Polycarbonate vs. Trivex

History

Polycarbonate: This material was developed during the "space race" of the late 1960's. It was used for helmets and visors for astronauts. It was soon adapted for use in safety eyewear applications due to its superior impact resistance. By 1978 the first single vision ophthalmic lenses were being produced. The following years brought improvements to resin purity, manufacturing, and lab processing.

Trivex: Trivex was originally developed for the military, as visual armor. PPG Industries adapted the technology for the optical industry. Trivex is a urethane-based pre-polymer. PPG named the material Trivex because of its three main properties which are good optics, light weight, and strength.

Product Comparison

Index of Refraction

Index of refraction is a number that compares the speed of light in a material to the speed of light in air. The higher the index number, the more a material will slow down and bend light. So less curvature is needed to create a given lens power. Poly has an index of refraction of 1.586. The index of Trivex is 1.530. Steeper curves would be needed to make an Rx in Trivex than in polycarbonate. The higher the lens power, the more difference there will be in curves and thickness.

Abbe Value

The Abbe number, or V-value, is a measurement of the dispersive properties of a material. The lower the Abbe number the more a material will disperse light into its component colors. This causes chromatic aberration which may be seen as color fringes or blur toward the edges of the lens. Low Abbe value is seldom a concern when the corrective power of the lens is less than seven diopters. Also the point on the lens at which the chromatic aberration is significant enough to create a visual problem is the point through which the wearer does not normally look. High index materials tend to have lower Abbe numbers. If low Abbe value was truly an issue, more people would be wearing glass, with its Abbe of 58.5. The Abbe of poly is 30, Trivex is 43.

Polycarbonate vs. Trivex (continued)

Product Comparison (continued)

Birefringence

Birefringence is a result of strain or stress caused by force that is applied to a lens substrate material. Excessive external pressure placed on the lens causes light to be double or multiply refracted. The pressure causes certain areas of the lens to become denser than others, increasing the index of refraction and causing light to travel slower through those parts, thus altering the path of the light rays.

While stress may be the result of the manufacturing process, it can also be created during surfacing if using a small block or generating the lens before the blocking medium has fully hardened. Another common cause is oversized lenses being forced into the frame or using a pattern that does not accurately match the frame shape. The screws of a drill mount frame can also be excessively tight and induce stress.

Even the most birefringent polycarbonate lens would only have a power difference of 0.002 D for a +5 or -5 lens. This would be imperceptible to a patient and could not be measured on a focimeter.

Specific Gravity / Density / Weight

The specific gravity or density of a material is its weight expressed in grams per cubic centimeter. The specific gravity of polycarbonate is 1.20 and Trivex is 1.11. Trivex is a lighter weight material, but due to its lower index of refraction more curvature and thickness is need to achieve a given power. Depending on the power and eye size, it will not always be the lightest lens.

Impact Resistance

Trivex claims to be as strong, or stronger than polycarbonate in impact resistance. This is not the case when the product is scratch coated or AR coated. According to Colts Laboratories, an abrasion resistant coating is going to be harder and more brittle than the lens in order to be abrasion resistant. This makes the lens easier to break due to that coating. The average coating reduces the strength 45% and the average AR coating reduces the strength another 20% for a total of 65%.

B Ralph Chou, MSc OD FAAO, and Jeffery K Hovis OD PhD FAAO of the School of Optometry and the University of Waterloo in Waterloo, Ontario, Canada did a study of the impact resistance of Trivex and polycarbonate lenses. Their study confirmed qualitatively that polycarbonate lenses have a much higher impact resistance that Trivex lenses. They were unable to break any 2mm poly lenses with blunt missiles at the maximum speed of the apparatus, which is approximately 100 m/s. The average impact speed for failure of the Trivex lenses ranged from 50 to 62 m/s, which is an impact resistance that is closer to that of 3mm CR39 than the 180 to 270 m/s range that is often quoted for polycarbonate. Trilogy branded Trivex lenses carry the disclaimer "Any modification of Trilogy lenses other than normal surfacing or edging may adversely affect impact performance characteristics.

Polycarbonate vs. Trivex (continued)

Product Comparison (continued)

Tensile Strength

Tensile strength is resistance to lengthwise stress. It is measured in force per unit of cross-sectional area by the greatest load pulling in the direction of length that a given material can bear without tearing apart. The greater the tensile strength of a lens material, the more it will resist cracking and the better it will be for drill mount frames. Tensile strength of some common lens materials:

Polycarbonate – 44.9kgf	Trivex – 61.2kgf
CR39 1.50 – 15.6kgf	1.60 index – 80.5kgf
1.67 – 67.3kgf	1.70 – 52.9kgf
1.74 – 31.6kgf	

Polycarbonate can be successfully drilled using a sharp burr, low speed and minimal pressure.

Pricing and Availability

Trivex, as all new products, will expand in availability and drop in price as it becomes commoditized. At this time polycarbonate still has a wider availability and is more economical.

Depend on VISON EASE Polycarbonate:

- Crystal Clarity – Made with proprietary 4th generation "water white" polycarbonate resins.
- Light Weight – Specific gravity of 1.20.
- Thin – Index of refraction 1.586 and minimum center of 1.0
- Flat – Available in aspheric designs.
- Impact Resistance - Able to withstand the impact of a ball traveling at 135 miles per hour without breaking; passes drop ball at 1.0mm center thickness.
- 100% UV Protection – No additional UV coatings needed.
- Superior Coatings – 3 levels of performance: Tegra, Continua, Continua Tintable.
- Wide Availability – Styles and ranges to cover most any Rx. Also available in Coppertone polarized, SunRx polarized and LifeRx photochromic.
- Superior Progressives – Outlook & Illumina have a 99% adaptation rate.
- Excellent Value.

For any additional technical questions, call the toll-free Technical Services Hotline: (800) 367-2544 ext. 5301
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