

High-Speed Plastic Recycling

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Environmental Problem

Postconsumer plastics have become a significant burden on waste disposal systems, totaling about 12 percent (30 million tons) of the weight of municipal solid waste in the United States. Transport and disposal to landfills is expensive because of the light weight and large volume. Disposal of plastics in landfills can be considered environmentally unsound because of their high resistance to degradation. Electronic waste (e-waste) is an additional and growing problem that can be a source of toxic materials, which pose a threat to human health and the environment. EPA has recommended recycling of plastics and e-waste as a preferred approach over incineration and landfill disposal. High-end recycled plastic resins typically are combined with virgin resins and used in manufacturing new products. To use these resins in new products, however, it is extremely important that the flake product used during the recycling process be as pure and clean as possible. A large portion of recycled plastics is from postconsumer packaging materials, many of which contain mixed polymers. Mixed polymers do not recycle well, so they must be cleanly sorted to have a wide range of uses.

SBIR Technology Solution

With support from EPA's Small Business Innovation Research (SBIR) Program, National Recovery Tech-

nologies, Inc. (NRT), developed FlakeSort™, a sorting system used for preparing a high-quality plastics resin material from recovered postconsumer plastics packaging materials. The FlakeSort™ system is the world's first sorting system designed to make high-accuracy, small particle, polymer-specific identifications and sorts in industrial feed streams of polymer flakes or pellets.

The FlakeSort™ system is a field-tested, industrial duty, computerized process combining leading-edge, polymer-specific infrared spectroscopic detection with proprietary high-speed identification algorithms to scan and classify polymer flakes or pellets fed through the unit at high volumes. The process employs precision air jet ejection to sort particles of a selected polymer or polymers from the feed stream using a binary sort approach. High-speed proprietary polymer-specific infrared spectroscopic sensing technology provides significantly improved performance over nonspecific technologies such as X-ray-based systems.

The system uses an array of specialized wavelength-dispersive infrared detectors to read spectral characteristics of plastic flakes as they pass at high speed through a detection zone. The technology can measure and sort contaminants up to 15,000 plastic flakes per second with highly accurate performance. The system is designed for ease of use and incorporates a color touchscreen operator interface for presenting operating status and diagnostics data and for accepting operator input. It also incorporates high speed Internet connectivity providing worldwide factory diagnostics and software upgrades.

EPA funding also has helped NRT develop a full line of sorting equipment:

- The VinylCycle X-ray automated sorter separates

polyvinyl chloride (PVC) from post-consumer mixed plastics streams;

- The MultiSort™ ES family of sorters separates plastic products by color/shape and polymer type;
- The MultiSort™ IR family of sorters applies infrared spectroscopic sensing technologies to separate plastic products by polymer;
- The FlakeAnalyzer™ family of automated analytical process control systems provides either laboratory batch analyses or continuous online system analyses of plastic flakes.
- The SpyDIR™ system identifies many polymers, and removes selected ones from a process stream of clear or opaque objects.
- The DXRT™ separates materials at high speed according to relative atomic number composition using an advanced multiple X-ray sorting system. This technology can remove materials containing brominated flame retardants from e-waste streams.
- The MetalDirector™ separates metals from nonmetals and is highly efficient at recovering aluminum cans from process streams during the recycling process and in removing tramp metals during the purification of plastic flake.



NRT DXRT™ system at work sorting materials in an electronics waste processing facility.



Commercialization Information

The first FlakeSort™ system was sold to NRT's Phase III partner and installed in the Midwest during participation in the SBIR Program. This installation has provided a valuable test and evaluation site for the technology in a production setting. Lessons learned from this installation led to a more user-friendly, second-generation product. These new units now are in operation and give excellent performance. Data show a measured 93% reduction of polyvinyl chloride contamination in product resin from facilities that have used the system. The company has sold installations of the FlakeSort™ system to plastics processing facilities in the United States, Europe, and China. These systems operate on a continuous basis and each processes nominally 5,000 lbs/hour of polyethylene terephthalate (PET) flakes. Furthermore, NRT has sold its sorting equipment to e-waste processing facilities in the United States and Canada for sorting crushed electronic printed circuit boards and flame retardant plastics during the recycling process. Additionally, NRT bottle sorting equipment has been installed in the United States, Canada, Mexico, South America, Europe, Japan, China, and Australia.

Company History and Awards

NRT is a major worldwide supplier of automated bottle sorting systems using X-ray and infrared spectroscopic technology. Located in Nashville, Tennessee, NRT was formed in 1981 and has 20 full-time employees. The company owns or holds exclusive licenses for 25 U.S. patents and 5 foreign patents. Numerous other patents are pending or are in the application stage. NRT has won various awards, including EPA's Award for Outstanding Achievement by a Small Business Enterprise in 1991, and a Tibbett's Award for "Recognition of

Outstanding Contributions to the SBIR Program" in 1996.

The majority of the world's recycled PET plastics are processed through sorting machines developed, man-

ufactured, installed, and serviced by NRT. NRT has inspection equipment in operation worldwide and has agents in Europe, Japan, and China with approximately one-half of NRT's business being export.

SBIR Impact

- It is environmentally preferable to recycle and reuse plastics and e-waste over other end-of-life options such as landfilling or incineration.
- National Recovery Technologies, Inc. (NRT) developed the world's first sorting system designed to make high-accuracy, small particle, polymer-specific identifications and sorts in industrial feed streams of polymer flakes or pellets.
- NRT has developed an extensive line of recycling equipment to sort such waste streams as municipal mixed container and mixed paper, plastic bottle and polymer flake, and electronic waste.
- The majority of the world's polyethylene terephthalate (PET) plastics are processed through sorting machines developed, manufactured, installed, and serviced by NRT.