Contamination and the Markets:

Smart Technologies for Contamination Management

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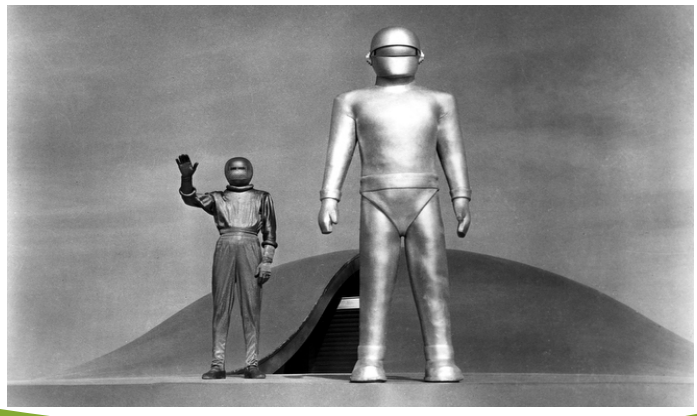
Processing Systems of the Future

The Rise of the Robots



Source: "The Day the Earth Stood Still" 1951

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Smart Technologies for MRFs

- The Future of Material Recovery Facilities (MRF):
  New Processing Systems will Consist of More of the Following:
  - **Combined Systems**
    - Systems will be capable of processing more than one type of stream, with some equipment processing multiple streams
  - **More Optical Units, less Screens**
    - Optical units will be utilized to recover more materials including fiber
    - Streams need only be divided by size/density prior to optical units (instead of by shape)
  - **Robotic Sorters**
    - Both for QC and for Pre-Sort – can positively pic multiple materials

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Combined Systems

Source: MRWMD – Monterey, CA

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Optical Units

If you can see it, you can collect it....

Source: CP Group / BHS

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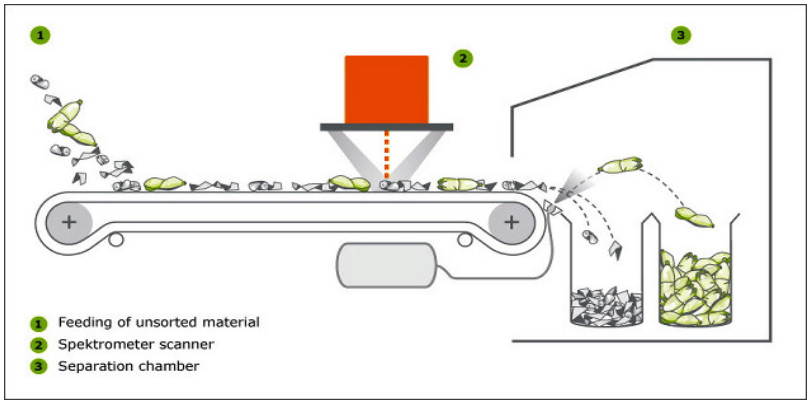
Optical Units



Source: TiTech/Tomra

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Optical Units

- Long and wide acceleration belt, material needs spread out
- Limited on throughput (7-10 tph)
- Up eject for recoverables (cleaner) *(Positive Sort)*
- Down eject for removal (higher percentage) *(Negative Sort)*
- Greater recovery and even purity than manual collection
  - For PET and HDPE, 95% recovery is normal, *with exceptions....*
  - Up eject has contamination levels of approximately 5% *(depending.....)*

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Improved Optical Units

- With improvements in algorithms, shape recognition and attention to air flow characteristics, optical units can now better recover:
  - **Types of Fiber**
  - **Clean Wood**
  - **Film**
  - **Flexible Packaging**
  - **Cartons**
  - **Other potential target materials (i.e. Black Plastics)**

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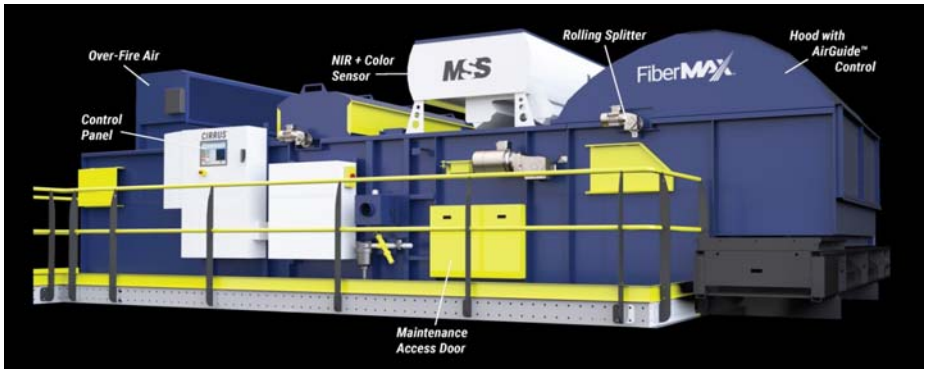
CIRRUS® FiberMax™



Source: CP Group

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Outputs from CIRRUS® FiberMax™

Negative Sort Fiber

Positive Sort Ejects

- Utilizes air flow to keep light-weight items from flying off the belt and improve trajectory
- Positive eject on plastics, other materials

Source: CP Group

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Video of CIRRUS® FiberMax™

Source: CP Group
www.mssoptical.com/cirrus-maxselect/fibermax//

Video of FiberMax in Action
www.youtube.com/watch?v=a0zZUWE3kkY

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Other Optical Advancements – Additional Spectrum and Lasers

Steinert Unisort Black

Source: Steinert

Tomra LOD

Source: Tomra

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Smart Technologies for MRFs

Robot Sorters SamurAI™ and Max-AI®

Source: Machinex / BHS

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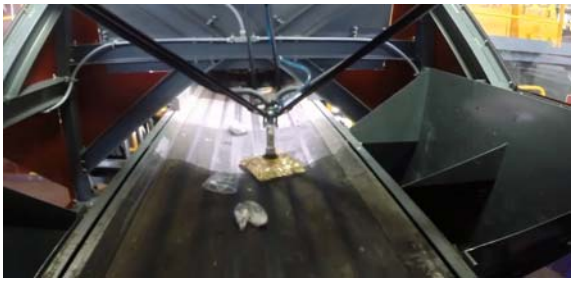
Smart Technologies for MRFs

QC Robotic Sorters – Utilizes shape and material recognition computer vision

AMP Cortex



Max-AI®

Source: AMP / BHS

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Video of QC Robotic Sorter – Max AI®

Source: BHS

www.max-ai.com/

Video of Max AI in Action
www.youtube.com/watch?v=Q7tE_vNYzzU

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Pre-Sort Robotic Sorters

Source: ZenRobotics

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Smart Technologies for MRFs

Video of Pre-Sort Robotic Sorters – Bag Recovery

Source: ZenRobotics
www.zenrobotics.com/

Video of ZenRobotics Bag Sorter in Action
www.youtube.com/watch?v=nejRkJH_1_8

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QC Robotic Sorters – Advantages and Disadvantages

- **Advantages**
  - Better Speed and Accuracy (*for most items*) than Manual QC *(Most will achieve 98% purity (or more) after an optical unit for PET or HDPE)*
  - No Pee Breaks!
  - Decent ROI
- **Disadvantages**
  - Expensive (not right for all situations)
  - So new, difficult to know lifespan and maintenance needs
  - Still susceptible to items that aren't "seen"
  - Limited belt sizes (for now)
  - Don't believe all the hype....

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Processing Conclusions

The lines between processing Single Stream, MSW and C&D will become blurred and Clean Bales will remain a necessity

- Systems will be capable of processing multiple material streams
- Opticals and robotics will be able to easily target multiple materials not traditionally recovered, but markets will dictate if these new streams are recycled or become residue
- The requirement for very clean commodities will become the norm
- Opticals and Robotics provide a solution for creating these very clean bales but are not for everyone....

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Thank you!

Questions and Comments?

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