AUTOMATED SORTATION OF PLASTIC CONTAINERS

Presented by

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One of the most interesting and fast moving aspects of plastics recycling is automated sortation. My presentation is designed to give you my snapshot view of what is taking place. It is guaranteed to be out-of-date in a very short time, as something new comes to light almost every week.

In order to cover as much of this topic as possible in the time allotted, let me establish some ground rules. First, I will be featuring work that has reached commercial state; to deal with development efforts would consume too much time. Second, while a good bit of the presentation is drawn from my experience as chairman of NAPCOR's Technical Committee over the past two years, I am also drawing on many other sources of information, including equipment producers, buyers of the equipment, and trade groups, particularly NAPCOR and The Vinyl Institute, who have led the way in not only helping to advance the state of the art, but also have helped get equipment placed in the industry. Third, I will be concentrating on whole bottle sortation. Two companies are involved in particle separation in North America. One is RPI, using froth floatation, and the other is Simco-Ramic, which uses their Vision Automation System. Fourth, I will limit my comments to what is taking place in North America.

The spotlight has been on the plastics industry to get more plastic bottles collected. The January 1994 issue of Modern Plastics Magazine lists 68.8 billion pounds of plastic sold in 1993. Of this amount, they list 17.3 billion pounds, or 25%, that was used to make packaging. Of the 17.3 billion pounds, the most visible in the waste stream is approximately 4.5 billion pounds of plastic bottles.

Ideally, all of us as homeowners and consumers would like to put all of our plastic containers into our recycling bins and be assured that they would be separated into pure streams and would all be sold for viable

reuse applications. While someday this may be a reality, it is more likely that we will wake up and realize that we are not going to recycle our way out of the solid waste issue. While recycling will no doubt be with us to one extent or another for some time, we will need an integrated approach of source reduction, composting, recycling, waste-to-energy incineration, and landfilling to accomplish our objective. In the meanwhile, we will need to direct our efforts at getting more plastic containers collected and separated into pure streams.

As recycling programs have grown, the sorting has been done by manual labor, with workers on sorting lines tossing natural HDPE, colored HDPE, and clear and green PET containers into separate bins. As plastics recycling grew, homeowners were instructed to put only "number ones and number twos" into our recycling bins. As indicated by 1993 data, HDPE and PET containers accounted for 90 percent of the poundage that went into plastic containers. We couldn't resist the urge to help even more, however, so more "three through sevens" found their way into the recycling stream.

The objective is to get these different types of plastic containers sorted into pure streams. Automated sortation is desirable in order to reduce labor costs. The American Plastics Council, in its publication "Handler News", estimates that the additional capital costs of a device that autosorts plastic bottles by color would be 7.5 cents per lb., but would reduce labor costs by 10 cents for a savings of 2.5 cents. The increased market value of a purer stream of color sorted material could net an additional two cent savings.

APC also estimates that the additional capital costs of a device that autosorts plastic bottles by resin only would be 5.5 cents per pound, but would reduce labor costs by 7.5 cents for a savings of two cents. The improved quality due to lower contamination could net an additional one cent savings.

Commercial autosort equipment today uses x-ray and infrared radiation as detection means. This factor, combined with the ground rules for this presentation, limit the number of equipment producers to three - Asoma, Austin, TX, Magnetic Separation Systems (MSS), Nashville, TN; and National Recycling Technologies (NRT), also of Nashville. One school of thought has it that you will need some manual sortation to go along with automated sortation. Apparently the company that has come the closest

to full-scale automated sortation is Eaglebrook Plastics, Chicago, Illinois, whereby using the multi-resin bottles sortation equipment made by MSS, they are able to sort 5,000 lbs. per hour of crushed bottles into 11 resin and/or color categories.

MSS has placed similar units at a plastics recycler in the U.S. and in a PRF location in the U.S. Also, two similar units have been sold in Europe. The BottleSort system uses three separate detection methods: (1) low level x-ray detection for positive identification of PVC; (2) infrared light for the identification of PET/PVC, natural HDPE, and mixed color HDPE, and (3) an advanced vision system for the color sort.

A new system was introduced by MSS in October 1993, referred to as their TPVC system. This system utilizes their High Density array to identify PVC and PET bottles with a throughput of 5,000 lbs. per hour. Proprietary MSS imaging software permits the unit to display a detailed computer image of the bottle stream with PVC bottles appearing RED and PET bottles appearing GREEN. Design, construction, and installation of a TPVC system began in 1993 for a U.S. recycler, and three additional units are in design and construction this year.

National Recovery Technologies (NRT) has also been an active player in supplying automated sortation devices. NRT has sold 18 VinylCycle mass sort devices in North America, and 12 in other locations around the world. This commercial success has led to the introduction of the AUTOSORT device, which uses machine vision technology to separate whole or crushed post consumer bottles from a mixed stream of HDPE and PET. NRT has sold five AUTOSORT units, three of which are in the U.S.

Although Tecoplast-Govoni introduced the first commercial automated sorting system for plastics in 1988, Asoma Instruments first introduced in the U.S. their VS-2 x-ray detector in 1989. To date, Asoma has placed 20 of their devices in the U.S. and Canada, in MRFs PRFs, and with PET recyclers.

Modern Plastics Magazine data for 1993 lists 180 million pounds of PVC used for bottles. Although this amount is relatively small compared to usage of PET and HDPE, the vinyl industry has been very active in their efforts to generate pure streams of PVC containers. Three automated sorting devices are in operation as a result of assistance from The Vinyl

Institute. Loans have been granted to Waste Alternatives, Ocala, Florida, for a BottleSort line; and to Envirothene in Chino, California, for a VinylCycle line. Clearvue Industries, Amsterdam, New York has been operating an NRT VinylCycle device for over two years. Running at about 1,000 pounds per hour, it ejects PET from a stream of PVC bottles.

NAPCOR has also been active in advancing the technology and placement of sortation equipment. About two years ago, NAPCOR contracted with PTI to study automated sortation and to work with NAPCOR in enhancing existing technology and getting equipment placed in the industry. Based on PTI recommendations, NAPCOR chose to work with equipment that sorted whole bottles and which fed the detection device by singulating the bottle stream. Working with suppliers who used singulation complemented the work being supported by the VI, who worked with NRT and their mass sort approach.

Detection units made by MSS and Asoma have been tested extensively on a "real world" sortation line. So far, the evaluation has resulted in the placement of two Asoma units, one at Starbrook in Bowling Green, Ohio, and a second at Browning Ferris' MRF in Plano, Texas. The Asoma unit appears to be best suited for the small MRF or PRF, both from an efficiency and a cost standpoint. NAPCOR will be releasing information on the evaluation of the MSS units shortly.

In order to help get more sortation equipment into recycling systems, NAPCOR has announced a "Loans for Sortation" program, the details of which will be announced shortly. The intent is to provide communities with matching funds for two to five years with no interest. Communities must meet certain criteria in order to qualify for these loans. NAPCOR has two primary goals in mind: one, to enhance the development of low cost detection systems, and two, to promote the development of more reliable and accurate systems. Incidentally, a side benefit of this work has been the expertise gained by PTI in developing protocols for testing the quality and purity of post consumer materials.

At this point, a question of interest is, "What is the ultimate market for automated sortation equipment?" Here is what I have come up with:

1. I estimate that the equipment sold to date by the three producers is capable of processing 150,000 pounds per hour on a one shift basis, 50 weeks a year, for a total of 300 million pounds per year.

I estimate that on average, all of this equipment operates on a two shift basis. Therefore, the existing equipment has the capability of sorting 600 million pounds per year of plastic bottles. This is somewhat misleading in that bottles will be run through sortation equipment at MRFs and PRFs, and then again at some PET recyclers. At any rate, if the marketing people at Asoma, MSS, and NRT have reached similar conclusions, they must be pleased.

2. Using the aforementioned 4.5 billion pound market for bottles in 1993, and growing that market by 300 million pounds per year, I estimate that by 1998, there will be a six billion pound market for plastic bottles. I am also optimistically assuming that by 1998, we will be recycling one third of all bottles, or two billion pounds.

3. If we now have the capability of sorting 600 million pounds, and we will need to sort two billion pounds, we will need over three times the capacity that currently exists.

With the promise of a bright future ahead, I'll make some observations on what remains to be done.

First, continual improvements must be made in reliability, durability, and serviceability. These devices are relatively sophisticated and high tech, and are being installed in all kinds of surroundings. In fact, each installation is virtually a custom job. At throughputs ranging from 1,000 pounds per hour to 5,000, they have to perform day in and day out with no slackoff in their ability to achieve separation of containers. They have to run at an optimum level of performance, balancing throughput with sorting capability. It does no good to run at 5,000 pounds per hour if you are getting only 95% sortation reliability. They must also run at freezing temperatures as well as at 100 degrees.

Second, the new generations of sorting lines need to be designed to include sortation equipment, rather than having to retrofit. There is a lot to be learned in this area. One MRF, using manual sorting, installed a detector head in the shute into which clear bottles - PET and PVC - were being sorted. The falling bottles pass under the detection device, taking advantage of gravity. This simple adaptation eliminated an expensive piece of conveying equipment.

Let's look at how an "ideal" sortation line might be set up.

First, a very efficient bale breaker and declumper. This is very important if the detector head is to see only one bottle at a time, rather than clumps. The debaled, declumped material then drops onto a vibrating trammel for removal of small pieces and other debris.

Next, a conveyer to feed bottles into the detection unit.

Next, possibly a visual and manual sortation device, such as a UV light box.

At this point, the decision has to be made to either rebale and ship to a plastic recycler, or to granulate and sell the "dirty grind" to the recycler. The trend seems to be toward dirty grind. If this is the case, the last step is some sort of detector/deflector to remove any remaining contamination from the stream.

Third, the industry needs more information on the cost/benefit relationship of a range of scenarios from 100% manual sortation to 100% automated sortation. In some cases, the buyer installs the sortation device without really knowing how much labor it will eliminate, except by trial and error. It is discouraging to buy an expensive piece of equipment, thinking it is going to replace 10 sorters, when it ends up only replacing five.

Fourth, the efficiency of any automated sortation device depends on the incoming feed stream of bottles. The "cleaner" that stream, the more efficient will be the sortation. This simplistic axiom points out the need for "design for recyclability" principles that have recycle friendly adhesives, labels, caps, and cap liners.

Fifth, there is a need for a final "polishing," or some method of assuming that the objective has been accomplished - that is, the sortation line has generated a 100% pure stream. Let's suppose that with a combination of manual and automated sortation, plus UV light box inspection, there is a high level of assurance that the facility is getting 100% separation. The bottles are then granulated and airveyed to shipping containers. However, the QC testing indicates that there is still random contamination. A possible way to eliminate this problem is by using a particle detector/deflector. This detection device is placed in the airveyer

tube. The flakes pass over the device, and when contamination is detected, the deflector would eject a certain volume of flake containing the contamination. Such devices are being developed today.

With the driving force of high demand, combined with the growing pool of knowledge about equipment performance and customer needs, I am optimistic that automated sortation of plastic containers will fulfill its bright promise.