



# Result Sheet

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Date: **30<sup>th</sup> March 2021** File No. **67200007** Report No. **21-0334**

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Number of pages including this page:

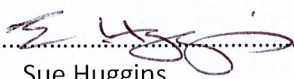
## ANALYSIS OF FIVE CARBON SAMPLES

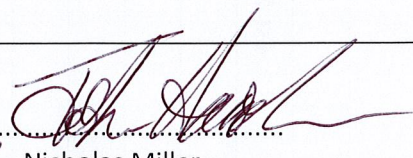
### INTRODUCTION

Five carbon samples were submitted by Green Distillation Technologies for a suite of analyses.

### ANALYTICAL METHODS

Refer to Table 1

Signed.....  
  
Sue Huggins  
Analyst

Approved.....  
  
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The results presented in this report relate exclusively to the samples selected by the client for the purpose of testing.  
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Table 2: Analysis results

| HRL Sample No. 21-0334             | 1               | 2             | 3               | 4             | 5                |
|------------------------------------|-----------------|---------------|-----------------|---------------|------------------|
| Sample Description                 | 1st Pass Coarse | 1st Pass Fine | 2nd Pass Coarse | 2nd Pass Fine | Reference Sample |
| Moisture @ 125°C % ar              | 4.4             | 1.7           | 2.1             | 1.6           | 1.2              |
| Ash Yield @ 550°C % db             | 15.8            | 29.9          | 17.8            | 21.2          | 48.5             |
| Sulphur % db                       | 2.2             | 2.0           | 2.2             | 2.1           | 1.6              |
| Volatile Matter % db               | 34.6            | 23.5          | 32.0            | 26.6          | 15.2             |
| Fixed Carbon % db                  | 49.5            | 46.6          | 50.2            | 52.2          | 36.3             |
| pH Boiling slurry                  | 6.0             | 7.9           | 7.0             | 7.6           | 8.3              |
| pH – Sonic slurry                  | 6.8             | 7.5           | 6.9             | 7.2           | 7.8              |
| Carbon % db                        | 76.6            | 65.2          | 75.2            | 72.7          | 47.9             |
| Hydrogen % db                      | 3.99            | 3.42          | 4.08            | 3.78          | 2.22             |
| Nitrogen % db                      | 0.17            | 0.21          | 0.43            | 0.18          | 0.15             |
| BET Surface Area m <sup>2</sup> /g | 6.9             | 11.1          | 8.1             | 12.8          | 14.2             |
| <b>Calorific Value MJ/kg</b>       |                 |               |                 |               |                  |
| Gross Dry                          | 31.2            | 25.6          | 29.9            | 28.5          | 18.1             |
| Gross Wet                          | 29.8            | 25.2          | 29.3            | 28.1          | 17.9             |
| Net Wet                            | 28.9            | 24.5          | 28.4            | 27.3          | 17.4             |

Table 1: Methods

| Item  | Test Method ASTM / AS     |
|---|---------------------------|
| Moisture  | D1509                     |
| pH  | D1512                     |
| Total Sulphur, % of air dry                     | AS1038.6.3.3              |
| Volatile Matter, %                              | IS EN15402:2011           |
| Ash Analysis ( including silica & zinc content) | AS1038.1                  |
| Ash Yield %                                     | D1506                     |
| PSD – with and without ultrasound               | HRL method                |
| BET surface area                                | PSS (external laboratory) |

The particle size distributions of the samples were determined by laser diffraction method in the range from 0.02 to 2000µm using Malvern Mastersizer 2000. The measurement was carried out using Propan-2-ol as the dispersant. Optical properties for Carbon particles were used for the analysis and results calculation. Each sample was analysed twice, once as dispersed and again after being treated with ultrasound for 10 minutes. The results are presented as individual sample distributions for each measurement, and grouped graphs for measurements with and without ultrasonic treatment. The results are reported as volume distributions using a general purpose analysis model.

## ANALYTICAL RESULTS

The results for moisture, ash yield, Sulphur, volatile matter, pH, C-H-N , BET surface area and calorific value are presented in Table 2.

The results of the ash analysis are presented in Table 3

The full reports on the PSD are attached as Appendix 1

The full reports on the BET surface area are attached as Appendix 2

Table 4: Ash Composition (Majors)

| Sample ID<br>21-0334 | Description                  | % oxide in ash db |                                |                                |                  |                  |     |                   |      |                 |  |
|----------------------|------------------------------|-------------------|--------------------------------|--------------------------------|------------------|------------------|-----|-------------------|------|-----------------|--|
|                      |                              | SiO <sub>2</sub>  | Al <sub>2</sub> O <sub>3</sub> | Fe <sub>2</sub> O <sub>3</sub> | TiO <sub>2</sub> | K <sub>2</sub> O | MgO | Na <sub>2</sub> O | CaO  | SO <sub>3</sub> |  |
| 01                   | 1 <sup>st</sup> Pass Coarse  | 37.2              | 3.5                            | 20.7                           | 1.2              | 0.83             | 0.8 | 1.0               | 4.0  | 5.2             |  |
| 02                   | 1 <sup>st</sup> Pass Fine    | 41.1              | 5.3                            | 13.2                           | 1.5              | 0.69             | 1.9 | 3.8               | 11.5 | 7.9             |  |
| 03                   | 2nd <sup>t</sup> Pass Coarse | 35.6              | 4.6                            | 20.0                           | 1.7              | 0.77             | 1.5 | 1.4               | 8.7  | 5.0             |  |
| 04                   | 2nd Pass Fine                | 36.9              | 4.7                            | 17.2                           | 1.8              | 0.74             | 1.3 | 2.8               | 8.1  | 7.2             |  |
| 05                   | Reference Sample             | 41.0              | 6.5                            | 29.4                           | 0.7              | 0.74             | 1.1 | 3.7               | 4.7  | 4.8             |  |

Table 3: Ash Composition (Majors) cont.

| Sample ID<br>21-0334 | Description                  | % oxide in ash db             |      |      |      |      |                                |      |                               |                                |       |
|----------------------|------------------------------|-------------------------------|------|------|------|------|--------------------------------|------|-------------------------------|--------------------------------|-------|
|                      |                              | P <sub>2</sub> O <sub>5</sub> | BaO  | SrO  | CuO  | MnO  | Cr <sub>2</sub> O <sub>3</sub> | ZnO  | V <sub>2</sub> O <sub>5</sub> | Co <sub>3</sub> O <sub>4</sub> | NiO   |
| 01                   | 1 <sup>st</sup> Pass Coarse  | 0.53                          | 0.02 | 0.01 | 0.08 | 0.13 | 0.02                           | 22.9 | 0.01                          | 0.24                           | <0.01 |
| 02                   | 1 <sup>st</sup> Pass Fine    | 0.32                          | 0.11 | 0.02 | 0.06 | 0.34 | 0.05                           | 11.1 | 0.02                          | 0.11                           | 0.02  |
| 03                   | 2nd <sup>t</sup> Pass Coarse | 0.44                          | 0.09 | 0.02 | 0.08 | 0.30 | 0.02                           | 18.4 | 0.02                          | 0.19                           | 0.01  |
| 04                   | 2nd Pass Fine                | 0.45                          | 0.06 | 0.02 | 0.08 | 0.23 | 0.04                           | 16.9 | 0.02                          | 0.18                           | 0.02  |
| 05                   | Reference Sample             | 0.30                          | 0.04 | 0.01 | 0.07 | 0.14 | 0.04                           | 5.9  | 0.01                          | 0.05                           | <0.01 |