PLASTIC Photochromic LENSES

by John M. Young
Senior Research Engineer
American Optical Corp.

PHOTOLITE

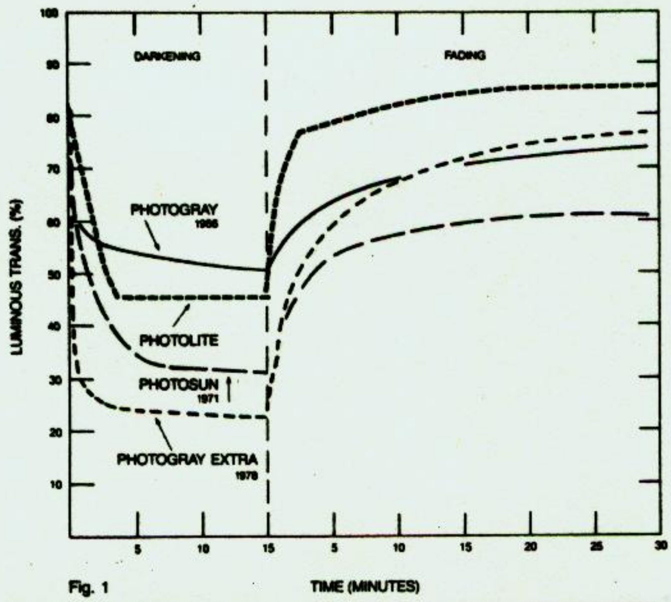

Fig. 1

When considering a new product for introduction, it is important to first determine if there is a need or desire for the product. Even if the product is unique, uniqueness alone cannot guarantee that it will be successful if there is no demand for the product by the end user. Studying the history of similar products is also important in determining past trends, the present situation and what the future may promise. The true value of a new product, therefore, can be established for the marketplace through the use of these criteria. The same criteria are just as relevant for photosensitive plastic lenses.

The history of the photochromic lens dates back to approximately 1964 when Corning Glass scientists invented the photochromic glass lens, which was released to the industry in 1966 as the PhotoGray® lens. As illustrated in Figure 1, visual transmittance decreases when ultraviolet light activates the lens. The PhotoGray lens darkens from about 80% to 85% luminous transmittance (LT) to about 45% to 50% LT.

The early PhotoGray lenses were affected by variations in temperature, as also seen in Figure 1. As the temperature increased, the fully darkened transmittance decreased. Also visible in higher plus and minus prescriptions was a variation in the density, or luminous transmittance, across the lens due to the change in thickness. This early product also exhibited an apparent "memory." Over time, the change in transmittance would become less and the lens would not fully recover from its darkened state. Boiling the lenses would restore them to their original reactive state, however.

The effects of various temperatures and the "memory" characteristic of the PhotoGray lens were corrected in later innovations by Corning, even though the PhotoGray lens was considered "state-of-the-art" and minor nuances were accepted. Some bifocal styles were added in 1967. However, the PhotoGray lens was and is still considered a fashion product and does not get dark enough to fulfill a sunglass requirement.

It wasn't until 1971, with the introduction of single-vision PhotoSun® lenses, that Corning had a true sunglass product. The PhotoSun lens, as seen in Figure 1, had a luminous transmittance of about 65% in its clear state, darkening to approximately 30% LT when activated. The PhotoSun lens was too dark in its recovered, or unactivated, state to be worn indoors or to be used for night driving, however.

Fused bifocals then became available from Corning in 1975, through a cooperative program with domestic lens manufacturers that manufactured fused flat top bifocals. Systematic testing was carried out in the development of the product to assure good quality to the wearer.

The PhotoGray Extra lens was introduced in 1978; the result of a culmination of efforts over the previous twelve years from the first introduction of PhotoGray lenses. The transmittance of the extra lens in the clear unactivated state was approximately 85% LT, darkening very rapidly to approximately 25% LT when activated by ultraviolet light, as seen in Figure 1. The PhotoGray Extra lens' range of 60% light transmittance spanned the combined range of both previous products. The PhotoGray Extra lens could be considered an all-purpose spectacle product, representing the newest state-of-the-art in photochromics.

Manufacturers that are also prominent in the field of photochromic lenses include Chance-Pilkington of England, who introduced Reactolite in 1973. Later, Reactolite Rapide was introduced as a faster acting, darker lens, similar to Corning's PhotoGray Extra lens.

Schott Optical was licensed by Chance-Pilkington to produce a photochromic glass and, in 1974, it introduced a phosphate-based photochromic. Synchrovision Slate Gray, a borosilicate photochromic glass, was also introduced by Schott, and they became the only supplier of both phosphate and borosilicate photochromics. The Synchromatic

PHOTOLITE

series of photochromics, introduced by Schott in 1980, offered a variety of colors to the market.

DESAG (Duesche Spezial Glas AG), a German-based firm licensed by Corning to produce photochromic glass, introduced Photosolar, which was similar to the PhotoGray lens product. The company then introduced the faster reacting Photosolar Super, a product similar to the PhotoGray Extra lens. PhotoVitar was also introduced by DESAG and was distributed by Zeiss under the name of Umbermatic and by Rodenstock as Colormatic II. Another product, PhotoSol, was drawn in sheet form and cut into lens shapes, as opposed to the traditional method of a molded lens blank.

The Sunsensitive lens was the result of a joint Corning-French venture and was similar to DESAG's PhotoSol, in that it was produced in sheet form.

Although photosensitive plastic is not new, photosensitive plastic ophthalmic lenses are. The photosensitive lens which will be manufactured by American Optical will be called the Photolite™ lens. This development was the result of the pioneering efforts of the late Dr. Richard Hovey, a research chemist who spent approximately 12 years almost exclusively on this product at American Optical. Slated for introduction in early 1982, the lens will initially be available in 75mm semi-finished, single-vision lenses.

In the unactivated, or clear, state, the Photolite lens exhibits a 90% LT (or 10% absorption), as seen in Figure 1. The lens darkens to about 45% LT when exposed to ultraviolet light and will activate to 75% of its darkened state in less than two minutes. The lens then recovers to 50% of its clear state in less than two minutes, with 70% recovery in about five minutes. The Photolite lens exhibits approximately a 40% change in transmittance between its clear and darkened states. Although Figure 2 exhibits a somewhat wider transmittance reaction than the original PhotoGray lens product in 1966, like the original PhotoGray lens, the Photolite lens should be considered a fashion product, as opposed to a sunglass, and will serve a function in this regard.

The Photolite lens, like the early PhotoGray lens product, is also sensitive to temperature variations. The Photolite lens will vary approximately 15% in transmittance for a change of 10°F, as seen in Figure 2. The cooler the temperature, the greater the reaction of the Photolite lens.

An advantage of the Photolite lens is that there is no transmittance variation across the lens in high plus or high minus prescriptions. Photochromic glass products demonstrate this variation due to the transmittance of color density, which is dependent on the thickness of the lens. The Photolite lens coloration is confined to a relatively thin region of the surface and is, therefore, unaffected by variations in thickness.

The process by which this lens is manufactured is chemical impregnation. The process, which is proprietary to American Optical, is not a "dye pot" process. The Photolite lens is clear and colorless in the unactivated state. When fully activated, it turns blue. However, the product's color potential is not limited to blue. It can be tinted to different colors. A Photolite lens that is tinted to a light brown or tan color in its clear state will become grayish when fully activated. Gradient tints add yet another dimension to this fashion product. The possible color combinations are extensive and should offer a challenging new fashion item to the field. However, individual lens replacement and color match may be problematical.

The Photolite lens does not have the memory problem that early PhotoGray lenses exhibited, and it has a life expectancy of approximately two years, or the average life of a prescription. This means that in about two years, the Photolite lens will exhibit about 50% of the reaction that it had exhibited when new.

The profitability of the Photolite lens depends on several considerations. It represents a new and unique product, the "state-of-the-art" for plastic photosensitive lenses. This in itself is an asset that, together with a desire by wearers to have the product, will create the potential for a profitable product. It should be noted, however, that the product must be represented properly. The Photolite lens is a fashion tinted product and not a sunglass. The identification with fashion is an asset in that the lens can be tinted in fashionable colors that will change as the lens darkens. Finally, the reaction in the lens due to temperature variation and its approximate two-year life expectancy should be explained to the wearer prior to purchase to assure correct representation.

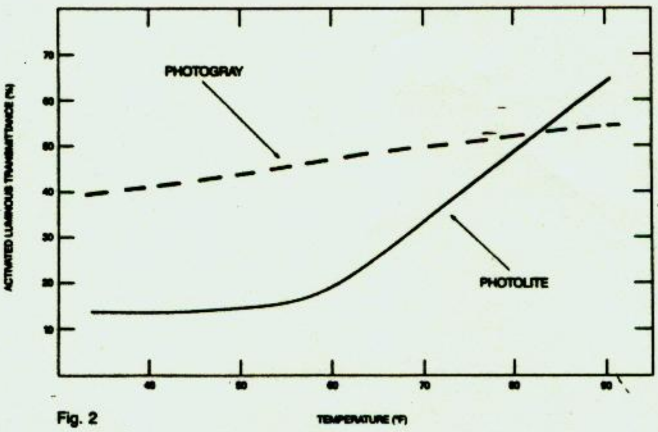

Fig. 2

Projected market growth of this product is, of course, unknown as it is so new, but examining today's photochromic market could be beneficial. In 1981, 11.3 million pair of glass photochromics were sold. The sales forecast projects a relatively flat market for photochromic lenses. Although the Photolite lens will be new to this marketplace, it should help the market grow. Its uniqueness and the attendant publicity that will accompany the new product will bring new visibility to the photochromic market.

The Photolite lens is not only unique but desirable, which is a criterion for the profitability of any product. The Photolite lens is "state-of-the-art"—the first generation of a new line of products. It is obvious that there will be other new innovations in the years to come. ■