Examination of segregated bio-waste dehydration method to obtain an alternative biomass material for lignocellulosic ethanol production

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Innovative Waste Drying Technology

Before

After

1.5kg

10kg

Natural Gas Systems
Enteric Fermentation
Landfills
Coal Mining
Manure Management
Petroleum Systems
Wastewater Treatment

TgCO₂ Equivalents
82 households were trained in source separation and send their bio-waste at the NTUA facilities for a period of 14 months now. The households have reached the number of 200 by this day.
Waste Management Scheme Description
Waste bins for the collection of domestic Bio-waste

Waste bin 5 L

Black, green, brown & silver from stock. All colours available to special order.

SPECIFICATIONS
- Weight 1315g
- Pallet Quantity 123pcs
- Print Size 100mm W x 110mm H Max

DIMENSIONS
- D 300mm
- W 320mm
- H 430mm

Waste bin 23 L
Large Waste Bins

Waste Bin 120 L

Bin placed in Papagos-Cholargos Municipality
What do people throw and do not?

Bio-waste Manual

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Bio-waste Manual
How does the drying take place?
Commercialized Biomass Dryer

How does it work?

1st Dust Filter

2nd Dust Filter
Commercialized Biomass Dryer

How does it work?
Commercialized Biomass Dryer
Decentralized Waste Dryer
Volume Reduction

<table>
<thead>
<tr>
<th></th>
<th>Decentralised Waste Drying</th>
<th>Domestic Waste Drying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume Reduction (%w/w)</td>
<td>83.25</td>
<td>78.52</td>
</tr>
</tbody>
</table>
Cellulose Seasonal Variation

Cellulose (%w.w.)

- Spring
- Summer
- Autumn
- Winter

Spring: 15.00
Summer: 5.00
Autumn: 30.00
Winter: 10.00
Starch Seasonal Variation

Spring: 10.00%
Summer: 4.00%
Autumn: 9.00%
Winter: 10.00%
Glucose Seasonal Variation

- Spring: 0.50%
- Summer: 1.00%
- Autumn: 1.50%
- Winter: 2.00%
200L Bioconversion Facility

- Pre-Treatment Unit
- Main Bioreactor
- Boiler
- Control Panel
<table>
<thead>
<tr>
<th>Procedure Description</th>
<th>Ethanol Production (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No enzymes/No pretreatment</td>
<td>16.23</td>
</tr>
<tr>
<td>Pretreatment (85°C)</td>
<td>29.60</td>
</tr>
<tr>
<td>Liquezyme (5.3U), Spirizyme (80U), Cell/Novo (38FPU)</td>
<td>29.37</td>
</tr>
<tr>
<td>Pretreatment (100°C)</td>
<td>28.49</td>
</tr>
<tr>
<td>Liquezyme (5.3U), Spirizyme (80U), Cell/Novo (38FPU)</td>
<td>31.97</td>
</tr>
<tr>
<td>Pretreatment (120°C)</td>
<td>29.86</td>
</tr>
<tr>
<td>Liquezyme (5.3U), Spirizyme (80U), Cell/Novo (38FPU)</td>
<td>32.85</td>
</tr>
</tbody>
</table>

**Batch system NSSF**
Results After the Process Optimization

**Process:** NSSF Semi Batch  
**Pre-treatment:** 120°C/1h  
**Concentration:** 30%w/v  
**Enzymes Used:**  
1. Liquozyme SC DS 5.3U/g Starch  
2. Spirizyme Fuel 80U/g Starch  
3. Celluclast 1.5L/Novozyme 188 (5/1 v/v) 38FPU/g Cellulose.  
**Fungi:** *Saccharomyces cerevisiae* (15 mg/g DM)
Conclusions

- The use of Decentralised drying technology as part of a waste management scheme reduces the mass of the produced domestic biowaste at source by 78%w/w.
- The volume reduction reaches 80%.
- Low moisture level of the end product (~5%w/w) guaranties the stabilisation of the dry product (non important microbial activity observed).
- Preservation of sugar content (especially Glucose content).
- Production of second generation ethanol 34g/L through a new resource (dried domestic biowaste).
Questions?
Information?

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