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RESEARCH ARTICLE

A STUDY ON POLYMER & PLASTIC WASTE AND RECYCLING

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ABSTRACT

Natural and synthetic polymer (plastic, ceramics, fiber, and fabrics, textile and clothing, rubber and tyres);Plastic products improve our daily lives and have made vast improvement areas such as: Transportation - Automotive, Aerospace, Space Exploration Medicines - helping us all live longer, healthier lives Electronics - information, communication, and entertainment Building and Construction - durability, aesthetics, and high performance Personal protection - children, athletes, police and firefighters Innovative packaging - freshness, storage stability, and protection from bacteria Recyclability and reuse (SPI created the international recycling symbols/numbers to facilitate recycling

INTRODUCTION

We wear clothes which are made of fabrics in turn are made out of fibers obtained either sourced out plants and animals (natural fibers) or made by humans (artificial synthetic fibers) several household articles are also made from fibers. During last decades, the great population increase worldwide together with the need of people to adopt improved conditions of living led to a dramatic increase of the consumption of polymers (mainly plastics). The world's annual consumption of plastic materials has increased from around 5 million tones in the 1950s to nearly 100 million tones today. Since the duration of life of plastic wastes is very small (roughly 40% have duration of life smaller than one month), there is a waste stream that reaches each year to the final recipients creating a serious environmental problem. The presently most common practice of handling such waste streams is to incinerate them with energy recovery or to use them for land-filling. Disposing of the waste to landfill is becoming undesirable due to legislation pressures (waste to landfill must be reduced by 35% over the period from 1995 to 2020), rising costs and the poor biodegradability of commonly used polymers. Therefore, recycling seems to be the best solution. The recycling of waste polymers can be carried out in many ways. Four main approaches have been proposed presented in Scheme 1. Primary recycling refers to the 'in-plants recycling of the scrap material of controlled history. This process remains the most popular as it ensures simplicity and low cost, dealing however only with the recycling of clean uncontaminated single-type waste. 2. Mechanical recycling (or secondary recycling). In this approach, the polymer is separated from its associated contaminants and it can be readily reprocessed into granules by conventional Mechanical recycling includes the sorting and separation of the wastes, size reduction and melt filtration. The basic polymer is not altered during the process. The main disadvantage of this type of recycling is the deterioration. Irradiation has been proposed. PET recycling in a microwave reactor has been proved a very beneficial method resulting not only in material recovery but also in substantial energy saving. This section will not be presented in detail here because it is the subject of another chapter of this book. Interested reader can find extensive details on the techniques used for the chemical recycling of PET in several recent review papers appeared in literature Best Practices and Industry Standards in PET Plastic Recycling

METHOD

Permitting and Regulatory Issues at Pet Plastics Recycling

It is possible that we have overstated access to recycling of non-bottle rigid plastic, but only once we reached a sample size of ovif a significant number of communities that had been collecting plastics beyond bottles stopped doing so; we do not believe this to be the case. The trend is toward increasing the types of plastic included in programs, not decreasing them. It is also possible that we have understated access to recycle bulky rigid plastics if programs that already collected non-bottle containers added these items. The other difference between this report and the 2011 report is that we used the 2010 U.S. Census data, rather than 2008. Using the internet and phone calls we determined which plastics were collected in each city and county's primary recycling program. Specifically, the study first looked at each community's access to curbside recycling;

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if no curbside program was in place, we looked for access to other collection programs such as municipal drop-off, subscription1 or dirty material recycling facilities (MRFs)2 . We did not gather data for deposit programs or retail drop-off programs. Our data collection form allowed us to record for e

Operations at PET plastics recycling facilities are subject to a wide range of codes and regulations at the federal, state and local level. The regulations that apply will vary with the type of PET processing operations taking place at the facility. It is the facility operator's responsibility to determine which regulations apply to their particular operation and to ensure that the facility is in full compliance with all applicable regulations at every level of government. One important aspect of this determination is to identify which regulatory agency has jurisdiction over a particular regulatory category. This will vary from region to region around the country, and can sometimes be confusing. For example, water discharges may be regulated by a local or regional sewer commission in some areas while in others it is the jurisdiction of a local or state environmental regulatory agency, while in still others it is regulated by a public works department. Therefore, it is not only important to determine which regulations apply to your facility, but also which regulatory body has jurisdiction. These agencies can provide full details on regulatory compliance to facility operators. Certain activities within recycling facilit require

operating permits or certifications. Once again, it is the responsibility of the facility operator to make sure that all required certificates and permits for operation are in place. Demonstrating compliance with regulatory agencies may involve submission of test results. If such test results are required to demonstrate compliance, it is the financial responsibility of the facility operator to provide them. Given the number and complexity of applicable regulations, many PET plastic recycling companies have a designated compliance officer who is responsible for identifying and complying with all regulations that might effect a facility's operations. Failure to comply with regulations is subject to civil as well as criminal penalties, in certain instances. Full regulatory compliance is the only responsible way to operate a PET plastics recycling facility. The simple best practice is to maintain compliance with all applicable regulations at the federal, state, and local level. What follows is a listing of some major categories where regulatory compliance is known to be required within the PET plastic recycling industry and what agency might have jurisdiction in those areas. This review is merely a guide to where regulatory compliance or operating permits and certificates might be required. It is not intended as a checklist for, nor does it ensure, full regulatory compliance. Best Practices and Industry Standards in PET Plastic Recycling

Best Practices in Pet Intermediate Processing

Sorting Systems: Introduction and Overview Due to the increase in curbside collection programs that collect recyclables in a commingled fashion, there has been an increase in the need for reliable and effective sorting systems that separate post-consumer PET plastics from other plastic and non-plastic containers and to remove other contaminants that might be present. To recover PET plastic bottles and containers from commingled recyclables, they must be delivered to a MRF and separated from other recyclable materials to prepare them for sale to an intermediate processor, re claimer or end-user. There are two generic types of sorting systems used at plastics recycling facilities. These are manual sorting systems and automated sorting systems. Manual systems rely on plant personnel who visually identify and physically sort plastic bottles traveling over a conveyor belt system. Automated systems employ a detection system or combination of detection systems, that analyze one or more properties of the plastic bottles passing through and automatically sorts these plastics into several categories, either by resin type, color, or both. The sorting system chosen for a particular facility is a function of several important factors. While cost factors influence system purchasing decisions, sorting system design is primarily a function of incoming plastic quality and level of commingling of plastic containers of different resin types. For example, bales of resin-segregated PET bottles and containers lend themselves to one type of sorting, while bales of two or more commingled plastic container types may require a different approach. In addition, sorting system design will depend on whether the plastics recycling facility is baling or granulating the plastics they receive from their suppliers. For example, baling operations at MRFs, IPCs or PRFs generally use less expensive and less sophisticated sorting systems than PRFs that debale, sort and granulate incoming bales of plastic into individual resin and color categories for sale to reclaimers and end-users. PRFs that granulate PET plastic bottles.

DISCUSSIONS

Best Practices and Industry Standards in PET Plastic Recycling Best Practices In Pet Intermediate Processing Sorting Systems: Introduction and Overview Due to the increase in curbside collection programs that collect recyclables in a commingled fashion, there has been an increase in the need for reliable and effective sorting systems that separate post-consumer PET plastics from other plastic and non-plastic containers and to remove other contaminants that might be present. To recover PET plastic bottles and containers from commingled recyclables, they must be delivered to a MRF and separated from other recyclable materials to prepare them for sale to an intermediate processor, PRF, reclaimer or end-user. There are two generic types of sorting systems used at plastics recycling facilities. These are manual sorting systems and automated sorting systems. 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Reusable packaging is easier to collect and to recycle than one-way packaging because it: is homogeneous (and clean flow) often retains an economic value remain in the same distribution circuit (no geographical dispersion) can be recycled for the same applications, which avoids the search of new outlets However, the material/product which plastic drums and other containers package may prevent the material from being recycled, i.e. when it is used to package hazardous substances. In such cases, mechanical recycling is not recommended (and even prohibited in some countries) leaving feedstock or energy recovery the best environmental option. Barriers to recycling The main barriers affecting commercial and industrial waste plastics concern commercial and distribution films and EPS, as opposed to rigid plastic applications, such as pallets, drums and crates (with the exception of containers used for the packaging of hazardous substances). Commercial and distribution films are mainly LDPE (stretch and shrink wrap) and HDPE (bags and sacks). Barriers towards recycling include: down-gauging low weight/volume ratio the main features that makes the recycling of commercial and industrial films attractive is that the waste is relatively homogenous, clean and is concentrated amongst a limited number of outlets. Packaging weight reduction, or down-gauging reduces the thickness and therefore weight of the film, in order to optimise resource efficiency. However, as the films become thinner, and weigh less, collection and recycling efficiency may be compromised. For EPS, the main barriers are associated with the low volume to weight ratio of the material and the costs involved in collection and transport if efficient systems are not established. Contamination is also an important issue and usually only clean, dry label-free material is accepted. Agriculture The use of plastics in agriculture has grown dramatically in recent years. It has replaced glass in greenhouses and become the material of choice for many packaging applications; it is also used widely for animal food conservation (silage) and gricultural (crop cover) applications. Although agricultural plastics account for just 2.5 per cent, 953,000 tonnes, of the total plastics consumed in Europe in 2002, they have a pivotal role to play in this sector. Plastics-based irrigation and drainage systems provide effective solutions to crop growing. For example, in the Almeria region of Southern Spain, plastics-based irrigation systems, greenhouses and films have helped boost horticultural output three-fold. Plastics' growth between 2000 and 2002 in this sector was. Symbol Polymer type Examples Recyclable? PET Polyethylene Terepthalate Fizzy drinks Mineral water bottles Squashes Cooking oils Recycling points are located throughout the UK HDPE High Density Polyethylene Milk bottles Juice bottles Washing up liquid Bath & shower bottles Recycling points are located throughout the UK PVC Polyvinyl Chloride Usually in bottle form however not that common these days Some Recycling points in the UK LDPE Low Density Polyethylene PP Polypropylene PS Polystyrene OTHER All other resins and multimaterials Many types of packaging are made from these materials, for example, plastic formed around meats and vegetables. Due to the mixture of compounds these plastic types are hard to recycle and not generally

Best Practices In Pet Intermediate Processing Shipping/Truck Loading, Receiving and Weight Determination Issue: Properly loaded trucks of PET bales and boxes of PET regrind can ensure regulatory compliance with maximum legal shipping weights, lessen the possibility of contamination, and prevent costly material losses and clean-up expenses due to improper loading. Proper paperwork and weight verification for shipments can help reduce disputes over material quality or quantity. Best Practices: Prior to loading a truck with PET bales or regrind, the truck floor should be swept to remove any potential contaminants that may be present. Bales should never be pushed across the truck floor surface to prevent potential contaminants from becoming imbedded in the bales. Shipments of PET should always be accompanied with a completely filled out bill of lading, certified weight slips, and preferably, a detailed packing list or shipping manifest from the shipper. The PET bale size proposed in these specifications (30" x 42" x 48") will allow for the most efficient truck loading and unloading. Standard 48-foot trailers, probably the most popular means of over-the-road transport, have interior loading dimensions of 47.5' long, 101.5" wide and 96"-108" high. With these bale dimensions and these truck dimensions it is possible to stack a truck "row" with six bales, that is, 2 bales wide (with the 48" side stacked in the horizontal direction), and three bales high (the 30" dimension in the vertical direction). This will result in a total of thirteen rows of bales, for a total of This bale configuration will not require special loading, such as standing bales on end, to achieve required minimum shipping weights. Facility operators should never load broken or partially broken bales. Bales should never be "jammed," or wedged into trucks, as this will adversely affect unloading and could possibly damage equipment.

Conclusions The study results show that there is widespread access to plastic bottle recycling, yet the recycling rate for PET and HDPE bottles is only 50 percent. Clearly access does not always correlate with optimized collection, in which programs would employ best management collection techniques, conduct consistent and strong outreach, and provide incentives to participate, or even truly service all points of generation. For example, many large municipalities may collect a broad spectrum of plastics, but the collection is only available through curbside service to single-family homes, village leaving multifamily homes without effective or communities may not provide recycling access at non-residential locations (e.g., restaurants, hotels, office buildings, athletics facilities, entertainment venues, parks). A future study could further explore the access to recycle for multifamily homes. Performing this study on an on-going basis will allow us to measure where the india has improved in plastic collection and where we still need to focus our time and energy. Although it was not part of this report because of the differing collection infrastructure, it is also important to document the access to film and bag recycling. For more information, please refer to the Plastic Film and Bag Recycling Collection: National Reach Study. Even with access and collection, plastic materials are often “lost” in the processing system Lost materials means lost resources and a lower recycling rate. The benefits of recycling are realized when recycled materials replace virgin materials in product manufacturing. Access to plastic recycling is not enough to ensure high recycling rates and there is much work to be done across the country in providing the public with clear and concise information about recycling programs, especially online. To this end: A multi-stakeholder effort is underway to develop a universal language to describe items acceptable for plastic recycling. Creating standardized outreach will help reduce the confusion surrounding plastic recycling collection and increase the capture rate in those communities that do collect plastic beyond bottles.

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