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# TEXTILE PIRN

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## ABSTRACT OF THE DISCLOSURE

A tubular aluminum textile pirn having a ground finished surface with a thin silicate coating thereon. The outermost 1000 angstroms of pirn surface contain at least 0.7 percent silicon.

## BACKGROUND OF THE INVENTION

This invention relates to textile pirns. More particularly, it relates to coated tubular aluminum textile pirns and a method of producing such pirns. As used herein, the term "aluminum" is defined as high purity aluminum, commercial grades thereof, and alloys of aluminum containing at least 80 percent by weight of elemental aluminum.

Textile pirns manufactured from various metals have been disclosed in the art heretofore. However, the several properties important in pirns utilized with the high strength synthetic filaments encountered in the present-day market place have not as yet been obtained through the use of an aluminum pirn. These properties include a high crush resistance when thread, such as raw nylon, is wound under tension; a capacity to retain in place without snagging the last layer of thread to be unwound; the prevention of smudging or discoloration on that last layer; and resistance against corrosion during storage prior to winding. These properties must be uniformly achieved in commercial textile pirns because several hundred pirns are usually connected in series in a commercial textile manufacturing operation. Therefore, if the thread on one pirn snags and tears, the entire line must be shut down. Similarly, if one pirn causes a smutting of the last layer of yarn, the discoloration is transmitted to the entire batch of yarn being processed, and substantial loss of valuable yarn results.

Conventional textile pirns are made of steel tubes having insertable plastic sleeves. Such plastic sleeves have surfaces that duplicate layers of wound thread. These pirns, however, are extremely costly. Also, it is the practice in the textile industry to return the used pirns to the pirn manufacturer for inspection and repair. This is another significant disadvantage of steel tube-plastic insert pirns. As a result of these and other disadvantages, there has been a long-felt demand in the textile industry for a low-cost, single-use, disposable textile pirn which possesses all the above-mentioned desirable properties.

Accordingly, it is an object of this invention to provide a new and improved textile pirn, particularly an aluminum textile pirn. It is a further object of the invention to provide a new and improved low-cost, single-use, disposable



aluminum textile pirn. Yet another object of the invention is to provide a new and improved aluminum textile pirn having a high crush resistance and a nonsnagging, nonsmutting, thread-retaining, corrosion-resistant surface. A still further object of the invention is to provide a new and improved method for producing an aluminum textile pirn. Other objects and advantages of the invention will be apparent to those skilled in the art from the description and claims which follow.

## SUMMARY OF THE INVENTION

In its broader aspects the invention concerns a textile pirn comprising a tubular body of aluminum having a rough finished surface and a silicate coating thereon. We have found that in order to achieve the desired pirn properties set out above, the silicate coating must be applied in a sufficient amount that the outermost 1000 angstroms of surface of the pirn contain at least 0.7 percent by weight silicon. A convenient way of measuring the silicon content is by use of an electron microprobe. When an electron microprobe is used, electrons contact the surface film of silicate, possibly penetrating somewhat into the surface of the metal itself, causing X-rays to be emitted from the layer penetrated, the intensity of the X-ray wavelength for silicon being indicative of the silicon concentration. In this particular instance the silicon content of a 1000 angstrom layer was measured. Thus, the silicon content of the outermost 1000 angstroms of surface of the tubular pirn at any point perpendicular to its axis according to our invention is at least 0.7 percent by weight. When the silicon concentration in the outermost 1000 angstroms of surface falls below this percentage, the pirn does not have this desired resistance to corrosion during storage, and the last layer of thread is subject to smudging with the discoloration transmitted to the yarn being processed.

According to our invention, the rough finished surface of the cylindrical pirn which underlies the silicate coating must be smooth enough to prevent snagging of the thread wound on the pirn and rough enough to permit proper adherence of thread to the pirn without dropping down or collapsing. This necessary degree of roughness of the pirn surface according to my invention is 30 to 70 microinches RMS (root mean square) as measured by a profilometer.

The silicate coating covering the ground finished surface may be any of those silicate coatings described in U.S. Pat. 2,714,066. For example, it may be an insoluble silicate film which is the reaction product of the aluminum of the tubular body and an aqueous solution of a soluble metal silicate such as an alkali metal silicate.

The base tubular body of aluminum may be formed by induction welding of coiled aluminum sheet. The pirn body may be of any desired length, e.g., 13 inches. The inner diameter of the tube may be about 1.875 inches. For example, for high crush resistance when the pirn is wound with thread under tension, the wall of the tube may be at least .045 inch thick. The pirn of the invention preferably has a minimum yield strength of 43,000 p.s.i. The tube weld flash may be removed from both inside and outside the tubular body according to conventional practice. The ends of the tubular pirn are preferably deburred and chamfered on the outside surfaces of both ends to a radius of 0.020 inch. Deburring and chamfering permits the handling of the pirn without fear of injury.

The invention also generally concerns a method for

producing a tubular aluminum textile pirn comprising forming a rough finished surface of the roughness set out above on a tubular body of aluminum, cleaning the rough finished surface of the tubular body of aluminum, forming a silicate coating on the cleaned rough finished surface whereby the silicon content of the outermost 1000 angstroms of surface of the pirn is at least 0.7 percent by weight, rinsing the silicate-coated tubular body, and drying the same.

One reason for the rough finished surface of the roughness defined above is that a prior art substantially smooth mill-finish surface would tend to cause excessive drag on the first layer of yarn. A surface of the necessary roughness may be formed on the tubular body of aluminum in various ways. For example, a low-cost suitable ground finish is obtained by simply dry grinding the surface of the tubular body with a three station grinder, using a wheel sequence of 150–240–320 grit. Alternatively, wet grinding, that is, grinding the tubular body of aluminum with 180–240 grit emery belts using kerosene as a lubricant, also provides a suitable rough finished surface.

The cleaning of the rough finished surface may be accomplished by various known cleaning systems such as solvent cleaning, nonetching chemical cleaning, or mild-etch cleaning, providing the etch loss is limited to avoid loss of roughness of the ground finished surface. Regardless of the particular cleaning system employed, the surface obtained prior to formation of the silicate coating should be sufficiently clean to prevent any adverse effect upon the rough finish. Especially good results have been obtained with an aqueous mild etching solution maintained at a temperature of about 140° F. containing tetrasodium pyrophosphate, sodium gluconate, and a surfactant, e.g., Nacconol 40F, or an organic isocyanate such as toluene diisocyanate. The pirn is preferably conveniently immersed in the cleaning solution for at least ½ minute and then rinsed with water.

The pirn is now ready for formation thereon of the silicate coating. The silicate coating is conveniently applied by immersing the clean rough finished pirn in an aqueous dispersion of a silicate. Suitable silicates include calcium silicate, magnesium silicate, alkali metal silicates, ammonium silicates and the like. Because they are inexpensive and readily available, we prefer to employ alkali metal silicates. Good results have been obtained with a sodium silicate solution having a concentration of at least 0.1 percent anhydrous sodium silicate and an $SiO_2$ to $Na_2O$ ratio of 1 or more. Employing a temperature between 140° F. and the boiling point gives a good coating, an especially good coating being formed when the temperature is between 160° F. and 180° F. The pirn is preferably immersed for at least 15 seconds in the silicate solution, an immersion time of two minutes being optimum. Following immersion in the silicate solution, the pirn is preferably rinsed with water and then dried, making it ready for yarn to be wound thereon.

The following example is illustrative of the invention.

Several 13-inch tubes were produced by induction welding coiled sheet of an aluminum alloy designated by the Aluminum Association as and commonly known as 5086–H39. The sheet had a thickness of about .0465 inch. This alloy has a nominal composition of 4.0 percent magnesium, 0.45 percent manganese, 0.10 percent chromium, balance aluminum, plus other incidental impurities normally associated with aluminum alloys. The tube weld flash was removed from each tube. The outside surfaces of the tubes received a rough finished surface by being dry ground on a three-stage centerless grinding machine (having segmented flap clothe wheels) using a sequence of 150, 240 and 320 grit wheels. After grinding, the outside surfaces of both ends of the tubes were deburred and chamfered to a radius of 0.20 inch. The tubes were next immersed for one minute in a mild-etching cleaning solution maintained at a temperature of 140° F., which solution contained 6 ounces per gallon of tetrasodium pyrophosphate, ⅓ ounce per gallon of sodium gluconate, and ⅙ ounce per gallon of Nacconol 40F surfactant. The etch loss was less than 35 milligrams per square foot in the cleaning solution with no adverse effect on the rough finished surface of the tubes. The roughness of the surface was approximately 50 microinches RMS according to the aforementioned profilometer test. The tubes were then thoroughly rinsed with water and immersed for 2 minutes in an aqueous solution of sodium silicate which had a concentration of 5 percent by volume of liquid sodium silicate with an $SiO_2$ to $Na_2O$ ratio of 3.2 to 1. Following removal from the silicate solution, the tubes were thoroughly rinsed with water and air dried. The silicon content of the outermost 1000 angstroms of surface at points perpendicular to the axis of the tubes was measured with an electron microprobe and exceeded 0.7 percent by weight at all measured points. The tubes or finished pirns had a minimum yield strength of 43,000 pounds per square inch.

Approximately three pounds of raw nylon were wound on each pirn, and the pirns were placed in series on weaving apparatus. The yarn spun off of each pirn was not soiled, and no snags or tears occurred in the unwinding operation.

While we have disclosed preferred embodiments of the invention for illustrative purposes, it is obvious that various modifications of the invention are possible within the spirit and scope of the following claims.

Having thus described our invention and certain preferred embodiments thereof, we claim:

1. A textile pirn comprising a tubular body of aluminum having a rough finished surface coated with a silicate, the outermost 1000 angstroms of said surface containing at least 0.7 percent by weight silicon.

2. The textile pirn of claim 1 wherein the roughness of the finished surface is from 30 to 70 microinches RMS.

3. The textile pirn of claim 1 wherein the minimum wall thickness of said tubular body is .045 inch, the ends of said tubular body are deburred and chamfered, and said tubular body has a minimum yield strength of 43,000 pounds per square inch.

4. A textile pirn comprising a tubular body of aluminum having a rough finished surface with a silicate coating thereon, said silicate coating being the reaction product of the aluminum of said tubular body and an aqueous solution of alkali metal silicate, the outermost 1000 angstroms of surface of said pirn containing at least 0.7 percent by weight silicon.

5. A method of producing a tubular aluminum textile pirn comprising:

(a) forming a rough finished surface on a tubular body of aluminum;

(b) cleaning said rough finished surface of said tubular body of aluminum;

(c) forming a silicate conversion coating on said cleaned rough finished surface sufficient for the outermost 1000 angstroms of surface of said pirn to contain at least 0.7 percent by weight silicon; and

(d) rinsing and then drying the silicate-coated tubular body.

6. The method of claim 5 wherein the rough finished surface formed on the tubular body of aluminum is from 30 to 70 microinches RMS.

7. A method of producing a tubular aluminum textile pirn comprising:

(a) forming a rough finished surface on a tubular body of aluminum of a roughness of 30 to 70 microinches RMS;

(b) cleaning said rough finished surface of aluminum by first contacting said ground finished tubular body with a cleaning solution comprising tetrasodium pyrophosphate, sodium gluconate and surfactant;

(c) rinsing said cleaned surface with water;

(d) treating said cleaned rough finished surface with

an aqueous solution of alkali metal silicate maintained at a temperature of at least 140° F. sufficient to provide a silicate coating on said rough finished surface of a thickness such that the outermost 1000 angstroms of surface of said pirn contains at least 0.7 percent silicon; and

(e) rinsing and then drying said silicate coated tubular body.

8. The method of claim 7 wherein the alkali metal silicate is sodium silicate maintained at a temperature of between 160° to 180° F. and having a ratio of $SiO_2$ to $Na_2O$ of at least 1 and said cleaned rough finished surface is treated for at least 30 seconds with the aqueous sodium silicate solution.



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