How Calobar and Other AO Sun Lenses Were Born

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One day, man's eyes may come equipped with tinted lenses. Until then, he needs all the help he can get from these American Optical creations.

As feature writers never tire of telling us, the use of colored glass as an eyeshade for excessive brightness (and incidentally as a decorative example of conspicuous consumption) is almost as old as the history of glass itself. Glassmakers were adding iron oxides to glass to produce a green lens long before anyone knew there were such things as ultra violet and infra red ranges in the spectrum. Old time glassmakers also experimented with producing various shades of blue by adding cobalt to molten solution or a greenish blue by adding copper. They also knew how to produce an amber shade by blending into a glass solution colloidal suspensions of carbon substances such as lamp-black – and a rich ruby red glass with a suspension of gold.

By the early 1930's, American Optical – like the rest of the optical world – had pretty well settled on a basic soda-lime silicate composition for almost all of its optical glass. It also began to take a scientific interest in the chemistry of glass coloration and found that the practice of adding a trace of iron to the glass, besides being inexpensive and decorative, also made good optical sense.

Around that time the formulation of the company's famous Calobar® sunglasses was developed; it consists of a solution of two iron oxides of different valences which dissolve into the amorphous non-crystalline structure of the optical glass. One valence is the ferrous ionic state which absorbs at the long-wave-length end of the spectrum, red and infrared; the other is the ferric ionic state which screens out the short-wavelength end, the blue and ultraviolet.

The remaining energy in the center of the spectrum produce the familiar sage green known by the tradename Calobar. This green, of course, can be made yellowier or bluer by nudging the balance between the two oxides one way or the other.

For many years the transmittance curve of the Calobar lens was regarded as the optical ideal because it screened out the potentially harmful invisible rays at the extremes of the spectrum while transmitting all of the colors in the visible range. Calobar lenses also found wide application in the industrial field, particularly as lenses for welding masks when used in darker shades than are available for ophthalmic lenses.

The next basic item in the AO sunglass line, Hazemaster™ glass, has over the years been the subject of a few paradoxes. Because it does not screen out the infrared end of the spectrum, and doesn't reduce brightness very much, AO refuses to call it a sunglass, referring to it invariably as an "outdoor glass" or

a “shooting glass.” Also, although many wearers of Hazemaster lenses swear that they can see better wearing them driving at night, AO scientists, maintain that because of the filtering effect of the lenses the driver probably sees less well with them on. They join most other optical scientists in the opinion that wearing day sunglass for night driving reduces visual acuity.

The yellow of the Hazemaster lens is achieved by introducing a colloidal suspension of cadmium sulfide into the glass formula. After the glass has been formed into lens blanks it is subjected to a heat treating process which determines the color of the finished glass. In heat-treating, the centers of cadmium sulfide grow larger – and the larger the centers the yellowier the glass. If the treatment goes on too long the centers grow big enough to cause visible scattering and the glass becomes cloudy.

A hint of the Hazemaster glass spectral transmission curve is found in the trade name by which the glass was known early in its history – Noviol® lenses, a contraction of “no violet.” They have a sharp cutoff curve that screens out everything below blue but admit all longer wavelengths.

This sharp screening characteristic probably gives rise to the persistent belief that even a plano Hazemaster lens improves vision. The total absence of the blue end of the spectrum from what the viewer sees seems to produce a crisper outline in outdoor haze and probably does “sharpen” vision under some circumstances. Devoted autumn foliage viewers favor the Hazemaster lens because the reds, ambers and yellows of the fall leaves are much more vivid with the blue tints absent.

Unlike Calobar and Hazemaster lenses, another venerable sunglass, Cosmetan®, was something of an original invention and not an improvement on an old idea. In the late 30’s there was a general desire in the company to produce “something new,” and what could be more natural than a fusing of the two most successful existing products. That essentially is the basic formulation of the Cosmetan lens.

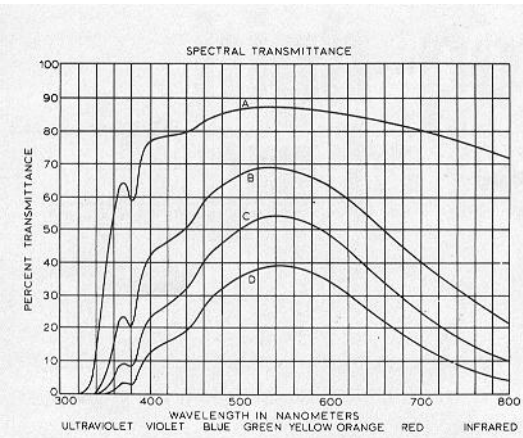

Figure 1. Spectral Transmittance: Calobars — A shade, B shade, C shade, D shade.

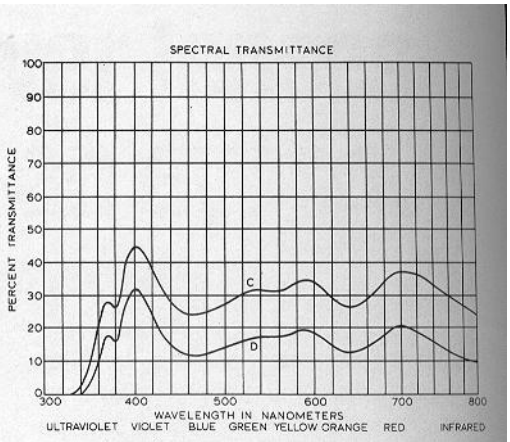

Figure 2. Spectral Transmittance: True color C shade, True color MIL/SG (~D).

Into a glass formula that includes the basic iron oxide solution of Calobar lenses is precipitated a colloidal suspension of selenium and nickel that produces a reddish amber tone. The resulting lens is an attractive tan color which combines some of the better features of Hazemaster and Calobar lenses and – at least in the late 1930’s – was something brand new.

As far back as anyone can remember, long before the current system of records was organized at AO, the company made a dark glass that was known for many years as a "smoked" glass and later came to be called simply a neutral, or gray glass. This early formulation produced something of a trough-shaped curve, screening colors in the middle of the spectrum but not ultraviolet or infrared.

This lens was considered satisfactory for many years. During World War II, an improved version featuring ultraviolet protection was issued to American and allied airmen, along with a large number of Calobar and Cosmetan lenses. During the early 50's however, military requirements called for more reliable color recognition than any of the existing lens formulations could give. Color recognition of smoke flares was an especially vexing problem. Reading electronic displays with unique new colors also added to the difficulty.

AO was requested to develop a sunglass material that would produce a uniform attenuation of transmission throughout the color spectrum. To achieve the desired effect, company scientists formulated a mixture of several coloring agents including iron, nickel, and cobalt. The resulting spectral transmission chart is a wavy, but essentially straight line curve which results in a neutral gray lens.

In a characteristically pragmatic approach to the art of dubbing new products, AO named the new lens TrueColor®. In 1958 the military flying services discontinued other sunglass lens colors and stipulated that all flying glasses procured thereafter were to conform to the True-Color lens specifications.

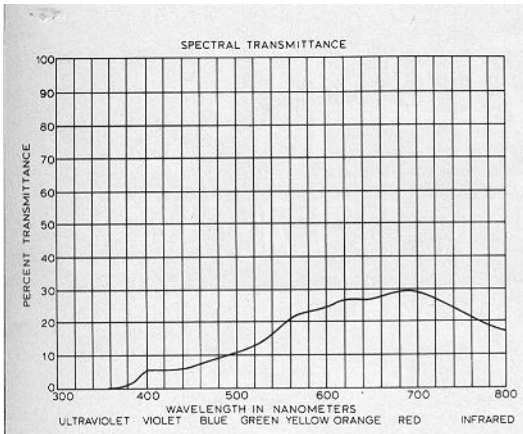

Figure 3. Spectral Transmittance: Cosmetan.

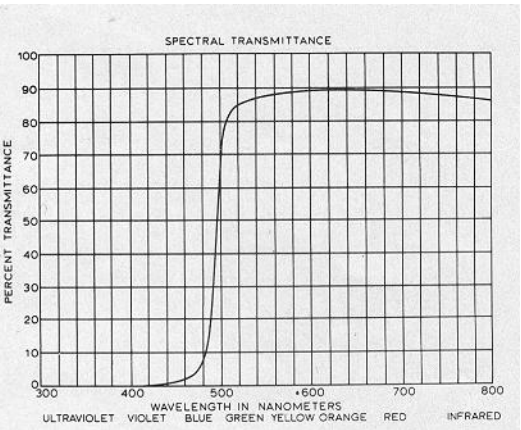

Figure 4. Spectral Transmittance: Haze-master (Noviol).

A layman thumbing through an AO catalogue might come to the conclusion that the company makes several dozen different shades of sunglasses, but only because he doesn't know the optical industry's rigorous definition of the term "sunglass." By AO reckoning, it makes lenses in 9 shades of sunglasses: Two True-Color lenses; three Calobar lenses; and four Tintomatic lenses. Cosmetan lenses are no longer manufactured by American Optical due to lack of customer demand. More and more people have found the AO Tintomatic lenses a better choice for their specific sunglass needs. As the sun gets brighter, Tintomatic lenses darken for comfort. As the sun weakens, they lighten for comfort. AO also makes one shade of Hazemaster "outdoor" glass and some eleven different shades of tinted lenses – not sunglasses – called Fashion Shades.

A strong corrective prescription can produce an eerie effect when ground into colored glass. For this and other marketing, fashion, and production considerations, AO has introduced in the United States a system in which the desired color is applied to a glass lens after corrective grinding and polishing. Known as the Ultracote® lens coating process, a thin veneer of color concentrate is deposited on the completed lens. Ultracote lenses are available in all of the standard sunglass shades as well as in the eleven Fashion Shades. Surface dyes have been developed for hard-resin lenses which also duplicate the sunglass colors although not the infrared filtering action.

Man evolved as a diurnal creature who lived and died within 20 miles of his place of birth. Within the last century his method of living has been altered sharply to include artificial illumination, rapid mechanized travel, and sharp environmental changes from mountains to seashore. These changes in lifestyle emphasize the need we have for corrected vision in all walks of life, and the fact that our eyes need every break we can give them.

Possibly the process of natural selection will one day equip mankind with bill-shaped extension of the brow and the tinted cornea and crystalline lenses we now apparently need to get along in our world of boats and planes, seashores, desert and snow. Until then, however, it's up to the eyecare professionals to make sure that the public get every edge available in taking care of the eyes we have – and that includes sunglasses scientifically designed to do the job.