APR Foam PS Recycling Best Practices Guide

The Association of Plastic Recyclers

I. Introduction

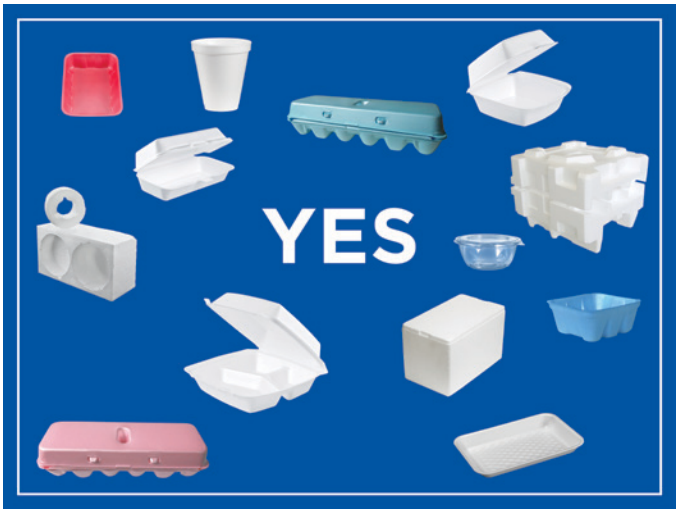
As communities work to maximize landfill diversion and move towards zero waste, they are often faced with the question of how to manage their expanded polystyrene (foam PS). This paper was written to answer that question and to offer a list of best practices.

Market demand for post-consumer and post-commercial foam PS is stable and growing. According to a 2017 study by More Recycling, "End Market Demand for Recycled Plastics", 50% of surveyed end users of reprocessed polystyrene post-consumer resin (PCR) increased their purchasing of PCR from 2015 to 2016, and end market capacity to purchase PCR continues to exceed the amount collected and recovered.

If the guidance in this Best Practices Guide is followed, it will help collectors and processors meet the needs of this growing marketplace while minimizing contamination and maximizing value. The practices outlined in this document cover collection and compaction for both Material Recovery Facility (MRF) and drop-off system design to enable a consistent and clean supply to reach market. Following best practices will provide both processors and users with the marketplace confidence they need to grow both supply and demand of this valuable post-consumer resin.

Quality Counts! To Enhance the Value of Your Material, Make Sure That:

- Tape, labels, cardboard, and wood are removed from foam PS molded shapes;
- Food residue is wiped or rinsed from take-out containers;
- Coffee or other liquid residue is minimized in cups.



Examples of Foam PS Typically Accepted.

II. What to Accept?

Markets are seeking optically sorted bulky, molded, white foam PS packing material typically used as shipping protection for large electronics, furniture, appliances, and other durable goods. Markets also exist for foodservice foam PS, such as coffee cups and take-out boxes.

Check to see if your markets will allow commingled loads of foam and solid PS (The solid plastic form of polystyrene, solid PS, is commonly used in applications such as take-out utensils, cold beverage cups, and CD cases.). If so, combining these material types will help make truckload quantities quicker and may also avoid the need for a densifier (See section "IV" below).

Markets will have different specifications for the cleanliness of the material, so investigate markets that fit the quality control abilities of your program.

Re-Use Packaging Peanuts

Contact your local parcel shipping service to see if they accept packaging peanuts for reuse.

Examples of Foam PS Not Typically Accepted.

A. Other Types of Foam PS – Ask Your Market

Certain foam PS materials may not be accepted by markets, due to characteristics that reduce the efficiency of processing, or introduce incompatible materials to the stream. These include the following

- **Packaging Peanuts** — Packaging "peanuts" were once made exclusively of foam PS, but other materials such as cornstarch pellets have become popular. These are not compatible with foam PS recycling, and mixing non-foam PS materials with your foam PS can potentially ruin an otherwise marketable load. Some parcel shipping companies accept clean packaging peanuts for reuse.
- **Colored Foam PS** — Some markets do not want colored foam, so check with your buyer prior to creating your program.
- **Flame Retardants** — Typically flame retardants are found in foam board insulation, which is often used in construction. Unless your buyer accepts this material, you should restrict your collection to eliminate this potential contaminant. These foam boards are often easily identified by their light blue or pink color.

III. Processing Foam PS into a Market-Ready Grade

Depending on the generating source and the type of collection system, loose foam PS may be processed at a dedicated drop-off site or in a MRF that accepts commingled curbside material. In either case, certain material handling, machine processing, and quality control procedures specific to foam PS material are performed. While details of equipment types and operations will vary, typically these process steps include:

- Quality control (QC) and initial inspection/ sorting
- Convey or direct feed into initial hopper
- Second QC inspection
- Grinding for size reduction
- Air conveying to secondary feed hopper
- Densifying for maximum compaction
- Finished goods storage

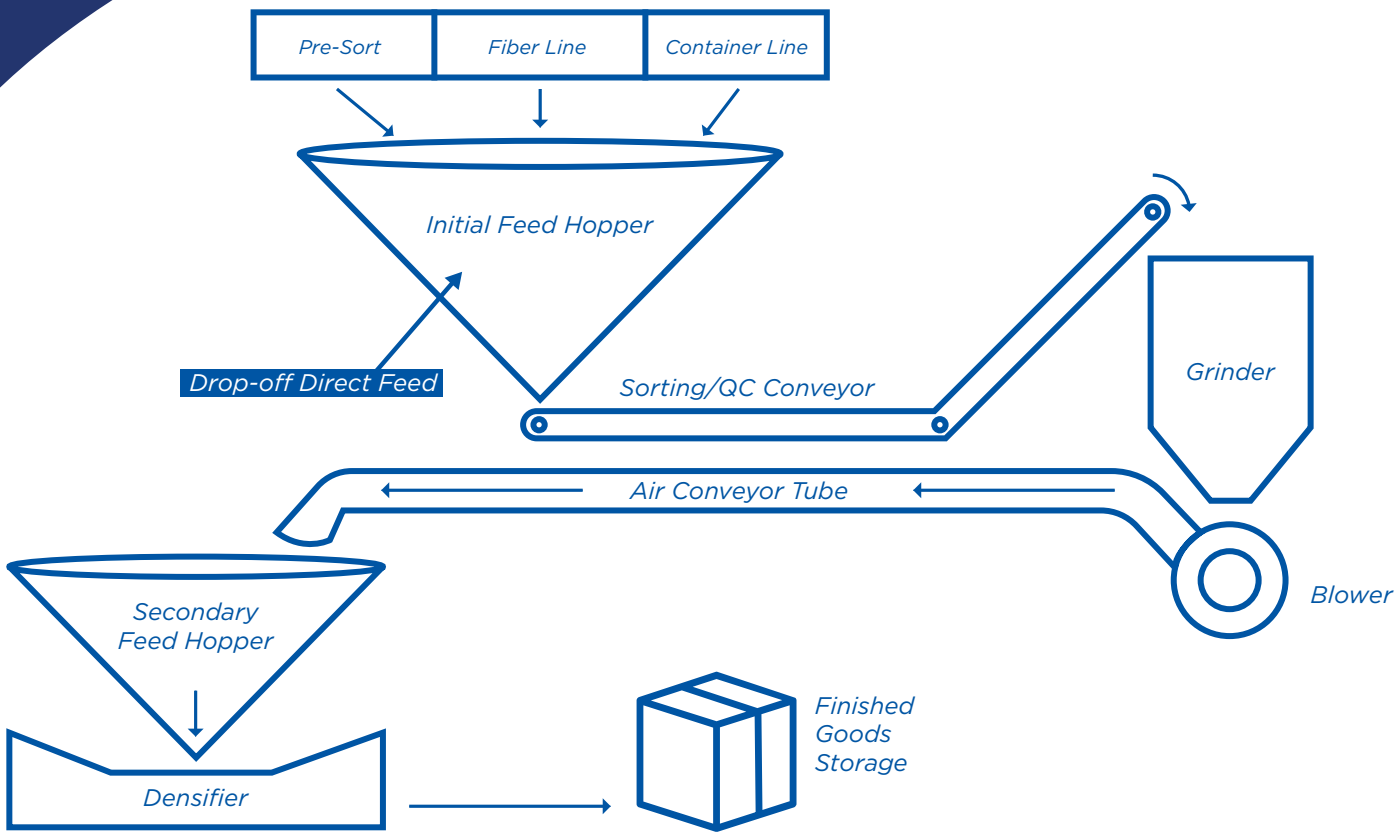
Remember that operator training and safety are important steps as well. Always follow manufacturer safety guidelines and implement a facility safety plan that follows local, state and federal requirements.

The diagram on page 3 illustrates the important processes and the order in which they are performed.

IV. Size Reduction and Compaction Equipment

Lightweight foam PS must be compacted for efficient storage and transportation. This is accomplished by grinding and densifying, or in some cases baling. Please check with your local authorities to make sure your equipment is property permitted.

Foam PS Recycling Flow Diagram



A. Grinder

The first stage of compaction is size reduction, accomplished by a grinder. Since feeding the grinder is the most time consuming and thus expensive part of the process, make sure that your grinder can process enough pounds (lbs). per hour to generate a profit. Since the ground foam will be transferred to a hopper, it is okay if your grinder throughput is greater than your densifier throughput. In fact, since the densifier process requires little labor, it can actually pay dividends to use an oversized grinder (An explanation can be found in section V. F). One more note, make sure your grinder has a large enough opening to process the type of foam you expect to receive.

B. Densifier

The choice of densifier can make or break your program. Conducting a trial with an equipment manufacturer using your actual feedstock is highly recommended. Here is a description of four common densifiers that will achieve the required compaction for foam PS:

- **Hydraulic Densifier** — This machine uses hydraulic pressure to compact foam. A series of rams compress the foam until the memory is gone. With a continuous operation model, the foam is extruded into a dense log. This machine does not use heat to compact the material, conserving energy and reducing emissions and odors. Hydraulic densifiers can also effectively process various densities of foam at the same time. Since community foam recycling programs typically receive a mixed stream of foam materials, this feature makes hydraulic densifiers ideal.
- **Thermal Densifier** — This machine uses heat to melt the foam into a taffy-like state. The “taffy” is extruded in the form of a rope, which is then fed into a container and molded into an ingot that is easily stacked on a pallet. These machines achieve the best compaction results, but additional labor is required to mold the extruded material into

a shape suitable for palletizing (This can be done manually or mechanically by compacting the taffy before it cools into a mold such as a metal box). Since these machines use heat they produce emissions and odors. Following manufacturers' instructions for proper installation and ventilation will mitigate any impact from emissions. These machines should be avoided if the material needs to be washed since thermal compaction bakes contamination into the ingot.

- **Screw Drive Densifier** — This machine uses an auger to push foam through a chamber, which compacts the foam into the form of a log/block. Typically, the speed and pressure need to be adjusted based on the density of the foam being processed. If not adjusted properly, either the log will be too light, or the excessive friction will cause the material to melt in the machine, shutting it down and requiring significant effort to clean it out. Screw drive densifiers are typically the least expensive model but they can be difficult to manage if the density of your feedstock varies. Consequently they are best for single density foams.
- **Hybrid Densifier** — Hybrid cold compaction densifiers use both augers and hydraulic pressure to compact foam without heating or the risk of melting. Advantages of hybrid densifiers include tidy output, a small footprint, and easily controlled output density.

C. Baler

If markets will accept combined bales of optically sorted foam and solid PS, this material can often be commingled and compacted in a dual-ram baler. With the addition of solid PS to a foam PS program, bale weights in excess of 1,000 lbs. are a real possibility.

V. Drop-off System Design for Foam Only

A. Operator Training — Create a board featuring acceptable and unacceptable materials. Use this board to train your incoming material inspectors, pickers and quality control personnel.

B. Initial Feed Hopper — The front of the system will include a hopper that can be loaded with foam. The hopper should have an electric conveyor on the bottom.

C. Sorting Conveyor — The conveyor from the hopper should include ergonomically designed space suitable for manual removal of contamination. A stop switch should be installed for safety and efficient operation.

D. Grinder — The conveyor will feed a grinder.

E. Blower — Use a blower and 10" diameter metal pipe to transport your foam to the hopper. Don't use plastic pipe as it creates static electricity.

F. Secondary Feed Hopper — Purchasing the largest hopper your space will allow makes it possible to grind foam faster than the densifier can process it. Because grinding is labor intensive, it is important to grind the foam as fast as possible and since the densification process is largely automated, it is okay if it takes the densifier a longer period of time to process the material. In fact, it will likely save you money since

Compaction is Key!

- Loose truckload of foam PS – 1000 lbs
- Densified truckload of foam PS – 35,000-40,000 lbs
- Typical OCC baler will not be effective on foam alone as foam PS has memory and will re-expand, but combining with solid PS can make market-ready weights.

a smaller densifier will cost less than a larger one. It is also recommended that a sensor is installed in the hopper that automatically activates the densifier (on and off) to further reduce labor costs.

G. Densifier — Place your densifier under the secondary hopper and let gravity feed it.

H. Finished goods — Allow space for palletizing material and staging it for storage.

VI. MRF System Design for Foam Only

A. Operator Training — Create a board featuring acceptable and unacceptable materials. Use this board to train your pickers and quality control personnel.

B. Storage and Initial Feed Bunker/Hopper Install a bunker/hopper that can be loaded with foam from various stations in the MRF.

Foam PS Densification Machine With Hopper

The hopper should have an electric conveyor on the bottom. If space is tight, consider placing the bunker/hopper under the existing conveyors/catwalks.

C. Manual Sortation

- **Pre-sort area** — Use pickers to remove foam in the pre-sort area prior to it passing through the first screen. Its popular bright white color makes it easily identifiable. The pickers can then place the material in a chute that feeds a bunker or hopper, or in transportable bins to be emptied into the feed chute or storage bunker.
- **Fiber Line** — Use pickers to remove foam and place it in transportable bins. The bins can then be emptied into a chute that feeds a bunker or hopper.
- **Container Line** — Use existing pickers to remove foam and place it in transportable bins. The bins can then be emptied into a chute that feeds a bunker or hopper.

D. Quality Control Conveyor — The conveyor from the hopper should include ergonomically designed space suitable for manual removal of contamination.

E. Grinder — The conveyor will feed a grinder.

F. Blower — Use a blower and 10" diameter metal pipe to transport your foam to the hopper. Don't use plastic pipe as it creates static electricity.

G. Secondary Feed Hopper — Purchase the largest hopper your space will allow to achieve maximum throughput. This way you can grind larger quantities of foam at a time. Install a sensor in your hopper that automatically activates your densifier on and off. This will reduce labor.

H. Densifier — Place your densifier under the secondary feed hopper and let gravity feed it.

I. Finished Goods — Allow space for palletizing material and staging it for storage.

VII. MRF System Design for Commingled Bales of Foam and Solid PS

A. Training — Create a board featuring acceptable and unacceptable materials, and include the various forms of solid PS that are acceptable to your market. Use this board to train your pickers and quality control personnel.

B. Fiber Line — Program your quality control optical sorter to recognize and accept various forms of PS so they can be rerouted to the container line.

C. Container Line — Place an optical sorter on the container line and program it to recognize and accept both foam and solid PS using its near-infrared signature. Work with the manufacturer and your markets to fine-tune the machine.

D. Quality Control — Staff the conveyor leading to the PS bunker with personnel trained to remove contamination from the line.

E. Bunker — Install a bunker to capture all the PS.

F. Baler — Bale the combined foam and solid material via a feed system from the storage bunker.

G. Finished Goods — Allow space for palletizing material and staging it for storage.

VIII. Additional Considerations

A. Storage — Keep your foam PS dry for best results in the densifier. Do not store your finished goods in direct sunlight as they will photo degrade. Hydraulic and screw densified logs will flake so take precautions to ensure the flake is contained.

B. Permits — Depending on the location, permits may be required to install and operate the grinding and densification equipment. Your local government public works or planning department should be able to provide guidance.

C. Markets — The markets for foam typically want to buy truckload quantities of 35-40,000 lbs. of densified material. Choosing the correct densifier and operating it correctly is critical to achieving these market weight requirements. To find markets, go to www.HomeForFoam.com and PlasticsMarkets.org

D. Revenue — Ensure your system is designed to process enough material to meet your revenue requirements.

E. Funding — Check with state and local governmental agencies to see if they have low-interest loans or grants to help pay for equipment. In addition, check with the Foodservice Packaging Institute (www.recyclefoam.org), to see if their grant program for foodservice foam recycling is available.

Home for Foam
Supporting the Growth of Foam Recycling
www.HomeForFoam.com