HORIBA Scientific

Application Note

Pigment Particle Size and Hiding Power

AN209

Particle size is intimately related to hiding power in pigments. Due to its speed and wide size measurement range, laser diffraction is an ideal tool for tracking the grinding process and therefore controlling the resulting pigment performance. Laser diffraction results rapidly tell the manufacturer when a product is at the right particle size or distribution width and, therefore, allows optimum use of manufacturing equipment.

Introduction

Color is critical. Appropriately used, it can give a clear message in seconds, as in a red stop sign. Or, it can provide pleasure to millions as in the Mona Lisa. In many cases, color is used in printing and painting and must be consistent across many production facilities and production lots.

Pigments are particulate materials that are often used to provide color. When made appropriately, they can provide vibrant and reproducible color. Pigment particle size is critical for determining many properties of the resulting ink or paint. Particle size affects color strength, the effect of the pigment when mixed with other pigments. Particle size also affects scattering, which is the physical phenomena that often determines hiding power.

Hiding power can be measured by preparing a pigment dispersion and painting it across a standard sheet of paper (sometimes known as a Lenata chart). Photos of these test sheets are shown in Figure 1. This measurement provides a neat indicator of final product performance, but does not directly or quickly guide the manufacturer as they control their grinding process.

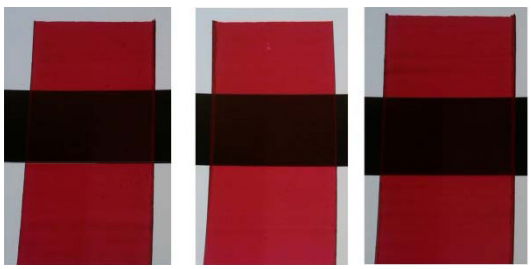

Figure 1: Illustration of test sheets for evaluation color strength.

Hiding power, among other things, is improved by grinding a pigment down to a fine, controlled particle size. This actually means two challenges. The first is the grinding and the second is the measurement of the grinding results for effective process control. Here, we are primarily concerned with the latter. Pigment size can be readily measured by laser diffraction. This measurement requires less time, training and effort than a color strength measurement and provides useful information for the process engineer. By rapidly identifying when a pigment is sufficiently ground, use of process equipment is optimized and profits are maximized.

Materials and Methods

A commercial pigment was ground by a proprietary process at Netzsch Premier Technologies in Exton, PA, USA*. The sample was then diluted for measurement with the LA-960 laser diffraction particle size analyzer, shown in Figure 2.

Figure 2: LA-960 laser diffraction particle size analyzer.

Results and Discussion

The obtained size values for various grinding times are shown in Figure 3 on the following page. Note that this data is readily overlaid in the LA-960 software. From this data it is clear that the grinding process is primarily breaking the large pigment particles down into progressively smaller particles.

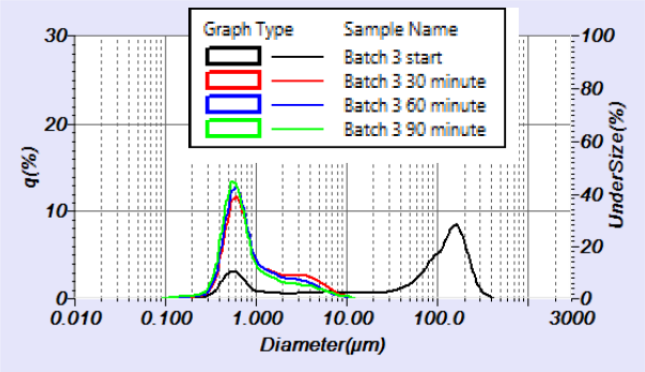

Figure 3: Particle size distribution after various grinding times measured with the HORIBA LA-960. The graph is generated with the LA-960 software which allows significant customization.

Table 1 shows the particle size distribution summary parameters, geometric mean size, geometric standard deviation, and mean size along with the measured color strength compared to the desired value.

Grinding Time, min.	Geo. Mean Size, μm	Mean Size, μm	Hiding Power (relative to desired value)
0 (start)	30.9	95.6	10%
30	1.01	1.48	85
60	0.895	1.23	92.5
90	0.812	1.16	99.5

Table 1: LA-960 measurement results from pigments at different grinding times.

Figure 4 shows a plot of the color strength as a function of particle size. From this plot it is clear that with increased grinding, the particle size decreases and the hiding power increases. Note that as the grinding time increases, the benefit of additional grinding becomes smaller. It is important to identify when a pigment is sufficiently small to ensure that grinding is stopped before manufacturing time is wasted. Thus, laser diffraction is shown to be a good measure of milling process and an excellent technique for determining the appropriate endpoint.

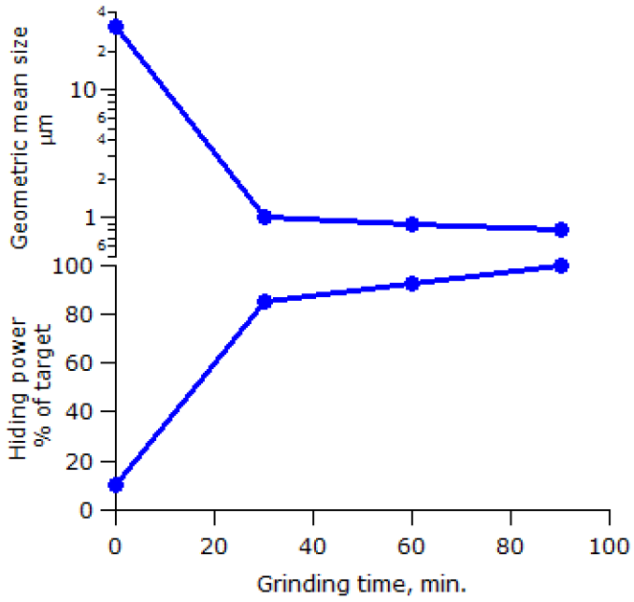

Figure 4: Plot of grinding progress.

Conclusions

The LA-960 can be used to determine the particle size of pigments throughout the grinding process. This determined particle size can be used as a predictor of color strength. Rapid measurement of particle size allows manufacturing processes to be optimized and improved cost control.

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