Sealing and Bonding Polypropylene and Polyethylene

by Jeff Lucius

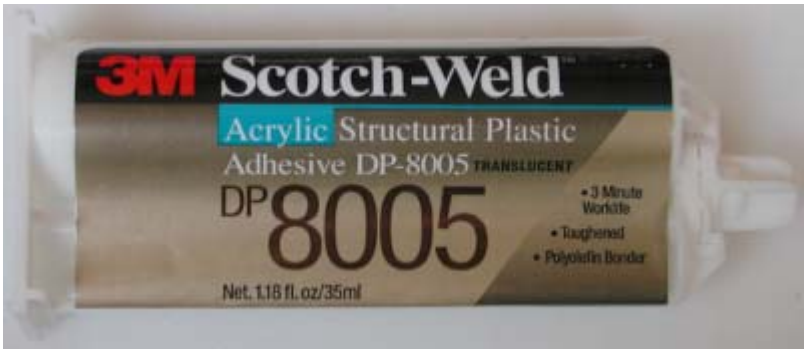
Introduction

This short note briefly presents a relatively new product (around the year 2000) for bonding polypropylene and polyethylene, 3M's Scotch-Weld™ Structural Plastic Adhesive DP-8005. But first, a little background on plastics, and in particular, polyolefin plastics.

Polymers are natural or man-made chains of structural units called "mers", which consist of basic chemical elements such as carbon, hydrogen, oxygen, nitrogen, and silicon. Natural polymers include tortoise shells, animal horns, tar, and amber. Man-made polymers include plastic. The first commercial plastic was Celluloid, made in the 1860's. In the early 1900's, Bakelite (or Phenol formaldehyde plastic), rayon, vinyl, and nylon were introduced. The 1940's and 1950's saw the development of polyethylene and polypropylene plastics, generically called polyolefins. Polyolefins are made from the petroleum-based monomers of ethylene and propylene, and are the most common commodity plastics in the world. Polypropylene (PP) is Code 5 in the Society of Plastic Industry's (SPI) resin identification code. High Density Polyethylene (HDPE) is SPI Code 2 and Low Density Polyethylene (LDPE) is SPI Code 4. These codes usually appear inside a triangle stamped or molded into the plastic product. More information about the SPI codes can be found at SPI's web site, http://www.plasticsindustry.org/.

Polypropylene and polyethylene are called "low energy" or "non-stick" plastics. This group includes Teflon (or polytetrafluoroethylene). The basically inert or inactive molecular structure of PP and PE is described as a "low energy state". This "low energy" quality and relatively inexpensive manufacturing costs make PP and PE an ideal plastic for milk jugs, liquid detergent bottles, grocery bags, many food product bottles, toys, medical tubing, appliance parts, and many auto parts. On the Dodge Stealth and Mitsubishi 3000GT, polypropylene and polyethylene are used to make the splash shields inside the fenders and various exterior trims and mouldings (see 2-synth-parts.htm).

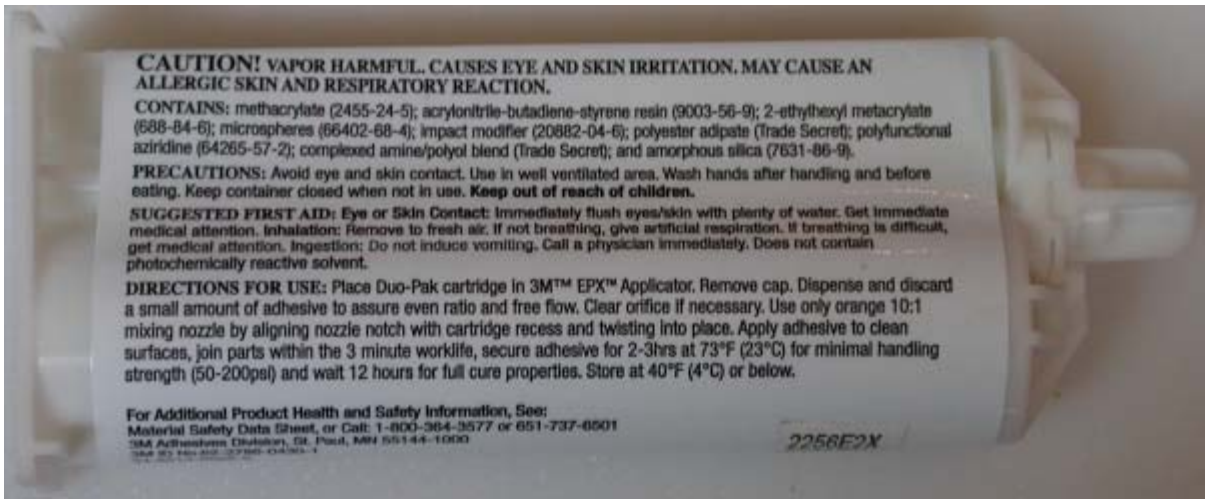
Despite their widespread usefulness, "low energy" plastics have a quality that can make them hard to work with - they are difficult to seal or bond using commonly available sealant adhesives. Cyanoacrylate, epoxy, polyurethane, silicone (RTV for example), and most acrylic adhesives do not stick to polypropylene and polyethylene. I have personally verified this with cyanoacrylate ("Superglue"), two-part epoxy, and several types of silicone RTV adhesives. In the past, PP and PE had to be surface treated to convert their low-energy polymer into a higher-energy state in order to improve bonding. Recently, 3M developed a unique adhesive that allows structural bonding of PP and PE to similar plastics, without any surface treatment except cleaning and light sanding, and to other surfaces such as other types of plastics, wood, aluminum, glass, and concrete. This product is absolutely amazing!



DP-8005

Scotch-Weld™ DP-8005 is a solvent-free, two-part, acrylic-based, structural plastic adhesive designed to structurally bond polyolefins to themselves and to many other substrates. It uses a one-step process that requires no pre-treatment of the substrates other than removing dirt and oil. Like Polyolefins themselves, DP-8005 provides very good chemical resistance. Similar to most polypropylenes and polyethylenes, maximum continuous service temperature for DP-8005 should be kept under about 212ºF (100ºC).

Using the special 3M applicator, ten parts of the methyl acrylate base are mixed with one part of the amine accelerator. At room temperature, you have 2 to 3 minutes to work with the adhesive. You should note that this adhesive has a very-limited shelf life, only 6 months from the date of shipment when stored at near-freezing temperatures in the unopened original container (Note: I have used this product successfully about 6 months past the "expiration" date). Complete instructions and property information are available in the 3M product data sheet misc/dp8005.pdf.



Previously only available in bulk quantities for industrial use, DP-8005 is now available for retail sale in small 35 ml (1.18 fl. oz.) cartridges. You may have a difficult time finding DP-8005 in the local hardware store. I purchased the adhesive and applicator system from a 3M distributor in Denver, Colorado. They have walk-in retail sales for purchases over $50, and take phone orders for shipment anywhere in the USA. They accept Visa and Mastercard. Their contact information is below.

Lane Supply Company
2050 West Barberry Place
Denver, CO 80204
Telephone: 303-534-5371
Fax: 303-825-1514

The adhesive itself is not too expensive but the applicator system is. Fortunately, the applicator is completely re-usable, except for the nozzle. You will probably want to pick up one or two extra nozzles. The nozzle has a dual spiral design inside to promote mixing of the two components. The applicator system can also be used with other 3M Scotch-Weld Structural adhesives that come in 35-ml cartridges. Below are the prices charged

by Lane Supply Co (in 2002).

Description	Unit Price
DP 8005 35ml Scotch-Weld Epoxy	$16.33
EPX Plus Applicator	$45.81
EPX 10:1 Plunger	$5.40
EPX Mixing Nozzle 9164 for DP-8005	$2.68

On-line References

About Plastics:
http://www.americanplasticscouncil.org/
Introduction to Plastics:
http://www.handsonplastics.com/hands_on_plastics/intro_to_plastics/teachers.html
Plastics Reference Handbook - Engineered Plastics:
misc/engineered-plastics.pdf
Plastics Reference Handbook - Technical Data:
misc/plastics-techdata.pdf
Polymers:
http://www.lsa.dmu.ac.uk/Research/LSA/cnst1002/plastics/pla_text.html
SPI Resin ID codes:
http://www.americanplasticscouncil.org/benefits/about_plastics/resin_id_codes.html

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