Standard Color Glasses

By H. J. MORRISON
Procter & Gamble Company

CERTAIN standard color glasses largely used for the reading of liquids consist of a clear glass base upon which a varying thickness of the desired color is superimposed on one or both sides.

Those who have not looked up the matter of manufacturing these glasses have various ideas as to how they are prepared. It might, therefore, be of interest to explain some of the details of their preparation.

Glasses of this character are known as "flashed." The method of making them is in the main as follows: Two pots of molten glass are prepared, one containing the clear or uncolored glass, the other containing a glass having the same thermal expansion as the clear glass colored to the proper hue and value.

The glass blower inserts his blow pipe into the pot of clear glass and builds up thereon, by successively cooling slightly and redipping, a ball of "metal" of a size which, in his judgment, will give the results sought. This ball is now blown to a greater or lesser extent, then dipped into the pot of the molten colored glass, and thus coated with a layer of this colored glass. This is now blown to a large size bubble of glass of a more or less spheroidal shape. When it has reached a proper size, it is then drawn so that the middle portion is of a cylindrical shape. After this has cooled sufficiently, the rounded ends are removed and the cylinder cut lengthwise. This main portion is then softened by heat and flattened. It will have upon one side a layer of colored glass which, however, will vary somewhat in thickness in various parts of the sheet as will also the total thickness.

If the blower had, after gathering his ball of "metal" from the pot of white glass, blown it to a considerably larger sphere than in the case described above, then dipped it into the pot of colored glass and had subsequently blown it to approximately the same final size as previously, it is at once apparent that he would have in this case a glass coated with a thicker layer of colored glass, i. e., the ratio of colored to clear glass is increased. By manipulating these variables, glasses of various thicknesses of the colored glass are produced.

In many cases, one will note that the color glasses in use are colored on both sides, i. e., there are two thin layers of colored glass between which there is clear glass. These are made by first dipping the blow pipe into the colored glass pot and gathering a certain amount of this, then into the clear glass pot, and finally coated on the outside with the colored glass. Upon blowing this then, it follows that a color glass will form both the outer and the inner surface.

Glass blowers become quite dexterous and can blow and control these shapes with considerable dexterity. It is, however, impossible to predetermine the color value or control exactly the thickness of the clear glass or of the coating colored glass. It is, therefore, necessary after these glasses have been cut to the size used for the various instruments to sort and standardize them by matching.

The variations are best shown by giving the thickness in thousandths of the inch on a number of such glasses comprising several sets and sold and guaranteed to have equivalent color values. Those colored on both sides are marked B. S., and if on one side only by O. S.

Red glasses	Thickness in inches No. 1 set	No. 2 set	No. 3 set
0.1	.083 B.S.	.125 O.S.	.110 O.S.
0.2	.071 B.S.	.107 O.S.	.110 O.S.
0.3	.084 B.S.	.064 O.S.	.113 O.S.
0.4	.134 O.S.	.056 O.S.	.090 O.S.
0.5		.061 O.S.	.063 O.S.
0.6	.095 B.S.	.055 O.S.	.117 O.S.
0.7	.084 B.S.	.087 O.S.	.080 O.S.
0.8	.086 B.S.	.103 O.S.	.085 O.S.
0.9	.067 B.S.	.074 O.S.	.070 O.S.
1.2	.081 B.S.	.103 O.S.	.073 O.S.
2.3	.082 B.S.	.092 O.S.	.099 O.S.
3.1	.086 B.S.	.108 O.S.	.107 O.S.
4.1	.082 B.S.	.075 O.S.	
5.1	.098 B.S.	.125 O.S.	.070 O.S.
6.2	.089 B.S.	.082 O.S.	.079 O.S.
7.0	.097 B.S.	.092 O.S.	.074 O.S.
8.5	.098 B.S.	.102 O.S.	.094 O.S.
9.0		.102 O.S.	.090 O.S.
10.0	.089 B.S.	.083 O.S.	
15.5		.125 O.S.	
20.0	.145 B.S.	.113 O.S.	.133 O.S.
40.0		.147 O.S.	.154 O.S.
50.0	.180 O.S.		

It will be noted that the variations in total thickness are as much as 300 per cent, that the variations are haphazard and not in any order comparable with the color value, that the thickness for the same color value varies widely in different sets.

It is not possible to measure the colored layers, but by examining the cross section and especially by viewing the end cross section the variations of the colored portion can be seen. Many glasses may be found in which the colored film varies widely in thickness from one side to the other.

The clear glass is made of as colorless a glass as practical, but nevertheless always contains some color. The thickness of the clear glass which backs up the actual colored glass will, therefore, alter the color value as this ratio varies. In the glasses which are ordinarily used, there may be a variation in the thickness of the colored layer from one end or side of the glass to the other. The varying thicknesses and changing ratios of the glasses affect all the various physical phenomena entering into color reading, such as dispersion, absorption, luminosity, etc.

The usual rules governing the reading of colors limit the number of glasses to be superimposed, in any one reading of a color. It is, of course, evident that a single glass is the best for a standard. The greater the number of glasses, the greater is the obstruction to the light. The same thickness in a single piece will not obstruct the passage of the light in anything like the degree which the same thickness made up of several separate glasses will.

Color type glasses are not a true or scientifically correct method of reading liquids. This is well understood by all who have given thought to the subject. The convenience and simplicity of such type, however, commend them for the daily use in routine work by both the scientific worker and the non-technical user. Also, it is only by comparison with some standard color that colors can be expressed as such. Any really scientific method would take into consideration all of the various colors present, although one may predominate almost exclusively. Such scientific methods would express the value in terms quite unintelligible to the average user of the results.

The trades in many lines, which have color standards for their commodities, express their colors in given shades of a certain set of standards. This has become so ingrained and is so widely known in most instances that it would be almost impossible to uproot it and supplement another standard for it. Therefore, it seems that the best method of procedure is to still use color glasses, but improve them to as large an extent as possible, and especially to make them duplicate for any given color value. It would seem that this could be accomplished by the use of wedges of solid glass, whereby the color glass being made to a standard formula, the wedges being ground to a given gauge should be then readily standardized and be directly comparable one with another.

The use of wedges is not new or untried. Heretofore, however, in practically all of the wedge machines, the various colors necessary for reading the composite colors of different commodities have been on separate pieces. It is well known by those who have had practice in color reading by glass standards that where two or more color variables are allowed, it is very difficult to get checks even by the same operator, but where only one variable is allowed and any other colors either fixed at a given amount or proportionately required, the checking is much closer.

By the use of such wedges, standard colors now used by the trade could be duplicated, and no change would be necessary in their rules and customs. Many of the variables now entering in when separate glasses are used would be eliminated. It is not contended, however, that wedges would give true colors, but it is contended that they would give more nearly check results and approximate the color of samples very closely, and be expressed directly in color standards now in use.

Castor Oil as a Lubricant

(Continued from page 14.)

tension runs parallel with low friction coefficient of metal and oil. This question, however, is being investigated.

The measurement of static coefficient of friction is made by one of two methods. Deeley[6] suggested a device which measures the oiliness by determining the friction between disks rotating at a slow speed and heavy load. Other investigators measure the static friction under high pressures. Loads applied to a lubricated inclined plane are permitted to slide just sufficiently to be detected electrically. The plane is manipulated until the angle of slip is determined and from which the coefficient of friction may be calculated.

Castor oil, it should be noted, gives both low coefficients of friction and low interfacial tensions. Its use in bearings and machines where it is not exposed to the air deserves careful consideration, and its employment in exposed bearings either dissolved in mineral oil or together with chemical stabilizing agents requires not only close attention but is worthy of serious and painstaking original investigation.