ZenRobotics Recycler

World’s first robotic waste sorting system
Why are cars made by robots?
Mass manufacturing = Affordable
Then and now...
The Product: ZenRobotics Recycler™
Enabled by ZenRobotics Brain™

1. Sensor unit for material recognition gathers gigabytes of data
2. ZenRobotics Brain analyses data & controls robots
3. Robotic manipulator, ZenRobotics Gripper, picks desired fractions
4. Sorting belt
5. Drop-off chutes

Customer earns from selling raw materials, savings in disposal fees and labor costs.

08/12/15
ZenRobotics Recycler: Technical Features

Common features for all models:
• Max object weight: 20kg
• Max object size: L 1,5 m, W 0,5 m
• Operating area per arm: 2m x 2m

Model ZRR2
• Max picking speed: 4 000 picks/h
• Length of system: 9,5 m (including safety cage)
• Power consumption: 14kW

Model ZRR1
• Max picking speed: 2 000 picks/h
• Length of system: 6 m (including safety cage)
• Power consumption: 10kW
Best Available Technology

- Learning system: Gets better over time
  - Customers can download new fractions and features as upgrades

- Easy operation: Switch the sorting task on the go
  - Easy User Interface, touch screen & mobile devices

- Multitasking system: Many fractions on one spot
  - Unique flexibility in waste sorting

- Very high durability: Hardware specifically designed for heavy waste processing environments
  - Requires minimum maintenance

- Small environmental impact: Low energy consumption, low noise, low dust, no sludge, minimal risk of fire, small footprint etc.
24/7 operation for cost efficiency

- Flexible and simple material recovery from C&D and C&I waste streams
- Low operating cost
- Performance:
  - Average object weight x average picking speed = tons sorted
    For example:
    - 0.7 kg x 3000 p/h = 2 tons/h
    - 2.0 kg x 3000 p/h = 6 tons/h
    - 4.0 kg x 3000 p/h = 12 tons/h
- Multiply that by net operating hours per year!
- There is 8760 hours in a year!
RoboticSortingStation:SimpleProcess

- Decentralized sorting stations possible, huge savings in logistics
- Sort large range of object sizes without complex preprocessing
- Expensive crushing and fine fraction generation is avoided
- Small environmental impact, i.e. low energy consumption, low noise, low dust, no sludge, minimal risk of fire, etc.
World’s First Robotic Sorting Station: SUEZ Environnement, Helsinki
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Robotic Sorting Station: Throughput

- As much as you can feed - but maintaining singularized monolayer
- Max belt speed 0,5 m/s, max belt width 1,6 m
- Max throughput in tons/h depends on density of material!
Robotic Sorting Station: Operation

Alternative Operation Modes:

1. Maximize throughput → run belt fast, or
2. Minimize reject → run belt slow, or
3. Switch to Automatic Belt Speed control and Automatic Virtual €-Screening - and let the ZRR choose the most profitable mode!
Waste Stream and Feeding Requirements

- Processed waste: Construction & Demolition (C&D) and Commercial & Industrial (C&I) waste

Pretreatment:

a) Remove fines (<80 - 150 mm)

b) Remove over sized materials (>1 – 1,5 m)

c) Remove 2D materials (such as foils, paper, cardboard, foams and carpets)

Distribution on sorting belt: Mainly singularized mono layer (>30 mm free space between objects)
HIGH QUALITY FRACTIONS = INCREASED PROFITS
Making Sense from Waste
High Purity & Reporting of Waste Composition

- Sensor Fusion enables accurate analysis of the waste
- High purity - up to 95 %, adjustable by the operator
- Easy User Interface

- Advanced self diagnostics, remote monitoring and support over the Internet
- Online analysis of the waste stream creates valuable statistics including
  - Waste composition
  - Tonnage
  - Value
Available fractions

- Metals (Ferrous & Non-Ferrous)
- Wood
  - A & B wood mixed
  - Class A wood separately
  - Class B wood separately
- Rigid plastics
  - Rigid plastics mixed
  - Tubes & pipes by color
- Inert
  - Inert mixed
  - Inert sub fractions: concrete, bricks, limestone, asphalt...
- Old corrugated cardboard (OCC)
- Sorting plastic bags by color
- Negative sorting (under development)

What do you want to have next?
Quality fractions: Metals sorted by ZRR
(If magnet would be installed, this would be very pure non ferrous)
Quality fractions: Inert sorted by ZRR
(Red bricks and light concrete can be sorted separately)
Quality fractions: Wood sorted by ZRR
(A wood is here sorted separately)
Quality fractions: Rigid plastics sorted by ZRR
(In future upgrade versions plastics can be sorted by color and polymer)
Quality fractions: Tubes & pipes sorted by ZRR
(Also sorting pipes & tubes by color)
Other sorting tasks: ZRR sorting plastic bags by color
ZenRobotics Customers

- **SUEZ Environnement Finland**
  - Based in Helsinki, Finland
  - Delivered 3 units: first pilot unit in 2012, Additional Next Generation ZenRobotics Recycler units in 2014
  - ZenRobotics and SUEZ Environnement have signed a global frame agreement for delivering ZRR units globally

- **Baetsen Recycling**
  - Based in Eindhoven, The Netherlands
  - Delivered one 2-robot unit in March 2013

- **Eberhard**
  - Based in Zurich, Switzerland
  - Delivered one 2-robot unit in August 2015

- **Shitara Group**
  - Japan
  - Delivery of one 2-robot unit in 2016
SUEZ environnement, Helsinki

SUEZ Environnement Finland – Robotic Sorting Station
- Plant capacity: 15-20 tons / hour
- Plant area: 42m x 25m
- Plant power consumption: 60-80 kW
- Three robot arms (1 ZRR2 & 1 ZRR1)
- Robot line capacity: 5 tons / hour
- Sorting task: C&D - Metals, wood, stone

The most energy-efficient sorting station in the world
Eberhard, Zurich, Switzerland

- Robot line power consumption: 15kW
- Two robot arms (1 ZRR2)
- Robot line capacity: 10 tons/h
- Pure final products from mineral stream
- Sorting task: Separating minerals by type: concrete, bricks, gasbeton etc.

Converting mono-stream to clean end-products
Baetsen, Son, The Netherlands
- State-of-the-art plant
- Plant capacity: 150,000 tons / year
- Two robot arms (2 x ZRR1)
- Sorting task: Wood, inert, metals
ZenRobotics Ltd. in Brief

- Founded in 2007
- **ZRR** product development 2009
  - Robotic waste sorting system
  - Artificial intelligence based control system is unique
- 30 employees
- Current status
  - ZRR units delivered to customers in Finland, the Netherlands, Switzerland
  - Several units to be delivered in Japan 2016
  - Wide distributor network covering key markets
- Ownership: Privately held company owned by management, employees, and long-term private equity investors
  - Invus, Veraventure, Lifeline Ventures
Thank you!

www.zenrobotics.com