

Separate waste collection

Recycling materials

With the Ronchi decree, separate waste collection was started in the Italian homes, and has now become part of our daily activities, and the small yet big contribution that we can give to the environment. Separate waste collection is the process in which domestic separation of waste is carried out with the aim of re-addressing, upstream, the various types of waste that are present in our homes and to optimize management of the same.

MSW materials that are collected separately often consist of the packaging of products we have purchased such as: paper, glass, plastic, aluminium, wood, humid or organic fraction, electronic waste (WEEE- waste electrical and electronic equipment) and bulky waste. According to the last report by ISPRA, separate waste collection amounted to 14 million tons in 2015 (47.5 % of the total), and the organic fraction was predominant (43.3% of the total), followed by paper (22.5%), glass (12.5%), plastic (8.4%), wood (5%), bulky (3.5%), metals (1.9%), waste electrical and electronic equipment (1.6%), textiles (0.9%), other (0.6%).

Paper

Paper is the material with the highest recycling rate in our country. In fact in 2015 the percentage of paper and cardboard packaging material that was recovered amounted to 88,7% and average per capita collection in Italy was assessed at 51.5 kg/inhabitant. Collection is extended to all types of paper, including drawing paper, paper for graphic use, for photocopies and for newspapers, cardboard and paper bags. However soiled paper (like the boxes used for pizza delivery) must not be put in the separate waste collection, as it might pollute and contaminate paper that can be recycled. The consortium of companies that collect and manage this packaging is called Comieco. Up to the 90s, Italy imported large amounts of raw material from Northern Europe in order to supply the paper industries, while now Italy is an exporter of recycled paper and cardboard. The paper recycling cycle starts with the separation of the different types of paper and cardboard that are brought to the specific plants: packages, discarded cardboard, mixed paper. After being sorted out, the paper is shredded with the help of special machinery, known as a pulper, and it is sifted in water to remove the contaminants, and finally also the glue and ink are eliminated. Subsequently the pulp that is obtained is mixed with raw material. In fact the process weakens the cellulose fibres that form the paper, making them short, and therefore it is necessary to include an additional amount of virgin raw material, so as to obtain the same characteristics of the standard material.

This degradation takes place every time the material is recycled and it has been noted that the maximum number of times that paper can be recycled is 4. Saving, in terms of materials and energy is remarkable. By recycling paper we save 30% energy, 50% water, and 100% material as no trees need to be felled. However the paper whitening process often requires use of chemical compounds, like bleach, that can be particularly polluting for the environment. Lastly, according to Comieco, 1.31 tons of CO₂ eq are avoided per ton of recycled paper.

Therefore paper recycling has a double advantage for our country. From an economic point of view imports of virgin raw material are decreased, and also the amount of material that is disposed in the dump decreases. From an environmental point of view there is a remarkable saving of energy, water and raw materials.

Glass

Glass is both fragile and eternal, and it is one of the most interesting materials from the point of view of recycling. Because of its physical and mechanical characteristics it is a particularly interesting material that does not become degraded qualitatively during the recycling process and can be reutilized practically an infinite number of times. A bottle that is melted again in the furnace of a glass industry, will generate another bottle with the same qualities as the previous

one, and this total recyclability enables a remarkable energy saving in the melting phase. Furthermore, with regard to this material the percentage of recycled glass in Italy is high, equal to 70.9% of the material consumed in the market in 2015, according to the estimates made by Co.Re.Ve., the consortium in charge of glass collection and management. The glass that is collected initially is subjected to a first selection, in order to remove any polluting materials, it is then crushed and any metal parts are removed. A final manual separation takes place in order to remove any ceramic and metal residues that may still be present. The material that is obtained is called glass cullet which is ready to be melted in the furnace. At this stage the glass production phases begin, which include mixing sand (silica) with limestone, soda and additives, plus a variable percentage of crushed glass (up to 90%). The materials are baked in special furnaces up to 1500°C, in order to reach the melting point. The vitreous mass that is obtained is sent to specific machinery where it is blown in moulds and transformed into new containers. Use of glass scrap requires a lower temperature for the material to melt than the raw materials and produces less atmospheric emissions. Furthermore out of 1 kg of glass scrap 1 kg of new product is obtained. Energy and material savings are very significant, equal to 25-30% and 100% respectively, and there is a 40% decrease in CO₂ eq emissions.

Plastic

If we look around, we will see that many of the objects that we use daily all around us are made of an extremely versatile, light and economical material, plastic. The toothbrush, the cover of the mobile phone, pens and felt pens, the computer, the television, all these objects and many others contain at least some plastic. However there isn't only one type of plastic. Items made of this material are of many different types, and it is sufficient to compare the plastic supermarket bag and the bottle that contains a detergent to immediately see a number of differences. The term plastic in fact is usually used to classify different families of polymers, i.e. long chains of molecules with a high molecular weight consisting of a large number of molecular groups, derived from petroleum refining and containing carbon, hydrogen, oxygen and chlorine. Each type of plastic corresponds to a different material, with specific physical, chemical and mechanical characteristics. This heterogeneousness implies different recycling processes, depending on the polymer or the family of polymers that are treated, so that in this case it is not possible to speak of plastic recycling in general, because actually there are many plastics. The most common and most widespread in daily consumption may be subdivided into two large groups: thermoplastic material, that softens in the presence of heat and becomes hard when cooled, and thermohardening material that solidifies irreversibly when heated. Thermoplastic resins are the easiest to recycle and among these categories the most common in our daily use are:

- PE, polyethylene, generally bags, bottles and film are made of polyethylene – depending on the type of processing it is subjected to;
- PP, polypropylene, used for a large number of different items from food trays to garden furniture;
- PVC, polyvinylchloride, for trays, film, pipes;
- PET, polyethylene terephthalate used for bottles for soft drinks and mineral water, synthetic fibres;
- PS, polystyrene, better known as thermocole used mainly for corks, plates, cutlery and trays for foodstuffs.

The recycling procedure can be mechanical (more common), or chemical. Firstly, in case of the mechanical recycling procedure, the material collected through separate waste collection must be selected so that any foreign bodies are identified and eliminated, and the different types of packaging are sorted according to the type of polymer and colour wherever possible. In order to guarantee high yields, selection of the different plastic materials is fundamental. The

sorted material is then sent to the recycling line where it is crushed, washed, ground, dried and finally granulated. In the final phase granules or flakes, that can be used in transformation plants, are obtained. Chemical recycling instead is applied on an industrial scale, and it is aimed at breaking the polymer macromolecule into its more simple individual units (monomers), to be used as new raw material. The granules and flakes can be used for different purposes depending on the initial polymer: for example PET bottles are used to produce fibres and textiles (such as pile blankets), PE is used for bottles and containers, PVC is used for pipes and sewage plumbing, and electrical materials. In Italy, separate waste collection is only carried out in the case of plastic packaging materials, for which the percentage of recovered product is however high. According to ISPRA, recycling of packaging material amounts to 84.4%. Furthermore, unlike paper and glass, for plastic, also energy recovery may be foreseen (remember, plastic is obtained from petroleum) as its lower heating power, i.e. the amount of heat that is freed during combustion, is sufficient to justify this option (30-35 MJ/kg). How much do we save by correctly recycling plastic? Energy saving is high, from 40% to 90%, with an average of 50%, while the saving of material is 100%! If we avoid sending plastic to the dumps and we recycle it correctly, we avoid emissions of 1.39 kg CO₂ eq per kilo of plastic, and therefore contribute to contrasting the increase in carbon dioxide emissions in the atmosphere.

Wood

Wood is a rather uncommon material in our daily separate waste collection, however it is not less important than the others. Wood, like plastic, does not always have the same characteristics. In fact there are many different kinds of wood, that are used in different ways depending on their nature. In any case recycling wood is very important for two reasons: firstly natural resources are preserved, since by recovering the material less trees are felled, and secondly, by avoiding sending wood to the dump there is a saving in emissions in the atmosphere of methane and carbon dioxide, which are gases that alter the climate. With regard to household separate waste collection, wooden items are mainly furniture, interior decorations, doors, fixtures and various bulk items, while wooden packaging is present in negligible quantities in the form of crates for fruits and vegetables, prestigious boxes for wines, liquors and distilled alcohol, small boxes for cheese corks, and occasionally pallets.

For this reason, wooden materials follow a separate circuit and are collected locally after contacting the appointed consortium, Rilegno, or they can be personally taken to suitably equipped stations or ecologic areas that are made available for the citizens. All the wood can be recycled and the resulting material is of a good quality. Wood waste that is collected, is prevalently subjected to mechanical recycling. The material from the platforms is selected and cleaned so as to eliminate any foreign bodies (metal, paper, various plastics, inert materials), after which it is chopped into small chips that are ready for use. These chips, after a drying process that is necessary in order to limit the level of humidity, are pressed with glues with a very low formaldehyde content, in order to produce chip-boards, which have the same characteristics as new chip-boards, used in the production furniture, interior decoration accessories and coverings for indoor and outdoor structures in homes and offices. 95% of wood waste is processed in this way. The remaining amount is used for the production of cellulose paste for the paper mills or is subjected to treatment that makes it suited for use as a raw material for the realization of wood and cement blocks that are used in green building projects. A small part can be used in composting plants, for the production of compost or loam for sale on a large scale. Lastly, wood waste can be transformed by means of various processes into solid fuel for incineration plants or for biomass combustion plants for the production of heat and energy. Another regeneration method is foreseen for pallets, which can be separated and re-introduced in the consumer circuits. According to ISPRA, in 2015 64.2% of the packaging that is used in the consumer market in Italy was recovered.

Aluminium

Aluminium is light, versatile, durable and quite malleable. This metal has exceptional characteristics that make it particularly suited not only for the production of cans but also for car parts and for use in buildings. Recycling aluminium is very important because its production is a particularly costly one from the point of view of material and energy, in fact

aluminium is obtained from bauxite which is a sedimentary rock, and 4t of bauxite and 14 MWh of electricity are required in order to obtain only one ton of aluminium.

What happens to our cans after they have been thrown in the separate waste collection bag together with plastic or glass? Collection of aluminium is generally carried out as a multi-material collection, i.e. together with other types of materials such as plastic, because of the costs involved. The first step towards recovery is the separation of the cans from other packaging materials, after which the aluminium is crushed and separated from any iron residues. After which the cans are treated at 500°C in order to remove any paint or adhesive substances. Finally they are melted at 800°C and new materials are produced. Among the advantages of recycling aluminium, there is the absence of a decline in the quality of the material during the process. As a consequence of this characteristic, this material can be recycled an infinite number of times, with remarkable energy savings (electric energy saving equal to approximately 95%), as the production process of bauxite and the material is particularly energy demanding. Also energy recovery is possible. Aluminium powder and sheets, in fact, can be assimilated with fuels and, when heated up to 850°C, 1 kg of aluminium releases 31 MJ of energy, the same energy released by 1 kg of coal. Saving of energy and resources is very high: 95% energy is saved and 100% of material. According to CiAl estimates, in 2015 the recovery of aluminum packaging was 75.5% and the avoided CO2 emissions of 345 thousand tonnes.

Waste electrical and electronic equipment (WEEE)

In Italy, the acronym WEEE stands for waste electrical and electronic equipment. In this category, many types of waste that differ in composition, method of utilization and characteristics, but which are all afferent to electronic devices, are grouped - i.e. all the devices that use electric energy for their operation. WEEE can be of two types: domestic and professional, which are then subdivided into 10 categories:

- Large household electrical appliances
- Small household electrical appliances
- IT and telecommunications equipment
- Consumer equipment (consumer electronics)
- Lighting equipment
- Electrical and electronic tools
- Toys, leisure and sports equipment
- Medical devices
- Monitoring and control instruments
- Automatic dispensers

In this category of waste, a number of different substances and materials can be found, such as plastic metals, chemical substances, etc. and for this reason their correct disposal and recycling is rather expensive. Up to not long ago, this waste was erroneously disposed of in the dump, which involved severe risks for health and the environment. In order to avoid this damage, the European Union and its Member States promulgated a series of measures in order to manage this type of waste correctly.

How are these special materials recycled? There are 4 phases in order to recycle WEEE: separate waste collection, making the materials safe, treatment and recovery. Separate waste collection of WEEE is carried out by the end user, who, in this case is not always the consumer, but can also be a retailer or the Company that is appointed to take care of the same. For the citizens, collection points are usually available, or a service for collecting the equipment directly at home, which is an alternative to the door to door collection. Professional WEEE is collected directly at the premises of the company, organism or plant. WEEE that is deposited is taken care of (in Italy) by ReMedia a consortium that is in charge of treating the materials and making them safe. This is because WEEE often contains harmful substances that must be separated before they are treated, and must be removed so that it is easier to recycle the materials. Waste is subjected to inverse production lines that break up the materials and transform them in order to recover the raw materials that can be utilized again in new production cycles.

Organic waste

What happens to a banana skin when we throw it away? If we want to try an experiment, and we leave it in a garden, we will notice that in a short period of time the skin will transform and disappear completely or almost completely, leaving a new organic substance in its place which is then absorbed by the ground. This happens because the banana is an organic waste and it is biodegradable like kitchen leftovers and garden cuttings, and therefore decomposes easily and is transformed by saprophytic bacteria. So can we also think of recovering organic waste? And if so, how? Organic waste is transformed by means of a biological treatment, composting, in order to recover the organic material that is present in this waste and to obtain a new material called compost. Compost is not a fertilizer, but is defined an organic amendment, because it adds an organic substance and nutrients to the soil (nitrogen, phosphorus and potassium), consequently leading to a decrease in the use of chemical fertilizers. The process consists of the decomposition of the organic substance by microorganisms, in aerobic conditions, i.e. in the presence of oxygen. The principal products obtained from the compost reaction are CO_2 , water and heat. This is a natural phenomenon that is forced by insufflation of air and by periodically turning over the material, in order to accelerate the reaction. Compost production times vary depending on the material and the period of the year, indicatively from 2 to 6 months. Microorganisms are the main promoters of the process, and they are many and of different strains – bacteria, fungi, algae, protozoa, etc.) and usually they are naturally present in sufficient amounts in leftovers; however, so that they can carry out their function correctly, they must be in optimum conditions. Therefore, in the production of compost, it is important to pay attention to some parameters: oxygen, sufficient porosity of the material in order to guarantee circulation, humidity and the Carbon/Nitrogen ratio. The starter materials, which must be used in compliance with the law, are: the organic fraction of MSW collected separately; plant waste from agricultural crops, sawdust, wood chips, wood fragments, zootechnical sewage, paper and cardboard (in small quantities), mud from civil sewage purifiers and discarded wood that has not been used and has not been treated. Dangerous waste and materials which have undergone chemical treatments are strictly prohibited and, lastly, also inert substances that would hinder the degradation process. In fact it is very important that the compost does not contain polluting substances, heavy metals and pathogenic agents. During the composting process, the materials are suitably mixed in order to obtain an optimum C/N ratio. For example, humid materials have a low C/N ratio while dry materials that act as structuring layers have a high ratio. Two main stages are identified in the composting process: the first phase, ACT (active composting time) is an accelerated bio-oxidation phase in which the waste is highly putrescible and the metabolic process is very rapid and there is a large consumption of oxygen, a maturing phase in which the metabolic process is slowed and the consumption of oxygen decreases, besides any refining process pre-treatment or post-treatment. Depending on the quality of the material, it is used in different ways: to fertilize the land (mixed with manure),

mulching, as soil for covering waste dumps, etc. Composting can be carried out on a domestic scale with small volumes of individual humid waste collection plus other selected materials, or on an industrial scale where large volumes are used and all the physical and chemical parameters are suitably monitored in order to obtain a good quality compost that can be sold in the market. Domestic composting can easily be carried out in composting bins of various sizes (usually 30 or 60 l) which are sold in the market.