

Polymer/Materials Research @ IBM

Enabling Materials and Processes for Computing Technologies

Photoresists, Materials/Processes for Device Fabrication

Expertise in Polymer Chemistry, Catalysis, Hyper-Pure Materials

HPC for Materials/Chemistry Simulation
AI/Machine Learning in Materials Design

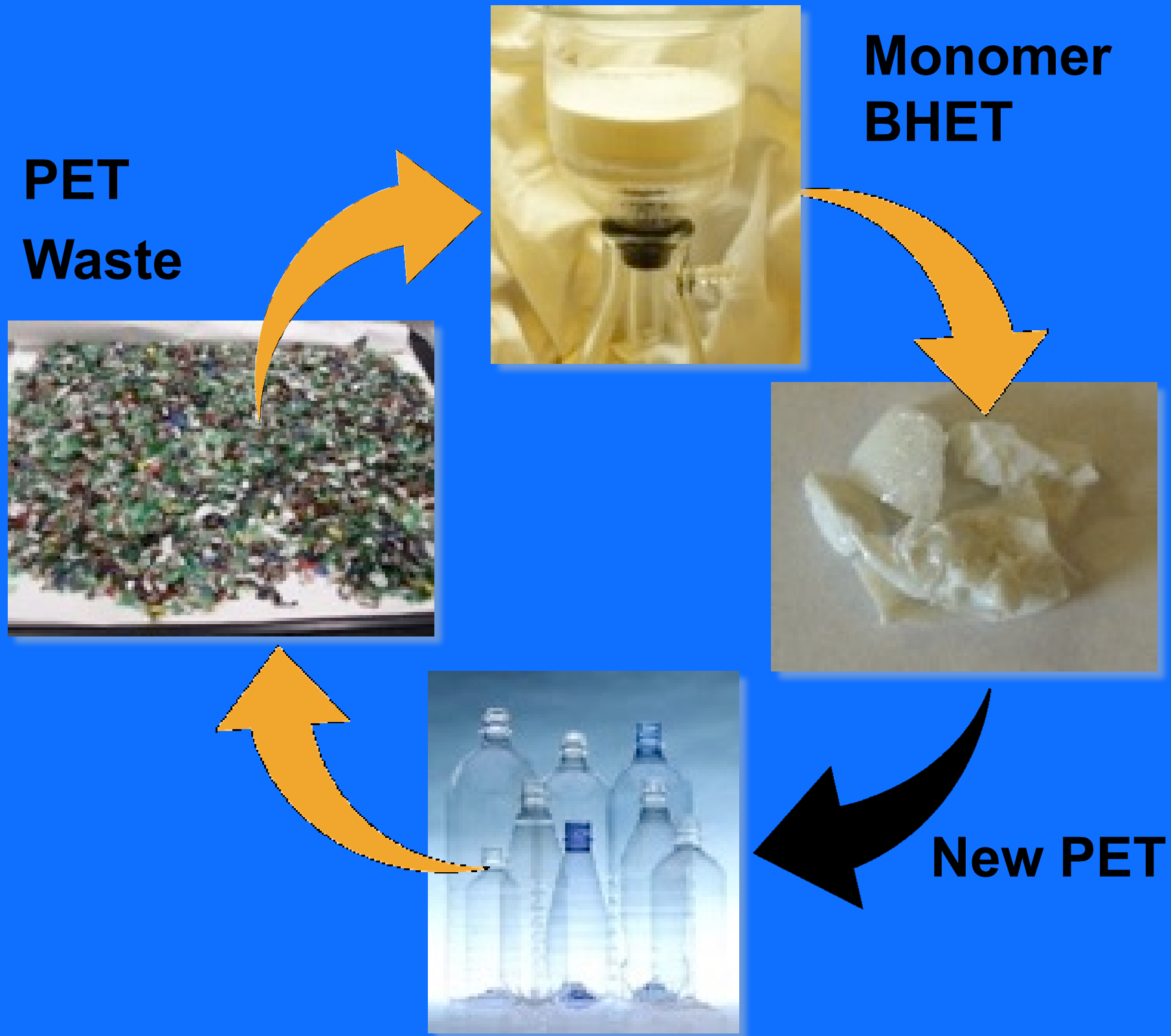


Bob Allen

Senior Manager/Distinguished Researcher
Materials Design/Innovation Department

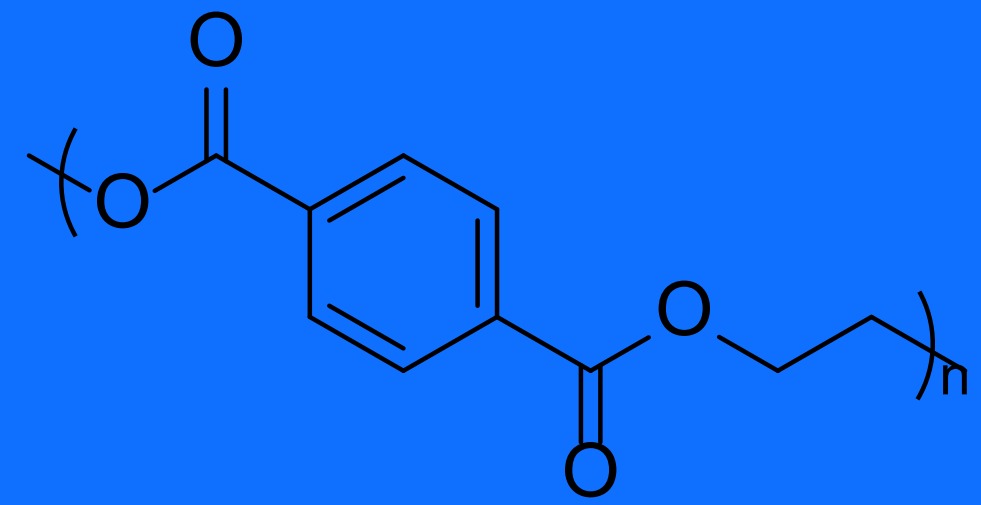
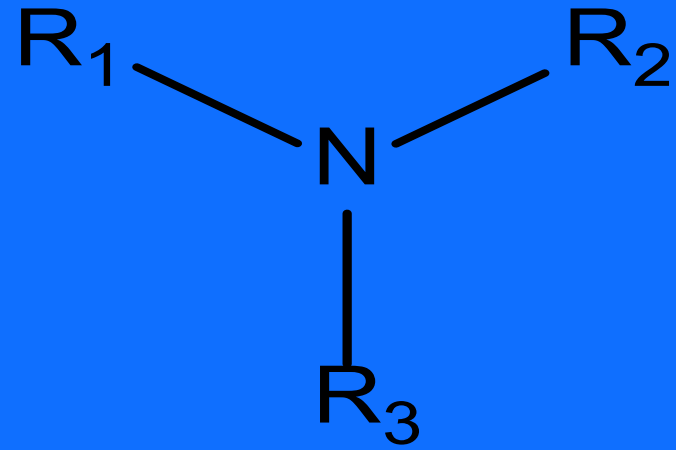
IBM Almaden Research Center
San Jose, CA

Selective Digestion: Toward a Circular Economy



VolCat Catalytic Depolymerization Process for PET

IBM's VolCat Technology



- Fast/Selective **Catalytic Glycolysis** Process, easy catalyst removal/recovery
- Key Attribute– **VolCat is a “Molecular Sorter”**
- Outstanding results with dirty clear and mixed/colored flake inputs

IBM's VolCat: Selective Digestion of PET



Output (BHET)

Feedstock (mixed waste)

Recycling of PET (r-PET): Challenges



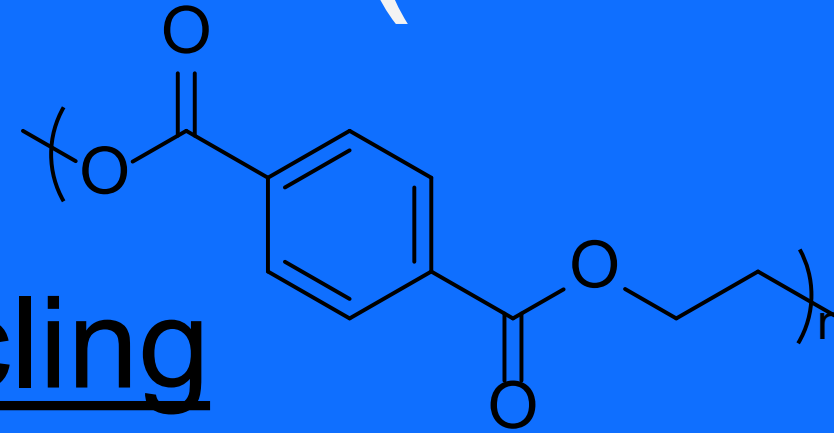
Mechanical Recycling

Sorting, washing (zero contamination tolerance)

Only “non-colored” bottles

High Temp Processing ($T > 250^{\circ}\text{C}$)

Optical Properties;
Lower Quality



Chemical Recycling

Chemical Depolymerization

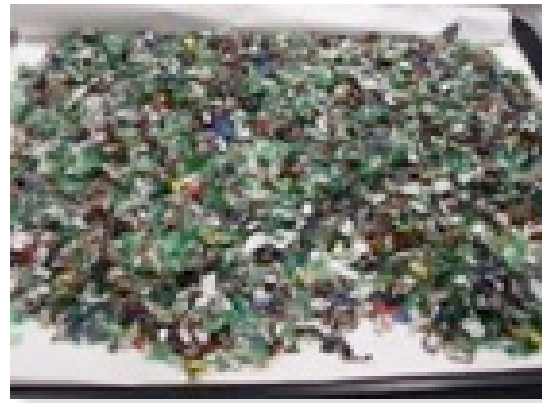
Reaction Product (Monomer)

Requires High Purity suitable for Polymerization

Incorporated into Virgin PET Polymerization

Economics; Robust Process;
Product Purity; Scalability

IBM Innovation to recycle PET: VolCat Technology



Feedstock

- **Insensitive to input** - low grade mixed, dirty, colored flake, post consumer or industrial waste, etc.
- Can use **lowest cost input**

Depolymerization

- Catalyzed Glycolysis
- Fast process
- Low cost, volatile organic catalyst that is removed recovered & recycled
- **No process waste**

Purification

- Catalysis is a Molecular Sorter
- Simple process for color and metals removal
- **Volatile catalyst removed prior to entering purification**

Recovery

- Monomer (**BHET**) recovered through simple crystallization
- No monomer distillation required

PET Production

- Monomer fully esterified
- Greater than **60% energy savings** for PET production from BHET
- Easily incorporated into any PET facility

**Insensitive to feedstock; Volatile organic catalyst; BHET as recovery product
Current focus is scale-up to Pilot**