

# Addressing questions and statements about UHMW-PE

ULTRA HIGH  
MOLECULAR  
WEIGHT  
POLYETHYLENE

by Bryan Olin and Reese Turner

**M**any articles have been written about the characteristics of UHMW-PE (ultra high molecular weight polyethylene). We make no attempt to reinvent the basic physical properties that have made UHMW-PE so popular. For high-wear applications, just about everybody in plastics distribution knows that UHMW-PE is the answer to many impact, release and abrasion problems.

There are some myths and misconceptions that we would like to address and some new formulations and profiles that offer interesting sales and profit opportunities for distributors. The following statements and questions we will discuss are posed to us, our distributors and end users regularly.

***“So-and-so is offering 9 million molecular weight UHMW-PE and that is what the customer wants.”***

This is always one of our favorites. We get asked this regularly, usually by one of our foreign distributors. By ASTM D-4020 which is our resin governing document,

there is no 9 million molecular weight, but it does say that “at least five equations have been developed to describe the molecular weight of UHMW-PE.” Europeans measure the same resin in different ways from ASTM, resulting in a higher report for the same resin if measured by our ASTM standards. This is similar to measuring any specific distance in our yards, feet and inches versus metric units (meters, kilometers and centimeters); the numbers will be different, but the exact distance will be the same.

***“What IS molecular weight?”***

It is the sum total of the number of carbon atoms in the molecule times the weight of a carbon atom — according to the standard Periodic Table (C Carbon, atomic number 6, atomic weight 12.001). High density polyethylene (HDPE) is made of the same carbon atoms, but in much shorter chains. A typical HDPE sheet will be a molecular weight around 500,000, while typical UHMW-PE sheet will be in a range from 3 million to 6 million molecular weight, using the ASTM D-4020 standard.

Not to confuse you, but keep in mind that “density” indicates nothing useful in selecting a wear product. “High density” sheet is around .96 to .97 gm/cc, while UHMW has a density of only .935 to .945. It is the molecular weight that makes the difference.

***“UHMW-PE must first be abrasion resistant, and the higher the molecular weight, the more abrasion resistance!”***

In most all applications, the FIRST problem which UHMW-PE solves is slip, also known as release or flow. End users seek help with sticking in hoppers, chutes, truck bodies, drag line buckets, along conveyor lines and in all manners of equipment where products must keep moving. The question of measuring abrasion resistance regularly comes up first, when the question really is about how



FLEXI FEND® after 2,000-pound impact test. The unique leaf spring shape of FLEXI FEND® allows it to flex with impact and return to shape. Fenders fully recover from repeated collisions and heavy loads.

long the UHMW-PE will last in the tough application where its job is to increase slip.

To settle the relationship between molecular weight and absolute abrasion resistance is very difficult. To be sure, there is a sand slurry test that seems to indicate that certain products perform better than others in a very precise set of conditions (wet sand or aluminum oxide at a given temperature at a given speed). These lab tests don't relate to “real world” applications and should be regarded only as a guideline, not the definitive answer to all application requirements.

In what we call the “real world,” there are so many factors, starting with the material being handled — some sands react differently with higher molecular weight than some metals, clays, glass, plastic bottles, wood, salts or cement. What about the speed or flow, the angle of drop, the morphology of the media, ambient heat, moisture content? These are all variables.

The point is, the actual molecular weight of the UHMW-PE is only one of many factors and there are so many tests in so many directions which draw such varied results, that we could not say. Our best suggestion is always, “Try a sheet of this next to a sheet of that and measure



Ultra Poly's FLEXI FEND® high impact UHMW fender system prior to impact test.

FLEXI FEND® during the load test.

FLEXI FEND® is patented by Ultra Poly, Inc. Patent Nos. 6,832,570 and 6,948,440.



the results." Differences might be found that one product seems to enhance flow while one wears a little better and that may be a function of fillers. A little liquid lubricant in a sheet will release better than a sheet without, but sliding abrasion is probably better with an unfilled sheet than with a lubricant — so what gives the best value to that end-use application is best determined at the point of use and a lengthy discussion of the problems that the UHMW-PE is envisioned to overcome.

***"Which filler in UHMW-PE makes it better?"***

Silica, glass, moly, silicone or carbon black? Or all of the above? Again, the best answer begins with full information on how the UHMW-PE is to be used and exactly what those conditions might be. A favorite additive is silicone, a liquid lubricant, added to enhance slip and flow, reducing wear from frictional heat. In most cases, a cross-linking agent improves wearability while silicone improves release. Since UHMW-PE is a dry powder it limitlessly accepts fillers. It can be made magnetic or to sink in water, even to the point that it rusts. It can be made to be "anti-static" or even "conductive."

Montel (Himont) did some revealing testing on various additives years ago. To us, it shows that to increase abrasion resistance, a cross-linking agent should be added. There are other additives which can make some differences (hardness, slickness, abrasion resistance), but the end user has to also ask if the "modified product" will result in good value. If a shorter production run of a special blend would give longer service life, would it be enough better to justify the extra cost? Himont's tests included silicone, glass fibers, glass spheres, metallic fillers, calcium carbonate, silica, cross-linking agents and radiation cross-linking. (We have posted these results on our company's web site for the reader's convenience.)

***"UHMW-PE is only for places needing a slick surface."***

Not necessarily. We have found some areas where the other properties of UHMW-PE are desired, but the slick surface is unwelcome; such as in marine synthetic decking or more simply walkways in highly corrosive or wet environments where conventional non-skid tapes and paints are the competition. The very high impact strength and stress crack resistance of UHMW-PE allows it to hold up well under the wheels of trucks and the

tracks of bulldozers. Even high traffic ferry ramps hold up well while offering a safe, slip-resistant surface for foot traffic.

UHMW-PE sheet can be manufactured as a large-grit surfaced sheet, which, regardless of its method of attachment from epoxies to mechanical fasteners, has remained in place working for more than 15 years. At about half the price of similar FRP (fiberglass reinforced plastic) surfaces — even in a Class 1 fire rated sheet — we believe that UHMW-PE non-skid surfaces have much potential for making work areas safer at a cost-effective price.

***"UHMW-PE has no ability to absorb energy."***

UHMW-PE can be bent and forged into an energy absorbing "P" shaped profile. In marine fendering, for example, the section shown in the picture on the previous page combines the low-coefficient of friction of UHMW-PE, a most desirable property for fendering. Once shaped into an energy absorbing "P" profile, it exhibits tremendous resilience. Tests of the profile reveal that it is even tougher than steel surfaces for protecting the hulls of ships.

***Summary***

The unique combination of properties of UHMW-PE continues to be the driving



Ultra Poly, Inc. manufactured LUNS® permanent synthetic anti-slip surface for the Grand Marina in Alameda, CA, USA.

force in its market growth. Where the application needs some amount of abrasion resistance, impact strength and corrosion resistance — and, all at a most cost-effective price — UHMW-PE will be a strong potential problem-solver for myriad applications. ■

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## **MYTH #5: DISTRIBUTORS JUST MAKE THE PRODUCTS END UP COSTING MORE.**

*You don't really believe that, do you? A distributor's products are usually cheaper when you look at the whole picture. The actual cost of a product is determined by price AND service. Distributors can offer you both.*

**THE TRUTH ABOUT DISTRIBUTION**

THIS MYTH HAS BEEN DISPELLED FOR YOU BY:



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