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THERMOSETTING RESIN COATED ASBESTOS YARN FOR USE IN DRYER'S FELTS

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ABSTRACT OF THE DISCLOSURE

An improved heat and moisture resistant paper maker's dryer felt, comprising an open weave construction of a composite of textile fibers including asbestos fiber with the asbestos fiber coated with thermosetting acrylic resin.

This invention relates to paper maker's dryer felts, and specifically to open weave felts, capable of use at higher-than-normal speeds, made possible by the use of thermosetting resin coated asbestos yarn.

Dryer felts generally made from cotton or wool have been notorious for their relatively short life, largely because of the deleterious effects of steam, moisture, flexing, abrasion and the like to which they are subjected during use. Of particular concern is the continuous exposure to high temperatures and moisture, which results in damage to the fibers and consequently lessens the effective life of the felt. While asbestos is weaker both as to tensile and shear strength than natural fiber yarns, its heat resistance and non-conductivity have made it acceptable in dryer felts in combination with natural fibers. In recent years, synthetic fibers such as nylon or Dacron fibers have been suggested as also useful in the manufacture of dryer felts. U.S. Letters Pat. Nos. 2,936,796 and 2,947,328 are illustrative of these modifications.

With the increased demands for paper, the increased speed of production has imposed even greater demands on the felts. The higher-than-normal speed requirements and the consequential greater friction and abrasion have substantially lessened the effective life of the felts. Moreover, the high speed processes require faster and greater water removal through the felt and it has been extremely difficult to provide a conventional felt which can absorb water and be dried for reuse at these speeds.

It is therefore an object of this invention to provide an improved dryer felt having an extended service life and increased water removal capacity.

It is another object of this invention to provide an improved dryer felt with lower manufacturing cost and consequently lower felt cost per given quantity of paper produced.

It is a further object of this invention to provide such a new dryer felt which is capable of use on conventional paper making machinery but at higher-than-normal speeds.

Other objects and further scope of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description, while indicating preferred embodiments of the invention, is given by illustration only since various changes and modifications within the scope of the invention will become appaarent to those skilled in the art.

The foregoing objects are satisfied by providing a new

dryer felt construction utilizing an open weave containing asbestos yarn coated with a thermosettable synthetic resin material which may be cured during weaving the felt to bond the asbestos yarn to the remaining fiber structure.

As noted above, the demands of the paper industry have necessitated increased production and have provided an impetus for reconsidering the basic concept involved in dryer felts. The instant invention involves a new principle of dryer felt construction whereby the prior techniques of utilizing an absorptive felt are no longer applicable. That is, the prior felts were constructed to absorb the moisture from the paper slurry and subsequently the felt would be dried and recycled for use. It is extremely difficult to provide a dryer felt which can absorb and be dried at these higher speeds. By utilizing an open weave construction, the water may be passed through the felt, as by suction, and by proper treatment of the felt fibers per se, the absorptive or hydroscopic capacity may be reduced to a minimum.

This is achieved by utilizing thermosetting resin coated asbestos yarn, which when woven with other fibers, such as cotton, is heat set so as to encase the asbestos yarn within the thermoset resin material, thereby reducing the absorptive or hydroscopic capacity of the asbestos yarn, and likewise setting the weave construction of the dryer felt. Inasmuch as the prior felts had a great amount of integrity because of the closeness of the weaves and the thickness of the mat, and because an open weave would permit the fibers to move relative one to another, the thermoset resin imparts the necessary integrity.

In addition to meeting the above objectives, it has been found that the dryer felts produced according to the instant invention have a faster rate of water pick-up from the paper and also a faster rate of water release when compared with conventional felts. Laboratory tests of the treated yarn indicate a 30% improvement in the service life when exposed to simulated paper making machinery.

The preferred thermosetting resins used in this invention are the emulsion and water-soluble acrylic polymers of acrylic and methacrylic acid and of their sodium and ammonium salts. As used in the instant specification and attached claims the term "polymer" includes all such individual polymers and copolymers and combinations of polymers and copolymers of acrylic and/or methacrylic acid. It has been determined that for improved thermosetting properties it is desirable to include a small amount of water-soluble melamine formaldehyde resin whereby in use the total solid applied to the yarn is in the range of 10 to 60 percent, and preferably between 15 and 30 percent.

The coating or impregnating composition may comprise, on a solids basis, between about 0.9 and 4 parts acrylic thermosetting resin, up to 4 parts melamine-formaldehyde modifier and sufficient water, usually between about 2 and 12 parts, to give satisfactory machine operation during the impregnation. It should be understood, however, that dependent upon the actual paper making procedure and the equipment used, the composition and percentage relationship of the ingredients can be varied. That is, dependent upon heat, moisture, speed, abrasion, flection and the like, the composition can be varied to produce satisfactory yarns which in turn produce satisfactory felts.

A more complete understanding of the invention may be obtained from the following example wherein all parts are by weight unless otherwise indicated.

EXAMPLE I

Asbestos yarn was coated with the following composition:

	Parts
Acrysol 2004 (36% solids)	5
Acrysol 2003 (36% solids)	3
Water	2

to a solids pick-up of 12 to 18 percent. The Acrysol resins are water solutions of acrylic acid and methacrylic acid copolymers with hydroxyl functionality and some carboxyl functionality. Both Acrysol resins used in the instant example had a pH of approximately 9.1 and contain butyl Cellosolve and t-butanol, resectively, in nominal amounts in addition to water as the solvent component.

Laboratory tests were run on the yarn to simulate felt service conditions and which are reasonably correlated to service conditions. The instrument used for the testing consists of a means for running yarn under tension over steam heated rolls and applying very dilute acid to it. This stimulates the conditions under which a dryer felt operates. The test consists of running a length of yarn for a given time period, determining the loss in tensile strength and comparing the results.

Table 1 below sets forth the data from these tests. From these results it can be seen that if the yarn is subjected to only 300° F. the tensile strength after running is very good. At 400° F. the yarn became more brittle and cracked.

TABLE 1

Sample No.	Weight, yds./lb.	Hours run on tester	No. of breaks	Average tensile strength		
				Before	After	Percent retained
1 [1]	535	88	1	19.3	19.2	99.0
2 [2]		73	1	19.3	19.3	100
3 [3]		41	3	18.3	15.9	85.4

[1] Yarn was in good condition after testing. Break occurred at knot.
[2] Yarn was in very good condition after testing. Break occurred at knot.
[3] Too weak to finish run. Yarn had degraded so that the resin and most of the asbestos was free to move the polyester core in some locations.

METHOD OF CURING YARN BEFORE BEING RUN ON TESTER

(1) Cured in lab oven at 300° F. for 10 minutes.
(2) Cured on the tester for 10 minutes at about 300° F. (80 p.s.i. steam).
(3) Cured in lab oven at 400° F. for 8 minutes.

RUNNING CONDITIONS

Steam pressure on rolls—80 p.s.i.
Acid water had a pH of 4.0

The yarn samples gave no trouble in winding and exhibited good dry heat resistance to softening. Resistance to hot water was determined by coating glass plates and subjecting the cured film to cold and hot water. The coated plate was unaffected by cold water for 24 hours and hot water at 165° F. for one-half hour. When the hot water test was extended to one hour the film exhibited some little softening.

An open weave dryer felt was woven containing the coated yarn whereby the resin was heat set during weaving at a temperature of 200–300° F. The felt performed satisfactorily in use, and demonstrated extended service life and good water removal.

EXAMPLE II

The felt of Example I, while performing satisfactorily under most conditions, showed some distortion when used in a first dryer felt position when it was subjected to the most extreme moisture conditions. This is substantiated by the above data. A second coated asbestos yarn was prepared having the following coating compositions:

	Parts
AC–201 acrylic resin	3
Acrysol 2004	3

	Parts
Uformite QR 418	2⅔
Permel B	1⅓
Water	3½

with similar solids pick-up. The AC–201 resin is a 46% solids acrylic copolymer with amide functionality and containing melamine as a modifier. The Uformite QR–418 resin is a 68 percent solids water solution of methylated melamine formaldehyde. Permel B is a 40 percent solids melamine resin based disersion containing stearamide. The resulting yarn was incorporated in a dryer felt which exhibited greater moisture and temperature resistance.

What we claim is:

1. A dryer felt adapted to withstand high temperature, moisture, flection and abrasion, and capable of use at higher-than-normal paper forming speeds, said felt being constructed of asbestos yarns woven with yarn composed of other fibers in an open weave construction to provide good water passage therethrough, said open weave construction effected by the inclusion of the asbestos yarn coated with thermoset resin selected from the group consisting of emulsions or water solutions of acrylic acid based polymers, methacrylic acid based polymers, and combinations thereof, and with the thermoset resin setting the weave construction, said resin serving to protect said asbestos yarn from moisture and to bond said yarn to the remaining fiber components to maintain the open weave.

2. A dryer felt as defined in claim 1 wherein said resin comprises between 0.9 and 4 parts of the coating composition and water between 2 and 12 parts, and providing between 10 and 35 percent solids pick up on said yarn.

3. A dryer felt as defined in claim 1 wherein said resin is modified by the addition of melamine-formaldehyde resin.

4. A dryer felt as defined in claim 3 wherein said thermoset resin comprises between 0.9 and 4 parts of the impregnating composition, the melamine-formaldehyde resin comprises up to 4 parts and water between 2 and 12 parts, and said composition providing between 10 and 35 percent solids pick up on said yarn.

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