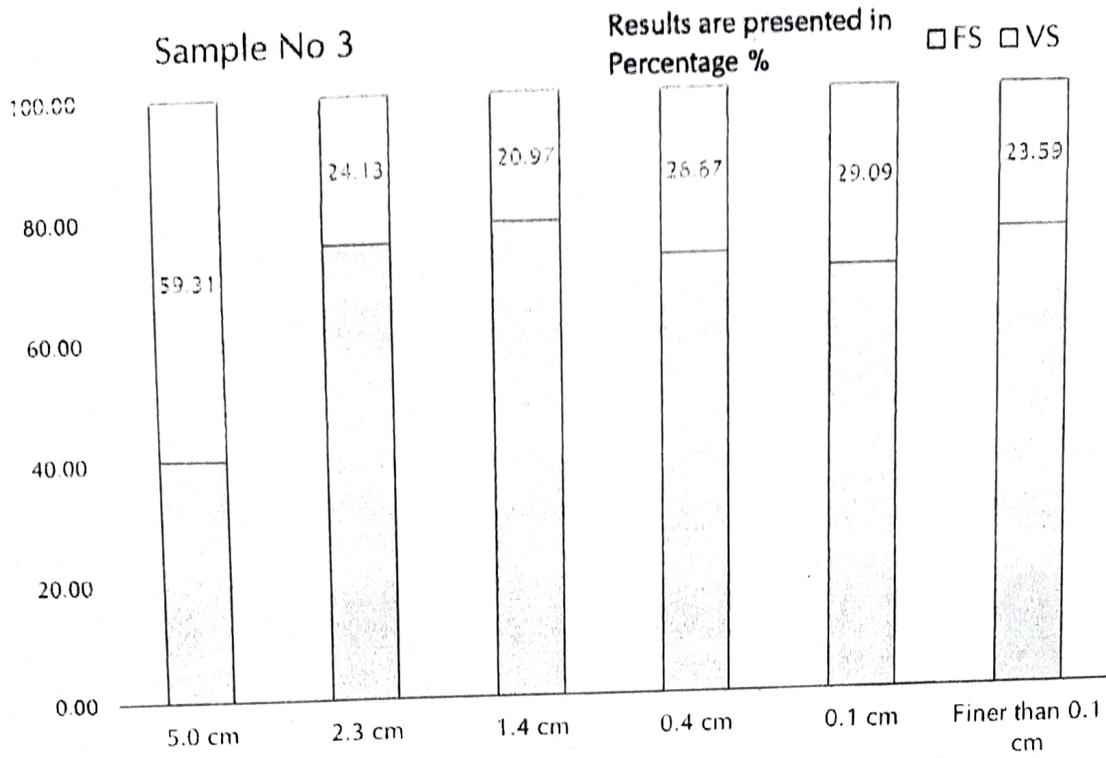


Figure 13: Fixed and volatile solids of Sample 3 retained on different sieves on a dry basis

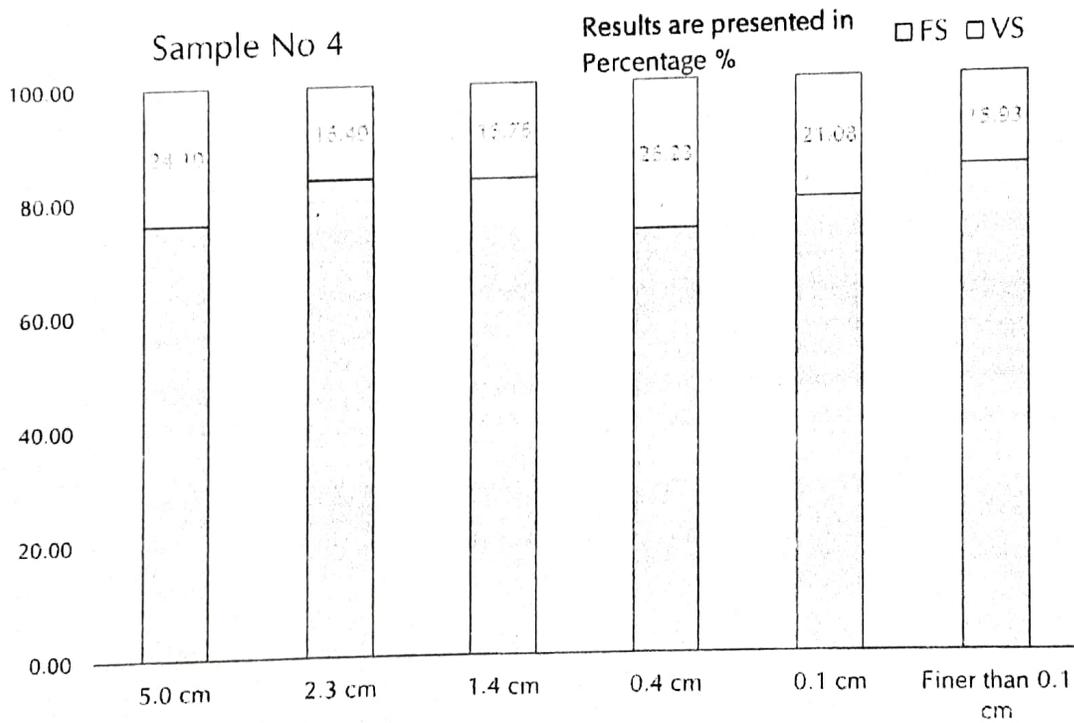


Figure 14: Fixed and volatile solids of Sample 4 retained on different sieves on a dry basis

3.3 Heavy metals and other elements of concern

Heavy metal concentration in all four samples is presented in Table 4. The results indicate that heavy metals concentration in the dumpsite is not a matter of concern. The metal in highest concentration was Calcium (Ca), (1114.37 mg/kg to 1662.31 mg/kg). Ca is not an element of concern with regard to hazardous waste.

To better understand the possible hazards from the waste materials, toxicity characteristics leachability procedures are typically employed. The TCLP is a chemical analysis process used to determine whether hazardous elements are present in waste material. The test involves a simulation of leaching through the landfill and can provide a rating that can prove if the waste is dangerous to the environment or not. At the same time, if waste is 100% solid, as defined by the TCLP method, then the results of the total constituent analysis may be divided by twenty to convert the total results into the maximum leachable concentration. This factor is derived from the 20:1 liquid-to-solid ratio employed in the TCLP (Source USEPA, Available at https://archive.epa.gov/epawaste/hazard/web/html/faq_tclp.html). In this case, all the samples were 100 % solids as they yield no liquid when subjected to pressure filtration as per section 7.1.1.1 of TCLP Method 1311 of United State Environmental Project Agency (USEPA).

Accordingly, the values for heavy metal concentrations obtained in mg/Kg were converted to maximum leachable concentrations in mg/L by dividing all the values by 20. The maximum leachable concentrations are also presented in Table 4, along with the TCLP limits recommended by the United States Environmental Protection Agency (USEPA). The same TCLP limits also form the schedule 2 of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 in India. It was found that none of the heavy metals in all the four samples exceeded the limit of heavy metals concentration as listed in Schedule 2 of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and thus safe in terms of heavy metals.

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	0.01	0.03	0.02	0.02	0.02	0.0005	0.013	0.005	0.006	-
Mg	175.37	982.82	1178.3	1453.5	0.0005	0.0015	0.001	0.001	0.001	0.75
Ca	1348.88	1114.37	1662.31	1538.76	8.76	49.14	58.91	72.67	72.67	-
V	0.64	0.35	2.12	2.25	67.44	55.71	83.11	76.93	76.93	-
Cr	0.42	0.66	1.13	0.53	0.032	0.0175	0.106	0.1125	0.1125	24.0
Mn	33.59	702.47	210.84	182.73	0.021	0.033	0.0565	0.0265	0.0265	5.0*
Fe	79.15	162.47	555.47	467.09	1.67	35.12	10.54	9.13	9.13	10.0
Co	0.12	0.56	0.53	0.27	3.95	8.12	27.77	23.35	23.35	-
Ni	0.28	0.51	2.31	0.63	0.006	0.028	0.0265	0.0135	0.0135	80.0
Cu	12.60	13.98	21.29	10.63	0.014	0.0255	0.1155	0.0315	0.0315	20.0
Zn	101.57	102.46	82.34	25.81	0.63	0.699	1.06	0.5315	0.5315	25.0
As	0.15	0.16	0.40	0.30	5.07	5.12	4.11	1.29	1.29	250.0
Se	0.39	2.12	0.45	0.56	0.0075	0.008	0.02	0.015	0.015	5.0
Mo	2.08	0.05	0.70	0.53	0.01	0.106	0.0225	0.028	0.028	1.0
Cd	0.13	0.43	0.26	0.12	0.10	0.0025	0.035	0.0265	0.0265	350
Sb	1.10	0.02	0.05	0.03	0.006	0.0215	0.013	0.006	0.006	1.0
Tl	0.01	0.03	0.01	0.01	0.055	0.001	0.0025	0.0015	0.0015	15.0
Pb	0.25	9.59	2.35	1.39	0.0005	0.0015	0.0005	0.0005	0.0005	7.0
Hg	0.02	0.21	0.03	0.02	0.0125	0.4795	0.1175	0.0695	0.0695	5.0
					0.001	0.0105	0.0015	0.001	0.001	0.2

See next page for foot notes...

- Not Specified in the TCLP and Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 (Schedule II)

* values represent hexavalent chromium (VI)

Li- Lithium, Be-Beryllium, Mg-Magnesium, Ca-Calcium, V-Vanadium, Cr-Chromium, Mn-Manganese, Fe-Iron, Co-Cobalt, Ni-Nickel, Cu-Copper, Zn-Zinc, As-Arsenic, Se-Selenium, Mo-Molybdenum, Cd-Cadmium, Sb-Antimony, Tl-Thallium, Pb-Lead, Hg-Mercury

The listed waste constituents are based on leachable concentration limits [Toxicity Characteristic Leaching Procedure (TCLP) or Soluble Threshold Limit Concentration (STLC)] given in USEPA Test Method 1311; and Waste Extraction Test (WET) Procedure given in Appendix II of section 66261 of Title 22 of California Code regulation (CCR)

Samples 1,2,3 and 4 were 100 % solids as they yield no liquid when subjected to pressure filtration as per section 7.1.1.1 of TCLP Method 1311 of United State Environmental Project Agency (USEPA)

The Leachable concentration limit based on Class A is given in Schedule II of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

5.4. Estimation of plastic content from the site

As per the secondary data provided by M/s Cella Space Limited at the start of the project and subsequent discussions, it was learned that the waste materials lying on the study site are a blend of plastic and ash from the incinerator. The volatile solids present in any sample reflect the presence of organic matter, either degradable or non-degradable (e.g., plastics). The ash from the incinerator has limited organic matter content. The other sources of organic matter can be the roots of the plant/trees. However, only grass with an average height of less than 1.5 to 2 feet was observed during the site visit. Hence, the organic content through the roots of the grass can be considered negligible. The other possible source of organic matter is microbial biomass, which is also considered insignificant given the nature of materials dumped on the site. The data presented in Figures 11 to 14 show that the volatile solids in the content finer than 1 mm range from 15.93 to 23.59 % on a dry weight basis. Initially, it was suspected that the plastic having size less than 1 mm might not be present in the sample. But the observation under the stereomicroscope revealed that the plastic pieces of size less than 1 mm are present in the samples. The screenshot of the sample visible through the microscope is presented in Figure 15. Thus, it was confirmed that the volatile matters present in the samples finer than 1 mm actually reflect the plastic pieces present in it.

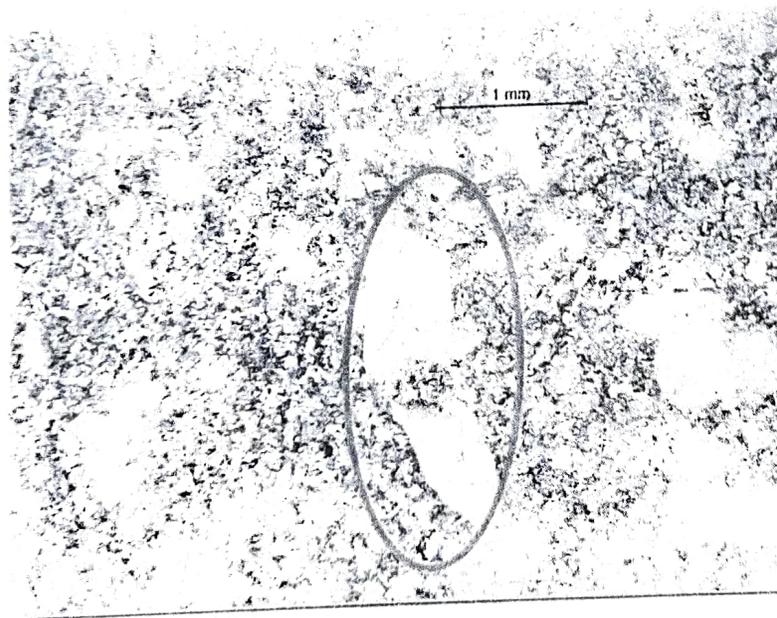


Figure 15: The presence of plastic in the contents finer than 1 mm visible through stereo microscope (Grey scale) Make: Leica MZ 10F

Based on the discussion, it is reasonable to assume, erring on the side of caution, that all the volatile matters present in the samples appear to be plastic. Accordingly, the plastic content of the waste dumped from the site was estimated.

- Approximate area of the site - 4047 m²
- Height of overburden - 1.5 m (approx.)
- Average Moisture content - 25.40 %
- Total volume of waste - 6070.5 m³
- Density - 1350 Kg/m³*
- Total weight of the waste - 8195.17 Tonnes
- Weight of Fixed Solids - 4682.72 Tonnes (57.14 %)
- Weight of volatile solids (Plastic) - 1416.12 Tonnes (17.28 %)
- Weight of the moisture - 2060.26 Tonnes (25.40 %)

*adopted from Bhatt et al. 2019 based on the optimum moisture content of the flyash (24 %)

Arpita Bhatt, Sharon Priyadarshini, Aiswarya Acharath Mohanakrishnan, Arash Abri, Melanie Sattler, Sorakrich Techapaphawit (2019) Physical, chemical, and geotechnical properties of coal fly ash: A global review. Case Studies in Construction Materials, 11, <https://doi.org/10.1016/j.cscm.2019.e00263>. In case of close packed storage or vibration, the bulk density of fly ash range can be 1120 to 1500 kg/m³ (Portland Cement Association. "Chapter 3 Fly Ash, Slag, Silica Fume, and Natural Pozzolans" Retrieved from http://www.researchgate.net/publication/31101101/notes/concrete/PCA_manual_Chap03.pdf)

6. Summary of findings and discussion

The samples from the M/s Cella Space Limited have a moisture content of 25.4 ± 6.5 % on a wet weight basis and is subject to change based on weather conditions such as rain, humidity, sunny days, etc. The average percentage retained on each sieve/mesh, along with the percentage of volatile and fixed solids, is summarized in Table 5. The average FS was found to be 76.0 ± 5.3 %, and the VS was 24.0 ± 5.3 %.

Table 5: Summary of the analysis results

Parameters	Percentage
Moisture content on a wet weight basis	25.40 ± 6.49
Cumulative retained on 0.1 cm sieve/mesh on a dry weight basis	77.45 ± 10.09
Average FS on a dry weight basis	75.98 ± 5.32
Average VS on a dry weight basis	24.02 ± 5.31
Average FS on a wet weight basis	57.14 ± 7.36
Average VS (plastic content) on a wet weight basis	17.28 ± 3.98
Maximum Leachable concentration	All the heavy metals max. leachable concentration as listed in Schedule 2 are below the limits in all the four samples

Management options for dumpsite reclamation

1. Transferring the waste to the Hazardous Waste Landfill operated by Kerala Enviro Infrastructure Limited (KEIL) at Amabalmugal, Ernakulam: - This is not considered to be an environmentally desirable solution as the dumpsite has combustible but non-hazardous material. Combustible materials should not be landfilled. The disturbance of the site also has an adverse environmental impact.
2. Transferring waste to cement factories for use as 'Alternate Fuel and Raw Material':
 - This is an environmentally benign option, enabling complete destruction of plastics and utilization of combustion residues. There is one cement factory in Kerala, M/s Malabar Cements Ltd., (MCL), a Government of Kerala Undertaking. Other suitable cement factories are located in Tamil Nadu. The disturbance of the site also has an adverse environmental impact.
3. Use of dumpsite excavated material directly for plinth filling or construction fills:
 - The plastic content for use in plinth filling and road subgrade fills or low-lying area fills must be less than 5%, as per CPCB guidelines (CPCB, 2019, Guidelines for Disposal of Legacy Waste (Old Municipal Solid Waste)). The plastic content is higher than the permissible limits in this study. The disturbance of the site also has an adverse environmental impact.
4. Biomining: - This refers to the separation of combustible fraction from inert and stabilized organic materials by physical methods of screening and density separation. The separated combustible fraction is used as Refuse Derived Fuel (RDF), and the inert materials are used as construction fills. The moisture content has to be reduced for effective biomining. Drying using thermal dryers is not practical for the materials excavated from this dumpsite. Sun-drying can be used to dry the excavated materials. However, the same is not practicable since the annual temperature range between 23 to 31° C with moderate to high humidity levels. The average annual rainfall is nearly 2978.00 mm, with a yearly average of 125 rainy days, as mentioned in section 2. Besides, the disturbance of the site also has an adverse environmental impact.
5. Capping of the site with the impermeable cover on top and sides: - This is a suitable option to prevent the transport of microplastics. The waste dump is retained undisturbed. No construction activity can be permitted in the capped site.

The site can be used for recreational activities. The site may be used for activities such as parking with the suitable impermeable and structurally strong pavement. Whatever the use, flood protection is essential considering the vulnerability of the site to flooding from the Edayar (Periyar) River.

4.3.3.3 Recommendations

Based upon the detailed characterization of the waste, including sieve analysis, moisture content, fixed and volatile solids determination, heavy metals concentration (mg/Kg), maximum leachable concentration (mg/L), it is recommended that any superstructure/construction activities that will disturb the underlying waste materials shall not be carried out. It is recommended that the entire area be covered with impervious concrete lining, and the same can be used only for vehicle parking or as an open storage yard. This suggestion is subject to detailed geotechnical investigation of the site to check the load-bearing capacity and other relevant geotechnical parameters and the expert advice by the structural/geotechnical engineers. Due care shall also be taken to protect the site by considering the flood levels of the River Periyar.

In case, if any material is to be removed from the dump, the excavated materials shall be mixed with the soil in the ratio of 1:5. This will ensure the plastic content of less than 5% as recommended in CPCB's guidelines to use such waste for plinth filling. The resultant mixture of waste and soil can then be used for plinth filling for the in-house construction activities, such as the construction of warehouses. Plinth filling ensures containment in the impervious layers, reduction in plinth filling cost, reduction in risk due to spillage while transportation, and may prove a techno-economic and environmentally sustainable option. At the end of the property's life, the construction and demolition waste may be managed as per the relevant regulations covered under Construction and Demolition Waste Management Rules, 2016, as amended from time to time.

-----End of Report-----

(Formerly Sree Sakthi Paper Mills Limited)
Regd Office : "SREE KAILAS", 57/2993, PALIAM ROAD, ERNAKULAM,
COCHIN- 682 016 Phone: (0484)3002000, E-mail: secretary@sreekailas.com

30/06/2021

To
The General Manager
District Industries Center
Ernakulam

Sub:- Permission for building boundary wall near rear side of the
Property situated adjacent to river periyar.

In reference to the above we request you to please permit us to construct
a boundary wall near the southern side of the property situated adjacent to
river periyar, The survey numbers for the property measuring 81 cents is
as follows;

132/16B-P	0.11		
132/14P	0.02		
132/15/1-P	0.08		
132/15-2	0.23		
132/11/B-P	0.02		
132/10-P	0.04		
132/11/A-P	0.06		
132/8/BP	0.06		
132/7/BP	0.02		
132/6P	0.17		
THE PROPERTY IS TOTAL 81 CENTS			
RIGHT SIDE--CMRL COMPANY			
LEFT SIDE--TMS LEATHER			
SOUTH SIDE-PERiyAR RIVER			
NORTH SIDE--PUBLIC ROAD			



Received

24/7/21
JUNIOR SUPERVISOR IN CHARGE
DISTRICT INDUSTRIES CENTRE
ERNAKULAM

36-

CELLA SPACE LIMITED

(Formerly Sree Sakthi Paper Mills Limited)

Regd Office : "SREE KAILAS", 57/2993, PALIAM ROAD, ERNAKULAM,
COCHIN- 682 016 Phone: (0484)3002000, E-mail: secretary@sreekailas.com

We are planning to do concrete lining of the property since this area is being planned for usage as Lorry parking Area for our customers. We have modified this area for Exclusive parking area with the following facilities;

- 1) Drivers Rest room
- 2) Fully fledged Lighting
- 3) The area is fully covered by Camera.
- 4) Separate Toilet Area and Bathing Area.
- 5) Separate Drinking water facility

We request you to please sanction the same at the earliest.

Thanking You
Yours Faith fully


Vinod (General Manager)







5











