



राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान
NATIONAL INSTITUTE FOR INTERDISCIPLINARY SCIENCE AND TECHNOLOGY

वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् | Council of Scientific and Industrial Research
इंडस्ट्रियल इस्टेट पी. ओ. पाप्पनकोड, तिरुवनंतपुरम, भारत - 695 019 | Industrial Estate P.O., Pappanamcode, Thiruvananthapuram, India-695 019

Report No.: NIIST-ETD/APTD/ Bio-Deg-R-21/(RH+GG)-01

Date: 26-01-2022

PART-I: PARTICULARS OF SAMPLE/MATERIAL RECEIVED

S. No.	Components	Details
1.	Name of the sample received, if any	: RH+GG
2.	Date of the sample received	: 05-08-2021
3.	Sample received from (Details of Company/Industries/Manufacturer/other)	: NIIST-APTD
4.	Type of sample (Grade/variety/type/size/class)	: Uncoated plate
5.	Declared value, if any	: Not applicable
6.	Customer Code No. if any	: None
7.	Batch No. and Date of Manufacturing	: None
8.	Quantity	: 02 No.
9.	Mode of packing	: Not applicable
10.	Sealed or not	: Packed in ziplock cover
11.	Other information	: Biodegradable tableware



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PART-II: BIODEGRADATION RESULTS

Biodegradability Testing and Analysis as Per ISO 14855-2:2018

- | | | |
|--------------------------------|--|---------------------------|
| 1. Sample details | : Uncoated plate
Qty. 2 | -as received by the party |
| 2. NIIST Sample Code | : S1(RH+GG)-01 | |
| 3. Starting date of analysis | : 05-08-2021 | |
| 4. Completion date of analysis | : 30-11-2021 | |
| 5. Standard Method used | : ISO 14855-2:2018-Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide | |
| 6. Details of analysis | : Conditions of reaction <ul style="list-style-type: none">• Compost composition: ETP sludge, municipal and vegetable waste• The reference materials used: Cellulose powder• Compost moisture (dry basis): 39.58 %• Compost volatile solid (dry basis): 14.21%• Sample moisture (dry basis): 2.42 %• Sample volatile solid (dry basis): 83.17%• CO₂ evolved during 1st 10 days in blank vessels: 64.12 mg/g of volatile solids of compost.• Reaction temperature: 50 °C (±2 °C)• Volume of reaction vessel : 1000 ml | |

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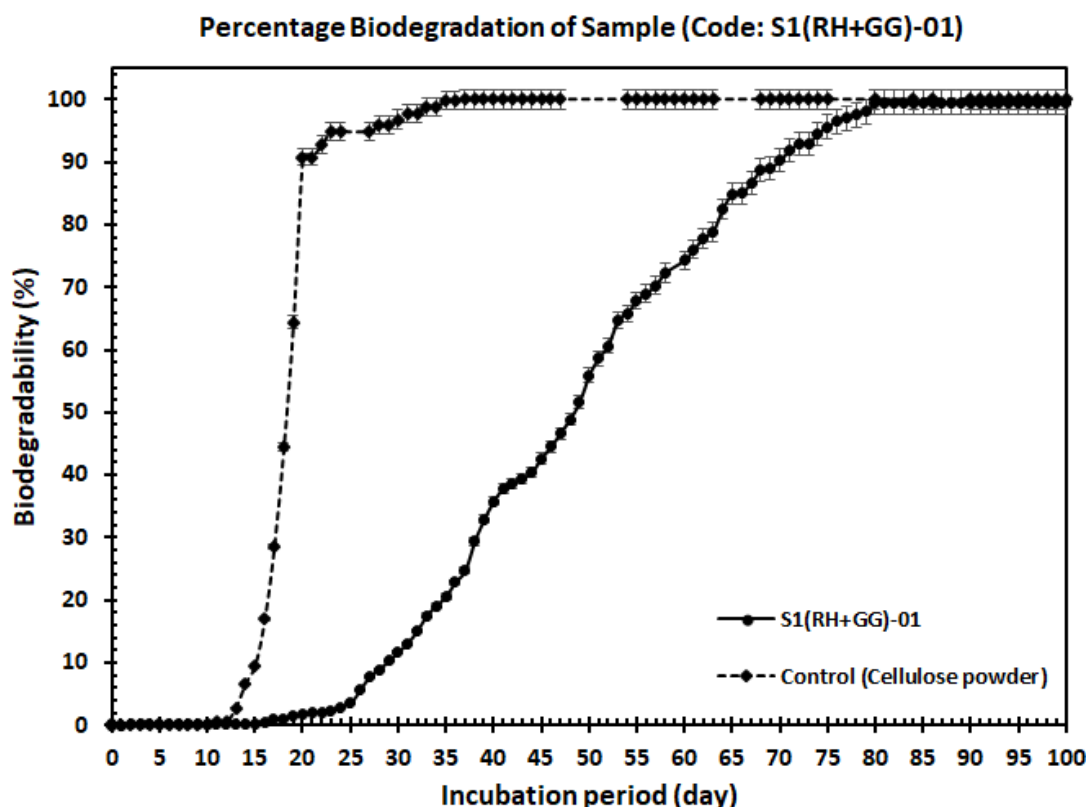
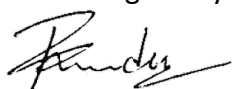


Fig. 1: Percentage (%) cumulative biodegradation of materials (Sample Code: S1(RH+GG)-01)

Results:

S. No.	Sample Code	Standard Method used	Duration of degradation	Average Biodegradability (%)	Specified requirements as per ASTM D-6954
1.	S1(RH+GG)-01	ISO 14855-2:2018	100 days	99.67±1	- Minimum 60% for single polymer/homopolymer after 180 days. - Minimum 90% for copolymer/polymer blends after 180 days.

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PART-III: VISUAL OBSERVATION OF SAMPLE DURING DEGRADATION STUDY

Description	Week 1	Week 2	Week 3	Week 4
Sample Structure/ colour	Shredded sample pieces	Shredded sample pieces	Shredded sample pieces/ disintegration observed	disintegration observed
Moisture	Appropriate	Appropriate	Appropriate	Appropriate
Matrix Colour	Dark brown	Dark brown	Dark brown	Dark brown
Smell	Wheat flour	Wheat flour	Organic	Organic
Fungal Development	Not Observed	Observed	Observed	Observed

Description	Week 5	Week 6	Week 7	Week 8
Structure	disintegration observed	disintegration observed	disintegration observed	disintegration observed/ Granular
Moisture	Appropriate	Appropriate	Appropriate	Appropriate
Matrix Colour	Dark brown	Dark Brown	Dark Brown	Dark Brown
Smell	Organic	Organic	Organic	Organic
Fungal Development	Observed	Not Observed	Not Observed	Not Observed

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Description	Week 9	Week 10	Week 11	Week 12
Structure	Granular	Granular	Granular	Granular
Moisture	Appropriate	Appropriate	Appropriate	Appropriate
Matrix Colour	Dark brown	Dark Brown	Dark Brown	Dark Brown
Smell	Organic	Organic	Organic	Organic/Mud like
Fungal Development	Not Observed	Not Observed	Not Observed	Not Observed

Description	Week 13	Week 14/15
Structure	Granular	Granular
Moisture	Appropriate	Appropriate
Matrix Colour	Dark brown	Dark Brown
Smell	Organic/Mud like	Organic /Mud like
Fungal Development	Not Observed	Not Observed

Comments:

- Physical disintegration of sample was observed in due course of degradation study. Test material showed significant biodegradability.
- No trace of test sample was observed after sieving the material through a 2.0 mm sieve (IS standard) at the end of experiment.
- Test sample was completely biodegraded.

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DISINTEGRATION DURING CONTROL COMPOSTING

Before Disintegration

Sample Code: S1(RH+GG)-01

Start of the experiment: 05-08-2021

After Disintegration

Sample Code: S1(RH+GG)-01

End of the experiment: 30-11-2021



Fig. 2: Disintegration of material (Sample Code: S1(RH+GG)-01) during degradation study

Comments: Physical breakdown of test material was observed during the course of degradation study. Test material was disintegrated into smaller fractions and completely mineralised. No trace of sample was observed at the end of experiment.

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PART-IV: TOXICITY ANALYSIS

Eco-Toxicity-Heavy Metal Analysis:

After completion of degradation study, the sample degraded compost materials was taken for toxicity analysis.

Standard method followed: ASTM D3987-12

Appearance of sample used for ICPMS analysis: Liquid, light yellow

Heavy metals	Test results, Concentration, (ppm)	Permissible limit# for leachates (ppm)	Permissible limit# for drinking water (ppm)	Remarks
Arsenic (As)	BDL*	0.2	0.01	BDL*
Copper (Cu)	0.016	3.0	0.05	Within limit
Nickel (Ni)	BDL*	3.0	-	BDL*
Zinc (Zn)	0.003	5.0	5.0	Within limit
Cobalt (Co)	BDL*	-	-	BDL*
Chromium (Cr)	BDL*	2.0	0.05	BDL*
Molybdenum (Mo)	BDL*	-	-	Limit not specified
Mercury (Hg)	BDL*	0.01	0.001	BDL*
Cadmium (Cd)	BDL*	2.0-1.0	0.01	BDL*
Lead (Pb)	BDL*	0.1-1	0.05	BDL*
Selenium (Se)	BDL*	-	-	BDL*
Silver (Ag)	BDL*	-	-	BDL*
Strontium (Sr)	BDL*	-	-	Limit not specified
Manganese (Mn)	0.001	-	-	Limit not specified
Magnesium (Mg)	0.010	-	-	Limit not specified
pH	6.53	5.5-9.0	6.5-8.5	Within limit

BDL* = below detection limit

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#Based on Solid Waste Management Rules (SWM), 2016, by Ministry of Environment, Forest and Climate Change, Government of India, notification on 8th April 2016.

Note: Permissible limit of metals i.e., Co, Mo, Se, Ag, Sr, Mn, Mg is not mentioned in the notification under standards of processing and treatment of solid waste and water quality criteria.

Comments: Test results is lower than the permissible limit. So the material cannot leach any chemicals into soil and ground water.

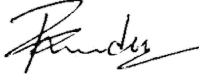
PART-V: DECLARATION

Remarks:

- All the testing and analysis is done by following standard methods.
- No deviation from the standard test method.

NOTE:

- The testing and analysis results are related only to the items tested as submitted by the party.
- All the testing and analysis were performed with the same material submitted by the party "As It Is" without any physico-chemical modifications.
- This analysis report shall not be reproduced in part without the prior written permission of Director, CSIR-NIIST.
- This reports cannot be used in connection with any judiciary trial/civil proceedings.


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