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TEXTILE FIBER DRAFTING ELEMENT AND
METHOD OF MAKING SAMERobert C. Treue, Dayton, Ohio, assignor to The
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1

This invention relates to textile fiber drafting elements, such as drafting aprons, cots or spinning rolls, roll covers and the like. The present invention also relates to a novel method for the preparation and treatment of such elements in order to improve their surface characteristics.

In the processing of textile fibers, a common method is to pass the fibers through sets of rollers which travel at progressively increased rates of speed, so that as the fibers pass between the rolls they will be drawn out and arranged in a parallel position. This drawing out process is known as drafting and the rollers are known as spinning rollers or cots. The function of these rollers or roll coverings is to hold the fibers very firmly so that they will not slip going through the rollers and will deliver the fibers at a certain rate of speed to the next set of rollers. Obviously, these rolls must have a certain amount of cushion in their surfaces and must retain this cushioning property over a long period of time without injuring the fibers during the processing. In certain systems of drafting fibers, such as the Whitin-Casablancas long draft system and other like systems, the front and back rolls are usually the same as those which are used in the conventional roller drafting frames. In place of one or more pairs of middle rolls an opposed pair of aprons is provided which perform the main drafting operation and in view of the better control of fibers obtained within the primary drafting zone it is possible to use high drafts and produce more uniform yarn. Combinations of an apron with an upper roll may also be used as in the Saco Lowell-Roth system.

It has been found that satisfactory textile fiber drafting elements may be made using synthetic rubbers of the conjugated diene emulsion copolymer type, such as butadiene-styrene copolymer commonly known as GR-S, and the butadiene-acrylonitrile copolymer commonly known as GR-A. The latter is generally preferred because of its greater oil-resistant properties. It has further been found, however, that fibers, rayon fibers in particular, have a tendency to lap up or to adhere to the surface of conventional textile fiber drafting elements particularly of the aforementioned synthetic rubber type. This disadvantage becomes particularly significant in the drafting of rayon and similar long staple fibers especially when aprons are used in long drafting. Apparently the surface characteristics of synthetic rubber aprons of this type are such that the drafting operation is impaired due to damage to the fiber and yarn, along with

2

interference in the continuous operation of the drafting members. This appears to be the result of exclusive friction and affinity between the fibers and the synthetic rubber.

Attempts have been made to modify the surface properties of synthetic rubber fiber drafting elements either by the incorporation of modifying materials in the surface thereof or by chemical treatment. In general, these have not been completely successful either because they impair the drafting properties of the elements or because they produce undesirable alterations in the durability or other physical properties of the rubber.

It is, therefore, an object of the present invention to provide a textile fiber drafting element having a working surface of synthetic rubber and which has been modified in a manner which will make it resistant to lapping of fibers.

It is a further object of the present invention to provide an improved fiber drafting apron having a synthetic rubber working surface so modified that efficient drafting may be carried out without injury to the fibers or to the aprons under the usual drafting tensions.

It is an additional object of the present invention to provide a method for the surface treatment of synthetic rubber textile fiber drafting elements which will impart to the surfaces thereof desirable resistance to lapping and decreased frictional properties.

In accordance with the present invention, it has been discovered that synthetic rubber surfaces comprising synthetic rubber-like materials of the conjugated diene polymer and copolymer type including the butadiene-styrene, butadiene acrylonitrile and polychloroprene polymers and copolymers, can be treated with aqueous sulfuric acid solutions containing dichromate ion to obtain working surfaces of increased lap resistance and decreased frictional resistance in the drafting of fibers. On the other hand, it has been found that the dichromate ion in an aqueous solution cannot be used satisfactorily alone, nor can sulfuric acid of itself produce satisfactory results. Furthermore, it has been found that other oxidizing agents either alone or in solution in sulfuric acid will not produce the desired results. It has further been found that the dichromate ion in solution with acids other than sulfuric acid does not appear to be operative to produce satisfactory results.

It has been discovered that when synthetic rubber fiber drafting elements are immersed in aqueous sulfuric acid solutions containing di-

chromate ion, improved effects are obtained at almost any and all concentrations of either the dichromate or the acid. However, as a practical matter, with excessive acid concentrations, there is a tendency for the material to deteriorate while with too low an acid concentration more highly colored products are obtained which do not have a greatly decreased affinity for rayon fibers. The most desirable results are obtained using acid concentrations of between 1% and 25% and dichromate ion concentrations corresponding to about 0.01 to 0.5 molar. The optimum acid concentration range is between 2½% and 20%, while the optimum dichromate concentration range is between 0.1 and 0.25 molar. The time of treatment may vary from a few minutes to several hours and while not critical will depend to a certain extent upon the exact nature of the surface desired and the acid concentrations utilized. For example, a long draft apron is prepared in accordance with the invention disclosed in the patent to Bacon #2,402,356. This apron is composed of a GR-A or perbunan polymer and is compounded with the usual compounding ingredients. The apron thus formed was subjected to the following treatment:

A solution of the following ingredients is prepared:

Potassium dichromate-----	g--	50
Concentrated sulfuric acid-----	cc--	200
Water -----	cc--	800

The acid is first dissolved in water after which the dichromate is added and the solution cooled to room temperature.

The aprons were then immersed in the solution for a period of 30 minutes, after which they were removed and thoroughly rinsed with water and dried in an air oven for 30 minutes at 180° F. The product obtained had a satiny finish and proved to have extremely low affinity for rayon fibers. Aprons prepared in this manner were then experimentally tested in a commercial type of drafting system and found to be fully satisfactory in their drafting qualities. Aprons of the same general composition but compounded with a fiber working surface composition free from carbon black gave products having a buff colored surface which also proved to be fully satisfactory in a commercial test.

The following additional data demonstrate the peculiar and cooperative action of dichromate and sulfuric acid. Aprons made according to Bacon #2,402,356 as referred to above were utilized in these tests and their affinity for rayon fibers investigated. These aprons had working surfaces free from carbon black and any change in color of the rubber could be readily detected.

1. *Sulfuric acid*.—Concentrated acid reacts quite violently with the cover giving a very slick surface in about one minute. Longer applications produce wrinkling and hardening of the surface. The surface obtained by contact with concentrated sulfuric acid has been found to be unsuitable since it tends to crack. More dilute sulfuric acid has been found to be ineffective for modifying the surface of the product.

2. *Nitric acid*.—An apron of the type referred to above was immersed in 20% freshly prepared nitric acid. Reaction took place very quickly to give a bright yellow surface. This surface, however, had a greater affinity for rayon fibers than no treatment at all.

3. *Potassium dichromate*.—The apron was immersed in aqueous solutions of potassium dichro-

mate ranging in concentration from a few grams liter up to the limit of solubility at room temperature. The apron was unaffected.

4. *Hydrogen peroxide*.—No reaction took place in solutions of concentrations as high as 15%. The surface was unaffected.

5. *Potassium persulfate*.—A solution of 5 grams of potassium persulfate in 100 cc. of water was made up and an apron of the type of Example 1 was immersed therein for a period of 30 minutes at 110° F. No reaction or modification of the surface was obtained.

6. *Potassium persulfate and sulfuric acid*.—A solution of 5 grams of 20% sulfuric acid was made up and the apron was immersed for 30 minutes at 110° F. No reaction or modification of the surface was obtained.

7. *Potassium persulfate, dichromate and sulfuric acid*.—An apron was immersed in a solution of 5 grams of persulfate per 100 cc. of 5% sulfuric acid containing 5 grams of potassium dichromate for a period of 30 minutes at 110° F. This produced a buff colored apron having a reduced affinity for rayon fibers and good drafting properties and appeared to be the same product which was obtained by the immersion of a similar apron in the same solution with no persulfate.

8. *Potassium dichromate and acetic acid*.—The apron was immersed in a solution of 5 grams of potassium dichromate per 100 cc. of 20% acetic acid. At room temperature no reaction occurred. At 150° F. a buff colored product was produced which, however, was not slick and had a definite affinity for rayon fibers.

9. *Potassium dichromate and trichloroacetic acid*.—The apron was immersed in a solution of 5 grams of dichromate and 20 grams of acid per 100 cc. This reacts very readily giving a buff colored apron which is very slick, but with a very decided affinity for rayon.

Similar solutions were made up except that 10 grams of acid and 5 grams of acid respectively were utilized. Buff colored aprons were obtained which had a definite affinity for rayon fibers.

10. *Potassium dichromate and boric acid*.—The apron was immersed in a solution containing 5 grams of dichromate and 5 grams of acid per 100 cc. No reaction occurred at either room temperature or at 150° F.

11. *Potassium dichromate and nitric acid*.—An apron was immersed in a solution containing 5 grams of dichromate per 100 cc. of 20% acid. This reacted very readily producing a greenish-gray surface which was slick and had a definite affinity for rayon.

12. *Potassium dichromate and hydrochloric acid*.—The apron was immersed in a solution containing 5 grams of dichromate per 100 cc. of 20% acid. This reacted very readily giving a brown surface which was slick, but had an affinity for rayon fibers.

13. *Potassium dichromate and phosphoric acid*.—The apron was immersed in a solution of 5 grams of dichromate per 100 cc. of 20% phosphoric acid. No reaction took place at room temperature; at 150° F. a reaction took place giving a dark brown surface which was slick but which had an affinity for rayon fibers.

14. *Potassium dichromate and sodium hydroxide*.—The alkaline dichromate solution produced no reaction.

15. *Potassium permanganate and sulfuric acid*.—The apron was immersed in a solution containing 1 gram of permanganate in 100 cc. of 20% sulfuric acid. A reaction occurred, but a

brown substance presumably an oxide of manganese deposited on the surface of the apron and the product could not be used in the drafting of fibers.

16. *Potassium permanganate and acetic acid.*—The apron was immersed in a solution containing ½ gram of permanganate in 100 cc. of 20% acid. A heavy dark brown substance was deposited on the apron similar to that described in 15.

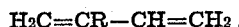
17. *Potassium permanganate and boric acid.*—The apron was immersed in a solution containing ½ gram of permanganate and 5 grams of boric acid per 100 cc. of solution. This reacted slowly at room temperature, produced a buff colored apron which was very slightly slick, but showed an affinity for rayon.

18. *Potassium chlorate and sulfuric acid.*—The apron was immersed in a solution containing 5 grams of chlorate per 100 cc. of 20% acid. In 60 minutes at 110° F. a slight discoloration had taken place and the apron was slick but had an affinity for rayon. At lower concentrations of acid no reaction appears to take place and the apron has an affinity for rayon.

The above results demonstrate conclusively that of all of the oxidizing agents and acids described, either alone or in combination, the only effective ingredients are the combination of the dichromate and sulfuric acid. In place of potassium dichromate other dichromates soluble in acid solutions which will liberate the dichromate ion, may be used, such as ammonium dichromate and sodium dichromate.

The results described above are applicable not only to aprons which are described only by way of example, but also to other textile fiber drafting elements composed of synthetic rubber materials of the type described, such as cots, roll covers, and the like. In general, the treatment is carried out subsequent to vulcanization and after the surface of the element has been ground to produce the desired final surface. Where grinding is not necessary, the product may be treated either prior to or subsequent to vulcanization.

The rubber-like conjugated diene type polymers and copolymers referred to herein include the polymerization products of conjugated diene hydrocarbon compounds of the type



where R is a hydrogen, methyl group, or a halogen, or their copolymers with styrene, acrylonitrile, and other monomers copolymerizable therewith to produce rubber-like compounds, having reactive ethylenic double bonds. These compounds include polychloroprene, polyisoprene, polybutadiene, and the copolymers of butadiene, isoprene and the like with styrene, acrylic nitrile and acrylic esters.

I claim:

1. A lap-resistant textile fiber drafting element having a fiber working surface comprising a synthetic rubber-like polymerization product of an aliphatic conjugated diene hydrocarbon and having the surface thereof modified by the reaction with an aqueous solution of sulfuric acid containing the dichromate ion, the sulfuric acid concentration being at least about one percent but insufficient to effect substantial deterioration of the rubber-like material, and its dichromate ion concentration being at least about 0.01 mol per liter.

2. A textile fiber drafting element according to claim 1 wherein the surface has been modified by contact with an aqueous solution of sulfuric acid containing from about 1% to 25% sulfuric acid and from 0.01 to 0.5 mol per liter of dichromate ion.

3. A textile fiber drafting element according to claim 1 wherein the polymerization product is the copolymer of butadiene and acrylic nitrile.

4. A long draft apron for use in fiber drawing having a fiber working surface comprising a synthetic rubber-like polymerization product of an aliphatic conjugated diene hydrocarbon and having the surface thereof modified by reaction with an aqueous solution of sulfuric acid containing the dichromate ion, the sulfuric acid concentration being at least about one percent but insufficient to effect substantial deterioration of the rubber-like material, and its dichromate ion concentration being at least about 0.01 mol per liter.

5. A long draft apron according to claim 4 wherein the polymerization product is the copolymer of butadiene and acrylic nitrile.

6. The method for the manufacture of lap-resistant textile fiber working elements having working surfaces comprising synthetic rubber-like polymerization products of aliphatic conjugated diene hydrocarbons which comprise immersing such an element in an aqueous solution of sulfuric acid containing the dichromate ion for a period of time sufficient to effect modification of the surface thereof, the sulfuric acid concentration being at least about one percent but insufficient to effect substantial deterioration of the rubber-like material, and its dichromate ion concentration being at least about 0.01 mol per liter.

7. The method according to claim 6 wherein the aqueous solution contains from about 1% to 25% sulfuric acid and from about 0.01 to 0.5 mol per liter of dichromate ion.

8. The method according to claim 6 wherein the aqueous solution comprises sulfuric acid and a dichromate selected from the class consisting of ammonium dichromate, sodium dichromate, and potassium dichromate.

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No references cited.