Low Cost, Scalable, Modular Sorting Technology for Municipal Solid Waste

Nalin Kumar, Ph.D.
President
nanoRANCH
UHV Technologies
Need for Sorting MSW

CONVENTIONAL WTE APPROACH
NOVEL WTE & M APPROACH

Municipal Solid Waste

Current Sorting Technology
Ref: BHS Website
Why Sorting? Higher Profit
Example of Automotive Metal Scrap

Sorting of a Truckload (40,000 lbs) of Automotive Metal Scrap

<table>
<thead>
<tr>
<th></th>
<th>Weight (lbs)</th>
<th>Price /lb</th>
<th>Value</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Un-Sorted Scrap</td>
<td>40,679</td>
<td>$1.00</td>
<td>$40,679</td>
<td>$40,679</td>
</tr>
<tr>
<td>Copper</td>
<td>14,170</td>
<td>$2.20</td>
<td>$31,174</td>
<td></td>
</tr>
<tr>
<td>Brass</td>
<td>8,890</td>
<td>$1.80</td>
<td>$16,002</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>12,270</td>
<td>$0.75</td>
<td>$9,202.50</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td>4,583</td>
<td>$0.55</td>
<td>$2,520.65</td>
<td></td>
</tr>
<tr>
<td>Coins</td>
<td>70</td>
<td>$15.00</td>
<td>$1,050.00</td>
<td></td>
</tr>
<tr>
<td>PCBs</td>
<td>12</td>
<td>$1.00</td>
<td>$12.00</td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>10</td>
<td>$1.50</td>
<td>$15.00</td>
<td></td>
</tr>
<tr>
<td>Leftover</td>
<td>674</td>
<td>$0.25</td>
<td>$168.50</td>
<td></td>
</tr>
<tr>
<td>SORTED Scrap</td>
<td>TOTAL</td>
<td></td>
<td></td>
<td>$60,145</td>
</tr>
</tbody>
</table>

Key to Value: Use/Recover/Recycle EVERYTHING

www.nanoRANCH.com
Requirements for MSW Sorting

- Low Cost and extremely high throughput (~100TPH)
  - Fully autonomous sorting and handling
  - Scalable to large width conveyors
- Simultaneous Sorting of large number of output categories
- Multiple output streams for 16-32 product Categories
- Modular, adaptable design for integrating in current manual sorting facilities
- User Friendly software can be trained for any “Look’
- High selectivity and accuracy
- High speed pickup of various types of irregular shaped, hardness, breakable materials
UHV’s Patented Technology

• **Latest Artificial Intelligence Technology** developed with US-DOE ARPA-E METALS funding over the last 5 years

• Selection of categories based on ‘LOOKS’
  – Simple Example: Al cans, plastic bottles & glass bottles from municipal waste
  – Different aluminum alloys for wrought, extrusions and cast products
  – Zorba into as many as 15 different outputs such as copper, brass, zinc, SS etc.

• **Multiple output streams for 16-32 product Categories**

• Adjust output stream composition to meet requirements

• User Friendly software can be trained for any “Look’

• Almost 100% accuracy is possible

• Sorting accuracy increases as you run more material

• Technology is scalable for width

• Air-jet, vacuum, electro-magnetic rejection & robotics for pick-up
Core Concept

US Patent # 10207296, Garcia, Kumar & Das
UHV’s Metal Sorters-1

Diagram showing the dimensions of the metal sorters:
- 94 in.
- 144 in.
- 144 in.
- 117 in.
- 74 in.

Images of the metal sorters in use:
- Left: A metal sorter with various components and red buckets.
- Right: A metal sorter with workers operating it.
UHV’s Metal Sorters-2

30 million lbs/yr Automotive Scrap Sorter in Erie, PA
UHV’s Metal Sorters-3

100 million lbs/yr Automotive Scrap Sorter in Fort Worth, TX
$0.02/lb sorting cost
UHV’s Modular AI Sorter

Modular AI Module for installing on an Existing Conveyor

- Low Cost
- Replaces Manual Labor
- Higher Speed
- Adaptable Width
- Multiple Actuators
  - Air Jets
  - Electro-pneumatic
  - Electro-magnetic
  - Vacuum

UHV Technologies, Inc.

www.nanoRANCH.com
Knowledge/Technology Gaps and Challenges for MSW

GOAL: How to maximize total value as compared to incineration.

• Clear demonstration of increased value by new technology(ies)
• What is in various MSW streams
  – Recyclables: paper, cardboard, plastics, glass, metals, electronics
  – High Valorization Value: wood, yard waste, food waste
  – Residuals: stones, brick, etc.
• Value proposition for different uses of Recyclables
  – Recycle vs Incineration
• Output stream purity requirements for recycling
• Low cost (Capex) and high throughput (~100TPH) sorting equipment
  – Fully autonomous sorting and handling
  – Scalable to large width conveyors
• High speed pickup of various types of irregular shaped, hardness, breakable materials
How AI Works-1

Latest AI/ML Technologies for Industrial Applications

UHV’s AI Projects:

1. ARPA-E METALS project for High Throughput Scrap Metal Sorting
2. ARPA-E ROOTS project for CT Imaging of Roots
3. US Air Force project for Identification from Drone Images
4. US Air Force project for Determination of Missile Attitude

UHV Technologies, Inc.

www.nanoRANCH.com