Source Reduction of Solid Waste [*Residuals*]

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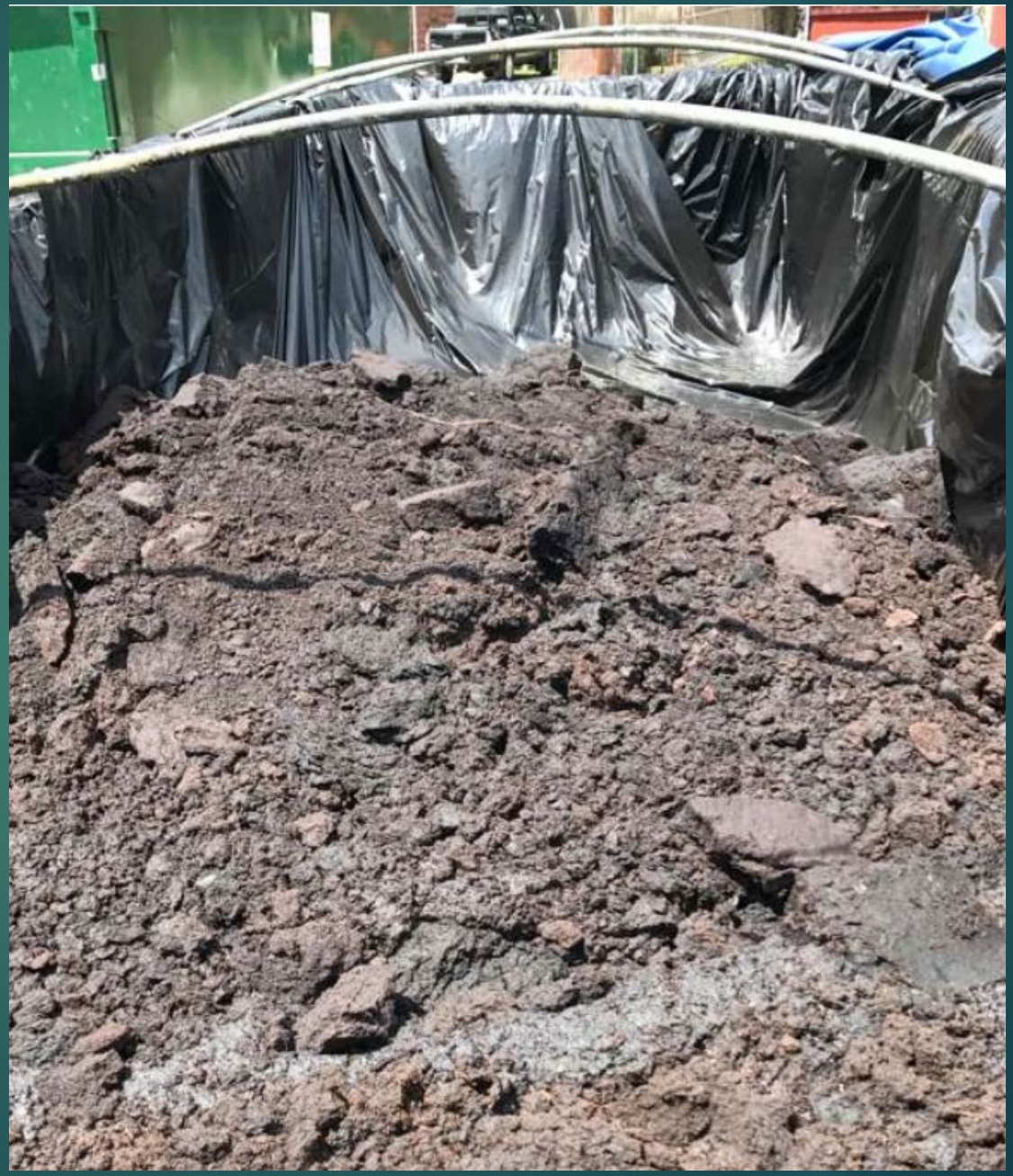
An EPA Award Winning Effort: Solid Residuals Stream Goes to Beneficial Re-use

Following grinding and resin extraction from the seedlac, Red Mud, which is composed of seedlac's non-resinous portions, is accumulated in a lined and covered roll-off for transport.



That was the easy bit, since it was part of routine operations …

- How did the idea of composting come about
- What was atypical about this material going to compost
- Extensive testing period to demonstrate consistency of the non-hazardous nature of the material
- Importance of other initiatives that opened up composting accessibility
- Why I nominated their project for an EPA award

The TUR Team who made it happen

MassDEP's WASTE BAN

- Objectives of the Waste Ban include:
  - boost recycling and support the recycling sector
  - capture valuable resources
  - save energy (and associated GHG emissions)
  - lessen reliance on landfills and incinerators
- The bans are specified in Section **310 CMR 19.017** of the Solid Waste Management Facility Regulations
- Material-specific compliance assistance can be found at https://www.mass.gov/guides/massdep-waste-disposal-bans#-material-specific-compliance-assistance-

2030 Solid Waste Master Plan bans the following materials from disposal or transfer for disposal in MA:

- Asphalt pavement, brick and concrete
- Cathode ray tubes
- Clean gypsum wallboard
- Commercial food material
- Ferrous and non-ferrous metals
- Glass and metal containers
- Lead acid batteries
- Leaves and yard waste
- Mattresses
- Recyclable paper, cardboard and paperboard
- Single-resin narrow-necked plastic containers
- Textiles
- Treated and untreated wood and wood waste (banned from landfills only)
- White goods (large appliances)
- Whole tires (banned from landfills only; shredded tires acceptable)

Investigating Solid Residuals

- Where To Begin
  - Known problem (as defined by cost, largest volume, storage challenge, worker issue, other)
  - Revival of a previous effort
  - Potential ease (demonstration project, service vendor changes)
  - Fits into a corporate directive or goal (e.g., minimize landfilling, sustainability)
  - Has been implemented elsewhere with success

Investigating Solid Residuals (continued)

- Intermediate Level of RC Effort
  - Is planning on-going for new equipment or process change? It could be an opportunity to influence choices that impact RC and TUR.
  - Is there existing data about solid waste/residuals?
  - What are questions to ask and of whom?
  - Is the solid waste/residual perceived as avoidable or unavoidable?

Investigating Solid Residuals (continued)

- Auditing
  - Define types/characteristics of solid wastes/residuals
  - Grouping of streams or simplification through separation
  - Rank quantities / costs / long-term liabilities
  - Gather supplemental information such as:
    - laboratory analyses
    - additional process characterization details
    - dumpster diving
    - interview personnel involved with the materials/processes

Investigating Solid Residuals (continued)

- How to prioritize opportunities
  - quantity impacted
  - cost coupled with payback period and certainty
  - ease of implementation
  - solves other problems (e.g., space, worker safety, community relations)
  - feasibility: technical, financial, AND administrative
- Issues of sequencing

Starter Opportunities

- Replacing bottled water
- Circular economy of batteries
- Food-related:
  - solid waste reduction
  - beneficial re-use
- Mini-Binny re-training
- Printing awareness

Opportunity: Replacing Bottled Water

- Energy input comparison between bottled water and tap water
  - up to 10x, up to 100x, up to 1000x, over 1000x
- Cost *
  - Average price of tap water in the U.S. = less than $.01 a gallon
  - Average price of bottled water in the U.S. = about $10 a gallon
- Quality
  - quality controls and sources
  - "Micro/nano plastics concentrations were estimated to be about $2.4 \pm 1.3 \times 10^5$ particles per liter of bottled water, about 90% of which are nanoplastics." **
- How to support the conversion
  - provide water bottles, mugs
  - dispensers of cooled, hot, and/or filtered water (PFAS)
  - ewg.org for PFAS POU system ratings

* Source: https://www.amnh.org/exhibitions/water-h2o--life/healthy-water-healthy-lives/tap-vs-bottled website March 2024

** Source: https://www.pnas.org/doi/10.1073/pnas.2300582121 research article of January 8, 2024

Opportunity: Battery Life Cycle

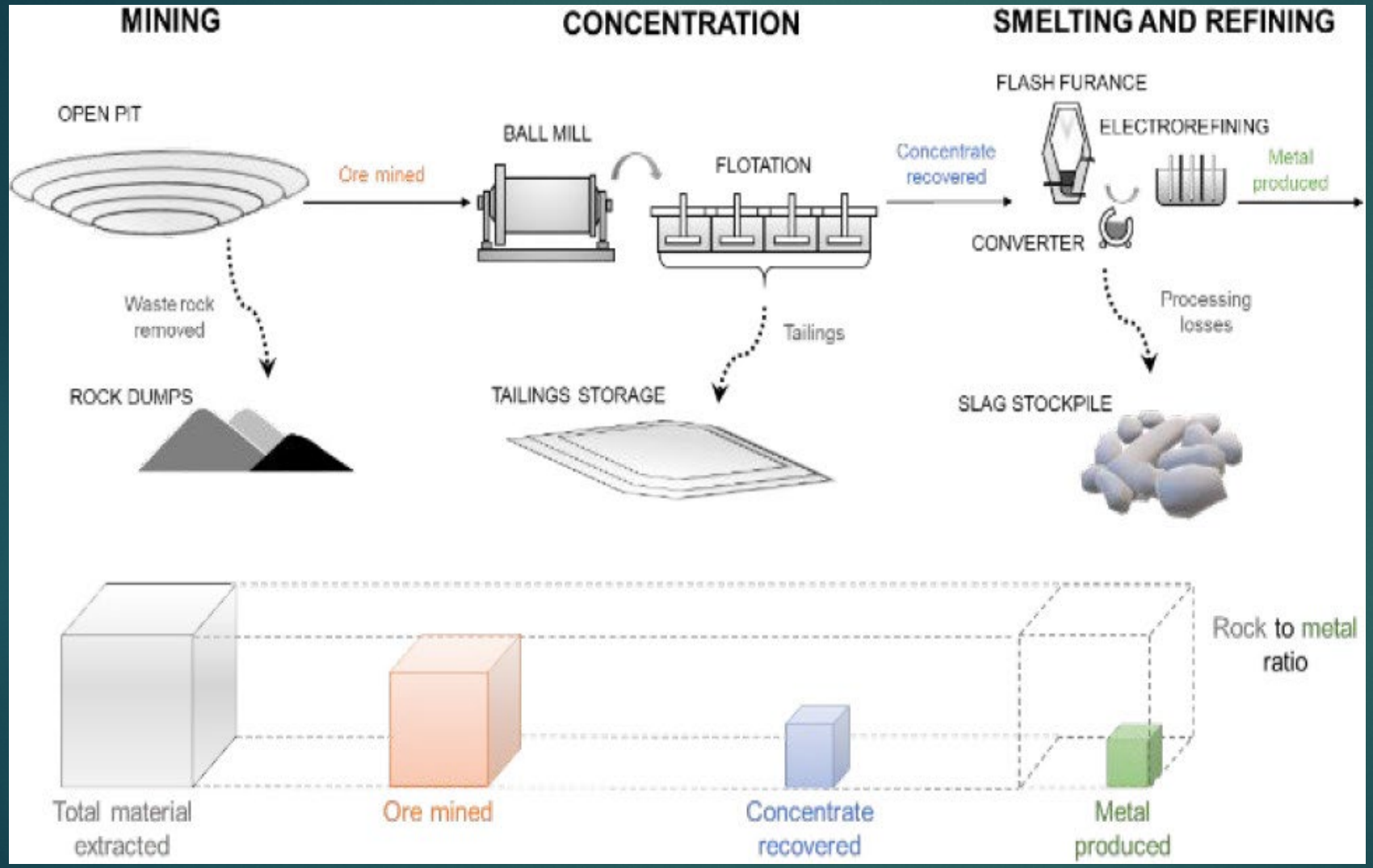
- Electric energy storage
- Types: rechargeable, single-use, lithium ion, lead-acid, etc.
- Over 25 states have either:
  - battery recycling requirements in general or requirements for producers to offer or fund battery recycling programs (i.e., EPR*)
  - in New England, only MA and RI do not have such requirements

* *Extended Producer Responsibility*

Opportunity: Battery Life Cycle (cont.)

- Not source reduction but part of a circular economy
  - significant upstream impacts/footprint
  - embodied energy
- Earth911.com has information about:
  - service providers, free drop-off locations, and other options
  - e.g., Call2Recycle – https://www.call2recycle.org/collection-program-overview/

Extraction of Metals



Source: *Environmental Science & Technology*. 2022, 56, 10, 6710-6721

The mass of the Earth is approximately 5.98×10^{24} kg.

In bulk, by mass, it is composed mostly of iron (32.1%), oxygen (30.1%), silicon (15.1%), magnesium (13.9%), sulfur (2.9%), nickel (1.8%), calcium (1.5%), and aluminum (1.4%); with the remaining 1.2% consisting of trace amounts of other elements.

Opportunity: Food-Related

- Food Service
  - Re-usable trays, dishes, cutlery
  - Support systems (equipment, pick-up from breakrooms)

- Composting
  - Collection from cafeterias/breakrooms/production
  - Landscaping residuals
  - Broader benefits (e.g., impacts to MSW, anaerobic digestion)
  - Emerging issues (e.g., what is compostable)

Opportunity: SW Awareness

DONNA COURTNEY'S MINI-BINNY METHOD

TRACKING PAPER USE IN PRINTERS

SHREDDING OF INCOMING PACKAGING TO REPLACE PACKING MATERIALS FOR SHIPMENTS

Potential of Starter Opportunities

- Simpler introduction to SW reduction, beneficial re-use, recycling
- Cultural / behavioral shift
  - ease of participation
  - minimal disruption
  - understanding that collective contributions make an impact (aggregate of small individual acts)
- Track metrics of performance to keep participants informed about the impacts of their efforts

Process Areas for Solid Residuals Reduction

- **Subtractive techniques for product creation**
  - machining: cutting, grinding, lathing, boring, shaving
  - product over-manufacture to allow fine-tuning of shapes
- Minimizing the need to subtract
  - product design, raw stock selection, additive approaches, forging the starting shape, new equipment, etc.
- Managing scrap (e.g., segregate types, centrifuge to de-oil) for maximum value and minimum life-cycle cost through off-site recycling

Source: www.Wikipedia.org
Metal Swarf, March 2024

Process Areas for Solid Residuals Reduction

- **Vibratory Surface Finishing** (a.k.a. tumbling)

Photograph Source: www.alternative-energies.net

Variable:

purposes – cleaning, polishing, hardening, drying agent

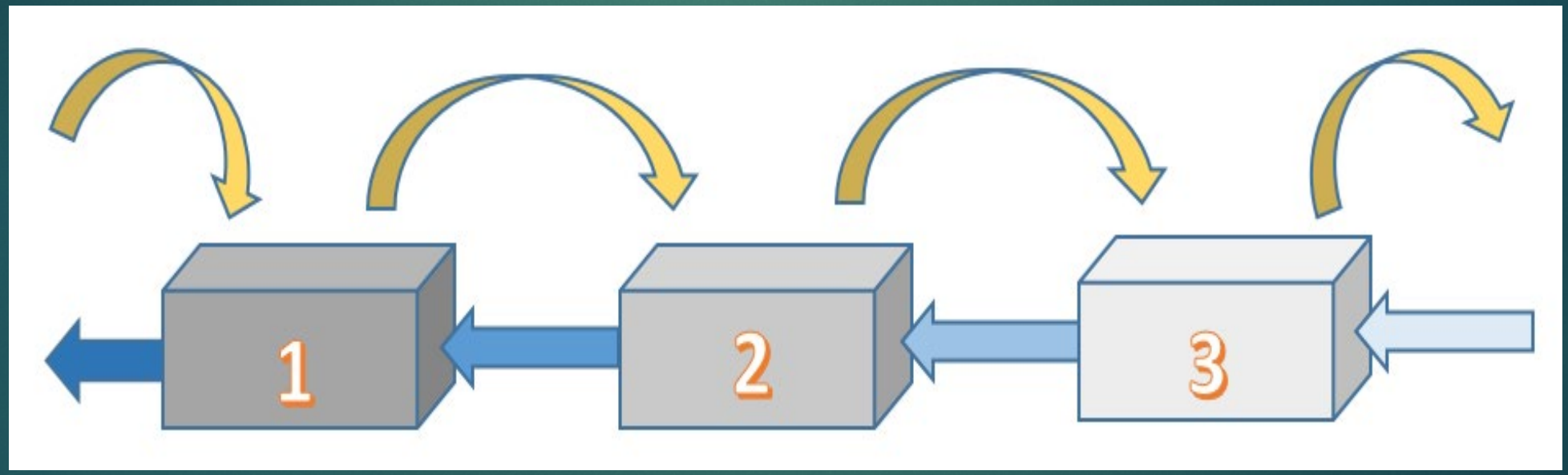
materials – ceramic, plastic, glass, steel, sand, organics (rice, ground corn cobs or walnut shells, etc.)

Process Areas for Solid Residuals Reduction (cont.)

- **Vibratory Surface Finishing** (continued)
  - selection of media (durability, start as large as practical)
  - use of media (e.g., sequencing, timing, upstream management of parts)
  - reasons for change-out
  - reconditioning of the media
  - options for off-site beneficial reuse

Process Areas for Solid Residuals Reduction (cont.)

- **Counter-Current Flow Principle**



Process Areas for Solid Residuals Reduction (cont.)

- **Ion Exchange Resins** -- on-site vs off-site regeneration

Source: lotusanalyzer.com

Source: rodiwaterservice.com

Source: researchgate.net

Process Areas for Solid Residuals Reduction (cont.)

- **Rejects**
  - What causes products to be rejected?
    - process dynamics
    - at what stage of production
  - Is reworking possible?
  - By-product as product?
  - Recyclable or is composition too complex?
  - Value of preserving time, energy, and material inputs

Process Areas for Solid Residuals Reduction (cont.)

- **Emissions Management**
  - Fabric Filters for Particulate Matter
    - selection
    - intermittent or on-demand cleaning (pulsed, reverse air, sonic, shaker)
    - prep: drop-out box, cyclone, pre-filter, moisture control, etc.
  - Wastewater treatment
    - flocculants = sludges
    - precipitation (gravity, chemical, ozonation)
    - minimizing water content (e.g., filter press, evaporation)

Image Source: www.nordfab.com

Image Source: www.simerics.com

Process Areas for Solid Residuals Reduction (cont.)

- **Packaging of incoming supplies**
  - Source reduction
    - bulk deliveries
    - refillable
    - reusable
    - rate/volume of use correlate with container size
    - offerings of chemical suppliers
  - Reuse / Recycling
    - pallets, cardboard, plastic, metal

Process Areas for Solid Residuals Reduction

- **Extended Producer Responsibility (EPR)**
  - Implications for customers versus for producers
    - electronics, batteries
    - packaging
  - Remanufacturing of durable products
  - Influence on product design and delivery

Resource Conservation Planning to Reinvigorate TUR

- Taking a break from generating ideas for toxics
- Use RC for solid waste/residuals as a path to a success, even if small – it can pave the way for future TUR/RC efforts
- Source reduction vs beneficial reuse (by-product as product) vs recycling

Resource Conservation Planning links to Solid Waste Master Plan Opportunities

310 CMR 19.060 – Beneficial Use of Solid Wastes

- Pre-application phase -- define concept
- Application phase -- submit information to describe:
  - how safety and environmental issues of the material will be investigated
  - what the benefits of use will be (e.g., substitution for virgin materials)
- Example: C&D recycling facilities

Sources for Solid Waste Information/Ideas

- EPA Sustainable Materials Management Program www.epa.gov/smm
- Product Stewardship Institute https://productstewardship.us/
- Northeast Waste Management Officials' Association www.newmoa.org
- Northeast Recycling Council https://nerc.org/
- Minnesota Technical Assistance Program www.mntap.umn.edu
- Washington State Department of Ecology https://ecology.wa.gov/
- **TURI and OTA!**

Developing Ideas

… and maintaining stamina

Attend	Attend conferences, workshops, and demonstrations
Ask/ Involve	Ask/involve many
Understand	Understand the facility's mindset and experiences regarding TUR, RC, etc.
Be	Be playful