any small amount of iodine that will volatilize. Nevertheless, dispatch in manipulation should be exercised to cut any possible loss to a minimum, due to the volatility of the iodine. From the initial weighing of the sample to the final titration, a maximum time of 10 minutes should suffice.

Conclusions

1. This method is a rapid quantitative method for the determination of the decolorizing power of carbons for iodine.
2. The method can be used for controlling the plant output of any one kind of carbon without a size preparation.
3. The method can be used for comparing decolorizing carbons manufactured by different methods.
4. The adsorption for iodine is practically instantaneous.

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A NEW TYPE OF COLOR-COMPARATOR

BY HERBERT S. BAILEY

History of Oil Colorimetry

Not so many years ago, the determination of the color of oils, in the cottonseed oil industry, was of minor importance, but when this factor was introduced into the trading specifications it soon became necessary to have some basis upon which to report colors. The earliest of these standards was probably bichromate of potassium solutions made up in definite concentrations. It was soon found, however, that such solutions did not simulate the color of refined cottonseed oils sufficiently to prevent grave disagreements between the buyers' and sellers' analysts.

The next step was perhaps the adoption of the Lovibond glasses and these are still in almost universal use, by American oil chemists. They have not, however, proven entirely satisfactory. Much time and energy have been given by members of the American Oil Chemists' Society, to finding some means for bringing about better agreement between their color readings. These studies have followed two distinct lines; the development of a new type of color comparator or a simple spectrophotometer; and refinements in, or more specific directions for, the use of the Lovibond glasses. Dr. Priest of the U. S. Bureau of Standards has most generously aided in devising a new color instrument and it is largely as a result of his work, that the E-K Color Analyses described elsewhere in this issue of the JOURNAL, has been placed on the market. Dr. Wesson in 1920 enlisted the assistance of the Eastman Kodak Company in the problem and they built, for a number of oil laboratories, a very convenient type of color comparator. This instrument is quite expensive and has the added disadvantage that its readings are in a new terminology which is unintelligible to the refiner and trader. Recognizing the difficulties in the way of getting the oil trade to adopt an entirely new basis for color readings, Dr. Wesson and others have studied the causes for the lack of agreement which exist, when different analysts determine the color of oils with the Lovibond glasses. A bibliography of the papers which have appeared in the Chemists' Section of the Cotton Oil Press and this JOURNAL, is appended for the benefit of those who may be interested in perusing further the history of the Society's work on color standards. It was largely due to previous investigators' work that the author was led to attempt the design of an instrument which he hoped would eliminate the variables in Lovibond readings and permit of our continuing to grade oils on this scale. To accomplish this, we must first bring the individual chemist's color reports on all oils into sufficiently close agreement so that the trade will no longer have occasion for complaint.

Causes for Lack of Uniformity in Lovibond Readings

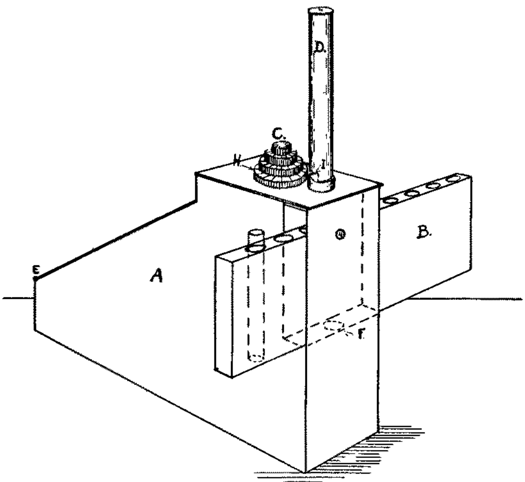
There are several more or less obvious reasons why in the past different laboratories have not agreed on the color of oils when these were read against Lovibond glasses. Some of these are inherent in the glasses themselves, others cannot be eliminated by any scheme which depends upon the color sensitiveness of our eyes. It is difficult to find any two persons who will match identical colors of different substances, in this case, oil and glass, exactly the same. To eliminate this personal equation, we must go to a color analyzer, not a color comparator. There are, however, several factors, such as the light source, its intensity, and the method of combining the Lovibond glasses, which may be made uniform in all laboratories. It is by the fixing of these variables, together with a standardization of the glasses in all instruments that we hope to bring about a satisfactory harmony in color readings.

The work of Priest and his collaborators has demonstrated that Lovibond glasses of the same number are not always of identical color, also that the scale is not strictly additive, by which we mean that three number 5 red glasses piled on top of one another are not exactly equivalent to the number 15 glass. Therefore, all laboratories must either have a full set of glasses, or use the same combinations for producing shades for which they have no single glass. Only by adopting as a color basis a properly standardized set of glasses, can the errors in the glasses themselves be obviated. Such a set of thirty-two glasses is now being compared with the U. S. Government's standard Lovibond scale. Should it become the property of the A. O. C. S., as is most likely, we will have available a basic standard against which can be checked the glasses in our laboratory instruments.

In the device, which is here proposed, a nearly standard light source, consisting of a 75-watt Mazda lamp and Eastman Kodak Company's daylight filter, is used for all color readings. The 32-Lovibond glasses are so arranged in suitable carriers that all colors from zero red—zero yellow to 39 yellow—10.9 red, can be made by the combination of four glasses, including the colorless ones, and always four glasses must be in the optical field. Thus in every reading there are the same number of reflecting surfaces which tends to keep the light intensity uniform. In this connection one should remember that in passing through glass, light is lost, not so much by absorption within the glass, as by reflection at the incident and emergent surfaces. Since the range of colors required in matching all ordinary cottonseed-oils, both refined and bleached is covered by the 32-Lovibond glasses and four clear slides, the use of the "fractional" glasses such as 7.6 red, is eliminated. The glasses are combined on the decimal system similar to the weights on an analytical balance: All the red tenths are in one carrier, and the units in another. Thus to make a red reading of 7.6 one must use the 7 and the 0.6 glasses and cannot obtain 7.6 red by any other possible combination. Similarly the "yellows" are in two carriers, those from 1 to 9 inclusive in one, and a 10, 20, 30 and 35 in another. To match a 22 yellow oil the 20 in one carrier and the 2 in the other are superimposed in the optical field. For convenience in reading refined oils a 35 yellow glass has been included in the device. This does make possible the setting up of the yellow values between 35 and 39 with two different combinations. For instance 37 might be made either with the 30 and the 7 or the 35 and the 2. Whether or not this inclusion of a 35 yellow glass is advisable, remains to be seen. If it is used only for 35 yellow oils and those darker than 39 there will be no danger of different operators getting different readings, if, however, some do not follow this scheme, then it were better to omit the 35 yellow and forego the slight convenience which its inclusion in the set occasions. For reading oils darker than those within the range of the 32 glasses, provision has been made for inserting in the optical field additional glasses. This will be explained more fully in the description of the instrument. Minor but added advantages in the proposed device, over the old manual method of handling the glasses, is that they are protected at all times from dirt and scratches and the value of the glasses is read directly from dials instead of paper labels all too often almost illegible.

Description of B-L Color Comparator

The new colorimeter, or color comparator as it should perhaps be called, is shown in the accompanying figure. It consists of a metal box (A), a rack for the standard color tubes (B), a series of four superimposed circular plates, carrying the color glasses and provided with suitable nurled heads for turning (C), and a sight tube or telescope (D). The box proper which is the housing for the light, color glasses and guide for the tube holder is a sheet iron affair finished outside in black enamel and inside in matt black. It is mounted on a suitable base and the entire appartus is self-contained and occupies a table space less that two feet square. The 75-watt Mazda lamp, which in the standard light source, is held in a horizontal position by a porcelain, pull-chain socket inserted through the back of the box near the bottom. At the front end of the box is a 45° platform upon which is placed the block of magnesia that reflects the white light through the oil and the color glasses. A large cover hinged (E) at the back, closes the sloping portion of the box and permits of easy access to the light and the magnesia block. The upper one and one-half inches of the box is separated from the lower part by a partition which forms a dust-tight compartment for the color-glasses in their carriers.



New color comparator

The only hole in this compartment is one for the admission of light to the glasses and this is made dust-tight by a piece of clear microscope slide.

To facilitate the handling of a number of samples of oil at one time, the rack (B) is made to hold ten regular $^3/_4'' \times 6''$ color tubes. This rack is of monel metal, with a brass-bottomed plate the holes in which are tapered and so shaped as to center the tubes automatically between the four small points that support them. This gives an unobstructed view through the entire bottom of the tube which is always in the center of the optical field irrespective of slight variations in its diameter. The tube rack slides in a narrow gallery across the front end of the instrument box and rests upon the floor of this gallery. The hole (F) through the floor which admits the light to the oil column is covered by a microscope slide which prevents oil and dirt from getting down onto the magnesia block immediately below it. This slide is readily removed from the inside, for cleaning when necessary. As a convenience in filling the tubes with oil to the proper depth, the rack is made of such a height that when the bottom of the meniscus of the oil in a tube in place can just be seen across the top of the rack, one has a $5^1/_4''$ column. Opposite each tube along the face of the rack is a number, in white, which appears through the hole (4) in the front panel of the instrument when the corresponding tube is centered beneath the telescope. Any number of racks can of course be provided and if they be serially lettered, one can prepare a large number of oils for reading, then run them through the instrument much as magazines of shells are passed through a rapid fire gun. The top of the box is a solid brass plate from which is supported the mechanism for holding the Lovibond Glasses and turning them into the field of vision as desired. The boss in which is fitted the observation tube or eyepiece is also a part of this top casting which is fastened by small screws to the box and by removing these, one can easily get, at the color-glass carriers, should that be necessary.

A full description of the device which holds the glasses would be difficult without a more detailed drawing than the one here shown. It consists of four cast brass disks, each fastened to a thick cylindrical ring. The upper ends of these cylinders, the center one of which is a solid rod, project above the cover as shown at (C). Upon their top surfaces are engraved the values of the glasses and sector lines in such a manner that when one looks directly down upon them he sees four concentric dials each divided into eleven, numbered spaces. The numbers on the dials are directly opposite the corresponding glasses and thus the value of the combination in the optical field appears as a vertical row of four figures opposite the white arrow at the back of the top plate, as shown at (H). Since the darkest yellow glasses, the tens, are on the outer circle, the unit yellows next, then the unit reds and lastly the tenths on the center knob, one reads a color as he would add a column of figures. Thus for 22 yellow, 2.2 red, 20 yellow is farthest from him as he stands at the front of the instrument, then 2 just below, making the 22 yellow, next 2 red and on the center or nearest dial 0.2 or 2.2 red.

The observation tube or telescope (D) carries in the eye-piece a blue filter which gives with the 75-watt gas-filled, electric bulb a practical equivalent of normal daylight. This same result might of course be obtained by using a so-called "daylight" globe as the light source. It is believed, however, the filters will be more uniform, as they are the product of a reliable optical manufacture, and not subject to the change which takes place with all electric bulbs as they begin to burn out.

Near the bottom of the telescope is a slot (I), previously mentioned, into which may be inserted additional glasses when needed for matching very dark oils. As the tube makes a slip-joint with the boss which supports it, the slot can be turned either to the back or front, pulled up above the boss or pushed down to close the opening. When at the back it permits of glasses being placed only over the field through which is viewed the color glasses. When at the front, standard glasses can be inserted over the field in which the oil is usually viewed, and if there be no oil below this field a direct comparison between the standard glasses and those in the instrument may thus be effected.

Summary

A convenient form of instrument has been devised for comparing the color of cottonseed oils with glasses of the Lovibond scale.

In this apparatus each color must be made up by a combination of the same color glasses, one chemist cannot use a single 8.5 red glass and another a 5, a 3, and a 0.5 glass to get the 8.5 match, all are forced to use an 8 and a 0.5 red, superimposed for this 8.5 reading.

The glasses are protected from dirt and scratches, and are easily revolved into the optical field by the turning of external nurled wheels.

The total color, yellow + red, when a match is made, is indicated in a straight vertical line upon four concentric dials, thus diminishing the chances for error in recording the glasses used.

A uniform light source, practically normal daylight, is provided in the instruments which will eliminate lack of agreement between different laboratories due to the use of various kinds of illumination.

The author wishes to express his indebtedness to Mr. P. F. Ballenger formerly Chief Engineer of the Southern Cotton Oil Co., for his assistance in solving the mechanical difficulties incident to the building of this device, for without his help it would be merely a chemist contraption instead of a finished instrument.

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SAN DIMAS, CALIFORNIA

THE K. AND E. COLOR ANALYZER

BY CARL W. KEUFFEL

The K. and E. Color Analyzer is a practical direct reading Spectrophotometer. It is used for determining the spectral transmission curves of all transparent substances, liquid or solid, such as colored solutions, oils, glass, etc., also for determining the spectral reflection curves of solid substances such as paper, soap, flour, etc. These curves can then be used to form the basis for a system of color specification or color control.

1. Spherical Light Source.
2. Photometer.
3. Spectromter.
4. Wave Length Scale.
5. Photometer Scale.
6. Holder for Standard Sample.
7. Holder for Reflection Samples.
8. Holder for Transparent Samples.
9. Field of View thru Eye Slit.
10. To Vacuum Ventilator.
11. Plug for Vacuum Ventilator
12. 400 Watt Lamps.
13. Lever for Raising Photometer.
14. Sector Discs.
15. Universal 110 Volt Motor.
16. Speed Control Rheostat.
17. Entrance Slit.
18. Collimator Objectives.
19. Dispersion Prism.
20. Bi-Prism.
21. Eye Slit.
22. Cast Aluminum Base.

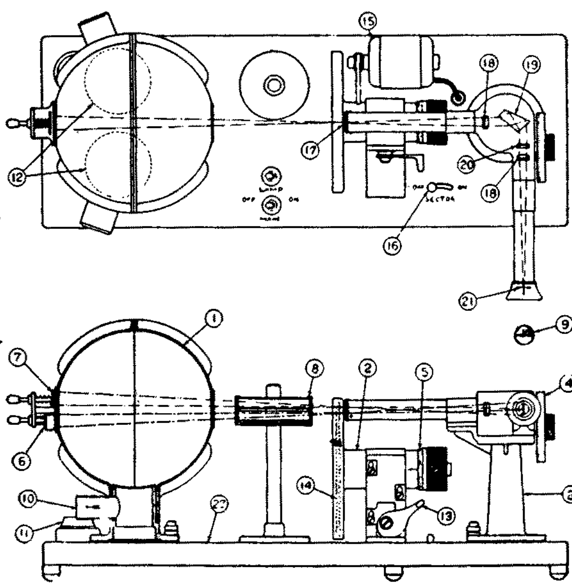

Diagram of K & E COLOR ANALYZER

Fig. 1

The Instrument consists essentially of (see Fig. 1);

A. The Constant Deviation Spectrometer (3) with its wave-length scale (4).

B. The Direct Reading Rotating Disc Photometer (2) with its photometer scale (5).