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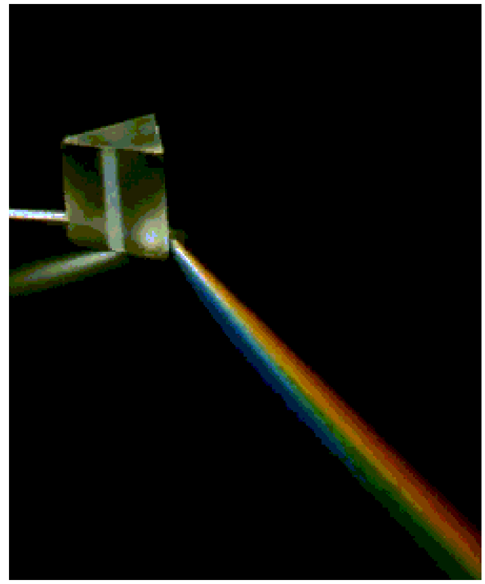
Understanding

Color

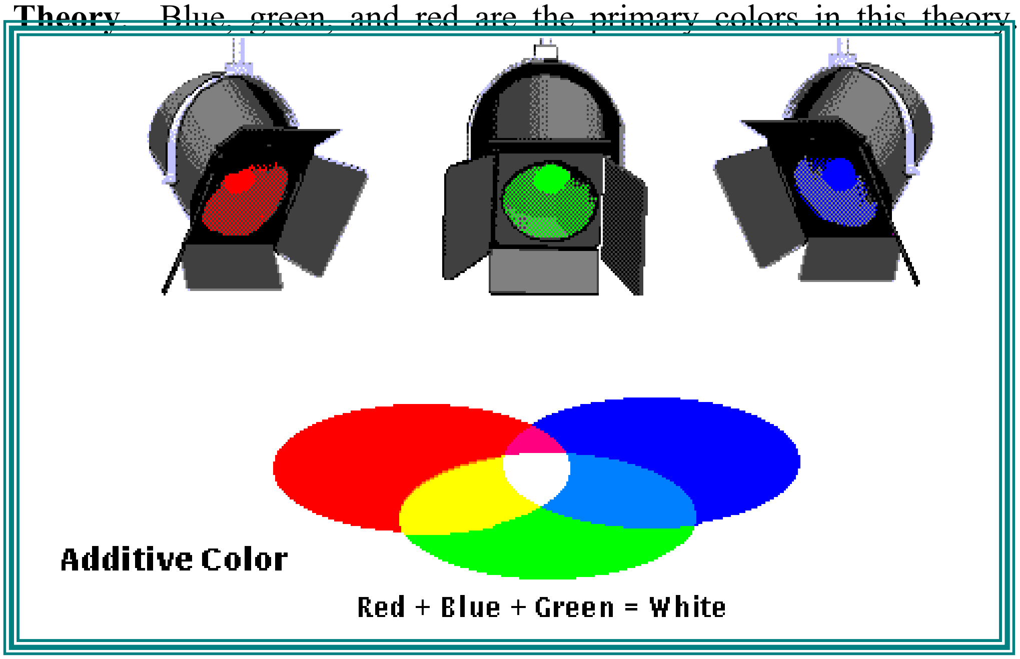
Volume XXIII

In order to gain an understanding of process color reproduction, it would be helpful to gain an understanding of the phenomenon of color. In a previous technical bulletin (Describing Color Vol. XVI), we describe the components of color and how to measure them. This bulletin will describe the basic color theories so that one can better understand the measurement of color.



In short, white light is radiant energy that is visible to the normal human eye. The color of light will vary with its wavelength. To demonstrate this, white light can be split into its parts by passing it through a prism. A prism can separate the white light by its wavelengths, resulting in a rainbow effect as the light exits the prism. The visible spectrum consists of infinitesimal variations of color. However, in practice three broad bands of color can be classified. The three bands are blue, green, and red.

We are able to see colors because our eye contains three different color receptors, red, blue, and green. When equal parts of this blue, green, and red light are cast, the eye perceives this as white light. When light is combined in unequal proportions, we will see color. This is the basic premise of the **Additive Color Theory**. Blue, green, and red are the primary colors in this theory. Secondary color can be created by combining or adding any two of these colors.



Thus the following combinations can be created:

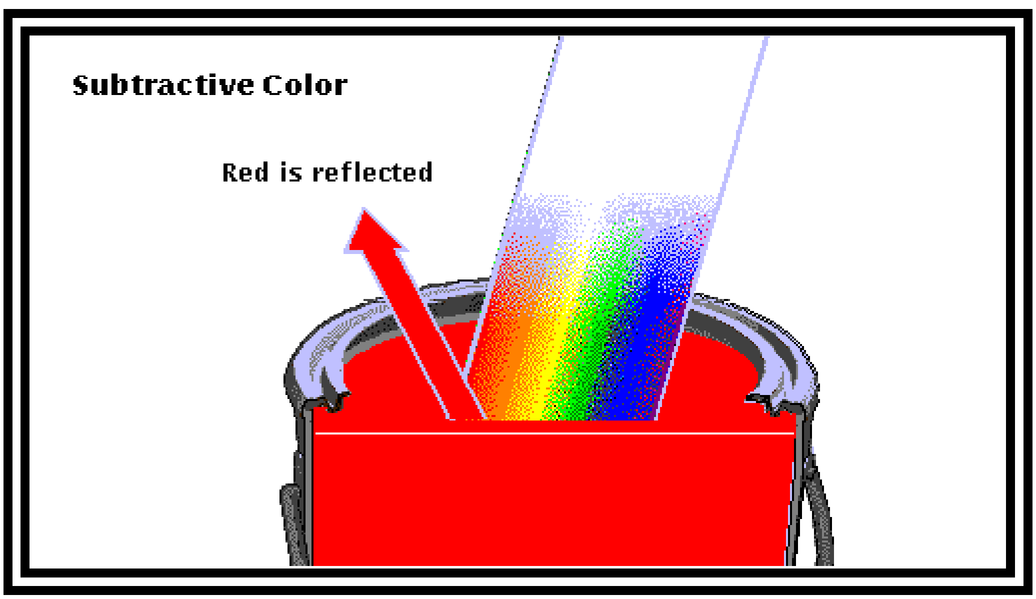
Yellow = **Red** + **Green**

Magenta = **Blue** + **Red**

Cyan = **Blue** + **Green**

The **Additive Color Theory** is best displayed by televisions. Television uses red, blue, and green lights to produce the images we see on the screen. The size of the light producing elements are consistent, the intensity of the light produced is varied to change the color.

As we look at the color printing process, the color cannot be produced by the additive process. Color prints are seen by viewing the light reflected off the surface of a print. **The Subtractive Color Theory** explains how colorants or pigments are used to subtract portions



of white light illuminating an object. When white light illuminates an object, some wavelengths of light are absorbed while others are reflected.

The subtraction of red, green, and blue light is achieved by using colorants that are their opposites. Cyan ink reflects blue and green light (absorbs red light), thus the eye perceives blue. Magenta ink reflects red and blue light (absorbs green light), thus the eye perceives red. Yellow ink reflects green and red light (absorbs blue light), thus the eye perceives yellow.

Colors are achieved by subtracting portions of light away from the white paper. The following colors are examples of the Subtractive process.

> To see **green**, a combination of yellow (minus **blue**) and **cyan** (minus **red**) is needed.
> RGB - B - R = Green
>
> To see **red**, a combination of **magenta** (minus **green**) and yellow (minus **blue**) is needed.
> RGB - G - B = Red.

Thus, any color in the visible spectrum can be obtained by varying the proportions of any or all of the colorants used. In color printing the colors are overlaid or trapped to produce the secondary colors. When all three of the primary colors overlap, black is produced.

Color printing is achieved by breaking up or separating color pictures into tiny dots of varying sizes by means of a halftone screen. The color variation is produced by varying the amount of the color printed or the size of the dot being reproduced.

In summary, the sensation of color in printing is dependent on the ability of a pigment to absorb portions of the visible spectrum. The non-absorbed portions of light are reflected and perceived by the eye and stimulate the brain for the particular color response.