# Collection Logistics and Waste Pre-Processing

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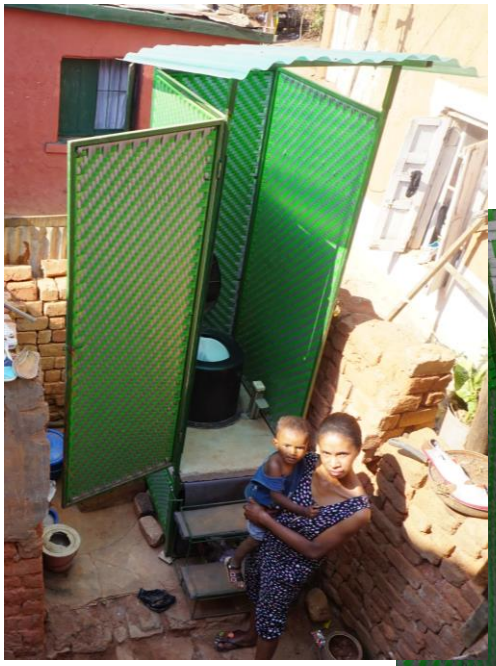
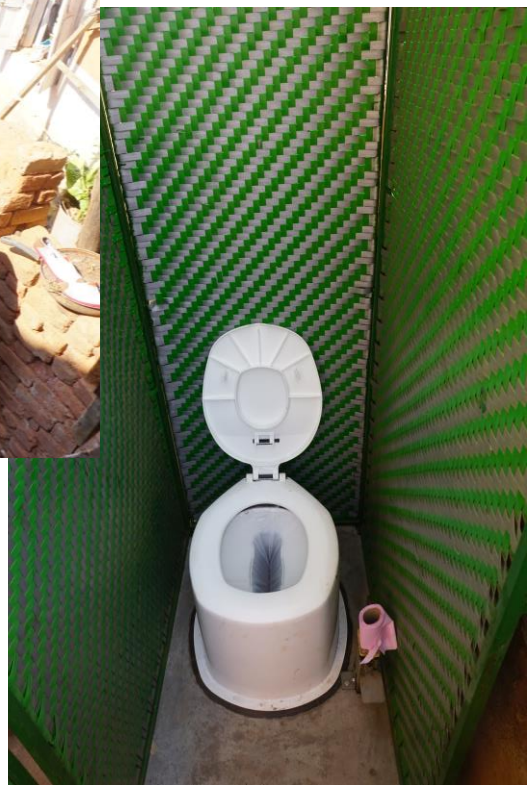
# Collection Logistic

## Safe containment of the waste is a key

- To reduce the smell
- To reduce the environmental risk
- To protect the workers
- Improve the customer and neighbors experience

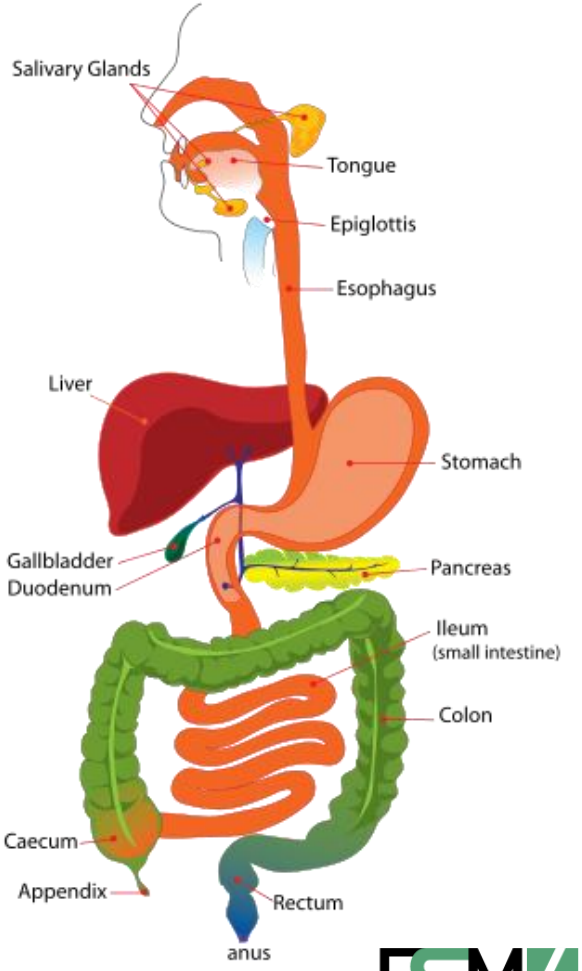




# Background

## Need for development in waste pre-processing

- Most waste-to-value treatment systems require pre-processing
- Removal of contaminants
- Particle size reduction
- Other thermal, chemical or biological treatment



# Waterless toilet waste is contaminated!

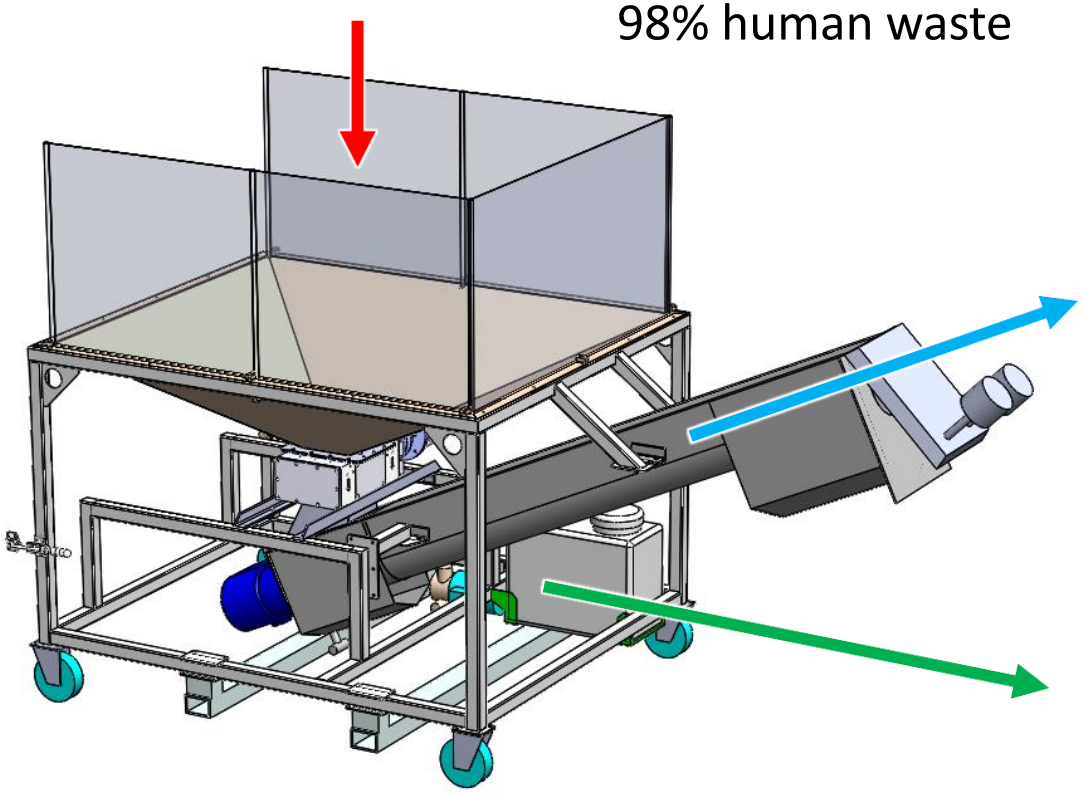
## Whether by design or by accident…

- Many waterless systems use additives or consumables to enable toilet function, safe capture and transport
- Polymer films feature in many container based toilets
- Other contaminants will get into the toilet
- Simple and robust pre-processing technologies can enable safe and efficient handling and processing

# Industrial Bag Shredder-Separator (IBS)

## Plug-in at utility Anaerobic Digester, United Kingdom

**Whole-waste input:** 2% film (UK festivals)
98% human waste



**Two Outputs**

**1. Separated film portion**
- Composting
- Recycling
- ~ 4% of total output

**2. Human waste portion**
- Pumped direct to AD
- Or other primary process
- ~ 96% of total output

# IBS

## Processed 20T UK events waste in Summer 2016

- Innovative and streamlined two-stage process can fit in a 10-foot container
- Unique combination of technologies to achieve result with minimal complexity and cost
- Shreds and screens organics, providing particle size control
- Separates films from organics, enabling multiple materials and treatment / pretreatment processes

# UK Trial Results

## Machine performance

| Feature | Result |
|---|---|
| Throughput | Up to 1 tonne/hr<br>Trials processed > 20 tonnes |
| Power requirement | Max 3.2kW electrical |
| Processing energy | Max 3.2kWh per wet tonne |
| Separation effectiveness | Output 1: Separated film portion (~4%)<br>Composed of:<br>55% film<br>45% human waste<br><br>Output 2: Human waste portion (~96%)<br>Only trace amounts of film identified visually in human waste output, @ < 5mm particle size |
| Particle size control | Organics fraction screened to <5mm |
| Weight | 1.5 tonne machine |
| Size | Can fit inside 10ft shipping container |

# Composting the Film Portion

## Research project at Cranfield University, UK

- Masters' project by Mr Lepekola Lepekola
- Lab testing (BS EN ISO 14855:2004)
- Windrow / in-vessel tumbler pilot study
- Grass clippings added to create autothermal mix

# Composting the Film Portion

## Compost mix

**Compost Mix (windrow and tumbler)**

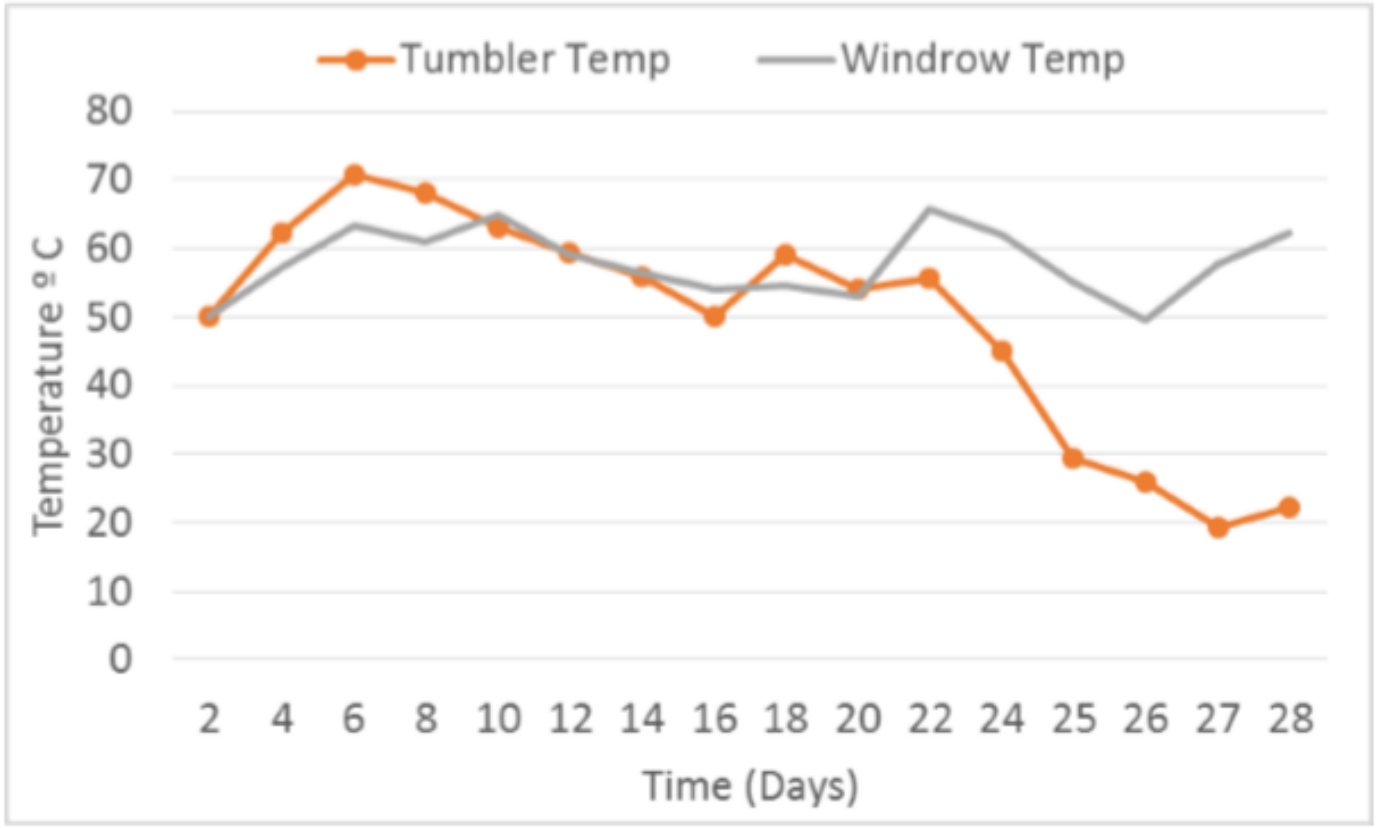
| Material | Parts by mass |
|---|---|
| Film Portion | 21 |
| Grass clippings | 22 |
| Sawdust | 1 |

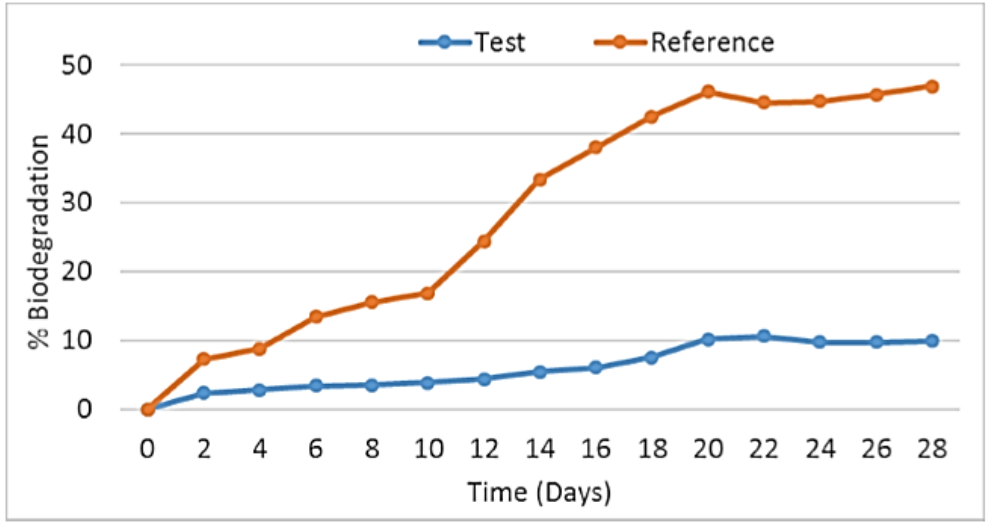
**C:N Ratios**

| Material | % N | C:N Ratio |
|---|---|---|
| Film portion | 0.36 | 139 |
| Grass clippings | 4 | 17 |
| Sawdust | 0.40 | 500 |

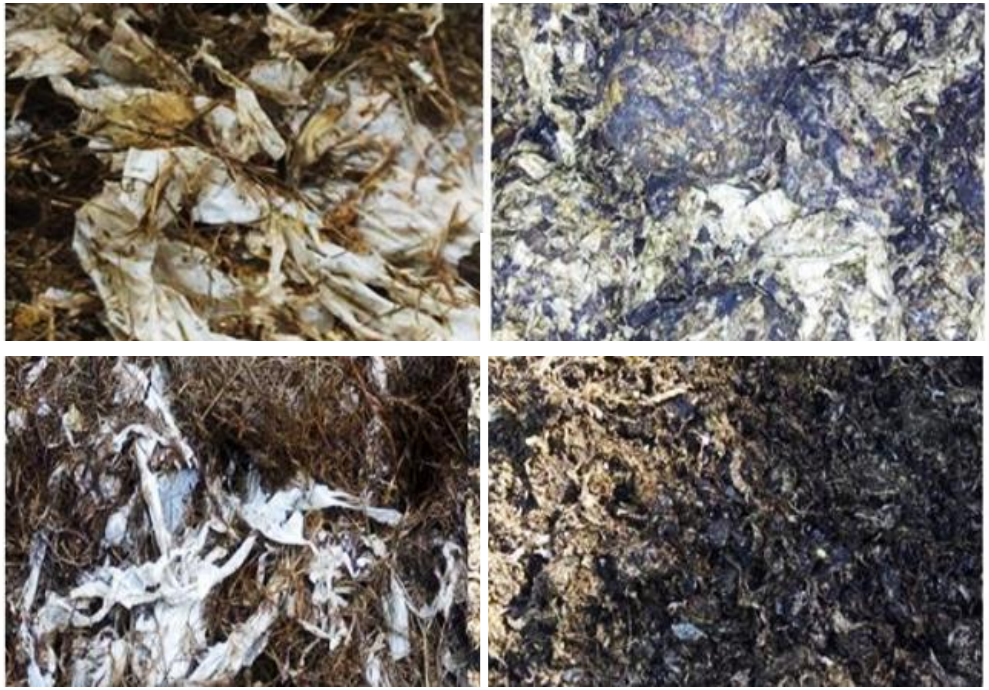
# Composting the Film Portion

## Research project at Cranfield University, UK






Lab test
10% degradation over 28 days



Tumbler System
(lesser affect on film)

Windrow System
(substantial breakdown)

After 7-days

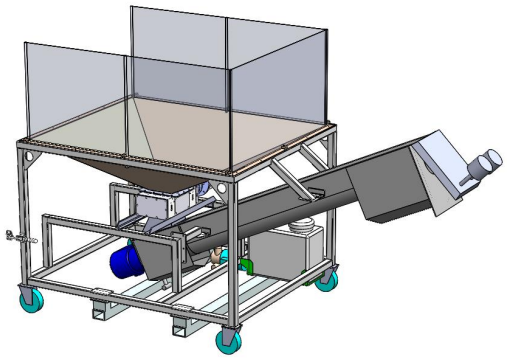
After 28-days

# Future Impact of Technology

**Separation** → Composting Option → Cheaper Materials + Thinner Materials film options

**Separation** → Chemical / Heat pre-treatment option → Cheaper AD-compatible option

**Separation** → Recycling Option (PE) → Much cheaper materials + Much thinner materials + Circular economy + Local availability



# Future Impact of Technology