How to start a fast and profitable business

Introduction to the practical plastic recycle
Assisted Self-learning course - Basic level

Promoting conscience, improving the standard of living, and creating a happier and clean world to enjoy."

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PROLOG

This basic course is dedicated to all those who are looking for an independent labour way do not find it; to the NGOs, whose members are working hard looking for micro-enterprises and goals for the organization. Here, they will be able to start that journey. First, it will teach how to select plastics, and then, the following stages of the process until the product will be obtained for its final use.

The main objectives are that these NGOs dedicate themselves to control the final destination of these recycled plastics since they should not be in direct contact with food (*); likewise, the management and reclamation of a wide legislation to the authorities, non existent nowadays, on the recycling and waste disposal.

Megaplastic.com will continue supporting this crusade, answering questions and extending the palette of texts and courses in order to, in a few years, be proud of recipients of a great plastic industry renewed from a simple course of recycling of plastic waste.

I dedicate this book to those who have made it possible: to the INSTIPLAST and its teachers, especially to Mr. Leo Peraldo; to the CDG and SKZ in Germany who gave me a scholarship to go to the Institute where I have studied, its teachers and technicians (outstanding Eng. Friedrich Wolfhard Ebeling.), and AERFA(**) as nexus.

To my mother Elena who was a life year recycler, to the memory of my mother in law Sara who was a recycler from heart, to my godmother‘s activity Lic. Emma Fiorentino, and to my staff: Adrián Borovich, Eng. Yolanda Szabó, Jackie Aisemberg, Guillermo Dobarán, and Nora Lizenberg, who make possible the growth and success of the website megaplastic.com.

Meanwhile I am doing this, my commitment is to continue moving forward in favour of what it was transmitted and contribute in such a way with the authorities.

Do not hesitate to consult us; we are at your disposal.

MARCOS WINOGRAD, Buenos Aires, March 2004.
WWW.MEGAPLASTIC.COM

(*) See note at the end of Chapter 7
(**) AERFA = Association of the Students and Former Fellows in the Federal Republic of Germany

RECOMMENDATIONS ABOUT THIS COURSE

The present course was based on the up-to-date knowledge obtained from everything related to the recycling of plastics, but fundamentally, the bases are the practice and the experiences on this activity at general levels.
This course will appear in printed material, interactive CD-ROM or will be available for downloading.

Besides, the course is supported by professionals dedicated to these topics, who offer you their entire support in case you have any doubts or you need to consult. In addition to some advise needed, you can ask about this topic if you want to extend your knowledge further or want to begin a new enterprise. For those interested people, we recommend always using the option of contacting the author and his staff to the e-mail address: megaplastic@megaplastic.com, who will be pleased to answer your queries as soon as possible.
In reference to the reading and interpretation of the course, we recommend you the following:

*Read all the chapters in the order they appear and try not to skip any.
*Answer the questions that appear at the end of every chapter. It is a good system to find out if the knowledge has been secured after reading each of them.
*If the answers do not turn out to be satisfactory, read the chapter over again. If your doubts still persist, do not hesitate to contact megaplastic@megaplastic.com.

It is recommended to make the indicated experiences to recognize the different types and qualities of plastics. In the event of doubts, we will send small samples which will help you out and avoid the contamination of the batches.

1. INTRODUCTION

The plastics surround us permanently in our daily life.
During the 24 hours of a daily life, whatever the activity we carry out, the plastics are present.

LET'S SEE THE CHRONOLOGY OF A DAY IN THE DAILY LIFE OF A COMMON PERSON:

We get up and go to the bathroom: the toilet seat is made of plastic (90 % of the existing ones), the towel bar, soap-dish, great part of the first aid kit and toilet paper holder, the toothbrush, and even the majority of the toothpaste tubes, they are made of plastic. The comb, many of the shampoo and lotions bottles and other elements of hygiene are made of plastic. Even, many towels contain a mixture of plastic fibres. After the hygiene, we have breakfast. The refrigerator has more than 50 % of its weight in plastic. Its insulation (polyurethane foam), the shelves, boxes, and its complete interior are made of plastic (generally high impact polystyrene).

We take out a bottle of milk (made with half density polyethylene), bag (low density polyethylene combined with other plastic materials, mainly with 3 layers - white, black, transparent), or we take a Tetra Brik package, which is formed by a combination of polyethylene, paperboard, and aluminium foil.
If we eat bread, surely we will have to open a bag of polyethylene: the cookies come packed in a film of laminated polyethylene - polypropylene, the yoghurt pot is made of a high impact polystyrene, as well as spread cheese, margarine, jams and others.

in the other hand, if we have breakfast in a self-service store or in the food courts, surely the dishes and cutlery are made of high impact polystyrene, and so successively with lunch and dinner, when we take mineral water or carbonated soft drinks in PET bottles (polyethylene terephthalate), the labels are generally made of polypropylene and the bottle lids are normally polyolefin (polyethylene, polypropylene and other materials that we will already detail).

Also, we use plastic in our clothes, such as the sports footwear and some shoes. Even with appearance of leather, they are made with PVC (polyvinyl chloride) with different looks: foamed, soft, rigid, calendered, etc.
T-shirts and sport shirts have a mixture of cotton and polyester (textile PET), which are normally combined in different proportions; the plastics are present in almost all the modern fabrics, even in the sheets, that we will sleep under at the end of the day, and the mattress, which the majority of them, essentially, have foamed plastic materials.

Let us continue travelling through a normal day. Apart from getting up, having breakfast and lunch, we also study. Besides the pens, great part of the benches and desks, blackboards and many objects of the classroom are made of plastics. Nowadays, we can find even pencils made of 100 % of plastic!

The plastics have the great share in the computer market: the majority of computer cabinets and almost all the computer monitors, printers, scanners, mouse, keyboards, modems are made of plastic.

If we travel by taxi, the vehicle in which we move has almost 40 % of its weight in plastic, the tank of fuel is made of polyethylene in different densities, the dashboard and the bumper are made of polypropylene, with the addition of different quantities of charges and mixtures. The seat pads are made of polyurethane foam. The upholstery is made of flexible PVC and parts of the car body may be made of polyester with fiberglass.

Already tired of walking, we go into a bar or drugstore to rest; we sit down on a chair of polypropylene and the waiter serves us an ice cream in small cup of high impact polystyrene or polystyrene foam (foam or unicel). As you can see, plastics surround all of our daily life.

From all of it was previously commented, we can determine that there is a variety of plastic materials. We have mentioned the polyethylene, polypropylene, PVC, PET, etc. The sorting and classification of every type of plastic is explained in the part 3, but important is to remark that:
- Every class of plastic material can be recycled in an individual way.
- Besides, it is possible to recycle a mix of plastic materials, that are hard to separate or whose classification is difficult.

HOW MUCH PLASTIC CAN WE FIND, HOW MUCH WE CAN RECYCLE...

From every kilogram of the household waste that is picked up in the city and urban localities, 100 - 120 grams are of mixed and dirty plastic.

From them, 40 % - 50 % can be recovered separately, with a relatively small investment and with a lot of manual work.

70 % - 80 % of the remaining can be recovered in the form of mixed and dirty plastic by means of processes that need more important (but with a rapid return) investments, bringing big possibilities of giving later work with the obtained stuff (e.g.: plastic wood)

SELFEVALUATION CHAPTER 1

1.1 The plastic are found:
- a. Easily
- b. Difficultly
- c. Very difficultly

1.2 The plastic recycle can be made by:
- a. Separating obligatorily all the materials
- b. In an individual way, for many plastics and all together for mixed plastics.
- c. It is complicated to recycle plastics

1.3 In one kilogram of waste, someone can find:
- a. a half kilogram of plastic
- b. 100 - 120 gr of plastic
- c. Less than 50 gr of plastic

1.4 The interior of the refrigerators is made of:
- a. Polyethylene
- b. PET
- c. High Impact Polystyrene

1.5 The textile products can have mixtures of:
- a. Wool and cotton
- b. Wool and plastic fiber**s**
- c. Cotton and polyester

1.6 The plastic bottles of soft drinks are made of :
- a. Polyethylene
- b. PET
- c. Polyurethane

2. MATERIAL' S ORIGINS AND INDENTIFICATION

Besides of the important sources of materials to be recovered that we have mentioned above (household garbage), we have other sources to obtain plastic, such as: the supermarkets, stores, the food courts, gas stations, factories, etc.

All goods delivered on pallets to supermarkets, shops, importing companies, factories, construction warehouses, etc. Another example is the printing paper rolls consumed by printers and big bureaus have an exterior protection of plastic material on the basis of low density polyethylene (LDPE) or linear low density polyethylene (LLDPE), materials of easy recovery and very requested.

In fact, most of the merchandise moving on pallets across the country is covered with PE's film. In some cases, it has adherence (made up of a stretch film or PE with a small percentage of PB (polybutene), a chemical substance that provides it with the propriety of being adherent and stretchable. This material adjusts easily to the products, preventing the pile on the pallet from moving and spreading; besides, this material produces an effect of "adherence" between pallets touching each other, achieving a major stability in the group of those whose faces are adhered.

When it is a matter of products of a major value, the pallet is covered with a thermo shrinkable plastic material. This material is a film that shrinks fast if heat is applied to it, pressing the goods and protecting them against the humidity (rain). Additionally, it avoids spread after a possible blow on the load.

The supermarkets themselves generate a great quantity of plastic by giving bags made of high density polyethylene (HD-PE).

In fast food restaurants and food courts, many products such as the yoghurt, desserts, breads and farm products, come in detachable (recoverable) plastic bundles, as well as cups and pots for ice cream, and other meals.

The cans for paint, oil and lubricating fats are made of recoverable plastic (PE or PP - polyolefin).

Moreover, it is worth mentioning that the bags commonly called “of Nylon (1)," which fly over the squares and ways, are made of plastic.

Another source to obtain plastic to be recovered is the fields. The agriculture, whether in greenhouse or in the open, is a great consumer of plastic; fundamentally of PE's film, but also of black plastic pipes for irrigation and watering places, as well as PE or PP; big trays for germination made of HIPS or PP; nets and bags for tubers, vegetables; PET wire, that replaces the common galvanized iron wire; bags, nets, and many other materials that,

(1) It is very common to say: "nylon bags" to those ones made of polyethylene. Nylon is a world registered trademark for the company DuPont and there refers to the material Polyamide, in its different types, called Nylon, which is a special plastic with a high resistance and which are to be found in the form of fibers (stocking, interior clothes, etc.), as a film in mixed laminating for very special packaging, for example for cheese or cold cuts, since it has the particularity of being resistant and not allowing the moisture and the oxygen to pass through, protecting and giving major useful life to the food.

Also, the empty fertilizer bags and / or agrochemicals, as well as jerry cans can be ground, treated, and recovered but not for uses with foodstuffs.

The wholesaler commercial system is also a great source of provisioning plastic to be recovered. Likewise, the small and medium business provides boxes and cartons to the collectors. In the same way, they can bring a great quantity of plastic wastes, fundamentally films.

These are only basic ideas about the origins where the plastics are normally found because it is possible to find plastic in an endless number of places, whether it is in a residential, industrial, or rural zones.

3. CLASSIFICATION, RECOGNITION AND PREPARATION

There is a great variety of plastic materials. The manufacturers, who use plastics as a raw material, have the great advantage of choosing and combining those ones which are most suitable for their products.

Every type of plastic has its own characteristics, and it will be more suitable than others to be used in certain processes and final products.

Given the important variety of plastic materials, an international coding system was agreed in order to make it easy to identify them.
Many packages - such bags, boxes, bottles, etc. - have in some place (often at its base) a triangle formed by three arrows, being this one the symbol of recycling. The number inside indicate the material forming the product:

Van los símbolos

In short, and in order to enter directly to the topic of recycling, we must say that the plastic materials, which can be recovered with fewer problems, are the thermoplastics of major consumption:

1- PET Polyethylene terephthalate (polyester)
2- HDPE High Density Polyethylene
3- PVC Polyvinyl chloride. In two versions: flexible and rigid - in this case it is necessary to have precaution with the types and quantities of charges it contains.
4- LDPE Low Density Polyethylene
5- PP Polypropylene
6-PS Polystyrene (High Impact Polystyrene – HI PS)
7-PC Polycarbonate and other thermoplastics

Other plastic types are called thermosets, elastomerics and crosslinked. They have different characteristics and their recovery need a special process and not always can have a good use. Examples of these plastics are:
Thermosets: plugs, handles of irons, etc.
Elastomerics: warm water bags, weather-strips.
Crosslinked plastic: plastic tubes for radiant crockery.

Among the thermoplastics, the most spread plastics are the polyolefins.

IDENTIFICATION OF PLASTICS

The polyolefins (Plastic recycle N °: 2, 4 and 5)

They are the most abundant plastics in wastes. Because of their low weight, they are easy to find in large quantities, fundamentally in the form of films, bags, wrapping, and other products like bottles of bleach, milk, yogurt, shampoo, paint containers, oil and fat cans, ice creams pots, not transparent cans, chairs, tables, and wastebaskets, among others, are made of polyolefins.
They are flexible but not fragile. The nail penetrates and marks a stripe. They are superficially silky. Since they contain a paraffin wax phase, they keep the flame when burning. The flame is yellow in the base and smell like wax or paraffin (like a burning candle). It is estimated that between 65 % and 70 %, of the circulating or available plastic for recovery, are polyolefins. These numbers included, also, those products made with virgin resins.

The PET (Plastic recycle N °: 1)

The second plastic material in importance to be recycled is the PET (polyethylene terephthalate). The percentage of PET contained in the whole recyclable plastics found in the solid urban waste is calculated in 10 % and clearly increasing.

The PET is an easily recognizable material, due to the fact that the majority of the water, carbonated soft drinks, refreshments, juices bottles and bottles for table oil, mayonnaise, ketchup, etc. are made of this bright and very transparent material.

It is necessary to keep in mind that the majority of the lids and labels of these packaging are not made of PET. Therefore they must be separated from these packaging, as well as, the ring that stays in the bottles after detaching the lid. Furthermore, it is necessary to have a precaution with the PVC packaging since there are possibilities of finding bottles and other packaging of this material and take them for PET. For it, the recycling symbol is helpful. When you have doubts, verify the number 1 inside the symbol to be sure that it is made of PET and not of another material.
Additionally, this material exists in flexible product form like audio and video tapes.

OTHER PLASTICS

The remaining 20 % - 25 %, are other plastics which are easily recoverable and other are not so much:

PS - POLYSTYRENE (Plastic recycle N°: 6)
When dropping it, it sounds like metal and exposed to the flame it produces black and spicy smoke.
It can be found in cabinets for electronics, many detachable products (cups, trays, detachable cutlery, yoghurt pots, etc.) and audio & video cassette cases.

PVC - POLY VINYL CHLORIDE (Plastic recycle N°:3)
It is a material very commonly used in: construction (doors and windows, profiles, pipes and rigid and flexible tubes), packaging, soles for sports footwear, and many other applications.
It is necessary to know well this material, to recover it and to try not to mix it in big proportions with other plastics materials since it modifies the physical characteristics of the other thermoplastics.

PC - POLYCARBONATE (recycling N°:7) (included in "other plastic ")
This material is, also, recyclable and easy to be recognized, for example, in the 20 litre bottles placed in the dispensers of transparent blue colour or colourless.
Nowadays, this material has a great acceptance in greenhouses, transparent roofs, galleries, armoured glass (e.g.: the "Pope mobil"). Moreover, all the CDs are made of this material, as well as many lighting articles.

SEPARATING PLASTICS

The major risk of recycling is the possibility that the material might become "impure" (contaminated) because of when it is mixed with materials it may modify its physical and chemical properties. That is to say, for instance, if we mix a small percentage of other materials with polyolefins, the batch remains unusable because it has "impure" material, and the products made of it do not to serve because they break or peel off in layers.

Therefore, the separation and the knowledge of the materials are very important. When it is the least doubt about the material, it is better to leave it aside than to mix it since the damage is irrecoverable.

There is an "almost" infallible method to separate the polyolefins from other materials. It is something expensive and the right equipment is needed to separate the polyolefins, but it is very reliable: the method of flotation.

Place the polyolefins into a tank with water - and bear in mind that it has a specific gravity slightly less than 1 gr/cm3 - we will notice that they float in the water, but, then, it is necessary to remember to dry well the material since the water is an enemy of the plastics (later we will see how to extract or eliminate it).

A cheap and very reliable way to separate materials, almost without mistakes, is to separate them by type of article. For example: the PET.

All the carbonated soft drinks bottles, without lids, safety hoop, base nor label, are made of pure PET. The mineral water bottles, with or without gas, those for juices, oil, vinegar, which are transparent and that when pressing them, it does not appear white colour in the fold, are made of PET.
The trays from fast food restaurants from exotic fruits which are transparent, very bright, and which the nail does not penetrate, are made of PET. Here it is necessary to be extremely careful of not mixing anything of PVC because PVC bottles can ruin up to 100 kg of PET; if a tray of PP slips in, it will not be noticed, but it is necessary to take care of the PVC, since while being a formulated material, it modifies the characteristics of the PET.
An economic way to start a recovery business is to collect bottles, to clean them, to rinse them, to extract the safety hoops, lids and labels, to scrape away the label's cement (this also contaminates the material).

If someone has special presses or reinforced presses for paper, it is possible to bundle up the bottles in bundles or rectangular bales, applying infrared radiation to them in order to soften the bottles and to reduce the volume. This can be an initial business that, if is done repeatedly over a period of time it can provide you with the capital to begin with the other materials.

Many countries have organizations supporting this activity. In Argentina, there is an association that promotes recycling called ARPET - Argentinean civil association for Recycling of PET – (In most countries there are similar organizations with similar abbreviation and equal aim), it is formed by the producers and dealers of row material, the manufacturers of moulding preforms (this is the initial product to transform it in bottle, by means of the stretched blow moulding process), and other interested parties like the large scale recyclers of this material.

These associations can offer, through his partners, agreements to give funding to buy a press or machines in a loan with a supply contract for clean and good bales. It is advisable to contact the associations that work in these activities at your zone and inquire about the programs of assistance in exchange for the supply of clean PET packaging bales.

In many big cities and its surroundings, usually there are buyers interested on large quantities of PET and many companies that consume them – providing that it is of a uniform and clean quality – They pay, according to the purity and cleanliness of the delivered material between U$S 0.20(*) and 0.50(*)per kg).

The Polycarbonate (PC) is another material to start without some mistakes, even though its market is smaller than the PET market.

All the 20 litre (4-5 gallons) bottles of water, which are transparent, very rigid and do not distort if boiled water is placed in, are made of PC. The baby bottles, which are bright and rigid, and that when being burned, they do not produce a flame with a green base and do not distort in boiled water, are made of PC.

The sheets and clippings of cellular panels of high transparency, bright and rigidity, used for closings, stands of exhibitions, green houses, etc., they are made of PC.
This one is an engineering material of a relatively small use in comparison with other thermoplastics, but it has a high value.

(*)The values are for informative purposes and can suffer the variations of the market.

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The recycled PC of good quality, homogeneous cut, can cost between U$S 0.80 (*) and U$S 1.20 (*) per kg, or even more, according to the buyer's needs. There are firmly and interested buyers (**), who are the same manufacturers of bottles. The material is delivered cut in big pieces, without powder or shaving, very clean and bagged, separating the transparent clear material from that of color one.

It is a hygroscopic material (that absorbs water), that is why it is necessary to avoid submerging into water. It is necessary to deliver it dry.

"Nobody pays for water in this business"

The seriousness and honesty is the best capital for a constant and lucrative business. This serves for the seller and the buyer, please bear in mind that
"To permanent serious supplier, permanent and good gratifying buyer"

(*)The values are for informative purposes and can suffer variations of market.
(**)See note at the chapter 7's end

The largest volume recycling is the PE recycling, which finally ends up being a recycling of polyolefins since in many cases it is difficult to separate PP from PE, especially related to films.

To obtain the best profit from this recycling, it is necessary to separate the film from other articles made of PE, the transparent clear film is the best paid; therefore, it must be separated from printed and colored films. Then, you must clean the material, bundle it and putting apart the dirty or with earth material. The articles separated from the transparent clear film should be mixed with the printed and colored films.

Within this selection, it is possible to separate according to the densities. All PE films that are silky and slippy are made of PEBD (low density polyethylene) or LLDPE (linear low density polyethylene). On the other hand, the most opaque film which sounds like "noise of paper" when is touched, is HDPE (high density polyethylene). It is also possible to find PP, which is a harder and scanty material at the same time since it is much more requested.

In order that new recyclers do not lose money and much more work time, we must warn them to take care of the PA laminated materials (polyamide - Nylon) and others mixed or co-extruded special materials of several layers since they are not compatible with the PE and they can contaminate it.

Moreover, it is valid to say that many lamination adhesives also contaminate the PE; therefore it is necessary to be very careful with the factory scraps because most of them are from laminated materials.

To verify if a material is a laminated one, you must take a piece, wrinkle it many times, and try to separate the layers. If the middle layer is brilliant, transparent and greatly more rigid, you can be sure that it is PA and it has an adhesive on every face. This adhesive allows it to stick to the PE. In packaging, the function of the PE is to bring weldability, what the PA does not give it

Name	Physical aspects	Flame color	Smell at burning	Sound
PET	Transparent, bright	Yellow, smoke	Like chemicals	Dull rustle
LLDPE	Soft film, very stretchable y bright	Yellow, burn down	Like wax	LLDPE
HDPE	Opaque and half rigid	Yellow, burn down	Like wax	HDPE
LDPE	Bright	Yellow, burn down	Like wax	Rustle
PS	Rigid, it brakes	Smoke	Spicy	Like metal
HIPS	Rigid, don't brakes	Smoke	Spicy	Like metal
PP	Rigid, bright	Yellow, burn down around	Like wax	Dull noise

since it liquefy with the heat and has another polarity (topic to be discussed in the advanced course).

The laminated or co-extruded materials, with different layers and configurations, are so valuable that may be recycled through a not common method and with high investment in equipment, which will be discussed in the chapter "Articles for direct re-use" of the present course.

Other containers of PE, the bottles of bleach (normally of yellow color) and the majority of the non transparent plastic bottles, cans, etc. can be separated without any trouble, If they yield when they are easily pressed, they are made of LDPE. On the other hand, if they offer resistance, surely, they are made of HDPE, so it is convenient to separate them since they have a better value.

The pieces of chairs, tables, trays coming from fast food restaurant, which are semitransparent, disposable, and marked with the nail, are made of PP and must be grouped separately.

SELFEVALUATION CHAPTER 3

3.1 - The symbols with numbers are used:

a. To identify the plastic disposable materials
b. To know the specific weight of the plastic material
c. To identify the constituent material, in order to separate it during the recycling process

3.2 - Which material, when is the flame test performed, gives off a strong smell of paraffin and its flame has a yellow color?

a. PVC
b. PS
c. PE (polyolefin)

3.3 - Which material float when we immerse it in water?

a. PE
b. PS
c. PVC

3.4 - Which is the most important enemy in the recycling of plastic?
a. The flake's size
b. The material's moisture
c. The high temperature

3.5 - What is the Nylon?
a. A thermo shrinkable material
b. The trade name of the polyamide
c. A type of thick and transparent plastic

4. GRINDING AND REDUCTION

Once the different materials are well selected and separated, they may be delivered to the different existing recycling plants, or if you want to add more value, especially to the polyolefins, the material must be ground and/or agglomerated. These processes reduce the volume to be transported and would add the possibility of delivering already to final user (customer) apart from the recyclers. In the case of the customer, it is already possible to obtain major added value.

For it, it is necessary to do the following investments:

a) Buy a cutting mill
b) Buy an agglomerating machine

Before buying a mill it is necessary to be aware that it will be our tool for work, exactly like the drill for an installer. Taking that into an account, do not to force it over its capacity, maintain it always operative, and clean it well, as it will give us the satisfaction of doing good cuts and keeping the capacity for which we have bought it.

It is well known that many recyclers complain that mills do not give good results, but the truth is that their bushing and bearings have never been cleaned nor lubricated; and the light between the stator knives and the rotor knives never need to be cleaned as well . The result is that the mill raises temperature because of the friction and the lower capacity of the cut. These people continuously increase the power of the motor of their mill, instead of sharpening or changing the knives and cleaning the sieve checking that all the holes will not be blocked and without any damage.

A universal mill does not exist for all the materials, though they can grind all the thermoplastic materials, the throughput and quality is not ideal.
A mill for thermoplastic films must have the knives with a light V angle and a very good adjustment of the light inside the fixed and rotator blades, cutting and bringing the film towards the centre. Otherwise, the film gets entangled around the rotor, touring it without being cut, warming up by friction, and producing a mass difficult to be ground and taken out, which ends up jamming the mill, putting under risk the motor, and destroying the belts.

The rotor of the cutting mill must be correctly balanced and with a heavy flywheel in a total balance with the gear. The gear must be perfectly lubricated, and it must turn, and reduce the velocity of the engine, increasing the cutting force totally free; this one must not crawl but turn. It is very convenient for the mills to have magnetic traps for the retention of metallic pieces because they usually come adhered to the materials, causing the damage the mills. The rational and correct thing to do is to feed the mill by means of a conveying belt, with the same width of the mill entry and with a metal detection bridge. This allows a visual selection of what goes into the mill and a constant feeding pace, avoiding accidents and an unnecessary overload.

To the big mill, a special kind of press is added to push uniformly the mass of film to optimise the grinding. The pieces, bottles, cans, etc. must be cut into several portions, so that the rotor could take them without any problems; otherwise, the pieces stay inside the hopper, bouncing against its walls and without being ground. In order to avoid this problem, modern mills and updated grinding installations have placed a shredder or a crusher before the mill. The shredder is a machine with several parallel counter-rotating rolls. It turns plastic parts into strips, and when they fall down into the mill, they are easily taken by the blades, allowing a constant grinding with less efforts without demanding too much power, since the torque is constant, and no force peaks are needed.

When a turbo exhauster is joined to the receptacle under the sieve it is suitable to extract the material and transport it to a silo; at the same time, it extracts the powder and sends it to a filter. Then, the material can be unloaded or bagged for later operations.

There are also washer-mills which are mills with totally enclosed motors and guided water jets that rinse the whole material entering from the hopper, moving the whole mud into a chamber, avoiding, in this manner, the early wearing of the knives, and obtaining a less dirty ground material. To dry the ground material, after letting it draining on a grid, it is to send it to a centrifugal dryer, where the major quantity of humidity is eliminated, and then, to be sent to a turbo-agglomerator in order to agglomerate the particles or flakes, increasing the density and allowing them to fall down or slip more easily inside the extruder hopper of the pelletizing line.

In this pelletizing line, the extruder will homogenize and filter the material, eliminating totally the humidity. Finally, the pelletizing process will take place, which is the form in which the recovered material has the best price (about 60 % and 75 % of the virgin material price according to quality, homogeneity and purity). The obtained final product is called "pellets" of the recovered material, ready to be processed again in the industry.

Taking this matter deeper, we must say that the most complicated process of the recovery is washing the materials. Simultaneously, the most important of the plastics´ enemies, besides contamination, it is the water. Wet plastic cannot be used. It has to be dried, so you have to keep drying until it is not wet anymore. This is the issue with the washing process.

Because of this problem, it is necessary to gather clean material, or those which can be clean when they are dry. These materials must be selected very carefully, because they don't have to be mixed. Dirt plastics have to be set apart from the clean ones because money gets lost.

USING AN AGGLOMERATOR

A good alternative to generate recycled materials is the use of an agglomerator.
The clean film, already in pieces or even unrolled from a bobbin, can be agglomerated without the need of grinding, still if it has some humidity or dew, it can help to the agglomeration. It takes place in a jacket or heated agglomerator where the film pieces are poured in while the blades are turning at a high speed to soften the material by a frictioning process until the state of almost plasticized and, to the point of being liquefy, it receives a regular shower water, making the material agglomerates into small lumps. Its permanent take off through the inferior opening allows an almost continuous agglomeration process. This process causes the reduction of volume and the obtainment of a good material that can be used in a direct way, being mixed or into a pure status, according to the process to which it is intended to.

After being centrifuged,the ground and washed materials, can reduce their volume. In this way, the pelletizing helps to save the cost of the material which must be warmed again (whenever the plastic warms up till plasticizing, it is degraded), because it loses chemical elements, such as lubricants, slip agents, etc., all what goes into a detriment of the quality of the final obtained material.

SELFEVALUATION CHAPTER 4

4.1 - To bring more durability and throughput to a cutting mill:

a - It is necessary to push and force the material
b. It is necessary to keep the knives clean and sharp
c. It is necessary to place a bigger engine

4.2 - What is a Schredder?
a. An element to decrease the mill's temperature
b. A hopper to be able to grind great size products
c. A crushing equipment placed before the material enters into the mill.

4.3 - Using an agglomerator:
a. The obtained material must be ground
b. The obtained material can already be processed
c. The obtained material cannot be recycled

5. THE “MAKE-UP” OF THE RECYCLED MATERIALS

Because of what it was explained above, many recyclers, before having problems and investing heavily,they avoid the washing process by taking much care into the selection, cleaning and drying of the pieces or bottles (jerry cans), etc. while they are still in one piece (before being ground). This allows to manipulate them into a better way and set them to dry to the Sun or into an environment with warm air (industrial heater with a fan), having them previously deeply drained.

THE HIGH CAPACITY CENTRIFUGAL DRYER USED IN THE INDUSTRY

In this case, it is necessary to take care of not bringing the plastic over the flame and never be over 50 - 60 °C since the small particles starts to be modified and burned forming black hard points damaging the lot.
This treatment, without deeply wash, is called "cosmetics" (make-up) in the slang of the recyclers.
The make-up is performed to show a lot of ground material very clean, without having immersed it into the water and without a deep wash (but it is like to put on deodorant and perfume without having bathed). This procedure is frequently used with the PET and the PC, and, also, by the transparent colorless film of packaging, thermo shrinkable, and stretch films coming from the supermarkets and any other places that collect a lot of these.

When we want to recycle material coming from agriculture, greenhouses, bags of fertilizer or other products, and / or cleaning and household articles such as bottles of detergent, oil cans from service and gas station, we can do it together or separated, by material and color. There is no other way than washing them, and to do it intensely together with the difficult task of drying them.

An industrial washing installation of good quality has a cost of U$S 100.000 to produce approximately 100 - 150 kg/hr, and one of 1500 kg/hr costs near a million dollars. There are automatic plants that eliminate impurities; they rub the particles with a similar technology to the hydro-cyclone, rejecting the particles with adhesives that did not go out during the process of wash. We can say that the flakes of plastic ground material ends up 98.5 % clean and free of impurities. This does not mean "pure" material since it may turn impure if mixed with other type of materials during the grinding process, or it may not have been selected well, the damage will be already be done beforehand and it would be very difficult to correct it with the washing process.

There are washing systems that, to correct the above mentioned, make the material get through several ponds with water of different density where, by flotation, one type of material it is collected. These types of facilities are trustworthy and have more components, therefore they are more costly.

We know that there exists intuitive and very intelligent people who improvise precarious facilities with enough manpower to wash plastic with a good enough result; we do not dismiss any inventiveness, on the contrary we encourage them. However, the drying topic is not to improvise as if this one is not effective because of the efforts priory made will be useless.

On the international market there are centrifugal drying machines that do not cost much more than an agglomerator; therefore, and with the agreement of the final buyer**,** it is good to agglomerate.

SELFEVALUATION CHAPTER 5

5.1 - The “make-up” of the recycled materials include:

a. Washing and drying up of the material
b. Recovery of the material without deep wash
c. Mixing of recycled materials without wash

5.2 - If someone wants to recover packaging of fertilizers:

a. It is necessary to wash them deeply
b. It is not necessary to wash them deeply
c. It is indistinct

6. RECYCLING PROCESSING SYSTEMS

This name is given to the machinery or line that, start with the material already clean and ground then it is used to plasticize, homogenize, mix and filter obtaining as final product plastic in pellets.

For this purpose, it is always necessary to use an extruder.

EXTRUDER

This machine is the one that plasticizes the materials, that is to say, takes them under high temperatures turning the mass of material totally malleable or plastic. To get this, it uses heat and friction (by means of pressure inside the same material).

The fundamental parts of the extruder are:

- A hopper to load the materials
- Screw with special geometry and profile to take the particles of plastic material towards the exit of the extruder while it applies friction to the material, gaining effective warming

as this one advances.

- Barrel or cylinder: it is the part that contains the screw and also has an important function in the efficiency of the plasticizing. The barrels are heated or thermally controlled to gain major efficiency in the work of the screw and achieve the goal of an effective plasticizing.
- Die or head: it is placed at the exit of the extruder. The plasticized material passes through this element taking the physical characteristics that are needed to continue with the forming process of final product's basis.

CHARACTERISTICS

It is a machine composed by: a gear and a motor driving or a driving geared motor. An outstanding constructive detail is that it must have a very good thrust bearing placed into the main axle, in order to resist the pressure, originated in the barrel, which presses the screw against the thrust bearing. When this one is missing or is not enough reinforced, the pressure breaks the main gear therefore, the whole gearbox. The ideal thing is that the gearbox has the possibility to change the speeds; most of the old machines do it by means of an additional main gearbox, others do it by means of direct-current motors through a rheostat, changing the speed proportionally to the received current. The most modern ones do it with alternate current motors provided with equipments with thyristors or electronic variators, which allow changing the turning speed of the screw in the cylinder, within a wide speed range. With these ones, somebody can improve the plasticizing and performance of the extruder.

The driving part of the extruder, the barrel and the screw are the productive elements.

THE SCREW

The screw diameter measures up to: 35 mm, 40 mm, 50 mm (2 "), coming up to approximately 150 mm. That corresponds to the biggest standard machines. The length of the screws is defined by the quantity of diameters. This is called: relation L/D (Length/Diameter). The most common ones are 24 L/D, 28 L/D, 30 L/D, and 33 L/D.

In addition, the screws have different geometries and designs; there are ones with mixing zones, with simple and double flight.

Moreover, there are with or without decompression zone of the screw, a matter that is very important for some recycling processes because two orifices can be made on the barrel at the decompression zone of the screw, achieving a degassing. In other words, they let gases and remains of water steam go out freely. This is fundamental to obtain a perfect recycled plastic material without spots (the water appears like little marks in the pellets and often as pores (spongy or not compact pellets), which decreases the quality and the price of the recycled material.
DIAGRAMA

Diagrama de un tornillo… = Diagram of a normal screw for extrusion.
To fulfil the safety and industrial hygiene standards, it is necessary to place a gas extractor-hood above the degassing zone and/or to connect it to a vacuum equipment that extracts the gasses and the dampness.

TYPES OF EXTRUDERS

There are extruders that work with one screw and there are other cases that work with two screws rotating synchronized and with an opposite direction. This will depend on the type of material that which it will be used.

There are extruders with gas heated barrels, they are cheap but dangerous. The ideal ones are those with the electric band heaters controlled by thermocouples and zones cooled with air blowers in order to get down more rapidly the temperature when needed.
There are adiabatic extruders, which are extruders with a minor relation L/D and high speed of rotation, with special geometry of the screw and minimal light between the flights and the internal barrel wall. These extruders increase the work temperature by themselves because its own material frictions and allow a good mixed material and a plasticizing process.

Also, there are tandem extruders in tandem: the first (and main) extruder plasticizes, mixes, makes the first filtering, comes out into another small extruder that compresses, filters, and expels the material trough the sieve, the strand die or the cutting head (see next titles: “The Filters” and “The Cutting Heads”.)

FOTO: Line of recovery which takes instantly the film from the winded rolls and keeps processing the material.

There are extruders for a recovering process, that is, instead of having a hopper in vertical form, they have a lateral opening to take, for example, the scrap of film rolls or ground material coming from a silo connected to the entrance of the extruder with a spiral conveyor, which presses and forces the material.

FOTO: Picture of the hopper

MATERIAL’S FEEDING

The material’s entrance to the extruder, in the hopper’s base, has to be very well cooled with water, in order not to make the above mentioned materials be squashed, leaving always the passage free for the material, and at the same time, preventing that the material and very warm gases move back due to the internal pressure inside the cylinder. This is very important, and it is necessary to check these parts frequently as it is the basics of a good functioning.

The hoppers are in a separate chapter in the recycling. In the case of the film, the hopper needs to have a pushing spiral since the ground film has a very difficult sliding property. It is possible to help it with slipping substances, for example, zinc stearate and materials of this family.

For hygroscopic materials as the PET, PC, it is necessary the use of closed heated hoppers, and in many cases with cartridges of silica gel or similar, to dry and extract the gases and vapours that are generated during the process. Other materials must be fed through forcing hoppers or with a good slide.

THE FILTERS

The filters are those that give the quality to the final material. They consist of metallic meshes located at the exit of the plasticized material from the extruder. At best, on filters with packages of screens done with stainless steel wire or with a galvanized wire of good resistance placed on the carrying discs. The discs carry a package with a minimum of 3 layers of mesh going from bigger to smaller mesh size, to the effect of retaining the impurities that are coming in such plastic wastes such as: metals, coal, burnt plastic and non thermoplastic materials. The filters can be changed manually, hydraulically or continuously. The last mentioned are very good and are advancing at a constant pace, as the plastic is flowing, allowing to work with continuity. They are elements placed at a high price and the inputs are not cheap, but without interruptions the savings in repeated stops, so that these filter changers are rapidly paid off.

The material is pushed inside the extruder into a semi-liquid state and passed through the set of filters, where the impurities remain retained. A clear sign that shows that the filters must be changed is when the amperemeters of the extruder accuse increases in the values of torque over that in normal functioning.

If using a mesh of high quality, these filters can be recovered burning them and checking that all the openings are clear. These recovered filters have to be used between two new meshes. A damaged filter will not stop the impurities from passing so the material loses quality. It is possible to realize when a filter has broken at the moment when the amperemeter shows values below the normal ones since there is a fewer resistance to the material.

CABEZALES

Un cabezal a la salida...: The head at the extruder´s output form strands, these ones are taken to the water bath for their cooling.

Once the material is filtered, it goes to a head whose habitual form is flat with conical holes (minor to major diameter) where every hole will form a strand of approximately 5 mm of diameter.
The strands are taken to a cooling bath of water, to obtain afterwards a good cut. An air jet at the end of this bath eliminates the water remains and the strands are pulled towards a cutter by a set of grooved rollers. The diameter of the strand can be smaller or bigger depending on the speed of the set of rollers of the pelletizer.

CUTTING DIES

These dies are the ones that will generate the final product, the pellets, of recycled material.

Nowadays, there are cutting dies that do not need the cooling bath and produce an uniform cut, unlike the type with cutting cylinders, allowing it to be employed at an almost closed loop circuit that, due to the air jet, the material dries up and is conveyed to a bagging devise.

With the cutting dies under water, it is the same; somebody saves exposing the material to the water bath and to the imperfect cut of the cutting cylinders. The water baths are not bad; you must control them, have a correct pulling, and a strand spacer in order that they enter correctly through the opening of the cutting cylinders pelletizer. It has a fixed knife and two or three rotating ones.

It is also important that the water cooling bath is not too cold, to avoid giving a thermal shock to the strands. It is advisable to have a closed loop cooling system.

There are modern recycling systems that mill the material, homogenizes it in an horizontal rotating drum, pours it into a continuous agglomerator, and then, the agglomerated material half plasticized, falls into an low L/D extruder that homogenizes, compresses, and filters the material pushing it directly to an under-water head and obtaining a material in the form of a lentil with a very good quality. These equipments are very sophisticated and with a high throughput but their cost is very high, between U$S 700.000 and U$S 1.000.000

On the market, it is usual to find rudimentary recycling machinery at a reasonable value coming from small projects, whose owners have already capitalized and then bought more modern equipments or from endeavours that have failed due to ignorance or inconstancy , but it can be successfully employed while being handled by more skilful and constant people. It is a matter of looking for and taking a correctly advice in order to obtain them.

SELFEVALUATION CHAPTER 6

6.1 - The function of the extruder is:

a. Plasticize the materials
b. Form the pellets at the end of the line
c. Cool the materials rapidly

6.2 - The degassing produces:

a. A material of better quality
b. A material with dampness
c. An impure material

6.3 – The hopper for PET must be:

a. Opened
b. Cooled
c. Closed

6.4 - The filters of an extruder must be changed.

a When the extruder temperature increases
b. When the strand comes out dirty
c. When the amperage of the motor begins to increase

6.5 - The head after the extruder, produce:

a. Final pellets
b. Flakes
c. Strands of material

6.6 – The cutting head will produce:

a. Final pellets
b. Flakes
c. Strands of material

7 ARTICLES FOR A DIRECT RE-USE

Once the materials are obtained, it is possible to give them different destinies:
- Sell them as they are suitable to the buyers who will later process and manufacture them for a final product
- Try to make final products, incorporating the necessary machines into the project.

There is a surprising variety of products that can be obtained from plastic wastes. It is important to bear in mind that the further we go in the processes and productions, the major the obtained earnings will be, due to these products have an added value.

WHAT CAN WE OBTAIN FROM PET

Once the processes of separation is finished (washed, dried and others, explained in the previous chapters), we start out with our raw material, which are homogeneous enough, clean, and dry flakes. From there, we will be able to invest in different machineries to obtain:
- Sheets for thermoforming. These are sheets that are used with the known as thermoforming machines, that applying pressure and heat we can obtain egg-cups, trays to place pieces, and diverse products (if the PET or any plastic product is quite recycled, it cannot be in direct contact with foods (*)

(*) See note at the end of the chapter

Thick sheets are used in room dividers, shower enclosures, eaves, greenhouses, roofs, etc.

For these first two applications, the used production lines are basically composed by an extruder with a flat die at its output and a set of cylinders (the calender). The roller that gives surface finish can be embossed by giving different types of surfaces to the material.

- Nowadays the production of sanitary pipes is being developed with a mix of PET and polyolefins (85% – 15%), which is being already used in the production of fibres or brushes.
- The manufacture of monofilaments of PET is done from recycled PET.
- In addition, the PET, from bottles, has an enormous expansion in the fabrication of "fleece" fabric for cloths (divers, outdoor), and in the carpets manufacture. These technologies need big investments. Therefore, the industrialized countries are the buyers of this PET, even the ones with “cosmetics” or “make-up” (without washed, as it was detailed in previous chapters).

WHAT CAN WE PRODUCE WITH POLYETHYLENE

When HDPE (high density polyethylene) and LDPE (low density polyethylene) have been separated , the manufacture of plastic bags is an application that does not need big investments, specially for residues (trash bags), black film to cover up and products that do not carry food inside.
These bags, generally, are made of dark colors since materials coming from printed and coloured films are used. Likewise, it is necessary to bear in mind another aspect of these materials, it is probably that the final products will release an unpleasant smell; most of the time, this can be treated and solved using additives that neutralize these smells.

Obviously, the great advantage they are the priceless in terms of cost since it starts from raw material of low value and the manufacturing process of the bag is not too costly either.

For the bag manufacture, two processes are needed:
1. To make the film: by the blown film system.

2. To make the bag: by placing this film in the bag making machine.
3. If it is not possible to have a line of blown film, it is possible to obtain the bobbins of film exchanging them for recycled materials and making the bags with bag making machines.

The obtaining of plastic film made with a line of blown film consists of an extruder, a circular blow die placed in a vertical position. The raw material is plasticized in the extruder, and at the exit, it is passed through the head to which it is connected to an air ring that blows air to pressure and form a great cylindrical tube of plastic called "bubble".
This bubble comes up as the low surface is blown and at the same time it is being cooled until it comes to a height where the plastic material has been cooled enough and collapsed by an element that presses it forming a flat tube. By means of rolls, the tube is driven down to be rolled. Plastics can be cut in a side and spread out as a broader sheet can be folded like a bellows, etc (*)
As soon as someone has the bobbins of the requested material, these are loaded in the unwinder of the bag manufacturing machine. This machine forms the bags by welding and cutting or welding and die cut in winders.

There are simple machines where the film is simply placed in position and a lever is manually pulled down (or a pedal is pressed), and in that precise moment, a metal bar is warmed, coming down and pressing the film and the placed parts get welded together. This process can be an interesting endeavour by itself in an individual form, or used inside the same general project, giving more manual labour.

There are, also, other machines that unwind**,** tense, fold where it is required, place the film, weld and cut the bags, pile them up to form packages with the required quantities of bags in an automatic way. All depends on the level of investment, the quantity and type of bags that you want to obtain and on the type of materials used. Provided that, there are many designs of bags on the markets, for example:

(*) This topic will be treated in depth in future courses

- Simple bags for delivery (greengrocer's shops, fruit stands, and other several types)
- Type T-shirt bags
- Garbage bags with lateral folds
- Garbage bags with reinforcements
- Bags for heavy articles or in bulk (sand, lime, etc.)
- Others

Besides the films and bags, it is possible to make products with recycled polyethylene with the system of plastic injection. In order to be able to do this, it is necessary to have an injection machine and the moulds of the products that are wanted to produce. The variety of products that can be made with recycled plastic is very wide with exception of the ones in contact with food products (*)

There are many injected products that fulfil this conditions, for example those products for gardening such as flowerpots, flowerpot underplates, plastic fences, tutors, elements to hang flowerpots, etc. If other alternatives are analyzed, they will find many suitable plastic articles for this process.

An injected product is recognized because they generally have an outstanding point in someone of its surfaces or sectors. This point is caused by the process of injection.

(*) see note at the end of the chapter

There are manual or semiautomatic injection machines with ancient technologies, micro injection machines for small products, or automatic injection machines (the most spread out). The best adequate size of the injection machine will depend on the dimensions and weight of the biggest piece that wants to be made. Based on this information, it will be possible to determine the plasticizing capacity, the necessary clamping force, and the mould dimensions that the machine must let in.

A typical injection machine has a special screw, which plasticizes the plastic material, moves it towards to the injection nozzle and introduces it into the mould. The clamping unit consists of a system that closes the mould and keep it in such a way that at the injection moment when receiving the plasticized material; and as soon as the mould is filled and the material has been solidified (the mould is cooled and the temperature difference makes the plastic harden), then the mould is opened and the piece is ejected.

Depending on the piece types, the mould can have one or many cavities. A mould for a garden chair is not the same as the one for flowerpot underplates. The latter one will probably have 4 cavities. This means that in every plasticizing-injection 4 plates will be made at once, in the case of the bleach bottles´ caps when the injection unit is opened, you can see from 24 to 36 coming out together.

Therefore, it is also important to know market size. Depending on the piece to be made, there will be different moulds which can have different cavities, and these can be interchanged in the same injection machine.

Moreover, there is another process where the polyethylene can be used; it is the extrusion blow moulding. By means of this process, hollow products are obtained like large bottles, bottles, and flasks, which are not going to be used for food products.
There is a possible market for products like lubricants and oils (not foodstuff), cleaning products, flasks for small products, and so on.

ESQUEMA

Procesos posteriores en los que se…= Following processes where recycled materials are used.
After the extrusion (machine at left) of recycled polyolefins it is possible to use a number of processes to produce a large number of products.
From top to bottom:
With another extruder is possible to obtain tubes, drain pipes and others.
With an injection machine you can produce housings for electric household appliances.
By means of blow moulding, you can produce hollow pieces.
With a bag making machine you can make garbage bags and others
With a press you can obtain different particular pieces.

WHAT CAN WE PRODUCE IF WE HAVE MIXED PLASTICS?

Plásticos mezclados y… = Mixed and dirty plastics in a landfill, many times difficult to separate

This one is one of the biggest challenges that plastic recycling has presented. We already know how we can separate the different plastics, how to recover them and how to make different products. However, in the real life, not all the plastics are that easy to sort out. Besides, there are several plastic products that are impossible to separate.

A meat bag is composed by 5 or 7 layers of different plastic materials since they must comply with the functions of protecting the meat from decomposition (caused by the contact with oxygen), keeping its original characteristics at the moment of packing and preventing that the

ultraviolet light changes its condition. However, the material of this bag is too thin to be able to separate every layer!

A juice can be presented in a Tetra Brik, which is a packing composed by: carton, plastic and aluminium. Evidently, it is an effective, comfortable, and easy to carry packing, difficult to break or to change the qualities of the product that it contains, it is attractive and of low cost. Precisely after being used, how do we separate its components?

If we walk around a landfill, we will see a great quantity of plastic, but we will not be able to determine which type of plastics because they are already mixed and dirty from time, discoloured or with wasteful liquids… so despite of all the above, what is possible to do with these plastics?

As the plastics are accumulated in the different landfills of the whole world, the concern grows and there has to exist some kind of solutions.

In the last years, technologies obtained some material form these kind of mixed plastics have been developed, with them being dirty (as they were found) and having no need to wash them, or dry or do any other process. This is a great discovery that can help solving the large accumulation of plastic in all the landfills of the world!

The process can be manual, industrial, or non-industrial. The final product is the synthetic wood, called like that because it is not wood but a product obtained from the dirty plastics that, after recovered, mixed, filtered and moulded, behave like wood in its different forms and uses.

The synthetic wood is ideal for outdoors use. Many people tend to compare with natural wood but, on the other hand they have so many advantages compared to this one that it is possible to say that it is a matter of having a new material for similar uses.

The synthetic wood:

- does not oxidize
- Does not rotten
- is neither attacked by bacteria nor chemical agents
- remains unaltered by different climatic conditions
- is insulating

In comparison with the processes of the natural wood, the synthetic wood can be:

- Cut
- serrated
- nailed
- stapled
- sanded
- channelled
- mass dyed (the wood does not allow it)
- others

From the production process, there are usually different types of profiles obtained (like if they were natural wood) such as tables, posts, or pieces like: tiles, gratings, and even pallets. With all these basic pieces and more final processes applied, it is possible to obtain infinity of elements and products:

Pallets, tiles, sink lids, speed bumps, grids, industrial floors, chairs and tables, camping sets, urban furniture like litter bins, square benches, street signs, children's playground furniture, curbs, cycle racks, booths, parking signs, road signs, platforms, decks, walk ways, picks, posts

for vineyards and tomato plantations, dock protections**,** and everything what imagination can construct.

An industrialized system developed in Europe bases its technology taking mixed and dirty plastic by quantity, sorting out simply the rigid ones (boxes, bins, cabinets, etc.) from those flexible ones(bags, totes, etc.) and grinding separately each group. Afterwards, a combination of these grinding is placed inside an extruder in certain proportions with special characteristics. The plasticized material is poured into moulds filling with a low pressure. This system is called "intrusion". When the material has been cooled, it is removed from the mould.
In this case, the investments are big, besides needing a great quantity of grinded plastic materials: approximately 300 kg/hr. That is why it is industrialized; big quantities of products are obtained. This technology is very modern and generally automated; there are approximately 200 plants in the entire world with this process.

Many municipalities have found in the world, across this technology, a very big saving in terms of the cost of sanitary landfills maintenance. It is an enormous opportunity to give work to unoccupied labour force, achieving an ecological and economically balance. Consequently, it tends to the improvement of the quality life of the population which can be obtained by their leaders – by means of decisions for sanitary politics actions - a great recognition and political income results from obtaining a social-economic balance in their zone of influence.

A valid alternative to this advance technology is the fabrication of synthetic wood with simpler processes - semiautomatic or manual ones – using simpler extruders and other elements. It is possible to obtain the same type of product, maybe in minor quantity and using simultaneously major labour force. This process can be the solution for many municipalities and town councils, where nowadays they accumulate the SUW (Solid Urban Waste) instead of separating and recycling it.

NOTICE: the work with high temperature of the PET and the PC in its previous steps, make that a small percentage of the recovered (10 % - 15 %) is innocuous when used to contain water and do not harm the health. International Control Institutions of great prestige have authorized certain recycled materials under control to be used with liquids, for example the PET and the PC. There is even an approval to use PET of "bottle to bottle" or, 100 % recycled by means of a special process of recuperation.
Argentina adheres and agrees to this topic, so it is recommended to consult to the organisms of your own country.

SELFEVALUATION CHAPTER 7

7.1 - The recycled materials:

a. can be used in contact with food
b. cannot be used if they are impure
c. cannot be used if they are of different colors.

7.2 - It is possible to make cheap translucent and brilliant panels, from the following recycled materials:

a. Polyethylene
b. PVC
c. PET

7.3 It is possible to make bags from the following recycled materials:

a. Polycarbonate
b. PET
c. Polyethylene

7.4 - The film of recycled polyethylene is produced with:

a. An agglomerator
b. A line with extruder, flat die and rollers
c. A extrusion blow film line (bubble)

7.5 - To be able to inject pieces of plastic, besides it is necessary to have:

a. Moulds for every piece
b. A film winder
c. An extrusion blown film system (bubble)

7.6 - To obtain synthetic wood, the plastic materials:
a. may be mixed and dirty
b. it is necessary to wash them
c. it is necessary to wash them and to separate them

CONCLUSIONS

Appreciated readers: we believe that we have introduced you in a great world of possibilities. We have offered across all these pages a brief review of what is the recycling of plastic with small and medium resources. We have also presented some of the basic terminology and explained practical technologies. This can be a guide to be better interiorised on this lucrative and interesting business for the professionals, the educators in general, the politicians and social leaders, and for every person who wishes to transform this activity in their way of life.

This course has given the fundamental guidelines on how it is possible to generate a great heap of labour ways at all levels. The authorities and leaders, who undertake this task, will be able to enjoy a high political and social profit, solving partially the problem of the unemployment and generating a more hygienic and neat life environment. The entrepreneurs of this activity (individual or nucleated in groups) will be able to obtain interesting earnings from this activity without doubts.

Consecutively, this can give place to new hopes and aspirations, especially to the people who wonder unhopefully for all the nations of our planet.

In the future, we will be presenting successive courses with specific topics treated in depth but always following the same orientation: to take care of the environment, " to teach to fish and not to give the fish served ", to create possibilities for the social improvement, offered to those who because of their age, job shortage, or other reasons were left aside on the poles of work and employment.

Let's fight all together and with a complete conscience for a better life, a cleaner world, and let’s allow ourselves to enjoy at the same time the results obtained from our own efforts.

Megaplastic.com, its staff, and this author are at your entire disposition repeating this line of work:

CONSULT - TAKE ADVICE - PREVAIL

To those who help to spread this course, we are early grateful and offer our hands and knowledge to enlarge the circle.
Thank you!

MARCOS WINOGRAD

ANSWERS TO THE SELFEVALUATIONS

If your answers do not coincide with the detailed ones, we recommend you to read the chapter again. If any doubt persists, bring these over and consult the author and his advisers on the email address megaplastic@megaplastic.com

Chapter 1
1.1 – a
1.2 – b
1.3 – b
1.4 - c
1.5 – c
1.6 – b

Chapter 4
4.1 – b
4.2 – c
4.3 – b

Chapter 5
5.1 – b
5.2 – a

Chapter 6
6.1 – a
6.2 – a
6.3 – c
6.4 – c
6.5 – c
6.6 - a

Chapter 3
3.1 - c
3.2 - c
3.3 - a
3.4 - b
3.5 - b

Chapter 7
7.1 - b
7.2 - c
7.3 - c
7.4 - c
7.5 - a
7.6 - a

APPENDIX
Most common symbols of plastic materials

PE	Polyethylene (general)
LDPE	Low Density Polyethylene
LLDPE	Linear Low Density Polyethylene
HDPE	High Density Polyethylene
PVC	Polyvinyl chloride
PET	Polyethylene Terephthalate
PS	Polystyrene
HI-PS	High Impact Polystyrene
PC	Polycarbonate
PUR	Polyurethane
ABS	Acrylonitrile Butadiene Styrene
SAN	Styrene Acrylonitrile
PA	Polyamide (Nylon)
EVA	Ethylene Vinyl Acetate

For more symbols, consult in www.megaplastic.com

The purpose of this self-learning course is to give basic knowledge and technologies about the plastics to be found in large quantities in the household waste, trash sorting plants as well as in stores or industries which discard packaging and production scrap.

From this basic knowledge you can initiate recovering micro-enterprises and/or popular cooperatives, or improve the existent ones, simultaneously to the collection of paperboards and papers.

Advancing in the reading, you can accede to the knowledge of plastics' selection criteria, to differentiate and collect them for their sale or industrialization with easy and fast investment return, giving the people involved the possibility for an important and economic labour way.

The present course is directed to collectors, rummages and to all those who are looking for alternatives and have limited resources; to technical students looking for an early labour way, to those, supported by municipalities or progressive leaders, who are looking for a direct or indirect profitable way out. The NGOs have a place and an important role to develop.