

## **Footwear Manufacturing**

The manufacturing of footwear has evolved from the use of animal skins by primitive people to a thriving modern-day mass production endeavor. The basic components of a finished shoe or boot consist of an upper, midsole and outsole or bottom portion of the shoe. After construction of the upper, it is attached to the midsole and outsole.

The upper of a shoe is often made of leather but manmade components can be used such as fabrics and polyvinyl chloride (PVC). The upper is made on a last which is a plastic foot-shaped form. The outsole is made of leather and PVC but can also be made of rubber and other materials.

Leather outsoles are attached to shoes using a process called welting which uses threads and tacks but they can also be cemented using adhesives. Outsoles constructed of rubber, PVC, polyurethane or other polymer-based materials are often attached to the upper using adhesives.

PVC and polyurethane outsoles are made through a process known as injection molding. Shoe uppers can be attached during this process. Rubber outsoles are made through a process known as compression molding (vulcanization) in a device similar to a waffle iron.

The designs for outsole molds are accomplished through a Computer-Aided Design-Computer-Aided Manufacture (CAD-CAM) process, Electrical Discharge Machines (EDM) or hand-milling/hand-engraving. These various processes are used in the many different designs seen today especially in athletic shoe outsoles.

Another process used in the manufacture of outsoles requires pre-molded sheets of outsole materials that are cut and trimmed to the desired size before attachment to the upper.

There are seven basic styles of shoes available in the marketplace, they are: oxfords, moccasins, sandals, mules, boots, pumps and clogs. There are many different varieties within these seven styles available to the consumer today.

Anon., "Footwear Manufacture", The Encyclopedia of How It's Made. A & W Publishers, New York, 1978, pp. 66 – 69

Anon., "Last: The Birthplace of Shoe Fashion", \_Leather and Shoes May 1974, pp. 36 - 42

Bodziak, William J., Footwear Impression Evidence, 2<sup>nd</sup> Edition, pp. 197 - 278

## **Tire Manufacturing**

In the early 1900s automobile tire manufacturing began in the United States. Passenger car tires are made of many complex parts and materials engineered to do a specific job.

The main ingredients of a tire are rubber compound, fabric and steel. The basic components of a tire are the body, bead, plies, belts and tread. The rubber compound must be right for the purpose it is to serve - a hard rubber compound for long tire life, softer one for better traction; and a flexible, heat and crack-resistant one for the sidewall.

Most passenger cars use radial ply tires. These tires are manufactured with the body plies at an angle of approximately 90 degrees to the center line of the tire with belts running the circumference of the tire.

The outermost layer of the tire is the tread. The primary purpose of the tread design is traction as it is the component of the tire that comes into contact with the road. The tread consists of elements, lugs, ribs, slots and grooves. Numerous tread designs or patterns are available for passenger car and truck tires. Tire tread is designed with various characteristics to include wet, dry, mud and snow traction.

Tire engineers use Computer-Aided Design-Computer-Aided Manufacture (CAD-CAM) for complex tread designs which are versatile for different road conditions and to alleviate humming that can be produced by the tire during driving.

Today, tires are produced in many sizes and tread designs depending on the type of vehicle on which they will be used.

Anon., "Building Firestone Tires for a Nation on Wheels", Product Booklet, Firestone Tire and Rubber Company, 1979

Anon., "How a Tire is Built", Product Paper, Goodyear Tire and Rubber Company