

SUMMARY

1. A detailed procedure for the oxidizing hydrolysis of unsaturated fatty acid ozonides has been presented.
2. This method has been used successfully in the solution of problems involving the determination of structure of naturally occurring unsaturated acids.
3. The procedure is simple in practice. It has been used successfully in the hands of elementary organic chemistry students.

SOME EXPERIMENTS IN COLORING CELLOPHANE

LOUIS A. TEST, Purdue University

As is well known cellophane may be easily and attractively colored by many organic dyes, all the direct cotton dyes being taken up very readily. Mention in the literature of any attempts to use inorganic substances for a similar purpose seem to be lacking.

The experiments here described were undertaken at the suggestion of Mr. R. B. Withrow of the Horticultural Department of Purdue University who was carrying on an investigation to determine the effect of artificial light on plant growth. Colored cellophane had been used to modify the quality of the light. As the organic dyes do not absorb the extreme red end of the spectrum satisfactorily, the thought occurred that inorganic colors might serve better. Mr. Withrow had used cellophane screens colored with Prussian blue in some of his work, the results of which are soon to be published. His preliminary experiments with Prussian blue showed that cellophane could be colored with inorganic substances, the desired colored substance being formed directly in the cellophane.

The cellophane used in these experiments was Dupont's number 600, which is about twice as heavy as that used for ordinary commercial wrappings. The preliminary experiments with Prussian blue seemed to indicate that the colored compound was formed in the cellophane in a colloidal condition and was not deposited on the surface. This led to the belief that those substances which easily entered into the colloidal state might give the most satisfactory results.

The general method of procedure was to soak the cellophane in water until free from glycerine. The wet cellophane was then placed for a few minutes in a dilute solution, usually 1 or 2 per cent of one of the reacting substances. On removal from this solution the excess of reagent was washed from the surface with running water, the cellophane immediately immersed in a solution of the necessary reagent to produce the desired compound and left as long as the color continued to develop. Finally it was washed in running water. If the color was not as intense as desired the process was repeated until the desired intensity was obtained.

Prussian blue, the first color used, was obtained by immersing first in ferric chloride solution and then in potassium ferrocyanide solution. The color developed well and the intensity was easily controlled by repeating the process the desired number of times, or if desired, increasing the concentration. The color so produced was perfectly fast to water. It seemed to make some difference in which of the solutions the cellophane was placed first though no specific experiments have been made to determine this point.

Turnbull's blue was produced by treating the cellophane successively with solutions of ferrous sulfate and potassium ferricyanide. This also gave a very satisfactory blue which was fast to water.

A very good yellow can be obtained with cadmium sulfide. The cellophane is first put into a dilute solution of cadmium sulfate and after washing transferred to a solution of sodium sulfide. The color developed easily and evenly to give a clear yellow. The color from antimony sulfide was not so satisfactory, was more difficult to obtain in the desired intensity and was not taken up quite so evenly. Good greens were produced by coloring first with cadmium sulfide and then with one of the blues until the desired shade of green was obtained.

Orange reds were obtained by immersing first in dilute ferric chloride solution and after washing transferring to boiling water. The desired intensity could be obtained by repeating the process a sufficient number of times. Concentration of the ferric chloride solution was also a factor. The color is fast to water and light.

With 1 per cent solutions of uranyl nitrate and potassium ferrocyanide a good, clear red brown (burnt orange) was easily obtained. This color was fast to water and sunlight.

Potassium permanganate in solution is easily reduced by cellophane, slowly at room temperatures, rapidly at the boiling point. At the same time the cellophane itself is colored by the reduction products of the permanganate. The color may vary from a light straw color, if the solution is dilute and the time of exposure short, to a dark brown, if the concentration is greater and the exposure longer. With long exposure the cellophane becomes brittle and cracks. The light browns fade on long exposure to direct sunlight.

Colloidal gold and silver can also be deposited in the cellophane by the use of proper reducing agents. With tannin as the reducing agent and very dilute solutions of gold chloride and silver nitrate, gold gives a good purple and silver a golden brown. Other reducing agents have not as yet been tried. Cellophane itself will reduce gold chloride, but some of the gold is deposited on the surface and is not colloidal. In the case of the silver, at least, it proved best to treat the cellophane with the tannin solution first.

Lead acetate and potassium chromate easily produced a good yellow but gave to the cellophane a translucent or almost opaque appearance.

In attempting to test the fastness of these colors to sunlight eight small samples of cellophane with inorganic colors and three with organic were clamped in a frame so that half the sample was covered and half exposed. These were placed in direct sunlight from three to six hours a day for a period of three months. All the organic colors faded more

or less though the red showed only slight fading. Of the inorganic substances ferric hydroxide, the uranyl compound, cadmium sulfide, and colloidal gold were unaffected and Prussian blue very slightly affected. The other three showed more or less definite fading.

The accompanying table gives a summary of the results.

Dye Reacting substances	Color	Condition of Color	Fastness to Sunlight
$\text{FeCl}_3 + \text{K}_4\text{Fe}(\text{CN})_6$	Bright blue...	Even, transparent good.....	Almost fast
$\text{FeSO}_4 + \text{K}_3\text{Fe}(\text{CN})_6$	Bright blue...	Even, transparent good.....	Fades slightly
$\text{CdSO}_4 + \text{Na}_2\text{S}$	Bright yellow.	Even, transparent good.....	Fast
$\text{K}(\text{SbO})\text{C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{S}$...	Orange yellow	Difficult to form, fair, somewhat uneven.....	
$\text{UO}_2(\text{NO}_3)_2 + \text{K}_3\text{Fe}(\text{CN})_6$	Burnt orange.	Good, even, trans- parent.....	Fast
$\text{FeCl}_3 + \text{hot water}$	Orange.....	Good, even, trans- parent.....	Fast
KMnO_4	Brown.....	Even, transparent.	Fades badly
$\text{AuCl}_3 + \text{tannin}$	Purple.....	Good, even, trans- parent.....	Fast
$\text{AgNO}_3 + \text{tannin}$	Golden brown.	Good, even, trans- parent.....	
$\text{CuSO}_4 + \text{K}_4\text{Fe}(\text{CN})_6$	Red brown....	Uneven.....	
$\text{CoCl}_2 + \text{K}_3\text{Fe}(\text{CN})_6$	Light purplish brown.....	Fair, even, trans- parent.....	
$\text{K}_2\text{Cr}_2\text{O}_7 + \text{SO}_2$	Very light green.....	Very slow in de- veloping.....	
$\text{CuCl}_2 + \text{NaOH}$	Light green...	Slow in forming, too light.....	Fades to yellow
$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{K}_2\text{Cr}_2\text{O}_7$.	Yellow.....	Translucent to opaque, forms easily.....	
$\text{NiCl}_2 + \text{Dimethyl}$ glyoxime.....	Pink.....	Somewhat cloudy..	
Carbie violet 16175.....	Violet.....	Good.....	Fades noticeably
Pontamine fast red S B.L.....	Deep scarlet..	Very good.....	Fades slightly
Orange G.....	Orange.....	Good.....	Fades badly