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Technical Data Sheet

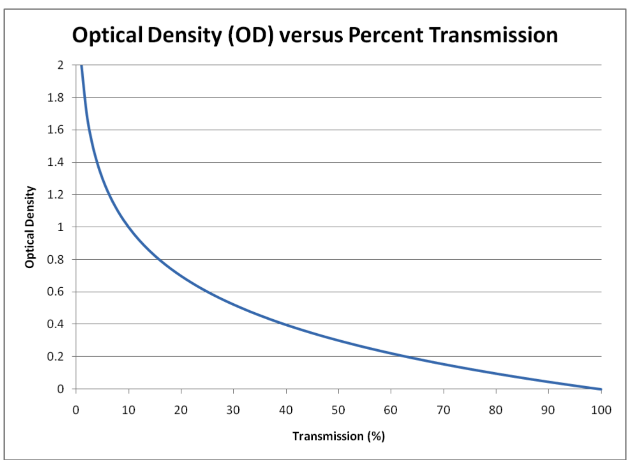
A HELPFUL GUIDE ON HOW TO CALCULATE YOUR ABSORBING DYE'S THEORETICAL STARTING CONCENTRATION

The journey begins by understanding Beer-Lambert's law then using it for a practical purpose. An overview of the equation will be provided followed by an explanation on how to use it for industrial applications.

Beer-Lamberts Law

A = ebc

A = Optical Density (OD)
Units: none
Optical Density is related to an object's ability to absorb light (radiation) and not re-emit it; the higher an object's optical density the more opaque it is. It is calculated using the following equation; 2 – log(%T). Below is a graphical representation of the relationship between percent transmission (%T) and optical density.



e = Absorptivity Value
Units: Liter * gram-1 * centimeters-1 (L g-1 cm-1)
The absorptivity value can be viewed as an efficiency rating. The higher the value, the more light (radiation) is absorbed per gram of dye. Please note that this is an over simplification but is true enough when evaluating two dyes with similar characteristics and incorporated into the same matrix.

b = concentration
Units: grams / Liter (g L-1)
This how many grams of QCR Solutions' dye per liter of solvent (If applying into plastic resin then we will assume that one kilogram of resin equals one liter)

c = path-length
Units: Centimeters (cm)
This is determined by the final thickness of your coating, film or other matrix.

Application of Beer-Lamberts Law

We now have the definitions of Beer-Lamberts law in place. We can use it for a practical purpose of getting a starting concentration for your application. First we will adjust Beer-Lambert's law where the variables that we control are on the right side the equation.

b = A / (e*c)

Variables in your control:
Absorptivity (e) value of the NIR Dye
Path-length (c) of matrix (coating, film, or thermoplastic)
Optical Density (A) requirement of application

Factors to consider:
1.) Bathochromic shift of the NIR Dye's absorption maximum when coated or placed into solid matrix
2.) Broadening of the NIR Dye's absorption peak
3.) Solubility limitations of the NIR Dye(s) in chosen carrier or matrix
4.) Degradation of NIR Dye in carrier or matrix
5.) Degradation of NIR Dye during processing into thermal resins

Example: If you require your 2mm (0.2cm) polycarbonate lenses to have an Optical Density of 5 using our NIR983A with an absorptivity value of 60.

Pathlength (c) = 0.2 cm
Absorptivity (e) = 60 L g-1 cm-1
Optical Density (A) = 5

Theoretical Starting Concentration (b) = [5 / (0.2cm * 60 L g-1 cm-1)]

So your theoretical starting concentration would be 0.42 gram / liter. This is only a starting point but it will get you on your way.

QCR Solutions Corp
Email: info@qcrsolutions.com • Phone 772-237-5354 • Fax: 772-672-3544
www.qcrsolutions.com

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All Applications using any QCR Solutions Corp products should be thoroughly tested prior to approval for production.

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