How a Densitometer Works

Color Separations

To reproduce a color original, an electronic color scanner separates the image into its cyan, magenta and yellow components using red, green and blue filters. A combination of these is then used to create the black component. The output of the scanner consists of a halftone screen for each of the four separations of the original with graduated dot sizes reproducing the tonal range of the original. Printing plates are then made from these screens which, in turn, print the image on paper using the four process inks. **To ensure color control and to maintain a consistent printed product**, the **ink film thickness and the size and color strength of** these **halftone dots** must be monitored.

Now, while **the human eye** is quite good at comparing the density of adjacent ink patches, it is not very good at judging them when they are separated, across a press sheet for example, and **cannot assign numerical values** to a sample. **Perception** is a **subjective judgment** and **may change with fatigue or vary from person to person**. What is needed is an **objective** method of evaluating the ink film thickness.

Enter the **Densitometer**! This device **measures the ink film thickness and provides** an **Optical Density** value. As mentioned previously, as **more** ink is applied, the **darker** it looks. The **densitometer measures the amount of light being reflected from the sample** and, **within certain limitations**, gives **higher** density readings **with increasing** ink film thickness. When the ink film thickness approaches a certain point, however, there is no further increase in density.

How Does a Densitometer Work?

A reflection densitometer fundamentally measures the amount of light reflected from a surface. There are certain specific conditions to be met which have been defined by the American National Standards Institute (**ANSI**) and by the International Standards Organization (**ISO**). These specifications deal with the geometric conditions of measurement and with the spectral responses of the instruments.

A reflection densitometer consists of a light source that has a stable output, optics to focus the light into a defined light spot on the sample, filters to define the spectral response of the unit and a detector to monitor the reflected light. The sample is usually illuminated from above, i.e. at 90° to the sample surface, and viewed at 45° to the surface. This viewing condition may be reversed if required. This viewing condition eliminates gloss reflections and only the diffuse reflections are seen by the detector. It is similar to looking at a glossy photograph - you tend to look at it at an angle to avoid shiny reflections that obscure the image. The electronics of the densitometer usually consist of a **logarithmic** amplifier and a digital display.

Why a **logarithmic** response? This is because the densitometer tries to provide numbers that correspond to what we see. The **human eye** has a **logarithmic** response, as, incidentally, does the human ear. We tend to see equal differences in density as equal visual effects.

For example, if a sample has a density of 0.80, it will appear to be about twice as dark as a sample having a density of 0.50. The **density scale** is **logarithmic**, a **density of 1.00** indicates that **10%** of the light **has been reflected** and a **density of 2.00** shows a **1% reflection**. In the example above, the sample that is twice as dark has a density difference of 0.30 from the lighter sample. The logarithm of 2 is 0.30. **See Figure 2** below.

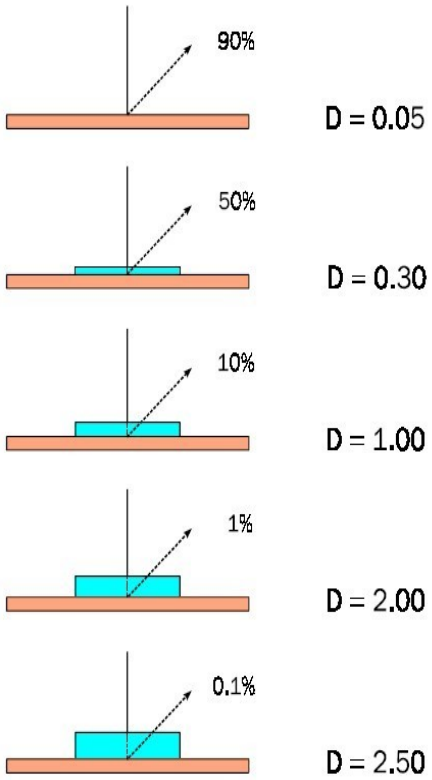

Figure 2: Ink Film Thickness vs. Density

Over a restricted range, the **density readings** from a **densitometer** are approximately **proportional to the ink film thickness**. So, if you run an ink to a s**pecific** density value, you can be reasonably sure that **the ink film thickness and**, in turn, the **product appearance**, will be **consistent**.