AMAZING ACHIEVEMENTS IN CHEMICAL ENGINEERING

CHEMICAL ENGINEERS

They Make Life Easier for Us

Chemical engineers take chemistry out of the laboratory and into the world around us. They're creative problem solvers who apply scientific knowledge and technical expertise to make useful materials at a reasonable cost and in the safest manner possible.

Chemical engineers are involved in creating new wonder drugs and materials that improve life on earth and make space exploration a reality. They even work on the soles of your sport shoes, the compact discs which give you so much listening pleasure, and the chocolate coating on your favorite candy.

Chemical engineers work in research, design, development, production, technical sales, and management. Some are consultants, computer system designer, lawyers focusing on patent or environmental law, or brewers of specialty beers.

Chemical engineers are responsible for the basic necessities in life that many of us take for granted. On the next few pages are examples of breakthroughs and advances in our society that make life easier, more efficient and user-friendly. Each of these accomplishments was made possible by a chemical engineer.

PLASTICS

A Part of Everyday Life

Billiard balls were once made of ivory. This was not only costly, but also endangered elephant herds. In 1858, John Wesley Hyatt won a contest to develop a substitute for ivory by mixing a cotton derivative with nitric acid and camphor to make "celluloid."

Celluloid turned out to be unsuitable for billiard balls, but other plastics worked. And, celluloid proved very useful in eyeglass frames, cinema film, collars and cuffs on shirts, and in many other applications.

Another breakthrough came in 1905, when Leo Baekeland developed a smooth, hard plastic from phenol and formaldehyde. "Bakelite" was used in electric insulators, clock bases, electric iron handles, and even in jewelry that is still fashionable today.

By the 1930s, new demands generated the development of special plastics. Nylon, polyvinyl chloride, acrylics, polystyrene, polyethylene, and polypropylene were developed for toys, clothing, records, and thousands of other uses.

Today, aerospace and automotive plastics, composites, and laminates continue the history of development. Plastics are used in everything from medicine to sports, from intravenous tubing to bike helmets.

AIR

More than What We Breathe

Chemical engineers pioneered ways to process and use the plentiful gases in our air-particularly oxygen and nitrogen-on a massive scale. They use "cryogenics'-the technology of very low temperatures to separate air into its component gases. Pure oxygen boils at 297 degrees Fahrenheit below zero. Pure nitrogen boils at 320 degrees below zero. Below these temperatures, each gas condenses into a liquid.

We can use nitrogen, which is about 78 percent of our atmosphere, to recover petroleum, freeze food, and produce semiconductors and other electronics.

We use oxygen, which is about 21 percent of our atmosphere, in steel making, copper smelting, metal cutting and welding, and, most importantly, for life support in hospitals.

Distributing and shipping these very cold liquids was, historically, a problem. Chemical engineers developed the vacuum-insulated tank trucks which you see on the roads today, delivering liquefied gases to plants and hospitals.

ENVIRONMENT

A Cleaner World for Us

Chemical engineers are seriously involved in environmental control technology-not only in cleaning up the problems of the past, but in preventing pollution for our future. Chemical engineers believe we can accommodate both economic progress and improved environmental quality.

Car engines with catalytic converters, double-hosed gasoline pumps, and modern jet engines are some examples of our efforts to keep the world cleaner. Scrubbers on smokestacks also help maintain the quality of our air.

Chemical engineers are champions of the reduced use of virgin materials and the increased recycling of useful materials.

You can do your part to help the environment by sorting your garbage for recyclable, such a paper, glass, plastics, steel, and aluminum.

FOOD

A Bountiful Balanced Diet

Food shortages have been a recurring problem in much of today's world. However, it is also true that many people on Earth are better fed than ever before. Crops are healthier and food is fresher. Chemical engineers have made these advances possible.

Chemical engineers have developed compact, economic ammonia plants which efficiently produce large quantities of fertilizer from nitrogen and hydrogen. Large-scale plants are located strategically, for example, in China, India, and Africa, where they can do the most good.

Chemical engineers also produce other helpful fertilizers, like phosphates and urea, and pesticides that enrich and protect our crops. And, they are at the forefront of efforts to improve food processing technology, whether the food is freeze-dried, extruded, or microwaved.

Chemical engineers working in biotechnology believe it promises even greater strides in increasing the productivity of our farms, improving the quality of our food and ending hunger.

WONDER DRUGS

Keep Us Healthy

In 1929, Sir Arthur Fleming discovered that penicillin inhibited the growth of staphylococci bacteria which can cause serious infections.

Similarly, in the late 1930s, Dr. Selman Woksman discovered that some chemical compounds destroy harmful bacteria. He called these chemicals "anti-biotics," Latin for "against life." Unfortunately, these antibiotics were difficult and costly to produce, and they could only be made in small quantities.

Enter chemical engineers. They developed ways to mass-produce antibiotic drugs:

- Increasing penicillin yield a thousand times through mutation
- Developing special methods for "brewing" penicillin in huge tanks.

Low-cost, widely available "wonder drugs" were the result. Penicillin, streptomycin, erythromycin-all make our lives better, healthier, and longer.

Antibiotics keep our farm animals and pets healthy, too.

SYNTHETIC FIBERS

The Clothes We Wear

Human beings have always needed to protect themselves from the cold. Early clothes were made from animal skins, furs, grasses, silks and other readily available materials.

In 1644, Robert Hooke, an English scientist, wanted to force a synthetic substance through tiny openings to make thread, just as silkworms and spiders do. But, it was not until 1910 that "viscose" rayon fibers were produced in this manner in the United State. And, in 1929, "nylon," the first synthetic fiber made from long molecules called polymers, was introduced.

Some synthetic fibers are soft and cuddly, like blankets. Others can keep you warm in the winter or "breathe" to keep you cool in the summer, like those used in suits, slacks, and dresses. Some are mixed with natural fibers, like wool or cotton, as blends. Some cover sofas, car seats, beds, and floor. Some are very strong, even "bullet-proof," and offer protection from injury.

Today, eight billion pounds of synthetic fibers are produced each year.

MEDICINE

Extends Our Lives

Biomedical technology helps us understand our bodies' functions. This understanding has led to improved clinical care, high tech diagnostic and therapeutic devices, and wonders like artificial organs.

The body is, in a sense, a chemical plant, with body functions similar to chemical process reactions.

Medicines and drugs help maintain balance in body processes and fight off germs.

Chemical engineers and physicians work hand-in-hand to develop medicines, replacement parts, and maintenance product to keep your body's "chemical plant" in good shape.

Chemical engineers played a major role in developing and using isotopes from fission in nuclear medicine as advanced diagnostic and treatment techniques. Clogged blood vessels are quickly located with fissionable isotopes, and body functions and processes are easily and more accurately monitored.

CRUDE OIL

Building Blocks for Things We Need

Petrochemicals, the building blocks for many things, like synthetic fibers and plastic, come from crude oil.

Chemical engineers discovered ways to use crude oil because kerosene was no longer needed for lighting after the introduction of electricity. They built thermal cracking units, called "Burton Stills," in Indiana in 1913 to break down long-chain carbon molecules into smaller ethylene, propylenes, etc. Later, they developed "catalytic cracking," a more efficient way to produce petrochemicals for plastics, fibers, and elastomers.

Ethylene is the largest petrochemical building block. Ethylene glycol is "anti-freeze" for cars. Polyethylene is used for soda bottles and trash bags. Other ethylene derivatives include styrene.

Closer to home, petrochemical derivatives include shampoos, soaps cosmetics, shower curtains, towels, and modern molded bathtubs.

SYNTHETIC RUBBER

Keeps Us Rolling Along

Modern society runs on rubber. More than twenty billion pounds are produced annually.

- 66 percent of it is synthetic, and that percentage is growing.
- 34 percent is natural rubber, and that percentage is declining.

Chemical engineers were important players on the team that developed synthetic rubber (styrene-butadiene rubber, or SBR) during World War II, when natural rubber was hard to obtain.

Today, SBR will accounts for half of all synthetic rubber produced, but the use of new synthetics is growing.

Synthetic rubber is used in tires for cars, truck, buses and planes, in industry, in equipment like conveyor belts, gaskets and hoses, and in consumer products, such as running shoes.

And, what would we do without rubber bands?

If you'd like more information about chemical engineering, contact the American Institute of Chemical Engineers. Telephone 1-800-242-4363 http://www.aiche.org. The American Institute of Chemical Engineers, an individual member society, was established in 1908 to promote excellence in the development and practice of chemical engineering.