THE RELATION OF SULPHONATED COMPOUNDS TO THE TEXTILE INDUSTRY

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Any compound which is used by millions of pounds annually is of interest not only to the manufacturers but also to the users. In the bulletin, "Census of Manufacturers, 1931" on "Natural Dye-stuffs, Mordants and Assisstants, and Sizes," appear the following figures: under the heading of Assistants 1929, is Turkey Red Oil 24,260,000 pounds; softeners 31,612,775 pounds, other assistants not noted in pounds, but were given a value of $2,103,171. Then under the heading of Assistants 1931, we find Turkey Red Oil 13,459,539 pounds, softeners 31,111,163 pounds, other assistants of a value of $2,158,456.

From the above figures it is easily seen that much sulphonated oil and sulphonated compounds are used. Of the above amount, the textile industry used a great deal, but also there is coming more and more in the textile industry, the use of not only sulphonated oil (the old Turkey Red oil), but also the newer sulphonated compounds. This paper will deal with the compounds in relation to the textile industry.

As oil chemists, you all are doubtless familiar with the process whereby vegetable oils have been treated with sulphuric acid to make the sulphonated product. You all are likewise aware of the fact that the insoluble oil becomes a compound and soluble in water. Both castor and olive oil have been sulphonated for many years, but the manufacturers also sulphonated other oils such as neatsfoot, linseed, rape, tallow, cottonseed, etc. Dyers, printers, mercerizers and finishers of the textile industry all realize that the different compounds have certain characteristics which are of special value in certain processes.

The regular sulphonated oils are often used as dispersing agents and penetrating agents which themselves are not soluble or miscible with water when used alone. There is a limit to the amount of sulphonation possible with vegetable oils, and as a high degree of sulphonation makes a more soluble compound, there have been placed on the market other sulphonated compounds of higher SO₃ content such as the oleo, palmito and glyceryl sulphonates.

Then there are the naphthalene sulphonic compounds which have found much use as wetting-out agents. There are compounds of the sodium tetraetil sulphonate type which are recommended as dispersing agents. We also have the compounds such as Gardinol, Igepon, Aviol, etc., of the sulphonated fatty alcohol type, and these are now of much importance.

We find the Mapro compounds, another type of sulphonated alcohol being used for dispersing, wetting-out, penetration and finishing agents.

Chemical and Physical Properties of the Fibres

The four fibres mostly used in textiles are cotton, wool, silk and rayon; all of which differ from each other chemically. First taking up cotton,
we know that it is composed chemically of carbon, hydrogen and oxygen in the form of cellulose. This is the same as in the regenerated cellulose compounds called rayon, but the arragement of the molecules is evidently different as we do not get exactly the same reactions with the two. As to physical properties there is much difference, not only in the appearance, but also in the impurities present. Rayon or cotton is protected by the presence of a waxy substance which prevents the cotton in the field from becoming wet during rain storms. This waxy substance gives the natural fibre much resistance to acid solutions used in scouring, bleaching and dyeing unless it is removed. Here is where the sulphonated compounds of the wetting out type are of value. In the old days, we used soap and alkali, but in the presence of hard water, the troublesome lim, and magnesia insoluble soap were formed; this led to the use of the sulphonated compound which form the soluble lime and magnesia soap. The replacing of some of the soap by the sulphonated soap has also helped by leaving the cotton in a softer condition, it being well known that alkalis leave a harsh condition.

In the bleaching processes, the sulphonated compounds have been made to help in place of the bleaching solutions. In mercerizing, special types of compounds were used as the ordinary sulphonated casein, a type which seems to give the required penetration. Here again, the finished goods after being treated with the strong alkali mercerizing solutions were washed in the last bath with some softening compounds which are found among the sulphonated compounds.

In sizing yarn, the starch compounds give too harsh a finish which interferes with weaving unless the starch compound contains something to make the sized yarn softer and more pliable. Here again, the sulphonated compounds have been found very useful, as they act as lubricating agents.

In the dyeing of cotton whether in the form of yarn or skin, in package, beam, etc.; and in pieces of goods in jig, padder, continuous or other type of machine; we find much use for the sulphonated compounds. Large sizes treated in the last bath with some softening compound which are found among the sulphonated compounds.

For some purposes, degumming takes place in the skin, in others the degumming is done on the finished hosiery or the piece goods. Here care must be taken that the pH does not become too high as alkali destroys silk even as it does wool, so the sulphonated compounds with a pH which can be controlled are much used.

In dyeing, we find that the facts apply to wool in the same way and that the sulphonated compounds are used for dispersing, penetrating and levelling purposes.

In finishing of silk there are any number of special finishes required and no one compound can be expected to give the results desired, so there are numerous sulphonated compounds each having some particular object in the finishing such as dulling the lustre, reducing harsh feel, brightening, French finish, etc. The compounds are also used in some of the processes of degumming which is applied by use of tin or lead salts to the silk.

In printing, the pastes are made smoother and more effective by use of the sulphonated compounds. A lumpy paste would be detrimental in the printing process.

In finishing, we find that a certain hard or feel is demanded by the buyer. This feel or form can be obtained by the proper application in the right machines of compounds which in most cases contain some sulphonated product.

Wool

Wool in addition to the carbon, hydrogen and oxygen also contains nitrogen and sulphur which makes a chemical composition quite different from cotton and naturally reacts differently with chemicals to some extent than cotton. But instead of having a waxy substance to protect the fibre from moisture, wool contains a large amount of grease, as well as other impurities. These impurities may amount to seventy-five per cent of the total weight. It is easy to see that a good detergent is needed here, and the sulphonated compounds have replaced in many cases the formula of soap and ash. Especially is this true where hard water must be used.

After the grease is removed, it is necessary to add some substance to assist in the spinning process. Here other sulphonated compounds are used as a base to form emulsions which are applied to the wool oftentimes in the form of a spray.

The remarks on bleaching, dyeing and finishing of cotton can be applied to wool with the addition of the following precaution. No substance should be used on wool of such a strength that the alkali contents will act on the fibre. Cotton is not harmed by alkalis but wool is very susceptible to their action. The sulphonated compounds of today have a controlled pH value which will not harm wool.

Silk

Here is a fibre which belongs to the animal class as does wool, it being the product of the silk worm. However, it does not contain sulphur like wool but does contain nitrogen which makes it chemically different from cotton. In fact, it acts like wool in dyeing in almost all cases.

The impurities of silk are not such as are found on cotton nor on wool. The principal impurity is the silk gum or sericin which is not water resistant like the wax on cotton nor the grease on wool. This sericin makes the silk fibre very harsh and somewhat brittle, so before it can be properly handled, it is usually soaked with some soaking compound. The soap have had much use in the past, but lately, sulphonated compounds especially prepared for the purpose have come into use. After the soaking the silk can be wound into skeins, etc.

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Rayon

This newest of fibres is treated in various processes with the sulphonated compounds. In fact, sulphonated compounds are used to a large extent as a base to carry the mineral oil used in the manufacture of the rayon. This mineral oil acts as a base, or itself, it is not saponifiable nor emulsifiable. By using the sulphonated base, it becomes emulsifiable and can be removed in the last bath with some softening compound.

New detergent type of sulphonated compounds first use in the scouring of this fibre and do not have the harsh action of such alkali as caustic soda.

In the dyeing of the artificial fibres, with the exception of the acetate type, the sulphonated compounds have been found to be more effective as when dyeing cotton. For acetate fibres, a special type of sulphonated product has been developed for dispersing the insoluble type of dye for these fibres.

Sometimes, rayon hosiery or piece goods are given special finishes whereby a dull lustre is obtained, or spot proofing, crepe effect, etc.

Here are a few advantages claimed for these compounds by various writers:

K. Winokk* says: "Sulphonated oils are claimed to have the characteristic property of preventing the precipitation of insoluble lime-soaps, or of keeping them in fine dispersion when soap is used with hard water."

A. J. Kelly* says: "Possibly the greatest quantity of Turkey Red Oil is used directly; as a wetting, levelling, softening or finishing agent. Its advantages are easy in handling, immediate solubility, resistance to hard water and desirable finish imparted to textiles. Sulphonated oils are non-toxic and will work well in conjunction with alkalis, salts and other chemicals ordinarily added to the processing baths."

Dr. H. H. Mosher* says: "Uses and advantages of the glycercyl sulphates are as follows: softening and lubricating the various fibres (also for silk and rayon, starch for cotton and rayon, and palmite for wool); in dyeing, in finishing, kier-boiling and as a base for emulsions. Advantages are the stability with organic acids or salts, hard water and various chemicals; do not develop any odor; penetration good."

Advantages of the naphthalene sulphonate compounds are the rapid and thorough wetting out properties. Used where time is valuable as it goes the scouring, bleaching or dyeing solutions into almost immediate action with the fibres.

R. Von Oesen's* says: "Sulphonated oils act as dispersing and penetrating agents, dissolve lime-soaps, give wool a fluffy feel or hand, and are also used as softening agents in the finishing processes. These are sulphonated compounds which have been found valuable especially in imparting certain hand or feel to the fabric and to the fibre itself."

R. A. Duncan* in writing of the sulphonated alcohols says: "Some of the more striking characteristics are as follows: At suitable temperatures they are not affected by the hardness of the water. They are good sudsing and wetting agents in acid solutions. While they are slowly decomposed by acids, the rate is sufficiently slow that this change causes little or no trouble for ordinary use. Aqueous solutions are stable in alkalis and retain their soaplike properties."

A anonymous article in the Textile World says: "What makes the sulphonated fatty alcohols of particular importance to the textile industry is the fact that they differ materially from the soaps in that as a class, they do not hydrolyze, are practically neutral in solution, having a pH value of approximately 7; are stable to acids, alkalis, hard water, concentrated solutions of common salt, etc."

In one of their booklets on "Sulphonated Fatty Alcohol Products" the Du Pont Co. state: "The superiority of the sulphonates of the fatty acids over the sulfonates of the fatty acids lies in their great stability, in addition to their ex-