REDUCING HEADLIGHT GLARE

***Daniel Karpen** revisits the advantages of neodymium oxide additives.*

In "The Road Less Traveled," which appeared in the July 1998 issue of *LD+A*, I described a novel solution to the problem of headlight glare: To add neodymium oxide, a rare earth compound, to the glass of the bulb to filter a portion of the yellow wavelengths between 565 and 595 nm.

In June 2000, I signed a licensing agreement with Federal-Mogul Corp., which will market the lamps under the Wagner Lighting trade name.

In March 2001, Wagner Lighting announced sealed beam lamp types H4651BK, H4656BK, H6024BK, H6054BK, and H6545BK. The neodymium oxide is added to the tungsten halogen burner, and the burner capsule appears bluish. Unlike the blue-coated lamps, the neodymium oxide is incorporated into the glass during the melt.

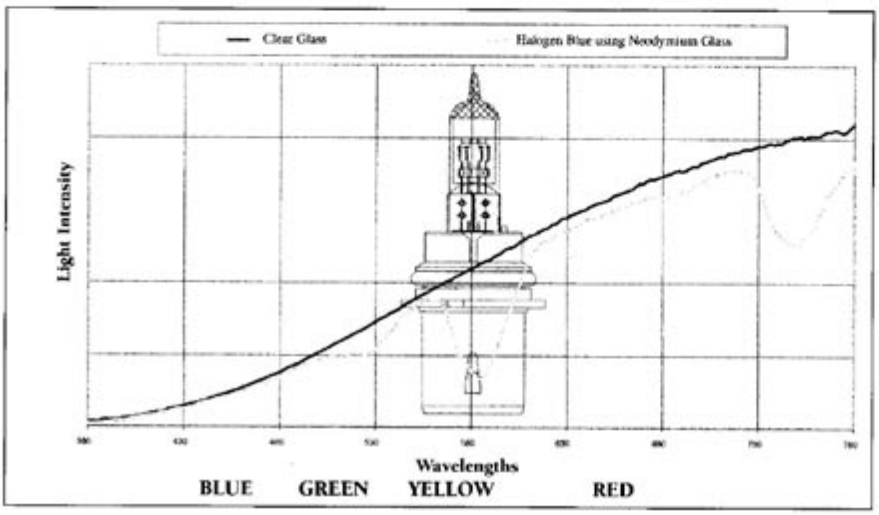
I have a 1987 Dodge Aries, which uses a sealed headlight lamp. I installed a set of H6054BK lamps, which Wagner Lighting supplied.

Due to the reduced yellow content, the light appeared whitish, rather than yellow, which is characteristic of an incandescent sealed beam or tungsten halogen lamp, or bluish, which is characteristic of xenon HID lamps.

Contrast of road markings was excellent—even those that were worn. Black-and-white road signs could be seen hundreds of feet away—even during use of the low beam. Red and green reflectors on mailbox posts could be seen from 800 to 1200 feet. Green street signs "jumped out." Stop signs appeared "redder" than they do in daylight.

I found it difficult to "overdrive" the headlights—whether high or low beam.

On roads with no illumination, I saw pedestrians from hundreds of feet away. The outline of a road, particularly on curves, was excellent.



An unexpected benefit was improved visibility while driving through rain. The neodymium oxide doped headlights cut through heavy rain as if it was not there.

Usefulness of candlepower measurements

Headlight lamps once all offered basically the same spectral energy distribution. The sealed beam incandescent lamps had approximately the same color temperature and spectral energy distribution of a filament lamp.

Today, however, headlight lamps are not the same. Incandescent sealed beams are available as tungsten halogen lamps with a color temperature slightly higher than a pure incandescent sealed beam.

Blue-coated tungsten halogen lamps, available for several years, vary from manufacturer to manufacturer.

Xenon HID lamps have a higher color temperature and appear to offer a wider light distribution pattern—better for the driver, glare-producing for everyone else.

All these light sources, including neodymium oxide doped tungsten halogen, have different scotopic/photopic (S/P) ratios. If these headlight lamps are used for night vision, their scotopic light output should be calculated. For the first time, S/P ratios have been calculated for several of these sources. These values were taken from a University of Michigan Transportation Research Report, UMTRI-2001-9, prepared in April by John M. Sullivan and Michael J. Flanagan.

Source	S/P Ratio
Tungsten halogen	1.55
Blue tungsten halogen	1.63
Neodymium tungsten halogen	1.72
Xenon HID	1.77 (typical)

The neodymium oxide doped tungsten halogen lamps appear to be 11 percent more effective than the standard tungsten halogen sources. Moreover, the xenon HID lamps have a 14 percent greater S/P ratio than the tungsten halogen lamps. Present National Highway Traffic Safety Administration (NHTSA) regulations are based on minimum and maximum photopic candlepower output for headlight lamps; however, procedures based on scotopic candlepower are necessary to properly regulate the differ-

ent light sources, as headlights are used at night.

On June 6, 2001, I petitioned the NHTSA to incorporate scotopic candlepower in its regulations. As this article goes to press, an NHTSA contact told me they are seriously considering this change. On September 26, 2001, NHTSA requested comments on the headlight glare problem. The docket number is NHTSA-2001-8885. Deadline was January 28, 2002. Comments may be acceptable after this date. (*http://www.nshta.dot.gov/cars/rules/rulings/glare.html.*)

The Lighting Research Center Study

A recent study by Michele McColgan, John Van Derlofske, and Insiya Shakir (June 2001, Lighting Research Center, Rensselaer Polytechnic Institute) had subjects evaluate the color preferences of neodymium lighting against other types of illumination.

Four lamps—neodymium tungsten halogen, standard tungsten halogen, blue-coated tungsten halogen and HID—illuminated road sign materials. Sets of light were compared side-by-side and in sequence.

Neodymium tungsten halogen lamps were preferred in side-by-side comparisons. Subjects used terms like "clearer," "more vivid," ""brighter," and "more natural."

Ninety-two percent of the subjects preferred the neodymium lamps in side-by-side comparisons; sixty-four percent preferred them in the sequential comparison.

Response of the motor vehicle manufacturers

Since my patent "Color Correct Motor Vehicle Headlight" was issued in 1996, automotive and lamp manufacturers have shown an interest in the new source.

Development work by Wagner Lighting on the 9004 neodymium tungsten halogen lamp is complete; work on the 9007 is underway. Development of the 9005, 9006 and other lamp types will begin soon. Large scale production is expected in 2002.

Neodymium street lighting

You can't see colors very well under either high-pressure or low-pressure sodium lamps. Perhaps it's time to consider neodymium oxide street lights. There would be a significant energy savings. My calculations, based on Sam Berman's work on spectral sensitivity, show that a 150-watt neodymium oxide doped incandescent could replace a 250-watt HPS source while offering improved color rendering properties.

Isn't it time we took a good look at how we light our streets and highways?

The author: Daniel Karpen is a certified energy manager and registered professional engineer in New York State. He has five U.S. patents related to lighting, and maintains a lighting and energy conservation consulting practice.