2 Color of Organic Compounds

2.1 Basic Concepts of Color

Color vision is based on a variety of physical, chemical, physiological and psychological processes. That part of the electromagnetic spectrum visible to man is the range of wavelengths between 400 and 700 nm. Light can be absorbed completely, partly or not at all by gases, liquids or solids. That part which is not absorbed can be reflected at the surface of liquids or solids or transmitted through gases, liquids or glassy solids. The light which is emitted from a light source and the reflected or transmitted light reach the retina in the human eye. There, the light with wavelengths between 400 and 700 nm initiates a photochemical reaction, and subsequently a series of light-independent reactions in the visual pigment take place. By a transfer of information between the eye and the brain, this process results in visual perception (see Sec. 2.7).

In this section light absorption and reflection are discussed in terms of simple physical concepts. This discussion forms the basis with which to treat the correlations between chemical constitution and light absorption of dyes (Sec. 2.2–2.6). During the last two decades colorimetry, in the sense of a quantitative description of colors as they appear to the human eye, has become very important for the application of dyes to textiles, plastics, paper etc. Colorimetry is based on the neurobiological processes in the eye and the brain and will be discussed in Section 2.7.

If electromagnetic rays, whose energy distribution in the visible range corresponds to that of sunlight on earth, reach a solid which reflects all visible light in a diffuse way and with complete reflectance, it appears to the human eye as *white*. On the other hand, if the solid absorbs all light, we recognize it as *black*. If it absorbs a constant fraction of light in the whole range between 400 and 700 nm it appears *gray*. White, gray and black are called *achromatic* colors. They are characterized by a constant absorption in the range between 400 and 700 nm (Fig. 2-1). In contrast to achromatic colors, solids having *chromatic colors* show one or more bands, *i.e.* absorption maxima and minima in the visible spectrum. If an absorption band is located in the short wavelength part of the visible spectrum (400–430 nm), that part of the incoming light will be absorbed. The rest of the spectrum will be reflected and the solid will appear yellow to the eye. Analogously, absorption bands at 430–480 nm, 480–550 nm, 550–600 nm and 600–700 nm yield solids which to the eye appear *orange*, *red*, *violet* and *blue*, respectively (Fig. 2-1). Solids which look *green* are characterized by two absorption maxima at