Why These Materials?

A Practical Guide to Food-Grade Plastic Properties & Applications

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DD Industries

Contents

Polypropylene (PP)

Polypropylene is good for dishwasher safe containers because it has a high melting point.
Polypropylene is also appropriate for dishwashers because it doesn't absorb water.
Polypropylene is easy to color.
Polypropylene is translucent, clear containers cannot be made of Polypropylene

http://www.psrc.usm.edu/macrog/pp.htm

Typical Applications:

Dishwasher Containers

DD Information:

Cost	: Inexpensive
Density	: 0.92
Weight	: Low
Flex or "bendy-ness"	: High
Water Absorption	: 0.01
Color Acceptance	: High
Heat Resistance	: High
Melting Temperature	: 338
Impact Resistance	: 1
Hardness	: R95

Polystyrene (PS)

Polystyrene is an inexpensive, hard plastic.
It is extremely common, probably only polyethylene is more common in everyday life.
Polystyrene is clear - Clear plastic drinking cups are made of polystyrene.
Polystyrene often used for molded parts, such as those inside of cars, like the radio knobs.
Polystyrene is also used in toys and housings for things like hairdryers, computers and appliances.

http://www.psrc.usm.edu/macrog/styrene.htm

Typical Applications:

DD Information:

Cost	: Medium
Density	: 1.05
Weight	: Medium
Flex or "bendy-ness"	: Low
Water Absorption	: 0.06
Color Acceptance	: High
Heat Resistance	: Low
Melting Temperature	: 212
Impact Resistance	: 0.8
Hardness	: R80

Polyethylenes

Low Density Polyethylene (LDPE)

Polyethylene is inexpensive.
Polyethylene is easy to color
Polyethylene has one serious flaw it starts to lose its shape at around 100 degrees C.
Polyethylene is a poor choice for containers that may be placed in the dishwasher.

Polyethylene is probably the polymer you see most in daily life. Polyethylene is the most popular plastic in the world. This is the polymer that makes grocery bags, shampoo bottles, children's toys, and even bullet proof vests.

http://www.psrc.usm.edu/macrog/pe.htm

Typical Applications:

DD Information:

Cost	: Low
Density	: 0.92
Weight	: Low
Flex or "bendy-ness"	: Medium
Water Absorption	: 0.01
Color Acceptance	: High
Heat Resistance	: Low
Melting Temperature	: 248
Impact Resistance	: NB
Hardness	: SD55

High Density Polyethylene (HDPE)

Polyethylene is a very commonly used plastic. It is popular due to its many desireable qualities (low cost, easy to color),but it suffers from one serious flaw: PE starts to lose its shape at around 100 degrees C. This makes PE a poor choice for containers that are usually placed in the dishwasher.

Polyethylene is probably the polymer you see most in daily life. Polyethylene is the most popular plastic in the world. This is the polymer that makes grocery bags, shampoo bottles, children's toys, and even bullet proof vests. For such a versatile material, it has a very simple structure, the simplest of all commercial polymers. A molecule of polyethylene is nothing more than a long chain of carbon atoms, with two hydrogen atoms attached to each carbon atom. That's what the picture at the top of the page shows, but it might be easier to draw it like the picture below, only with the chain of carbon atoms being many thousands of atoms long:

http://www.psrc.usm.edu/macrog/pe.htm

Typical Applications:

DD Information:

Cost	: Low
Density	: 0.96
Weight	: Low
Flex or "bendy-ness"	: Medium
Water Absorption	: 0.01
Color Acceptance	: High
Heat Resistance	: Low
Melting Temperature	: 248
Impact Resistance	: NB
Hardness	: SD65

Polymethyl Methacrylate (PMMA or Acrylic)

Poly(methyl methacrylate), which lazy scientists call PMMA, is a clear plastic used as a shatterproof replacement for glass. The barrier at the ice rink which keeps hockey pucks from flying in the faces of fans is made of PMMA. The chemical company Rohm and Haas makes windows out of it and calls it Plexiglas. Ineos Acrylics also makes it and calls it Lucite. Lucite is used to make the surfaces of hot tubs, sinks, and the ever popular one piece bathtub and shower units, among other things.

When it comes to making windows, PMMA has another advantage over glass. PMMA is more transparent than glass. When glass windows are made too thick, they become difficult to see through. But PMMA windows can be made as much as 13 inches (33 cm) thick, and they're still perfectly transparent. This makes PMMA a wonderful material for making large aquariums, whose windows must be thick in order to contain the high pressure millions of gallons of water. In fact, the largest single window in the world, an observation window at California's Monterrey Bay Aquarium, is made of one big piece of PMMA which is 54 feet long, 18 feet high, and 13 inches thick (16.6 m long, 5.5 m high, and 33 cm thick)

PMMA is also found in paint. The painting on your right, *Acrylic Elf* was painted by Pete Halverson with acrylic paints. Acrylic "latex" paints often contain PMMA suspended in water. PMMA doesn't dissolve in water, so dispersing PMMA in water requires we use another polymer to make water and PMMA compatible with each other. To see how we do this, go visit the poly(vinyl acetate) <pva.htm> page.

But PMMA is more than just plastic and paint. Often lubricating oils and hydraulic fluids tend to get really viscous and even gummy when they get really cold. This is a real pain when you're trying to operate heavy equipment in really cold weather. But when a little bit PMMA is dissolved in these oils and fluids, they don't get viscous in the cold, and machines can be operated down to -100 oC (-150 oF), that is, presuming the rest of the machine can take that kind of cold!

http://www.psrc.usm.edu/macrog/pmma.htm

Typical Applications:

DD Information:

Cost	: High
Density	:
Weight	: High
Flex or "bendy-ness"	: Low
Water Absorption	: Low
Color Acceptance	: High
Heat Resistance	: High
Melting Temperature	:

Polyvinyl Chloride Straight Resin (PVC)

Poly(vinyl chloride) is the <plastic.htm> known at the hardware store as PVC. This is the PVC from which pipes are made, and PVC pipe is everywhere. The plumbing in your house is probably PVC pipe, unless it's an older house. PVC pipe is what rural high schools with small budgets use to make goal posts for their football fields. But there's more to PVC than just pipe. The "vinyl" siding used on houses is made of poly(vinyl chloride). Inside the house, PVC is used to make linoleum for the floor. In the seventies, PVC was often used to make vinyl car tops.
PVC is useful because it resists two things that hate each other: fire and water. Because of it's water resistance it is used to make raincoats and shower curtains, and of course, water pipes. It has flame resistance, too, because it contains chlorine. When you try to burn PVC, chlorine atoms are released, and chlorine atoms inhibit combustion.
Structurally, PVC is a vinyl polymer <vinyl.htm>. (well, duh!) It is similar to polyethylene <pe.htm>, but on every other carbon in the backbone chain, one of the hydrogen atoms is replaced with a chlorine atom. It is produced by the free radical polymerization <radical.htm> of vinyl chloride.

http://www.psrc.usm.edu/macrog/pvc.htm

Typical Applications:

DD Information:

Cost	: Low
Density	: 1.42
Weight	: High
Flex or "bendy-ness"	: Medium
Water Absorption	: Low
Color Acceptance	: High
Heat Resistance	: Low
Melting Temperature	:

Polycarbonate

Polycarbonate, or specifically polycarbonate of bisphenol A, is a clear plastic used to make shatterproof windows, lightweight eyeglass lenses, and such. General Electric makes this stuff and sells it as Lexan.
Up until now, we've been talking about only one polycarbonate, polycarbonate of bisphenol A. But there's another polycarbonate out there, that some of us look at all the time. In fact, some of us, like me, never look at anything without the help of this polycarbonate. This is the polycarbonate that is used to make ultra-light eyeglass lenses. For people with really bad eyesight, like me, if the lenses were made out of glass, they would be so thick that they'd be too heavy to wear. I know. I used to have glass lenses. My glasses were so heavy that wearing them gave me a headache. But this new polycarbonate changed all that. Not only is it a lot lighter than glass, but it has a much higher *refractive index*. That means it bends light more than glass, so my glasses don't need to be nearly so thick.
There is a fundamental difference in the two types of polycarbonate described here that I should point out. Polycarbonate of bisphenol A is a thermoplastic <plastic.htm>. This means it can be molded when it is hot. But the polycarbonate used in eyeglasses is a thermoset <xlink.htm>. Thermosets do not melt, and they can't be remolded. They are used to make things that need to be really strong and heat resistant.

http://www.psrc.usm.edu/macrog/pc.htm

Typical Applications:

DD Information:

Cost	:
Density	: 1.20
Weight	:
Flex or "bendy-ness"	:
Water Absorption	: 0.16
Color Acceptance	:
Heat Resistance	:
Melting Temperature	:
Impact Resistance	: 2.4
Hardness	: R75

Ethylene Vinyl Acetate Copolymer

Poly(vinyl acetate), or PVA for short, is one of those low-profile behind-the-scenes polymers. It isn't blatantly obvious where it's found, as is the case with polyethylene <pe.htm> or polystyrene <styrene.htm>. PVA likes to hide. But it's everywhere, if you're willing to look for it. It's a polymer that rewards one who is willing to look beyond the surface. One place PVA can be found hiding is between two pieces of wood that are glued together. PVA is used to make wood glues, as well as other adhesives. Paper and textiles often have coatings made of PVA and other ingredients to make them shiny.
PVA is a vinyl polymer <vinyl.htm>, as if you couldn't guess from the name. It's made by free radical vinyl polymerization <radical.htm> of the monomer vinyl acetate.

http://www.psrc.usm.edu/macrog/pva.htm

Typical Applications:

DD Information:

Cost	:
Density	: 0.95
Weight	:
Flex or "bendy-ness"	:
Water Absorption	:
Color Acceptance	:
Heat Resistance	:
Melting Temperature	: 176
Impact Resistance	: NB
Hardness	: R40

Polyformaldehyde Resin

Typical Applications:

DD Information:

Cost	:
Density	: 1.10
Weight	:
Flex or "bendy-ness"	:
Water Absorption	:
Color Acceptance	:
Heat Resistance	:
Melting Temperature	:

Acrylonitrile Butadiene Styrene (ABS)

Typical Applications:

DD Information:

Cost	:
Density	: 1.05
Weight	:
Flex or "bendy-ness"	:
Water Absorption	: 0.27
Color Acceptance	:
Heat Resistance	:
Melting Temperature	: 221
Impact Resistance	: 6.6
Hardness	: R110

Styrene Acrylonitrile Copolymer

Typical Applications:

DD Information:

Cost	:
Density	: 1.08
Weight	:
Flex or "bendy-ness"	:
Water Absorption	: 0.20
Color Acceptance	:
Heat Resistance	:
Melting Temperature (F)	: 239
Impact Resistance	: 1.2
Hardness	: R120

More Information

More information on Plastics can be obtained at the following resources on the WWW:

http://www.plasticsusa.com/polylist.html