CHAPTER 1

INTRODUCTION

1.1 General Remarks

The judgement of color permeates our industrial life. The (1) farmer judges the worth of farmland by the color of the soil. He judges the worth of fertilizer by the color of growing crops. His vegetables and fruits are often graded and priced according to color. His prime beef and pork are identified by their colors. The miner selects the commercially valuable minerals by color and discards those having no commercial value in the same way.

The manufacturer is both buyer and seller. (1,4) He judges the worth and uniformity of his raw material by its color; and his product is judged in turn by its color. Raw wool, cotton, and silk are graded and priced according to color. In this way the textile manufacturer can produce goods of uniform color at a price low enough to sell.

Many industries excel at mass production. To make a complicated machine like a refrigerator or automobile takes a whole series of steps, each one performed by a specialist. In each of these steps the color question may, and often does, arise for the article or part both before and after processing. Take a refrigerator for example. The walls may be of sheet steel coated with white vitreous enamel; the door to the freezing compartment of white plastic. It is no accident that these two whites are alike. To get this symbol of the machine age into our houses at a price we can afford, a hundred thousand plastic doors have to come out the same white, and not be of the several hundred other whites and near-whites that the eye can distinguish, the essence of mass production is interchangeable parts; any one of the 100,000 doors must be suited to any one of the 100,000 refrigerators in size, shape, and color. A (2) modern magazine with its wealth of illustrations in color, color photography for the amateur as well as the professional, colored plastics, goods in colored packages, all testify to the increasing important of color in our daily lives. Color has become the concern not only the artist, but of the physicist and chemist and of the engineer and industrialist as well.

To the casual observer the measurement of color may seem to be a fairly simple matter: samples are compared with standards in an atlas, and the job is done.

In the complicated network of processes that make up our economic life, (1) we use our eyes time and again to choose among competing products, be they raw materials from below and above ground or processed materials. To carry out this inspection, color measurement, and selection, there have been developed various tools and technics.

(3) Before we can see our sample we must have a light source. If light came in only one form, then we would use that light and there would be no complexity here. But the most basic form of light, daylight, comes in many forms (sunlight,

overcast light, blue-sky light, and many others), and in addition tungsten-filament lighting and many different forms of fluorescent lamps are used. It is common experience that the appearance of colors is affected by the type of light employed, hence, either new measurements must be made for every light source, which would be intolerable, or standard sources representative of the most commonly occurring groups of light source must be provided.

Having chosen our standard light sources, we must now consider our atlas, and immediately we encounter further problems. The human eye, under good condition of observation, is capable of distinguishing an enormous number of different colors; one estimate puts this at over to million. Clearly an atlas having this number of samples would be extremely costly to produce and unwieldly to use, and so a selection of samples has to be made; this means that interpolation between samples is necessary, and, when small color differences are involved, the colors may easily fall between successive samples in the atlas, and thus their measurement by this means is imprecise.

Another problem with an atlas is the impermanence of its samples; even if fading does not occur, deposition of dirt or scuffing of the surface of the samples is likely to result in changes of color with use. The range of colors covered by the atlas also presents difficulties, in that the more vivid colors tend to be exhibited by colorants that are somewhat unstable; hence a compromise has to be reached between covering a large gamut of colors and maintaining a high degree of permanence. New colorants also appear from time to time which are beyond the gamut of existing colorants and hence beyond the limits of the atlas.

For the measurement of color to be of general, as opposed to very local, use, and this presents a severe practical problem necessitating a compromise between the cost of producing the atlas and the color tolerances within which the samples are held.

The systematic way in which the samples are arranged in the atlas, and the way in which a color specified within the system, must also be decided. So, different observers will not always agree in their judgements when comparing colors with those in an atlas; the color vision of observers differs, even if those with defective color vision are excluded.

The above considerations have inevitably resulted in the simple concept of the color atlas being abandoned as the basis for modern colorimetry. Atlases still have their uses, but the fundamental basis of colorimetry is now physical measurement. Physical measurements can be made corresponding to millions of different colors, they can be made independent of the permanence of actual color samples, they can cope with all samples so that their gamut is never inadequate, they can be based on internationally agreed physical standards, the systematisation of the results becomes merely a matter of numerical manipulation, and the color vision of a standard observer can be specified. Thus all the objections to the use of color atlases are dealt with. However, in reality, it must be admitted that what has really happened is that one set of difficulties has been replaced by another. But, whereas with atlases there appears to be no chance of overcoming some of their inherent limitations, with physical measurement the difficulties encountered should be amenable to solution eventually.

Both color atlas and physical measurement are employed in color matching in our textile industry. Composition of dyestuff mixtures is determined by trial and error until color matching is accomplished. Thus, it is a time consuming process and is dependent on past experience and uneconomic.

1.2 Purpose of Research

It was the purpose of this work to study the applicability of the mathematical model for reactive dyeing on cotton fabric based on the turbid media theory. It was hoped that this work would lead to a suitable mathematical model for obtaining accurate dyeing both in shade and strength rapidly.

1.3 Scope of Research

This work includes:

1) Setting up the suitable mathematical model based on turbid media theory.
2) Reactive dyeing on cotton fabric by the exhaustion method with single color and color mixtures of two and three dyestuff.

   Using various dyestuff concentrations.
3) Colorimetric measurement of colored cotton fabric.
4) Calculating the parameters in the mathematical model

based on single color data.

5) Prediction of dyestuff concentrations with the aid of the mathematical model.