



## Limonene: Multipurpose Citrus Product

Orange oil is extracted from orange peels. About 90% of the raw orange oil is d-Limonene. The remaining 10% consists of other terpenes and aroma components. In its purest form, d-Limonene is odorless, but the product that comes from oranges has an orange smell.

d-Limonene is an excellent solvent and cleaning agent that has many uses.

### Historical Perspective

One of the pioneers in developing the limonene industry in Florida is H. E. "Bert" Schulz of Winter Haven. In 1942, Bert and his father formed a company that later became the Florida Chemical Company. Prior to that time, the citrus processing industry disposed of citrus pulp and peels by dumping them into pastures for cattle feed. Later, water was pressed out, and the peel was dried to make citrus-processing pellets that could be bagged and sold as cattle feed. Initially, the press water was dumped down the drain and caused pollution problems. Later, it was found that this watery residue could be made into molasses and then fermented into ethyl alcohol.

During World War II, there was strong demand for alcohol to help in the production of gunpowder. The small company initially made alcohol from molasses, but after Bert returned from serving in the Navy during the war, he and his father shifted emphasis to d-Limonene. Frozen concentrated orange juice was developed after the war, and the Florida industry changed from a relatively small fresh-fruit business to a much larger processing industry. More fruit processing for juice meant more orange peels and the resource for greater d-Limonene production.

From the 1950s to the 1990s, Bert helped develop and market a variety of products that used d-Limonene. At that time, many of the competitive solvents and cleaning agents

### Stored and ready to go. The warehouse of Florida Chemical Company.



H. E. "Bert" Schulz in front of his facilities.

were derived from pine oil (for example, turpentine) or the petroleum industry. These competitive products were abundant and cheap, and limonene remained a modest business in the 1950s and 1960s. Nevertheless, Bert stuck with limonene when few others cared about it.

### Increased Demand

A major advantage of limonene is that it is both biodegradable and relatively non-toxic compared to other solvents. In the 1970s and 1980s, environmental issues became more important, and companies started introducing citrus-based cleaning products, creating more demand for d-Limonene. Regulatory pressure increased on industries that used chlorinated solvents or more toxic cleaning agents. Disposal costs for traditional solvents went up, and companies started looking for less toxic cleaning agents. Limonene became more competitive and widely used.

In 1985, Paul Schulz, Bert's son, came back to manage the company. Because products using d-Limonene smell good and are environmentally friendly, demand has increased dramatically.

Limonene can be used in a surprising multitude of products, and this family-owned company developed many of them. Limonene is used as a laundry detergent, chewing gum and stain remover, engine and lift station degreaser, floor wax and paint stripper, adhesive resin, nail-polish remover, paint defoamer, and odor-control agent. It is also found in all kinds of products for cleaning upholstery, jewelry, carpets, stovetops, floors, driveways, grease traps, machine parts, and even in disposable baby diapers.

Florida Chemical Company has evolved from a small trading company to a specialty chemical manufacturer that makes and blends a variety of products. It helped create the market for d-Limonene, and is now the largest dealer of d-Limonene in the world. As Paul said, the company is a 60-year overnight success story. For his contributions to the citrus industry, Bert was inducted into the Florida Citrus Hall of Fame in February 2007. He pioneered a new avenue for the citrus industry by making limonene a citrus by-product of major importance.