Recycled plastics and the composite decking industry

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- Full service lab for the WPC industry
  - 3 extrusion lines
    - Counter, conical TS- 86, 55, 35mm
    - Tri- extrusion capping
  - Injection molding, compression molding,…
  - Refiners, dryers, blenders, pellet mills
  - Numerous analytical capabilities
  - International Code Council certified lab

- Working with us
  - Fee for service, contracts
  - NDA/CDA
  - Sponsored research projects
    - NSF, DOE, SBIR, etc..
Composite decking (related products)

- Decking and guardrails
- Fencing
- Window and door lineals
- Misc exterior products
Issues in the past??

- Primarily aesthetic
- Some physical deterioration
  - UV, water intrusion
- Incorrect installation
- Lawsuits

Not the plastics fault... most of the time
WPC recycled plastic consumption

- Early adopters
  - Off-spec virgin grades
  - Post-industrial
  - Post-consumer
- Process robustness
  - Could handle wide spec
- Marketing push
  - Recycling was not used early
  - Current, more prevalent

- Global Plastic Consumption
  - Total polymer
    - 380,000+ MT
  - Recycled amount
    - 160,000+ MT
  - Primarily PE and PP

- Why not more?
  - Cost benefit
  - Reliable volumes
  - Processing issues
WPC history

- 1980’s
  - American Woodstock
    - Flat sheet extrusion - auto
- 1990’s
  - AERT and Mobil (Trex)
    - Use for waste plastics
  - Other manufacturers
    - Virgin and some recycled
- 2000’s- present
  - Refined products
  - More use of recycled throughout
Recycled plastic industry development

- Inherent problem
  - Put recycled plastics into existing virgin plastics processing
    - Sensitive processing
    - Not the same material
    - Additives, MFI differences, contaminants...
  - With WPCs
    - Recycled plastics were the original feedstock
      - Not replacing a virgin feedstock
      - Filled a new niche
        - New product in existing market

- Deck market share increasing
  - Performance over wood
    - Aesthetics, maintenance, consistency, resistant to rot and water
Similar recycling success story

- What to do with wood scraps??
  - Creation of a new industry.... From waste materials
    - Particleboard and fiberboard
      - Derived from wastes of the wood industry
      - No virgin materials
        - Except - Resin, additives
    - Replaced solid wood for paneling
      - Better, cheaper, efficient...
  
Now a multi-billion $ industry
WPC process

- In the mix...
  - Wood flour
  - Plastic
  - Additives
    - Processing
    - Lubs, AO’s,
  - Performance
    - Fire, pigments, CA,
- Other fillers
  - CaCO3, talc, mica, etc...

The process
- Thermal forming
  - Extrusion
    - Most common
    - Long continuous
      - Decking, window lineals, fencing
  - Injection molded
    - 3-d parts
  - Pressed/compression molded
    - Limited volume
    - Variety of processes

[Image: techminy.com/extrusion-moulding]
Home for recycled plastic

- Advantages of WPC process
  - Robust - Less concern on flow/rheology
    - Highly filled system
    - Low contribution of plastic flow

- Plastics processing
  - Flow (MFI) is crucial
  - Allows for more intricate dies and molds
    - Less tolerance

Current processing

- **Incoming**
  - Post Consumer and Industrial
  - Bails, fractions, pellets
- **Integrated line**
  - Processed to feed-able size
    - Washed/cleaned
    - Pelletized and colored
- **Ready for composite processing**
- **Capping**
  - Virgin polymer
  - Covers inconsistent appearance
Issues with plastic recycling

- **Concerns**
  - Contaminates
    - Thermosets, dirt and bio-based, metals (non-ferrous), plastic additives
  - Consistent and reliable stream

- **Costs**
  - Fluctuations

- **Thermal limits of natural fibers**
  - Can’t use... PET, Nylons, other high temp processing plastics

- **Fixes**
  - Pigments
  - Capping
  - Process refinement
Advantages of recycled plastic

- **COST**
  - Marketing/promotion
Next steps

- Recycling Research Opportunities - Plastics
  - $70 M DOE funded Institute
    - Advanced Manufacturing Office Award Number DE EE0007897
  - REMADE
    - Industry-Govt-Academic collaboration
    - remadeinstitute.org/

The REMADE Institute established three primary goals:

- Develop technologies capable of reducing energy emissions through a reduction in primary material consumption and an increase in secondary feedstock use in energy-intensive industries.
- Develop technologies capable of achieving feedstock “better than cost and energy parity” for key secondary materials.
- Promote widespread application of new enabling technologies across multiple industries.
Surveys for the recycling industry

- Strategically Managing Material (Feedstock) Consumption in Manufacturing

- Design Tools and Methods for Reuse, Remanufacturing and Recycling
  - [https://remade.crowdsoscope.com/app/design-tools-and-methods](https://remade.crowdsoscope.com/app/design-tools-and-methods)

- Improving Recycling and Recovery
  - [https://remade.crowdsoscope.com/app/recycling-recovery](https://remade.crowdsoscope.com/app/recycling-recovery)
Questions??

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