



## **Film, PET and Mixed Plastic Recycling in China**



**An Account of Patty Moore's visits to several Plastic Recycling Facilities in China.**

## Acknowledgments

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PARC



UNM

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## Summary

Shipping scrap plastic to China makes economic sense because China is a huge manufacturer of finished goods and they need low cost raw material. However, the growing middle class in China is resulting in more available scrap. Today, only 30 to 40% of the plastic scrap used in China is imported, the remainder comes from China's growing domestic collection, thus it is essential that the U.S. develop its infrastructure to sort and reclaim plastic for our own domestic use.

China's plastic reclaimers are able to convert almost all of the scrap plastic we send them, into lower-cost raw material for their use, but they do not have the infrastructure to properly handle contamination. It is our responsibility to create quality material for export to China. Unfortunately, an effective feedback loop does not exist between the buyers in China and the suppliers in the U.S.A., which prevents communication about quality control and allows low-quality bales to continually be shipped overseas. In some cases, suppliers of poor quality bales deliberately sell to brokers that will sell the material through many hands before it gets to the recyclers. More direct communication between suppliers and users in China would help, but the current system prevents good communication.

## Introduction

Over a three year period—2008 to 2010—Patty Moore, of Moore Recycling Associates, made multiple trips to The People's Republic of China (PRC) to assess the state of the plastic recycling industry there, and to address common misconceptions and myths that have surrounded the Chinese plastic recycling industry for several years. We'll focus our discussion on three primary materials: PET bottles, film plastic, and non-bottle mixed resin.

Before we go into specifics, let's go over some interesting facts concerning China's plastic recycling efforts. China's scrap plastic imports have been rising rapidly for several years. For example, in 2004, China imported 5.5 billion pounds of scrap plastics. By 2008, this figure had risen to 9.7 billion pounds. This represents an increase of over 70% within four years. While this was an incredible period of growth for imports, there was an even more dramatic growth in the Chinese domestic collection of scrap. Most of the scrap plastic used in China does not come from imports. Rather it is generated from internal plastics collection.

The plastic recycling efforts in China are achieved through the efforts of tens of thousands of independent plastic recyclers. Most of these facilities are small family-owned, labor-intensive operations utilizing hand sorting and domestically fabricated equipment.

Contrary to popular belief, China does not burn scrap plastics for energy: the scrap is far too valuable for that. It is possible that some plastics are burned off of other scrap (e.g., wire and cable) to harvest the more valuable metals, but this is the exception and not the rule. It should be pointed out that the Chinese economy is not sheltered from the realities of the larger world and as many as 39% of plastic recyclers in China ceased business at the end of 2008, when we saw a global downturn of all scrap commodities.

## Findings

### Rules and Regulations

One economic advantage the Chinese recycler gains, is the gap between the disposal costs in developed countries and China. The Chinese do not have as high of a cost of disposal as the U.S. and other developed countries. This allows them to extract the valuable materials and then dispose of the residue. It is this gap that can create problems over the long-term through improper disposal techniques. In one of the more egregious disconnects in our business—the lack of an effective feedback loop between the US suppliers of recycled plastic and the Chinese recyclers and converters—has burdened plastic recyclers in China and the US with poor quality bales. To a large extent much of the environmental responsibility lies with us. Strong demand, lack of inspection at our end coupled with the cavalier attitude of many suppliers causes problems. This part of the system is broken and needs to modernize. Whether this modernization comes by acts of free will or is legislated, the eventual placement of safeguards is necessary and inevitable.

Just as in the U.S., quality control is a concern to the plastic recycling industry in China, especially as it affects the rate of output. A representative of the body that governs the recycling industry in PRC, the State Environmental Protection Administration (SEPA), stated at a recent conference in China: "The import and utilization of scrap plastics has taken a leap forward yet there is a gap between the economic development and the level of technology". Referring broadly to the necessity to hand sort virtually all recyclables and the generally low-tech solutions that are applied to the recycling process in China. To address this issue, the Chinese government has passed a number of regulations to exert some measure of control over supply and processes, while enforcement is inconsistent, significant progress is being made in this area.

In 2007, China established technical specifications for pollution control during the collection and recycling of plastic waste. The issues addressed in the 2007 edict established regulations for air, water, noise and waste pollution. Other aspects of the law dealt with incineration, transport and storage, record keeping, and packaging & labeling of recycled products. This law also deals with the

grinding, washing, and melting (inclusive of pelletizing). It also addresses the location of facilities and worker health & safety.

General Administration of Quality Supervision, Inspection and Quarantine of the PRC (AQSIQ) regulation no. 119, passed in 2009, went further in trying to regulate the industry by requiring the registration of foreign suppliers and domestic assignees. These groups are subject to an assessment by officials including the creation of a national “Black List” of both groups developed from those who had run afoul of the regulation. Blacklisted organizations will no longer be allowed to import or process scrap plastic. Also included within this measure was the establishment of on site inspections before loading at the port of origin. The law also dealt with the training of 1,883 new AQSIQ staff members to provide unified law enforcement. Finally, the law allows the direct import of unprocessed PET bottles. To date, there are eight companies that hold a license to import whole PET bottles. Despite this new law, most of the PET entering China, still comes through the traditional buyers network via Hong Kong.



Currently there are no specific goals or laws for recovery or recycling of scrap plastic, but this is changing. China’s 12th Five Year Plan targets an 80% recycling rate for all resources. China will be establishing recycling areas and systems. According to the Plan, they will build 50 recycling parks over the next 5 years and work to unify individual collectors into a structured system rather than the informal scavenger system currently operating. The government will maintain control, inspection and management facilities for recycling parks.

Clearly the Chinese government is making progress toward regulating the large and diverse plastic recycling industry, but progress will take time. Even though there is a strong central government in place in China, the daily oversight of all these small facilities is relegated to the control of local government.

### Reclamation and End Uses

Most postconsumer US material enters China through the port of Hong Kong where port employees inspect the material. Dependent on the destination, containers are emptied and processed in Hong Kong or loaded into domestic containers for shipping to the mainland. It is a common misperception that the cost to ship scrap plastic to China is negligible. In fact, while the cost from U.S. ports to Hong Kong is minimal, the cost of shipping from Hong Kong to the mainland ports, along with the import tariff and VAT, makes shipping plastic to China as expensive, if not more so, than shipping from California to New York.



Hong Kong Inspection Facility



Hong Kong Harbor Transload



Typical mainland small truck transport

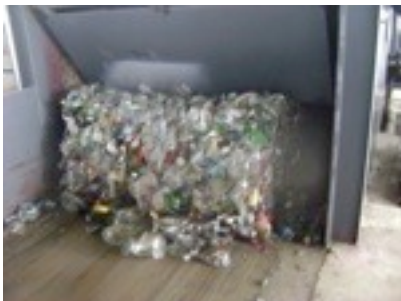
Each material has its own path. Most PET recycling facilities are in Zhejiang and Jiangsu: the two provinces north and south of Shanghai, the heart of the Chinese textile industry. Plastic film recycling tends to take place in the Chinese provinces of Shandong and Fujian, while the majority of mixed resins recycling facilities are in Fujian and Hebei.

The different areas of China tend to specialize in one or two types of plastics and do not have the capability to handle all types. Once the bales of recyclable materials reach their prospective recyclers each material has its own path to reuse.

In some cases, the material is shipped from Hong Kong directly to the reclaimer in China and in other cases it is stored in a warehouse until purchased by a local recycling operation. Since most operations are small and family owned, they can only handle a limited amount of raw material at a time without becoming overwhelmed. To this end, they purchase a few bales of material at a time. Once that material is recycled they acquire more.

PET

The recycling operations for recycling PET tend to be larger and more technically advanced compared to those of mixed resins and film recyclers. This is due to the fact that PET (polyethylene terephthalate), the material utilized for water and soda bottle manufacture, is a high-value recyclable material that has been recycled in China for several decades, thus the reclamation and end use infrastructure is very well developed.



Bale being loaded into hot water bath



Positive-sort line



Flake from grinder to float/sink tank

After arriving at a facility, the bales are opened and placed in a hot water bath. This initial bath aids in removing labels and contamination. From here the material is subjected to a “positive sort”, meaning the PET bottles are hand-extracted from the mix and color sorted, leaving contaminants behind. Most material in China is sorted in this fashion as opposed to “negative sort” in which

contaminants are extracted leaving the desirable material behind. Green and clear are separated from each other at this point and follow parallel paths to reuse.

The PET is ground into flake and placed in a float/sink tank: PET sinks while the PP (bottle caps) float. The PP caps are sold to recyclers that turn them into new products, including PP woven bags and sacks. Additional labels are also removed at this point. The separated materials are then washed in hot water, surfactants and caustics. It is then dried and bagged for shipment to fiber manufacturers.



Clean Flake



Bagging area



Finished goods ready for shipment

Most of the recycled PET bottles are converted into fiber, primarily spun yarn. Some are used for non-woven fibers, filament fibers and fiberfill. A number of the amber and green bottles are converted back into non-food bottles, primarily chemical bottles. Lower grade material, such as multi-layer PET bottles (e.g., nylon/PET combinations), and some non-bottle PET is used in paints and wood varnishes.

FILM

Film follows the same transport path via Hong Kong as the PET material except that clean commercial film is often direct shipped to China. The path diverges once the bales are delivered at the recycling facility. Bales are opened and each piece of film is hand-inspected. Any labels or printing, which would contaminate the clarity of the film, are removed with scissors.



Film inspector



Printing and labels cut from clear film



Small recycler transporting a few bales

If the inspected clear material is clean enough it is fed directly into an extruder where the material is pelletized and made ready for shipment to the final user, a manufacturer who will once again turn this into film. If the material is not clean enough for immediate reuse, it is subjected to an additional simple washing process.



Film wash



Clean film ready for extruder



Clean clear film pellets ready for bagging

Colored material is sorted by color and processed in a similar fashion to clear film. Most of this material is made back into blown film. While inferior quality materials are used for applications that are less demanding, such as fish floats used by commercial fish farmers.

**MIXED RIGID PLASTICS**

Postconsumer bales arrive in Hong Kong where the material is inspected, placed in containers and moved by means of local shipping into the interior of Mainland China, to a warehouse or directly to a recycling facility. Like film, clean commercial bales (e.g., crates, hangers) are direct shipped to recyclers. Unlike film and PET, the content of postconsumer bales goes to several facilities to be recycled. The predominant material in mixed-resin bales is polyethylene (PE) and polypropylene (PP); both are olefin plastics. Thus, the first facility pulls the PE and PP where is hand-separated by resin and color. There are usually nine categories of color for each resin: green, blue, red/orange, yellow, black, white, natural (clear), grey, and brown.



Color and resin separation



Float/sink, wash, rinse and spin-dry



Clean flake and finished goods ready for shipment

After color separation the PE or PP is ground (flaked) and put into a float/sink tank: the olefin plastics float and contamination sinks. The flake is moved to a wash tank, rinsed, and spun dry. Some facilities pelletize the material and others sell bagged flake. Small particles that sink are disposed of.



Bottles made from PCR



Stool made from PCR



PP woven Bags made from PCR

One often hears that the plastic we ship to China is sent back to us as finished goods. My experience has proven otherwise. The olefin material will more commonly find a useful life as domestic goods such as stools, PP sacks, toys, flowerpots and miscellaneous consumer products.



Small pieces



Pieces in super sack



Pieces in super sacks

After the initial sort of PP and PE, small pieces remain that are not worth taking the time to separate. These are held in super sacks until they are ready to process. Once there are enough of them they are put in a float/sink tank. The float material—a mixture of PP and PE—is recovered, dried, bagged and used in low-end, color-neutral applications such as profiles and shapes.



Non-olefin plastics baled for shipment



Non-olefin plastic being separated



Separated PS in super sacks

The remaining plastics, primarily non-olefin, that were not pulled from the first sort, are sent to a separate facility. In some cases they are baled first then shipped, but if the secondary sort facility is close by, they are shipped loose. The secondary sort facility uses a similar hand sort to further separate by color and resin type. A similar grinding and washing process is employed for each resin type—now separated by color—and the resultant material is dried and bagged for shipment.



Car charger made from PCR



Vinyl fabric made from PCR



Shoe soles made from PCR

This material will find another useful life as floor tiles, shoe soles, vinyl fabric, flowerpots and miscellaneous consumer products.

## Issues

One of the primary issues facing mixed rigid plastic is that there is no common terminology to describe the different types of bales. Traders and buyers of mixed resin material use very inexact terminology such as “1-7 bales” or “mixed rigid bales”. This misses the first and best opportunity to distinguish the various mixtures thus quality control is forfeit to expedience. This is not true of PET bales that have established, recognized specifications as a long-traded commodity. Mixed resin bales remain inconsistent. The supply of mixed resin material available is growing, but the inconsistent quality limits its value. The buyers/separators do not have the financial depth to take on the risk of poor quality, so that risk falls onto the importers.

Some concerns of the plastics recyclers in China:

*“Import quality is a problem”*

*“The public thinks of plastic recycling as garbage”*

*“There is a lack of R&D and investment into technology”*

*“There is no import tariff on waste paper, yet the tariff on waste plastic is 6.5%”*

*“The entry-level barrier into plastic recycling is very low”*

*“The VAT is 17% and the price that customs puts on scrap is not always correct”*

*“The media reports bad stories, but ignores the good ones”*

There is lack of an effective feedback loop between the buyers in China and the suppliers in the U.S.A. This is true for all plastic scrap commodities. In some cases, U.S. suppliers of poor quality material specifically sell to brokers that will then sell it through many hands before it gets to the recyclers. More direct communication between suppliers and users in China would help, but the current system imposed by Chinese import regulations prevents good communication.

At the global level, shipping recycled raw materials makes economical and ecological sense; however there are social, equity and environmental considerations if U.S. companies are shipping their garbage to China in the form of substandard scrap raw material. Improving the quality of bales—through education and proper terminology—will not only help the buyers in China, but will make it possible for more U.S. reclaimers to begin using mixed rigid material.

A brief aside here: the importance of rinsing or washing items before placing them in a recycling container cannot be stressed enough. Keep in mind that, no matter where the material is recycled, human hands will handle every piece of recycled material again, usually multiple times, throughout the process. As a matter of courtesy, cleanliness and regard for your fellow man, please scrap clean or rinse every piece of recyclable material before you place it in a bin.

## Conclusions

Shipping scrap plastic to China makes economic sense because China is a huge manufacturer of finished goods and they need low cost raw material. I predict that China will become the leader in sustainability within a few years. This is mainly due to a very large population with very few natural resources and the development of policies to push China's "circular society". For these reasons the U.S. should not rely on China as our future market for scrap plastics. Currently only 30 to 40% of the plastic scrap used in China is imported, the remainder comes from China's rapidly growing domestic collection. Plus, by exporting our plastic scrap resources we are exporting the downstream benefits including jobs, energy savings, and lower cost raw material.

*Information in this report was gathered by Patty Moore on a trips to China in 2008, 2009 and 2010. All photos are the property of Moore Recycling Associates Inc. Please do not use photographs or information without permission.*