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WHAT'S THAT STUFF?

# GOLF BALLS

## Polymer chemistry has played a key role in the evolution of the golf ball

Former British prime minister Sir Winston Churchill once described golf as "a game whose aim is to hit a very small ball into an even smaller hole, with weapons singularly ill-designed for the purpose." He may have been right in his time, but not today. Golfers have become wanton technophiles, and although the most noticeable advances have come in the form of ever-expanding club heads, the most sophisticated technology resides in the one place where size and shape have stayed essentially constant: the golf ball.



PHOTODISC

Today's golf balls look remarkably similar to those from the 19th century, but what's inside has changed in a dramatic way, with new materials and designs fueling a veritable distance revolution in recent years. The credit tends to go to physics, but it is the chemistry of the golf ball that allows it to leap off the club head, bend in the air, and stop on a dime--while emerging from the ordeal virtually unscathed.

The golf ball was not always such a marvel of materials science. The first golfers, on the eastern coast of Scotland in the 15th century, used balls made of local hardwoods like beech. In the early 17th century, the "featherie" was developed--a leather pouch stuffed with boiled feathers from chickens or geese. In 1848, the "guttie" came on the scene. The ball was made from gutta-percha, which is a coagulated latex, consisting mainly of trans-1,2-polyisoprene, that exudes as sap from sapodilla trees. When the sap is heated in water and rolled into a sphere, it forms a virtually indestructible ball.

With the advent of industrialization in the late 1800s, companies began producing rubber balls from molds. In 1898, the Ohio-based tire and rubber company B.F. Goodrich introduced the first ball that had rubber threads wound around a natural rubber core, all encased in a gutta-percha sphere. The wound ball went through a number of incarnations--including one with a compressed air core that tended to explode--before manufacturers adopted a design that replaced the gutta-percha cover with balata, a form of natural rubber obtained from a South American tree. The balata ball became the weapon of choice for most golfers, pro and amateur alike.

In the late 1950s, Richard W. Rees, a chemist at DuPont, created a material that would ultimately transform the game of golf. Another DuPont scientist had recently copolymerized ethylene and acrylic acid. Rees took a sample of this copolymer and converted it to its sodium salt, producing a hard substance known as an ionomer resin. Rolling the substance into a golf ball showed tremendous potential. "You could really hit some rotten shots, and the ball just came back for more," Rees said. "It seemed to be the perfect duffer's ball." Rees and DuPont went commercial with the material in 1964 under the trade name Surlyn, and it became the staple cover material for the vast majority of wound golf balls on the amateur market.

Around the same time that Rees was developing Surlyn, Robert A. Molitor, a chemical

engineer with Massachusetts-based sporting goods manufacturer Spalding, came up with the first real alternative to the wound ball. His two-piece ball had a polyurethane cover and a synthetic polybutadiene rubber core. The polyurethane was eventually replaced with Surllyn or other ionomer resins to become what was commonly known as a "distance ball."

These balls flew far and were tough, but they also had an undesirable characteristic: "If you are old enough and a golfer, you may remember that the golf balls were hard as a rock back then," says Bob Weiss, a chemical engineering professor at the University of Connecticut. To soften the blow, researchers developed "soft ionomers." These are terpolymers of ethylene, methacrylic or acrylic acid, and a third component--usually an acrylate--that softens the material considerably and gives the golfer a better feel.

In recent years, everything has changed. Multilayer balls hit the market in 1996, and the so-called distance revolution was launched. The Top-Flite Strata, the first of the multilayer balls, essentially bridged the gap between wound and solid-core balls with a hard "mantle" between the solid core and the soft terpolymer covering. "You want to reduce the spin that comes off the driver so that you don't have the ball ballooning up in the air and losing distance; hence the mantle," says chemist Tom Kennedy, vice president of research and development for Top-Flite Golf. "Then, in order to have a good playing ball around the green, you have the very soft outer cover."

In late 2000, many tour players began teeing up another ball heralded for its distance, Titleist's solid-core Pro V1, and the average driving distance of professionals increased by more than 6 yards, according to *Golf Digest* magazine. "The hottest material right now is polyurethane," Weiss explains, and that is what Titleist and other manufacturers are using as a cover. Soft materials like polyurethane do not transfer energy well from the club to the ball, dampening the impact of the club head. But manufacturers have found a way to put an extremely thin layer of polyurethane over an ionomer mantle, minimizing the dampening effect.

"Distance is a big thing for people," Kennedy says, speculating about the future of golf ball technology. "The problem is, in order to gain distance on high-end tour-quality golf balls, you have to have the skill set to take advantage of them. Most people don't."

Still, a duffer can dream, and manufacturers will push the envelope while the demand is there. The next big thing, according to Kennedy, is a ball that will "mutate" in the air. Such a ball would soar like a cruise missile, hit the ground at a very shallow angle, and roll for up to 40 yards on hard ground.-- JASON GORSS

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