SOME USES OF SOYBEAN OIL IN PAINTS AND VARNISHES*

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PAINTS and varnishes from time immemorial have been used as decorative and protective coatings. The practice of the early savage tribes to use paints made from mineral and vegetable colors mixed with fats and oils is an example of one of the early mixed paints. These paints were used as decorations for the face and body and also for the beautifying and waterproofing of animal skins. Some 2500 years ago the Egyptians were known to have used coatings composed of fossil resins and oils for finishing mummy cases. It is not definitely known that these people used linseed oil in the making of their varnishes but we do know that they made linen and cultivated the flax plant. They also used olive oil for food purposes and apparently had some method of extracting oil from seeds. The first definite record of the pressing of linseed oil was made by a Swiss monk, Theophilus, in the tenth century, who described the use of the olive oil press[1] for extracting linseed oil. His book on the use of linseed oil for paint and varnish making gives numerous examples of combinations of linseed oil and resins. The formulations and uses of this oil in both paints and varnishes have since the beginning been handed down from father to son, until the early part of the 20th century when science took a hand in the development. Soya oil like linseed oil is not a recent discovery of science, as it has been used some 3000 years as a stable article of food in China.

In 1804 the first Soya beans were brought to this country and the first plantation was made in North Carolina. The value of Soybeans was little appreciated until about 1908 when on account of the scarcity of cotton seed the soap and glycerin manufacturers turned their attention to its possibilities. About this same time the linseed oil market fluctuated from 75 cents to $1.00 per gallon, compared to 40 and 50 cents between 1900 and 1907. This increased price of linseed led the paint chemists for the first time to investigate the oil as a possible substitute for linseed. In the early investigation there were many conflicting facts regarding the oil, but this is not unusual as there are no less than 20 varieties.

During the early years of volume consumption of Soya oil and especially during the World War Manchurian oil was principally used. When the first domestic raw oils were kettle bodied for varnish they darkened under heat and would break badly. The break of the domestic oil, which is a dark orange color, is in contrast to that of the Manchurian oil which bleaches when heated and shows either no break or only a very slight one. Consequently in the early days the varnish maker was quite prejudiced against domestic oil and it was up to the oil refiners to acid or alkali refine the oil in order to prevent this break and make it possible for the paint industry to use it. The break of the alkali refined oil are composed principally of stearol, phosphatides, fatty acids and it is a relatively simple matter to refine Soya oil in this manner. In the acid refining process the stearols and phosphatides are separated, but not the fatty acids. Furthermore, it is quite essential for the greater part of the lecithin to be extracted from the oil as this prohibits the drying considerably. There are various other treated forms of Soya oil, the principal one being a winterized oil in which the waxy portions of the oil is separated by freezing.

The refined domestic oil can be heated to 500 F. and it will bleach to remain bleached the same as Manchurian and slightly better than linseed. The bodying of Soya oil is quite difficult. When cooking at a temperature of 580 F. it takes about eight times as long to get the same viscosity with Soya as it does with linseed. However, the general practice is usually to combine it with China Wood or Perilla oil, both of which body quickly. Soya cannot be classified as a substitute for linseed oil. Linseed oil is a drying oil whereas Soya oil is semi-drying. Linseed has an iodine number between 180 and 190 whereas the iodine number of Soya oil is 130 to 135. Linseed is composed of about 10 per cent saturated Glycerides and about 90 per cent unsaturated. The unsaturated portion consists of 53 per cent linoleic, 41 per cent linolenic and 5½ per cent oleic. Soya is composed of 10 per cent saturated glycerides and 90 per cent unsaturated, the same as linseed, but in this case the unsaturated portion consists of 63½ per cent linoleic, 30 per cent oleic, and 6½ per cent linolenic. These characteristics of Soya oil place it in a very definite class and as a limited substitute for linseed. However, mixtures of Soya and linseed or various other drying oils have a very definite place in the paint industry. Fifteen per cent to 20 per cent Soya oil in a ready mixed linseed oil paint will increase the elasticity of the paint without affecting either the drying time or the strength of the film. Thus it will necessarily increase the life of the paint. Larger proportions, however, are detrimental to a house paint inasmuch as it will slow the drying time to the extent that a white paint will darken as a result of dust particles and in some localities will develop a fungus growth. In paint films Soya oil flows more freely, works better under the brush and produces a more elastic film than linseed. Flat wall paints for interior purposes are often made by pigmenting a Soya oil varnish mainly because of the fact the Soya oil dries with a more flexible film even though highly pigmented and it retains its color much longer than linseed.

Lead manganese and Cobalt driers can be used with Soya oil preferably in the form of resinate or linoleate. With a lead manganese tungate drier, a fairly hard dry film is obtained within 24 hours by the addition of 5 to 7 per cent drier. Soya oil has some properties which make it more valuable than linseed. Pigments grind easily

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in the oil and it is particularly well adapted for the grinding of oil colors. When used in this manner soft pastes are obtainable which do not become hard on long standing and hold their original tints remarkably well. The amount of Soya oil introduced into a white base paint as a result of the use of these colors is relatively smal and does not affect the drying of the paint. Soya oil can be blown in the same manner as linseed. When heated and blown at 500 F. for several hours Soybean bean oil bleaches and thickens to a consistency desirable for baking japans. Besides being used in the paint industry it has also found a place in the linoleum and printing industry.

In the last two decades Soya oil has found a very definite place in the modification of synthetic resins. These resins, principally of the Glycerol Pthalate and Phenol Formaldehyde type, require certain proportions of oil as a modifying agent to make them soluble in mineral thinners. In general the Phenol Formaldehyde type of Soya oil varnish is used as a mixing varnish. In glycerol pthalate resins Soya oil is used as a modifying agent for both air dry and baking purposes. Quite a number of the automobiles of today are finished with Glycerol pthalate resins modified with China Wood and Soya oils, China Wood giving the speed of drying and Soya the plasticizing properties. In the electric refrigerator field the Glycerol pthalate resins are usually modified with Soybean oil, and when properly pigmented these enamels are extremely resistant to moisture, not affected by butter fats and oils, and will not turn yellow with age.

Linseed oil has been known to the paint industry for the last 3000 years, yet there are many facts about linseed oil and its uses in paints and varnishes which must be developed. Soya oil has been used in the paint industry for about 40 years and one can readily foresee that although Soya oil is not a substitute for linseed it has certain properties which make it necessary to the paint industry, and who knows but that with 3000 years' experience and development Soya oil may supersede linseed in the paint and varnish industry.

SOAP FROM OXIDIZED FATS*

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IT was observed that an oxidized fat could be washed out of a container with an alkaline washing powder much more readily than a fresh fat. This observation raised the question as to what effect the oxidation of a fat had on the properties of the soap made from this fat, inasmuch as some fats for soap making are bleached by processes which favor the oxidation of the fat, and also some soap stocks are in a more or less oxidized state as received by the soap manufacturer.

EXPERIMENTAL PROCEDURE

Soaps were made by the graining process from cottonseed oil, lard and beef tallow in various stages of oxidation; the extent of the oxidation being determined by the peroxide number. The oxidation was carried on by bubbling air through the fat while being held at the temperature of a boiling water bath. The oxidations of the lard and beef tallow were catalyzed with copper. The soaps were tested for moisture by the xylene distillation method and all soap solutions were made up on a moisture-free basis. The various soap solutions were tested for alkalinity, surface tension, interfacial tension and water softening ability.

EXPERIMENTAL RESULTS

From the results shown in Table 1 it appears that the oxidation of the fat has very little, if any, effect on the cleaning properties of the soap made from that fat as judged by the surface tension, interfacial tension, and water soft-

TABLE I

Soap From Oxidized Fats

	Fat			Soap Solution		
Sample	Peroxide Number	Koettstorfer Number	Alkalinity	Surface Tension	Interfacial Tension	Water Softening Ability
			Cottonseed Oil Soap			
Water	....	....	...	73.0	10.75	...
I	4.0	193.4	0.65	27.3	24.5	18.5
II	10.0	196.5	0.50	28.6	22.5	18.5
III	14.1	194.3	0.60	27.3	23.0	18.5
IV	21.2	196.6	0.60	22.8	34.25	19.0
V	35.9	198.0	0.50	25.2	21.5	18.5
VI	50.1	196.4	0.60	25.2	24.5	18.0
VII	110.0	197.8	0.70	27.3	25.0	24.0
VIII	203.6	200.2	0.70	23.2	33.0	18.5
			Lard Soap			
I	2.4	193.6	0.65	27.3	21.25	22.5
II	12.2	194.3	0.50	27.3	20.5	22.0
III	3.4	194.1	0.70	25.5	32.5	22.5
IV	4.8	212.7	0.65	25.5	26.5	21.0
V	5.9	198.0	0.45	27.3	22.75	25.0
VI	5.3	197.7	0.55	24.5	23.5	19.0
VII	5.1	200.3	0.60	24.5	26.5	19.5
VIII	4.5	199.5	0.55	25.2	26.5	20.0
IX	5.3	203.6	0.65	24.5	26.5	20.0
X	5.3	199.3	0.60	24.5	27.5	20.0
			Beef Tallow Soap			
I	0.5	196.9	0.50	27.9	22.5	24.0
II	1.5	196.8	0.55	27.3	24.0	22.0
III	3.5	197.0	0.65	27.3	21.0	23.0
IV	16.7	197.9	0.50	26.9	21.5	21.5
V	30.9	201.6	0.50	26.5	25.5	21.0
VI	43.3	203.7	0.55	26.9	25.5	20.5
VII	28.4	205.0	0.20	32.7	12.5	25.0
VIII	24.1	203.4	0.25	31.4	12.75	23.0
IX	16.9	200.9	0.30	30.0	13.5	21.5
X	14.5	210.0	0.45	28.3	21.0	20.5
XI	18.0	207.7	0.55	27.3	23.0	20.0

Note: All soap solutions made up on a moisture-free basis.

PEROXIDE NUMBER—Number of millimoles of active or peroxide oxygen per kilogram of oil or fat.

ALKALINITY—Number of cubic centimeters of N/14 sulfuric acid required to neutralize the alkali in 25 cubic centimeters of a 0.1% soap solution.

SURFACE TENSION—Dynes per centimeter, DuNouy's method, 0.05% soap solution.

INTERFACIAL TENSION—Expressed as the number of drops of 0.05% soap solution delivered under olive oil by a stalagnometer.

WATER SOFTENING ABILITY—Number of cubic centimeters of 0.1% soap solution required to soften 10 cc. of Madison city water.

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