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(54) Title: GAME BALL WITH SYNTHETIC LEATHER COVER

(57) Abrégé/Abstract:
A softball has a high end synthetic leather stitched cover formed from a non-woven fiber mat impregnated with polyurethane. The softball, which can be formed to meet association specifications, has a cover to core weight ratio significantly less than 0.2 and typically in the range of 0.08 - 0.16, while meeting durability requirements. Because a greater weight concentration is in the core of the ball, the ball has improved playability characteristics over conventional balls having synthetic leather covers.

ABSTRACT OF THE DISCLOSURE

A softball has a high end synthetic leather stitched cover formed from a non-woven fiber mat impregnated with polyurethane. The softball, which can be formed to meet association specifications, has a cover to core weight ratio significantly less than 0.2 and typically in the range of 0.08 - 0.16, while meeting durability requirements. Because a greater weight concentration is in the core of the ball, the ball has improved playability characteristics over conventional balls having synthetic leather covers.

GAME BALL WITH SYNTHETIC LEATHER COVER

Field of the Invention

The present invention relates to game balls used in diamond sports, and more particularly is concerned with balls, such as softballs, having highly durable, synthetic leather stitched covers.

Background of the Invention

Conventional softballs have one of four different types of covers, namely full grain leather stitched covers, coated split leather stitched covers, synthetic stitched covers, or molded covers. Stitched covers customarily are formed from two separate pieces of leather or synthetic material which exhibit the traditional interfitting dumbbell configuration and are fastened together with herringbone stitching. The stitching forms ridges which enhance the gripping characteristics and desired aerodynamic properties of the ball.

Genuine leather traditionally has been deemed to be the best cover material due to its softness, texture and durability. Such material provides firm but relatively soft cover that advantageously provides for potentially increased spin off of the bat, which can produce additional carry and lift, which in turn results in increased hitting distance. Furthermore, a leather-covered ball produces a solid crack-type sound when struck with a bat. This sound is not replicated by many synthetic ball covers.

All conventional softball cover materials are found to reduce the coefficient of restitution (C.O.R.) of the ball to a limited extent. However, leather traditionally has been found to result in a smaller reduction in coefficient of restitution of the ball than results from the use of synthetic or molded covers.

Synthetic leather softball covers typically are formed of polyvinyl chloride (PVC). While PVC covers have good resistance to wear and moisture, it is necessary to make such covers thicker than leather in order to obtain comparable durability and stitchability. Unfortunately, the thicker covers tend to dampen the sound when the bat hits the ball, thereby losing the solid crack players have come to expect, and also result in a greater reduction in the coefficient of restitution of the ball as compared to balls with thinner leather covers.

Summary of the Invention

Accordingly, it is an object of the present invention to provide a new and improved game ball for diamond sports, particularly a softball, having a high performance, synthetic leather, stitched cover that exhibits the softness, durability, stitchability, low reduction in coefficient of restitution and sound of balls having full grain or coated split leather covers.

Another object of the present invention is to provide a ball of the type described having a synthetic leather stitched cover wherein the ball has play properties, such as spin, lift and distance carrying characteristics, which replicate, or are superior to, the properties of a ball having a leather stitched cover.

A further object of the present invention is to provide a synthetic covered ball for use in competitive play that employs a significantly lower cover to core weight ratio that facilitates enhanced performance characteristics without significant change in the core dimensions.

Yet another object of the present invention is to provide a ball of the type described with improved wear, feel and handling characteristics without significantly compromising the traditional characteristics associated with leather covered balls, particularly the impact sound or "crack" when struck by a bat.

A still further object is to provide a synthetic stitched cover ball utilizing a cover of durable, fiber-reinforced polyurethane in place of the finer grades of leather.

Other objects of the invention will be in part obvious and in part pointed out more in detail hereinafter.

These and related objects are achieved by providing a game ball for diamond sports comprising a core and a cover encasing the core wherein the ball has a cover to core weight ratio substantially less than 0.2. The cover preferably is made from a urethane impregnated fibrous web having a microporous structure that contributes to the leather-like tactile qualities of the cover.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description wherein the features of construction, combination of elements and arrangement of parts will be exemplified and are indicative of the way in which the principles of the invention are employed.

Detailed Description of the Invention

While it is believed the present invention will have application to all game balls used in diamond sports, for ease of illustration and simplicity of understanding, it will be described in connection with softballs.

In compliance with all current softball association specifications, a regulation slow pitch "12 inch" softball should have a circumference of 11⅞ - 12½ inches (about 30.5 cm), a weight of 6¼ - 7 ounces (171.9 - 198.5 grams), and a coefficient of restitution (C.O.R.) for traditional flight balls of no more than 0.500 when measured at 88 feet per second. Regulation "11 inch" balls are essentially one inch smaller in circumference, weigh about 165 - 175 grams, and exhibit the same C.O.R. The ball consists of two primary components, a core that constitutes the major portion of the ball's mass and weight and a stitched cover that encloses the core. The cores preferably are substantially solid members and can be formed from conventional core materials, such as cork, kapok, polyurethane, ionomers, synthetic rubber, and other polymeric materials. Some cores may include a filament wound wrapping, but the preferred core for the softballs of the present invention do not include such wrapping. The size of the cores will depend upon the thickness of the cover, as the balls normally are made to meet the above-mentioned exterior size standards and regulation dimensions of all softball associations.

The core of a traditional softball typically will have a weight in the range of 135 - 150 grams while a total ball weight ranges from 175 to 195 grams. Thus, the covers of traditional softballs may vary from about 30 to about 60 grams with the average cover weight being about 40 - 45 grams. This results in a cover to core weight ratio ranging between about 0.2 and 0.45 with the average ratio being greater than 0.25.

While, in accordance with the present invention, the size of the core preferably remains unchanged or is only slightly larger than cores which are surrounded by genuine leather covers, the weight of the core is significantly increased since the invention provides for a cover having a thickness and weight significantly less than that of a genuine leather cover. By increasing the weight of the core that accounts for a substantial portion of the ball's C.O.R. and putting a cover of reduced weight over the core, there is greater control over the ball's C.O.R. and less reduction thereof by the softer cover material. As a result, flight distance characteristics are

improved since the impact of the bat is transmitted with less absorptive cushioning by the softer cover component.

The core used in the present invention, therefore, is about 15 grams heavier than the traditional core with weights ranging from about 155 grams to about 165 grams for 12 inch balls. The total ball weight remains substantially unchanged at about 178 - 185 grams. This results in a cover weight of about 17 - 20 grams and a cover to core weight ratio well below 0.2 and preferably below 0.18, with a typical ratio range being about 0.08 to 0.16 and preferably about 0.09. It will be appreciated that smaller balls, such as the 11 inch ball, will have a cover of substantially the same thickness but of lighter weight due to the reduced amount of material forming the cover. Nevertheless, even at a cover weight of about 14 - 17 grams, the cover to core weight ratio of the present invention does not change substantially from those set forth.

Due to the high durability of the cover material which is used according to the present invention, the softball covers can be thinner than leather covers which have the same durability. It has been found that the cover thickness of the softballs of the present invention can be 10 - 20% less than the thickness of leather covers having the same durability. Thus, the thickness of the cover can preferably be reduced to about .045 - .055 inch. Because the balls of the invention have a synthetic leather cover which is even thinner than the covers of comparable balls having genuine leather covers, the impact when struck with a bat provides the same sharp, crack-like sound that players have come to associate with leather covers and high performance softballs.

A ball's coefficient of restitution (C.O.R.) is the ratio of the relative velocity of the ball after direct impact to that before impact. One way to measure the coefficient of restitution is to propel a ball at a given speed against a hard massive surface, and measure its incoming velocity and outgoing velocity. The coefficient of restitution is defined as the ratio of the outgoing velocity to incoming velocity of a rebounding ball and is expressed as a decimal. The typical incoming test velocity is 88 feet per second. As a result, the coefficient of restitution can vary from zero to one, with one being equivalent to an elastic collision and zero being equivalent to an inelastic collision.

It is advantageous for softballs to have as high a coefficient of restitution as is possible while meeting association specifications. The coefficient of restitution of a traditional flight

softball must be 0.500 or less. An uncovered softball core will have a somewhat higher coefficient of restitution since the softer cover will tend to reduce the C.O.R. of the final covered ball.

Generally, a high performance softball with a solid polyurethane core will have a compression of 0.006 - 0.012 inches and preferably about 0.007 - 0.008 inches. The compression is measured in an apparatus having an indentation in which the ball is placed. The ball is secured by a mount opposite the indentation. Once the ball is held in place, compensation is made for the securing force and a gauge in an associated measuring apparatus is set at zero. A ten pound weight is then placed on the mount so as to bear on the ball between the mount and the indentation and an immediate measurement is taken and recorded. The test is conducted six times, two each at the poles, the sides, and the equator. The results are averaged to obtain the final compression reading.

The cover of the softball according to the invention is a two piece stitched cover with each piece having a conventional dumbbell shape. The cover typically is stitched with conventional herringbone stitching. However, other stitching patterns also can be used. It has been found that a softball cover according to the invention having a thickness of _0.030 - 0.060 inches, and preferably 0.045 - 0.055 inches, will provide a durability which is better than that of a coated split leather cover having a 10 - 20% greater thickness of about 0.055 - 0.060 inches.

The texture and feel of a softball are important for both throwing and catching as well as hitting, and the object in making synthetic leather covers generally has been to replicate the characteristics of genuine leather covers. The cover of the invention results in a softball having a feel and texture which closely replicates the finer grain leather covers. The cover of the invention will yield slightly to finger pressure applied by the player to provide a firm comfortable grip on ball without excessive give. Thus, the soft texture improves the grip for throwing without compromising hitting performance. In fact, the ball of the present invention exhibits improved performance since the improved spin and loft results in improved distance. Further, because of the spin, there is a minimized "knuckling" effect on direct hit balls.

The core of the ball can be manufactured in a conventional manner. The preferred cores are single component members made of polyurethane and formed using low pressure or high pressure molding techniques.

The cover used on the balls of the present invention is constructed from two segments which are of substantially the same dumbbell shape as the two segments of cover material used on a conventional stitched softball. While various polyurethane covers may be used, particularly satisfactory results have been obtained from a urethane impregnated substrate of a non-woven monofilament fibrous web material. The urethane encases the fibers such that no fibers are visible on the outer surface, although the fibers on the undersurface may be visible prior to adhesive application to the core. The fibers are made of a polymeric material, preferably a polyamide, such as nylon, or a polyester, and have an individual extremely fine thickness of only about 1.0 micron. The preferred material is more fully described in U.S. Patent 5,310,178. The material is not only fiber reinforced, but also exhibits a microporous cellular structure that contributes to the soft, leather-like tactile quality of the material. The soft feel and flexible texture also can be enhanced by the grain-like pattern applied to the outer surface to simulate the visual appearance of a leather cover.

The polyurethane layer includes a plurality of monofilament polymeric fiber material, preferably a polyamide, such as nylon, or a polyester, compressed together in an array to form a mat with polyurethane material located above, below, and throughout the spaces between the fibers. Such fibers have a diameter of about 1.0 micron. On the exterior surface of the cover, a grain-like pattern of raised portions in an irregular pebble-like pattern, is formed to simulate leather. The exterior surface is also then preferably painted to simulate grain leather.

The process for preparing the cover material, when considered in greater specificity includes the preparation of the substrate which is prepared by providing a mat of fibers of nylon or polyester, with a diameter of about 1 micron, to a thickness of up to about 2.0 millimeters. Each fiber is coated with a starch. The next step is the impregnating of the fabric mat with a solution of polyurethane in dimethylformamide (DMF) with the special additives described in the above-mentioned patent. The additives represent a few percent by weight.

The same polyurethane with the special additives is put into the substrate mat layer to form a polyurethane coating layer on top of the mat. Then, the substrate with the polyurethane coating layer on its surface is immersed into an aqueous solution containing less than 50% of DMF for coagulation. In this wet coagulation process, the polyurethane impregnates into the nonwoven fabric which comes to have a microporous structure which can be expressed as a cellular plastic. Polyurethane in the substrate layer provides this very microporous cellular structure with the help of the special additives.

The fabrication for the cover material includes an impregnation of fibers with polyurethane in DMF. The material subsequently undergoes an extraction process to give the material a soft feel. The top coat on the material is also a polyurethane, preferably the same material that is used to impregnate the fibers. Also, the diameter or denur (size) of the fibers is smaller than usual. More specifically, a solution of polyurethane elastomer in DMF, with sorbitan monostearate and stearyl alcohol as additives, is forced into the nonwoven fabric of the mat fibers and the solution impregnates down into the inside of the nonwoven fabric. In addition, a polyurethane solution with these additives in DMF is coated on top of the base material to form a polyurethane coating layer. Then, the base material with a polyurethane coating layer is put into an aqueous solution of DMF. This coagulates the solution of polyurethane elastomer and, during this wet coagulation process, the polyurethane elastomer changes the fibers into a microporous structure. In this coagulation process, these additives work as an accelerator to get more micropores and/or as a controller of the size of the pores.

The sheet material formed by the above-described process is dipped in toluene for a period of time sufficient to dissolve off one component in the fiber. At the same time, the special additives are extracted or removed out of the sheet material for softening of the material. A certain amount of starch deposited on the surface of nonwoven fabric has, at this time, already been removed out of the sheet materials during the process of coagulation. In order to obtain a sufficiently soft feel and texture, the polyurethane is coagulated unbonded to fibers with a microporous cellular structure in the substrate layer is if the fibers were floating.

The microporous cellular condition of polyurethane is not formed after the extraction of one component in the fiber. Such condition is formed earlier in the process of wet coagulation before the extraction process. The main purpose of the extraction process is to give the soft

flexible texture to the sheet material as explained above. By this process, the ball of the present invention can be manufactured economically in a consistent manner, and has substantially identical, or even better, properties than a ball with a genuine leather stitched cover.

The cover material alone, when tested for physical properties and compared to current raw material specifications for both leather and polyvinyl-chloride, meets or exceeds all specification requirements for softball covers. Accordingly, the cover material can be appropriately stitched over proper sized cores to meet not only manufacturing requirements for the balls, but also the standard impact and field play requirements for durability.

The cover material is secured to the core in a conventional manner including the use of adhesives. This can involve the use of various known cements, but typically a urethane adhesive is employed.

From a subjective standpoint, the difference between the polyurethane cover and other synthetics is obvious to the touch. The ball which is produced with the above-described polyurethane has a distinctly softer feel which results in improved ball control. The material described above differs from other known synthetic softball covers in that the other known synthetics have a harder, more plastic-like feel. After normal wear, the covered ball of the present invention retains its soft feel and develops increased tackiness as a result of the backing of the fibers becoming exposed, as more fully described in U.S. 5,310,178. This quality is similar to the wear characteristics of leather. On the other hand, conventional synthetics tend to acquire a rubber-like feel after extended use.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departure from the spirit and scope of the invention.

What is claimed is:

1. A game ball for use in diamond sports comprising a spherical core, and a stitched cover encasing the core, the ball having a cover to core weight ratio of less than 0.2, said ball complying with standardized regulations for said diamond sport.

2. The game ball of claim 1, wherein the cover to core weight ratio is less than 0.18.

3. The ball of claim 1, wherein the weight ratio falls substantially within the range of 0.08 - 0.16.

4. The game ball of claim 1, wherein the weight ratio falls substantially within the range of 0.09 - 0.13.

5. The game ball of claim 1, wherein the cover has a weight of up to about 20 grams.

6. The game ball of claim 1, wherein the core has a weight equivalent to about 155 - 165 grams for a 12 inch circumference ball.

7. The game ball of claim 1, wherein the cover has a weight equivalent to about 17 - 20 grams for a 12 inch circumference ball.

8. The game ball of claim 1, wherein the cover is a fiber reinforced polyurethane material.

9. The game ball of claim 8, wherein the fibers have a diameter of about 1.0 micron.

10. The game ball of claim 1, wherein the cover is a microporous, polyurethane impregnated fibrous web material.

11. The game ball of claim 1 wherein the ball exhibits a sound comparable to that of a leather covered ball, when struck with a bat.

12. A game ball for use in diamond sports comprising a spherical core, and a cover formed from a substrate of nonwoven synthetic fibers impregnated with a polyurethane, the synthetic fibers being a polymeric material, the impregnated substrate having a thickness of about 0.030 - 0.060 inches.

13. The game ball of claim 12, wherein the synthetic fibers have a diameter of about 1 micron.

14. The game ball of claim 12, wherein the nonwoven fibers are in the form of a nonwoven web material and the cover has a microporous cellular structure.

15. The game ball of claim 12, wherein the fibers in the cover are selected from the group consisting of polyamide and polyester fibers.

16. The game ball of claim 12, wherein the ball has a cover to core weight ratio of less than 0.2.

17. The game ball of claim 12, wherein the ball has a cover to core weight ratio within the range of 0.08 - 0.16.