Design objectives

- Recovery of energy from faeces – solids stream
- Recovery of water from faeces
- Production of a sterile, nutrient-rich product in a form suitable for agricultural applications
- Disposal of waste streams from other unit processes within the toilet

**Concept**

The faeces and solids processing operation consists of three stages:

(i) separator unit; (ii) dryer; and (iii) combuster.

- The separator unit separates the mixed solids stream into an optimal form for subsequent treatment.
- The dryer reduces water content in the solids to a level where efficient combustion can occur.
- The combuster performs the energy recovery function, supplying energy back to the dryer and potentially to an electricity generation process.

Waste streams from other unit processes within the toilet – waste solids from the urine processing plant and odorous air from the toilet – are also disposed of via the combuster.

**Extruder**

Separation of faeces and non-faecal solids: a variety of solid materials may enter the toilet in the community. An ablation block (foil paper, newspaper, plastic, rubber, clothing) (see Figure 2), some of which may require preprocessing (shredding or composting) before feed stream, is sent to the dryer. Extruder separates faeces from other solids by using a ram to pressurise the mixed solids stream, causing faeces to be extruded through the extruder and frangible material to accumulate against the extruder wall (see Figure 3 and 4). Extruder forms faeces into a geometry which allows for more energy-efficient drying and combustion (see Figure 4). Frangible material must have sufficient structural integrity to remain intact through the downstream processes. Extruder forms faeces into a geometry which allows for more energy-efficient drying and combustion (see Figure 4). Frangible material must have sufficient structural integrity to remain intact through the downstream processes.

**TABLE 1**

<table>
<thead>
<tr>
<th>Model Class</th>
<th>Stage (Bond 2011)</th>
<th>Description</th>
<th>Water content range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Shredded, feed lamps</td>
<td>Up to 55%</td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>Spent wood, sawdust</td>
<td>10%–15%</td>
<td></td>
</tr>
<tr>
<td>Type 3</td>
<td>Spent wood, pulp, rice hulls</td>
<td>10%–15%</td>
<td></td>
</tr>
<tr>
<td>Type 4</td>
<td>Spent wood, rice hulls, and sawdust</td>
<td>10%–15%</td>
<td></td>
</tr>
<tr>
<td>Type 5</td>
<td>Spent wood, rice hulls, and sawdust</td>
<td>10%–15%</td>
<td></td>
</tr>
<tr>
<td>Type 6</td>
<td>Spent wood, rice hulls, and sawdust</td>
<td>10%–15%</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3**

**EXTRUDER CONCEPT**

**Figure 4**

**PROTOTYPE CONCEPT**

A. Extruder
B. Mixed solids stream
C. Extruded simulant
D. Accumulated non-faecal material at end of extruder

**Figure 5**

**VARIATION IN DYNAMIC VISCOSITY OF HUMAN Faeces WATER CONTENT OF SAMPLES 15% / S. 25% (A) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS AND 15% / S. 5% (B) VARIATION IN DYNAMIC VISCOSITY 15% / S. 25% (C) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS.

**Figure 6**

**VARIATION IN DYNAMIC VISCOSITY OF HUMAN Faeces WATER CONTENT OF SAMPLES 15% / S. 25% (A) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS AND 15% / S. 5% (B) VARIATION IN DYNAMIC VISCOSITY 15% / S. 25% (C) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS.

**Figure 7**

**VARIATION IN DYNAMIC VISCOSITY OF HUMAN Faeces WATER CONTENT OF SAMPLES 15% / S. 25% (A) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS AND 15% / S. 5% (B) VARIATION IN DYNAMIC VISCOSITY 15% / S. 25% (C) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS.

**Figure 8**

**VARIATION IN DYNAMIC VISCOSITY OF HUMAN Faeces WATER CONTENT OF SAMPLES 15% / S. 25% (A) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS AND 15% / S. 5% (B) VARIATION IN DYNAMIC VISCOSITY 15% / S. 25% (C) VISUAL APPEARANCE OF SAMPLES CORRESPONDING TO DIFFERENT WATER CONTENTS.