POLYOLEFIN (PE AND PP)

Physical and mechanical properties:

Polyolefins are milky white in appearance and waxy to the touch (except for transparent polymethyl-pentene PMP as it is uncrystallized). Polyolefins are opaque when thick and transparent when in the form of film. Although often used as a container or as packing, polyolefins are not completely impervious to water, air or hydrocarbons, but this implies the notion of time and amount of loss tolerated. At ambient temperature (23°C), PE and PP, partially crystalline, are above their vitreous transition temperature, thus their uncrystallized phase is rubbery. The vitreous transition temperature of PP is very close to ambient temperature. LDPE (low density PE) is, at ambient temperature, more sensitive to creep than HDPE (high density PE) and PP (more crystalline). Polyolefins are more sensitive to orientation, i.e. the mechanical properties are improved if the macromolecules are oriented in the direction of the stress. For these crystalline polymers, cuts reducing shock resistance should be avoided. The paraffinic nature of polyethylene (especially HDPE), makes it a material with good frictional properties.

Chemical properties:

Polyolefins have very good chemical stability. At temperatures below 60°C, they are practically insoluble. They are attacked neither by acids (except for oxidants), nor bases, nor salt solutions. They are insoluble in water and even have little affinity for it. They are recognized as being usable for food applications. Polypropylenes are sensitive to hydrocarbons. Polyolefins are, in their natural state, very sensitive to the action of ultraviolet (UV) rays in the presence of oxygen (air), but there are effective photo-stabilizers, as for example black carbon, the ultimate use of a black dye.

Electrical properties:

Polyolefins are excellent electrical insulators for various ambient conditions. This explains their tendency to be electrostatic. They have a very high resistivity and a high dielectric strength. The low dielectric loss factor (tan δ) that represents the energy lost, converted to heat in the dielectric, prohibits high-frequency welding.

Thermal properties:

PE and PP burn, even when the igniting flame is no longer present, with a bluish flame, and they "drip". In incomplete combustion (fire), carbon monoxide and small quantities of hydrocarbon are formed. Polyolefins are, in general, rated HB by UL94, but some flame-retardant grades of PP can be V0 or V2. The vitreous transition temperature crossover is all the less sensitive when the polymer is more crystalline, as HDPE and PP.

Dimensional properties:

Stability is independent of the ingress of humidity (low < 0.2 %) (little affinity for water). These highly-crystalline polymers thus undergo extensive retraction when molded.

Printing and marking properties:

In a general way, polyolefins have a surface on which adhesion is difficult. However, each manufacturer provides solutions and a surface preparation for printing, painting, marking, and even vacuum-system metallization. Polyolefins are pleasant to the touch. Certain grades of copolymer are specially provided for "pleasant contact" applications (handles, grips, etc...).

Implementation properties:

Polyolefins are very difficult to glue together. It is necessary to carry out a flame-type surface preparation (light oxidation) or chemical attack. Infrared, contact, ultrasonic or hot-air welding is no problem. Induction welding (high frequency) is not applicable directly as the energy spreading through the material is insufficient for heating it. This drawback can be corrected by embedding a metal insert in the material. Heating of this metal in the molding parting line will melt the polyolefin to be welded, prohibiting high-frequency welding.