

Acrylonitrile-Butadiene-Styrene (ABS) is one of the most widely used and versatile thermoplastics.

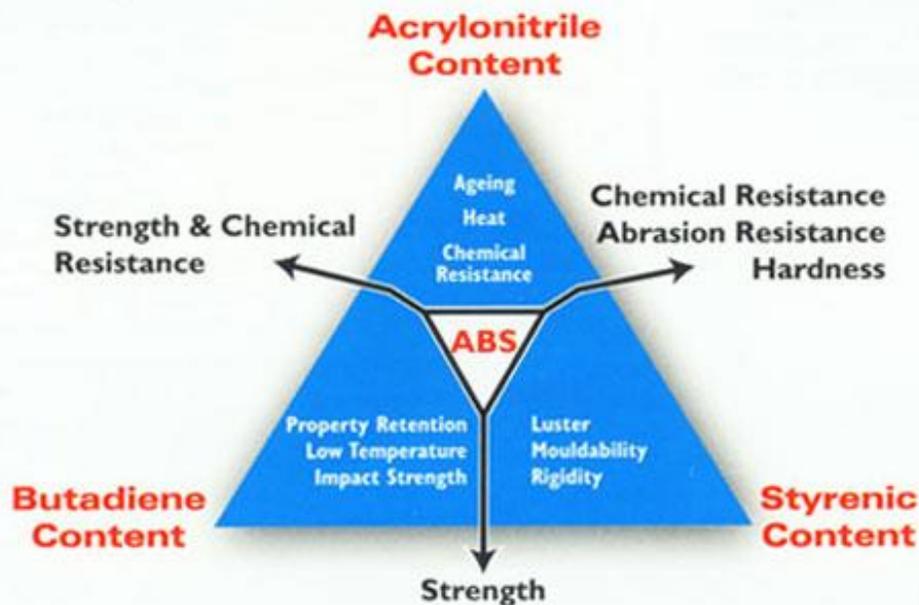
ABS is an amorphous blend consisting of three monomers; acrylonitrile, butadiene, and styrene. The first is

- Acrylonitrile adds chemical and thermal enhancements.
- Butadiene contributes increased toughness and impact strength to the plastic.
- Styrene will add a sleek, glossy surface to the plastic.

These three monomers are typically added together in specific proportions: 15-35% acrylonitrile, 5-30% butadiene and 40-60% styrene. [1] A small change in even one of the monomers can create drastic changes in the mechanical and physical properties of ABS.

ACRYLONITRILE-BUTADIENE-STYRENE

Contribution of Components



Acrylonitrile – used principally as a precursor in the manufacture of synthetic polymers, especially acrylic fibers, nylon and synthetic rubber. Small amounts are also used as fumigant.

Butadiene – used in the manufacture of synthetic rubber, latex paints and nylon.

Styrene – used to make plastics

Figure 1: ABS physical/mechanical properties as a function of monomer content.

ABS resins can be used for molding parts requiring close dimensions, outstanding surface finishing, high impact resistance, and metal plating.[2] In addition, ABS has good toughness and rigidity, low creep, good dimensional stability, low weight and a good resistance to acids and alkalis. [2] These properties are due to its microstructure; long

chains of polybutadiene intertwined with shorter chains of polyacrylonitrile and polystyrene.

ABS also has a high abrasion resistance. Depending on the percentage of butadiene, ABS will have little or no wearing effect when being moved along a rough surface for an extended period of time.

Processing the plastic at different temperatures can also manipulate its properties. Processing ABS at a higher temperature will create a nicer looking finish as well as higher heat resistance. Higher strength and higher impact resistance is the result of processing ABS at a lower temperature.

ABS can also be recycled by using a process called "froth flotation." Froth flotation is a process that separates high purity plastics from waste streams containing a mixture of plastics. This is the only process which can recover over a 99% purity level from recycled ABS. [3]

Although there are many positive properties about this plastic, there are also some negatives. One of the biggest concerns with ABS is the effect humidity has on it when it is being processed. If humidity enters the system while the plastic is being made the appearance of the molded part will not be uniform and in some cases, unusable. Another problem with ABS is the effects of Ultra Violet (UV) rays. When ABS is exposed to UV rays a deterioration of appearance happens due to microcrack formation. These microcracks lead to chemical and mechanical problems. Environmental Stress Cracking (ESC) occurs when ABS comes in contact with certain organic solvents and surfactants, including ketone, ester and ethylene dichloride.

From refrigerators to instrument panels in cars and even to sail boats, ABS is everywhere. The future worldwide growth of ABS is predicted, by industry observers, to increase 4-5% annually. It seems as if there will be no shortage of demand for the ABS industry any time soon. [4]

High demand, however, creates supply issues with the resin. A shortage in any of the three feed-stocks causes supply problems.

[1] ABS – acrylonitrile butadiene styrene." 2003. 5 Jun 2008
<<http://designinsite.dk/htmsider/m0007.htm>>

[2] Campo, E. Alfredo, *The Complete Part Design Handbook*, Hanser, 2006.

[3] Process for Recovering Usable Plastics from Mixed Plastic Waste. 2007. Argonne National Laboratory. 6 Jun 2008

[4] "Chemical Intelligence: Polymers, Rubbers & Resins." 6 Jun 2008
<<http://www.icis.com/v2/chemicals/9071028/acrylonitrile-butadiene-styrene-copolymer.html>>.