Abstract

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris et laoreet ante. Aenean quis odio non neque tincidunt pulvinar. Sed sed congue diam. Quisque turpis dui, finibus eget sodales vitae, imperdiet a metus. Praesent mauris eros, vestibulum blandit tortor id, pretium malesuada purus. Pellentesque iaculis ullamcorper lectus at mattis. Nunc vitae scelerisque purus.

1 Introduction

The laboratory activity concerns the analysis of several polymer materials in PP, PE, PS, PET, PLA, PMMA and tire rubber. Endothermic and exothermic transition of samples has been studied and it was also possible to determinate their degree of crystallinity by considerations on specific enthalpy of melting. Density measurements have been carried out, comparing results with theoretical ones and comparing found degree of cristallinity with one of thermal analysis. In order to study directly the thermal behaviour of samples, different heat treatments have been done. Thermal analysis of PMMA and tire rubber has been done in order to study the composition of samples and their residual mass at high temperature. Sample has been treated with solvents of different concentration in order to study their resistance to chemicals. The various samples used during the activity have been made by different processes. Cups have been produced by thermoforming, in which a plastic sheet is heated to a certain forming temperature, formed to a specific shape in a mold and cut to produce an usable product. Coffee sticks and bottle cups have been obtained by injection molding: the polymer is melted in a specif chamber, injected in a mold and then cooled and solidified. PET bottles have been produced by injection blow molding, a process in which a cylindrical preform is heated and then blown in a mold.

1.1 Materials

1.1.1 Polyethylene

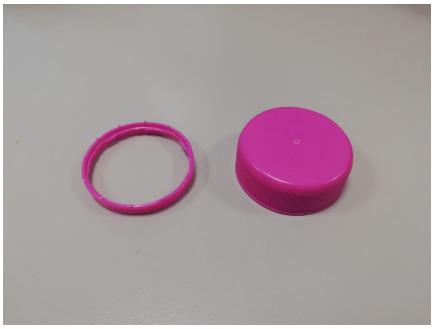


Figure 1: PE sample

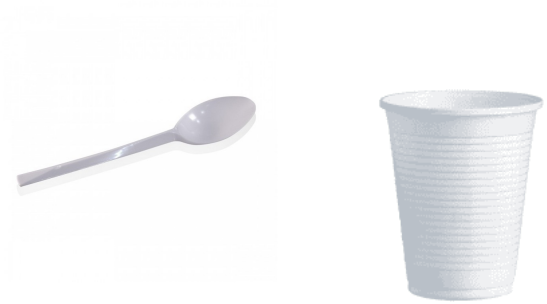
PE is a semicrystalline polymer and due to its low glass transition temperature (below room temperature) it shows a certain deformability.

1.1.2 Polystyrene

PS presents an aromatic ring in his structure that leads to a steric envelope responsable of the low mobility of the chain. Therefore it's an amorphus and rigid polymer.

1.1.3 Polypropylene

PP is a tough and rigid thermoplastic material. Isotactic conformation is obtained by Ziegler-Natta or metallocene polymerization. It shows an high thermal stability due to its semycrystalline structure.



(a) (b)

Figure 2: PS samples

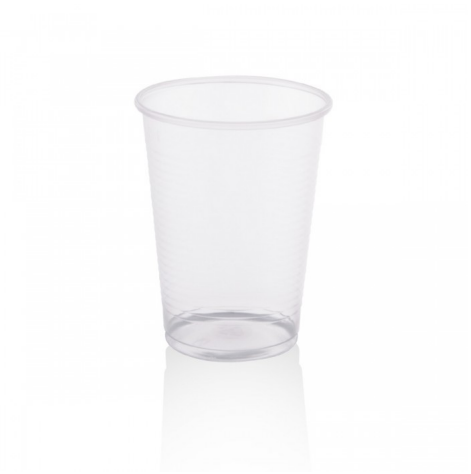


Figure 3: PP sample

1.1.4 Polyethylene terephthalate

Figure 4: PET sample

PET is a naturally colorless, semi-crystalline material. Some of its most important characteristics include: water resistance, high strength despite low density, shatterproof ness and its wide availability as an economic and recyclable plastic.

1.1.5 Polyactic acid

Figure 5: PLA sample

PLA is an amorphous, biodegradable and bioactive thermoplastic polymer derived from renewable resources like corn starch or sugar cane. It is principally made through condensation and ring-opening polymerization.

1.1.6 Polymethyl methacrylate

PMMA is a transparent thermoplastic non-cross linked polymer often used as a lightweight or shatter-resistant alternative to glass.

2 Materials and methods

2.1 Materials

The polymeric materials that have been used are: plastic yogurt cup (PS), disposable coffee stick (PS), plastic coffee cup (PS), plastic water bottle (PET), plastic bottle cap (PE), plastic cups (PS, PP, PLA), disposable spoon (PS), tire piece supplied by Marangoni (Rovereto (TN), Italy). In Table **??** main properties of the analyzed polymers are reported.

Table 1: Glass transition and melting temperatures.

Materials	$\mathbf{T_g}$(°C)	$\mathbf{T_m}$(°C)
High density polyethylene (PE)	−110	138
Polystyrene (PS)	100	–
Polypropylene (PP)	−10	165
Polyethylene terephthalate (PET)	70	265
Polylactic acid (PLA)	50	140
Polymethyl methacrylate (PMMA)	105	–

Tire samples have been provided by Marangoni (Rovereto (TN), Italy) and are mainly composed by styrene-butadiene rubber (SBR), carbon black, sulfur, accellerators and other additives. All the others objects used in the experimental activity have been provided by University of Trento.