

Printer Ink-Jet Nanosize Measurement Using Microtrac Dynamic Light Scattering Particles Size Analyzers

Instrument: Wave II / Wave II Q / Nanotracs flex

Philip E. Plantz, PhD

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Introduction

Microtrac dynamic light scattering (DLS) instruments are perfectly suitable for measuring the particle size of pigment suspensions used in printers. One big advantage is that measurements can be performed at high concentrations to avoid effects of dilution on dispersion. Printing and writing have involved the use of color or black materials contained in various vehicles since the time of cavemen. The first pigment believed to be used was probably lampblack dating back as long as 4000 -5000 years. Modern printing inks contain many components each having a specific purpose in maintaining color, intensity, dispersion, viscosity, as well as acting as a milling aide. The table below shows the general type of chemical and its application. These materials impart specific properties to the ink to allow for design considerations of printers and final use.

Material	Purpose
Buffers	Control of acidity and pH
Humectants	Avoid too rapid drying
Polymers	Binding to substrate
Defoamers	Eliminates bubbles which cause interruption of ink flow from a printer –head tip
Wetting Agents	Dispersion, reduction of surface tension
Biocides	Biological stability
Thickeners	Viscosity
Dispersants	Maintenance of separated particles
Clays	Filler

Approximately 50% of the cost of inkjet ink is due to the coloring agent. The colorant can be of two types: pigment or dye. Dyes are very small molecules usually considered to be in complete solution. Molecules smaller than 1 nm are considered to be in solution while those larger than 1nm are considered to be in suspension. Pigments are used and are considered to be in suspension (not solution) and may be either organic or inorganic in chemical composition. The type of black pigment used in the past was spinel, rutile or iron. These have been substituted mostly by carbon black.

The ink is developed by mixing the components in a primary blender. Milling or grinding is performed after the more gentle blending operation and includes addition of one or more components. Addition of surfactant reduces surface tension to allow mixing of all the components in water. Along with dispersants, surfactants also assist in maintaining dispersion during the subsequent step of ball or roller mixing. Dispersants may also be used to lower the mechanical energy required for grinding. Polymers such as polyacrylates, polyurethanes and polyesters are used to obtain the best “blocking” characteristics of adherence to a substrate. It is necessary to be careful with balancing the relative quantities of surfactants and polymers since they may interact which would reduce their effectiveness in maintaining suspension applicability and color strength.

The purpose of all the components is to finally provide a colloidal suspension of crystals or particles which scatter light according to the characteristics of the pigment and other materials present. The resulting light scattering affects light fastness, shade and intensity of color. Modern advances in electronics and paper coatings allowed the commercial development and availability of color printers in the early 1980s. Of these printers, probably the most popular is inkjet technology. The ink for these printers has the same general composition but small particle size and low viscosity are necessary to pass through the small nozzle of the print head. There are three types of technology used for transfer of the ink: Drop on demand, Continuous Ink Jet and Piezo Ink Jet DOD. These vary depending upon printer manufacture.

Microtrac DLS Analyzers

Microtrac MRB has taken an innovative approach to dynamic light scattering (DLS) by using a proprietary probe design to deliver and collect light. By focusing the laser probe at the material interface, Microtrac combines the benefits of a short path length with reference beating and 180° backscatter, delivering the best accuracy, resolution and sensitivity. The probe as the catalyst for Microtrac MRB’s Reference Beating, an enhancement to traditional DLS, increases the optical signal back to the detector anywhere from 100 to 1,000,000 times more than systems that use “self-beating.” The enhanced signal produces superior analysis results when measuring single modes or multi-modes across the widest concentration range. Figure 1 shows the three DLS instruments available from Microtrac. The NanotracsFlex has a dip-in probe for in-situ measurements so that almost any vessel can be used as a sample cell. With the Wave II Q five different cuvette types can