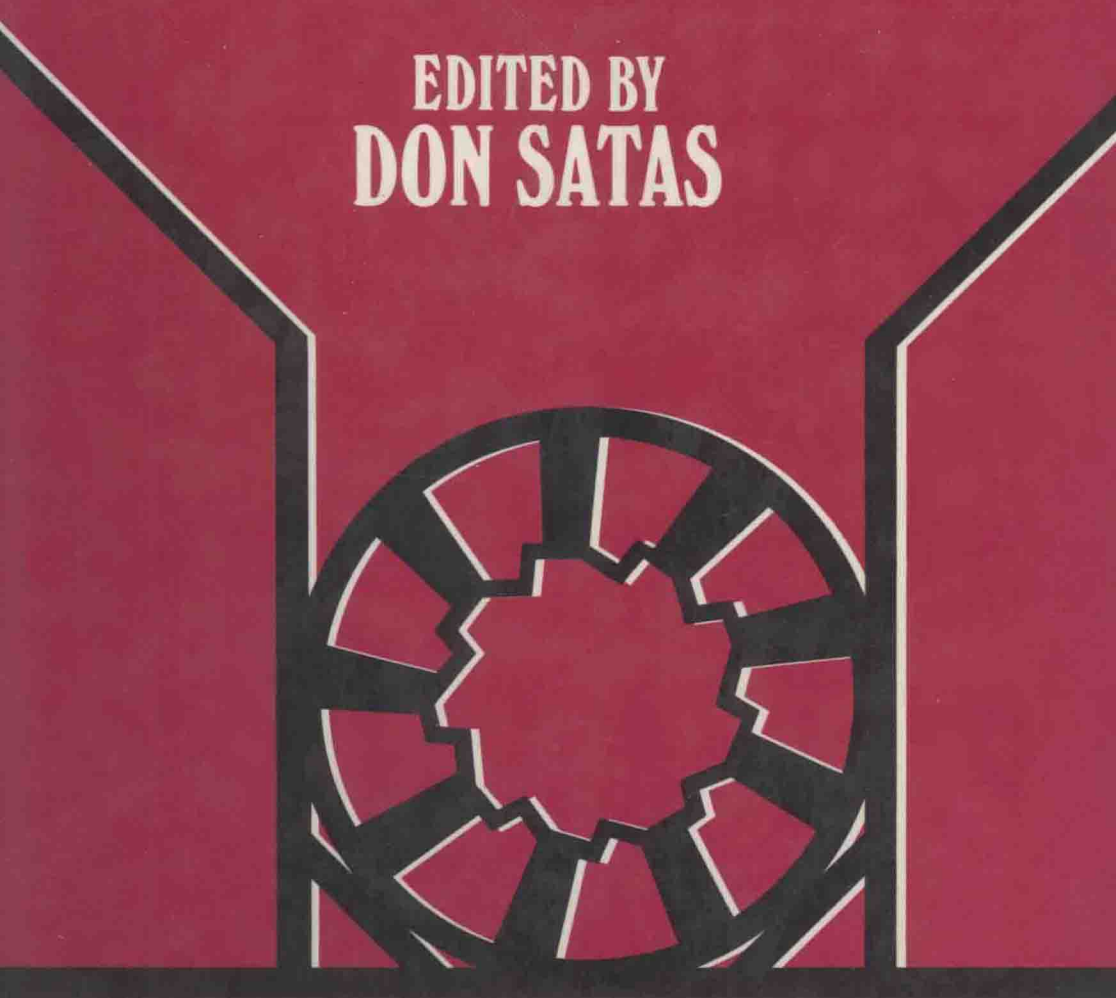
PLASTICS FINISHING AND DECORATION

EDITED BY
DON SATAS



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PREFACE

The use of plastics is spread so widely throughout industry that it is difficult to think of a product group which does not employ plastics in some way. Plastic materials are especially useful as enclosures, containers, covers, or surfacing panels. In all of these applications, the surface appearance is important. Sometimes the required surface appearance can be achieved during fabrication of the plastic part, but often, an additional operation is required to change the surface in order to satisfy the aesthetic or functional product requirements. Thus plastic surfaces may be painted, printed, metallized, embossed, or polished. These finishing operations, although clearly secondary in importance, can amount to a significant part of the total cost. Furthermore, these secondary operations are carried out not only by the fabricator of the plastic parts, but also in the product assembly facility. Thus the use of decorating technology is spread more widely throughout the industry than the fabrication of plastic parts by molding or other techniques.

Despite such widespread use of surface finishing operations, there has been no comprehensive survey of available techniques, at least not in the English language. This book is an attempt to fill that gap. The book is aimed primarily at the technologist in the plastics industry, but it also should be useful to the manufacturers of inks, coatings, and other supplies used for plastics finishing and to almost anyone involved in the processing or use of plastic materials.

I would like to thank the contributing authors for the time and effort they have given to make this book possible, as well as the numerous individuals whose names appear only in the references but whose work enabled us to prepare this overview. I would also like to thank the editorial staff of Van Nostrand Reinhold Company, especially Susan Munger, Alberta Gordon and Florence Poillon, for their help in putting this book together.

Warwick, R.I. D. SATAS

CONTENTS

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SURFACE APPEARANCE

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Surface appearance of plastics is mainly perceived visually, although the surface condition perceived tactilely may also be important. Optically, plastics may be transparent, translucent, or opaque, or they may reflect light. Usually they exhibit some of these modes of light distribution. The appearance of opaque plastics is affected by the depth to which some of the light is transmitted; thus it is not a purely surface condition.

From the point of view of human perception, visual appearance may be subdivided into two main categories: color and light distributive properties. The color depends on the selective light absorption. It can be described by the CIE (Commission International de l'Eclairage) tristimulus values which can be measured by colorimeter. The color can also be described by comparing it visually to a collection of samples arranged in some order. Perhaps the best known system is the Munsell, which classifies colors in terms of hue, lightness, and saturation. Hue describes whether the color is blue, green, red, yellow, etc; lightness describes to what extent the object reflects the light; saturation (chroma, colorfulness) describes the amount of color or hue. Color principles and coloring have been described in numerous books.[1,2]

The light distribution factors can be described optically, but they are difficult to relate to human perception. Transparent plastics exhibit specular transmission as a dominant light distribution mode, although some specular reflection and some diffuse transmission are also present (Figure 1-1).

Opaque plastics exhibit a dominant mechanism of diffuse reflection, but some degree of specular reflection is also usually present which shows up as a surface gloss (Figure 1-2). Opacity is achieved by incorporating pigments, fibers, or air bubbles into the plastic. Translucent plastics ehibit diffuse trans-

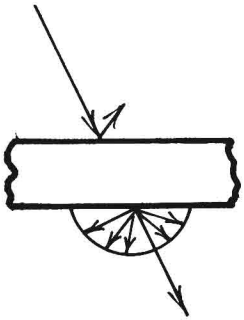

Fig. 1-1. Light transmission through a transparent plastic.

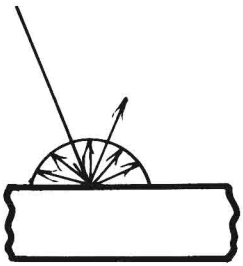

Fig. 1-2. Diffuse reflection.

mission (Figure 1-3) accompanied by some specular reflection. Predominantly specular reflection, along with some diffuse reflection (Figure 1-4), is exhibited by metallized plastics.

In addition to the mode of light distribution, the uniformity of the surface condition is an important factor in surface appearance. Surface damage, unintended nonuniformity in color and gloss, and other imperfections detract from acceptable appearance. Surface appearance may be changed by several means which require either deposition of new material on the surface, as in coating or printing, or removal of some material from the surface as in grinding.

Coating and printing operations require an even distribution of fluid material over the surface, drying or otherwise solidifying the coating in a uniform and blemish-free way, and development of an acceptable adhesion between the coating and the substrate. Coating must flow during the coating operation, and it must solidify when its application is completed. This requirement evolved several different types of coatings and inks. They may be applied as a solution and solidified upon evaporation of the vehicle. Most of the solution coatings of interest for plastics are dissolved in organic solvents. Coatings may also be applied as emulsions or dispersions, usually in water, which harden upon evap-