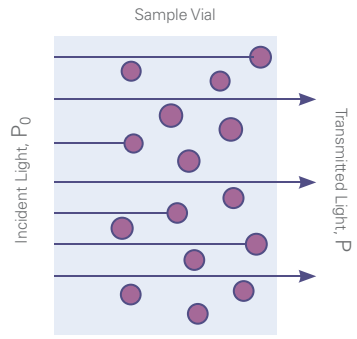
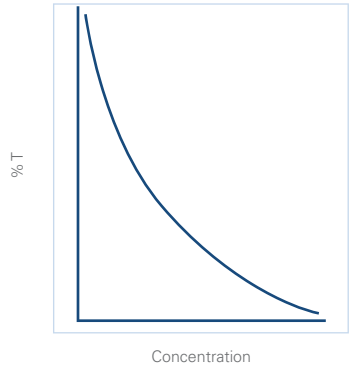
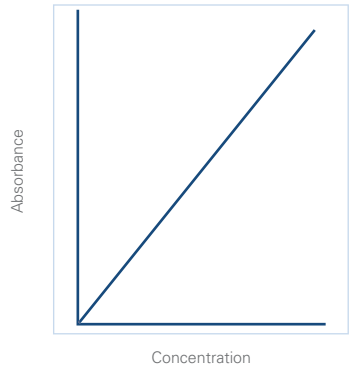
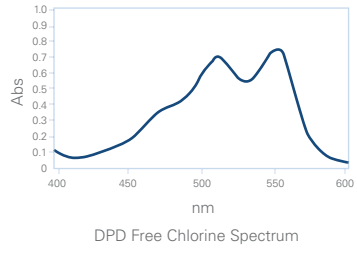
Thermo Scientific Orion Colorimetry Theory Overview









DPD Free Chlorine Spectrum

Colorimetry is an optical measurement that uses color to quantitatively determine the concentration of a component in a liquid sample. A chemical reagent for the component of interest is added to the sample being tested. A color will develop that can be measured by a colorimeter.

As depicted in the figure on the left, colorimetry is a chemical measurement based on Beer's Law. Beer's Law describes the relationship between the amount of light transmitted through a sample and the component's concentration in the sample.

Transmission = $P/P_0 = 10^{(-abc)}$

Where:

P_0 is initial power of incident light

P is power of transmitted light

a is a constant - *the ability of a given molecule to absorb a particular wavelength of light*

b is the path length - *the longer the path, the less light gets through*

c is the concentration - *the more molecules in the solution, the more light is absorbed*

As expected from Beer's Law, an exponential curve results from plotting the percent transmission versus concentration points, and a linear curve results from plotting the absorbance versus concentration points.

A typical colorimeter has one or more fixed wavelength light emitting diode (LED) sources in the meter. To have the most sensitivity and selectivity to the compound of interest, the wavelength of the LED is chosen to match one of the maxima or peaks, in the visible spectrum of the compound of interest when reacted with the reagent. In the free chlorine DPD spectrum, there is a peak near 520 nm, the wavelength range used for this test. The colorimeter is designed to pass light through a sample and collect the transmitted light through the sample and the vial. By establishing a calibration curve from readings of standards with known concentrations for the component of interest, the concentration of that component in the sample can be determined. For many official colorimetry methods, a wavelength range is specified for the test.

Colorimetry Tips and Techniques

- Colorimetry is often a good technique for low-level readings in the ppb to ppm range.
- Colorimetry is a value oriented test for a specific concentration range that can be measured in either the lab or field.
- Both reagent blank and deionized water zero measurements are important for accuracy and precision. Be sure to review specific steps of the method to see if both are used.
- It is good practice to run a "zero" of deionized water to correct for stray light and to correct for internal reflection of light by vial walls.
- Some methods require or recommend a reagent blank, which uses deionized water instead of the sample. The user adds the test reagent and follows the test method as if it was a sample. When recommended, a reagent blank should be performed.
- Reagent blanks can be used to subtract the amount of color contributed by the reagents and not due to the sample itself. This gives greater accuracy in the sample result. In advanced meters, the subtraction is performed for you.
- Concentrated samples that are above the range of the test method may be diluted with deionized water to meet the concentration range. These results needs to be corrected for the dilution amount to obtain the actual sample value.
- Turbidity and color in the sample itself can often be "zeroed (subtracted) out" if the level is not too high.
- Precision depends on concentration and range and is typically between 5-10% in the middle of the method range.
- Be sure to insert the vials so the mark on the vial and the mark on the instrument are aligned for reproducibility.
- Routinely inspect vials before use and discard any with cracks or scratches, as they can affect the results.

Thermo Scientific Orion Colorimetry and Turbidity Markets

You can find colorimetry and turbidity measurements in a wide variety of industries. The tests are quick and easy and often cost less than alternative methods. Thermo Scientific Orion AQUAfast colorimetry and turbidity products have approvals and meet the regulatory requirements in many industries. We also have several types of tests for common parameters to give you choices of reagent types, ranges and simplicity to fit your requirements. The reagent table on pages 84 and 85 highlights our EPA approved, accepted and equivalent methods.

Commonly Tested Parameters by Market

Agriculture	Beverage	Drinking Water	Environmental	Wastewater	Aquaculture	Boiler/Cooling Water	Chemical
Ammonia	Bromine	Aluminum	Ammonia	Aluminum	Ammonia	Aluminum	Aluminum
Chlorine	Chlorine	Ammonia	Bromine	Ammonia	Bromine	Ammonia	Ammonia
Iron	Chlorine Dioxide	Bromine	Chlorine	Bromine	Chlorine	Bromine	Copper
Nitrate	Copper	Chloride	COD	Chlorine	Copper	Chlorine	Iron
Nitrite	Fluoride	Chlorine	Copper	COD	Nitrate	Chlorine Dioxide	pH
Oxygen	Iron	Chlorine Dioxide	Iron	Copper	Nitrite	Copper	Phosphate
pH	Manganese	Copper	Nitrate	Iron	Oxygen	Hydrazine	Silica
Phosphate	Nitrate	Fluoride	Nitrite	Manganese	Ozone	Iron	Sulfate
Silica	Oxygen	Iron	Ozone	Nitrate	pH	Nitrate	Sulfide
Sulfate	pH	Manganese	pH	Nitrite	Phosphate	Nitrite	Zinc
Turbidity	Phosphate	Nitrate	Silica	Oxygen	Turbidity	Ozone	
	Silica	Nitrite	Sulfate	Ozone		Oxygen	
	Turbidity	pH	Sulfide	pH		Phosphate	
		Phosphate	Zinc	Phosphate		pH	
		Ozone		Sulfate		Silica	
		Silica		Sulfide		Zinc	
		Sulfate		Zinc			
		Sulfide		Turbidity			
		Zinc					
		Turbidity					

Metal Plating	Mining	Pulp & Paper	Solid Waste/ Sludge	Petroleum	Pharmaceutical/ Biotech	Semiconductor
Copper	Copper	Aluminum	Aluminum	Ammonia	Chlorine	Aluminum
Iron	Iron	Chlorine	Copper	Chlorine	Cyanide	Copper
pH	pH	Chlorine Dioxide	pH	Iron	Ozone	Fluoride
Phosphate	Phosphate	pH	Phosphate	Nitrate	pH	pH
	Zinc	Phosphate	Zinc	pH	Silica	Silica
		Silica		Sulfide		
		Zinc				