

## **Case Study for Invention: The Benefits of Plastic Innovation**

Since the Age of Plastics began, the United States has been the unquestioned leader in polymer innovation. This prominence is due in part to the ingenuity of chemists in the United States and in part to the support polymer innovation has received from industry, the government, and academic institutions. As the United States faces economic challenges from rising industrial nations like China, it is important to consider that this supportive atmosphere has allowed the United States to remain on the cutting edge of new discoveries and developments.

The Age of Plastics began in America. In 1869 John Wesley Hyatt invented celluloid, the first synthetic plastic, while searching for an artificial replacement for ivory. The growing popularity of billiards generated a demand for ivory that made it, and the elephants it came from, a scarce resource. Hyatt's invention was inspired by the \$10,000 reward promised for a workable ivory substitute. After several years of experimentation he found that by treating nitrated cellulose, which is derived from cotton, with camphor, he could produce a light, strong material that could be crafted to look and feel like ivory, tortoiseshell, linen, and other natural materials.

Hyatt's invention wasn't ideal for billiard balls; the balls made an explosive *crack* when they collided. But manufacturers churned out other celluloid products that imitated expensive ones, like tortoiseshell combs and linen shirt collars, creating a revolution in the production of goods. Until the creation of synthetic polymers people were confined by what nature provided. With celluloid Hyatt opened the door to the development of new, useful materials that loosened our dependence on nature.

Plastics not only freed humans from the material constraints imposed by the world but also weakened the social divisions between rich and poor. Celluloid brushes and combs mimicked more expensive versions. Working-class men could buy easy-to-clean celluloid shirt cuffs and collars that imitated linen, allowing them to blend in with wealthy businessmen. Inexpensive consumer goods made material wealth more widespread and blurred class distinctions.

Plastic became even more inexpensive and widely available with the invention of Bakelite in 1907. Leo Baekeland was already a wealthy chemist and inventor when he began searching for a synthetic replacement for shellac, a natural substance used for electrical insulation. His invention, the durable plastic he called Bakelite, was not only a superb insulator; it was also an excellent material for use in mass-produced consumer goods, even better than celluloid.

Bakelite was so successful that it inspired large chemical companies like DuPont and Dow to invest in the development of more plastics. While Hyatt and Baekeland mostly worked independently, the growth of American corporations provided polymer innovation with the resources and support of organized business. These new corporate research ventures worked to invent new polymers and *then* figure out how they could be used rather than seek materials with certain properties, as Hyatt and Baekeland had.

Some of these inventions were entirely serendipitous. In 1938 chemist Roy Plunkett was experimenting with new refrigerants when he found his canister coated with a slippery white substance. He recognized that the frictionless qualities of the new polymer could have many useful applications. Marketed as Teflon, his surprise discovery has been used in everything from medical equipment to nonstick pots and pans.

Scientific investigation proved critical for American victory in World War II. The war was won not only on battlefields but also in research laboratories. Americans searched for alternative materials that would substitute for and improve the performance of scarce natural resources like rubber, metal, wool, wood, and cotton. Advances in polymer science provided the needed materials, and plastics proved invaluable to the war effort. For example, nylon, invented in 1935, was used for parachutes, ropes, body armor, and more. Plexiglas provided a light, durable alternative to glass for aircraft windows, and nonstick Teflon was used in the atomic bomb.

When the war ended, the American economy shifted from producing tanks and planes to making consumer goods. New plastics inventions again proved valuable, improving Americans' quality of life. For example, plastic food packaging improved food safety and changed the way people shopped. Perfected by William Hale Charch in 1927, moisture-proof cellophane protected food from spoiling and contamination. Cellophane ads reminded shoppers of sanitation issues: "Strange hands. Inquisitive hands. Dirty hands. Touching, feeling, examining things you buy in stores. Your sure protection against hands-across-the-counter is tough, clear, germ-proof Cellophane."<sup>1</sup> Plastic wrapping became ubiquitous in grocery stores as consumers responded positively to cellophane packaging. Cellophane also allowed food to be transported longer distances and stay fresh longer, reducing food waste from spoilage.

Plastic inventions changed American society for the better. The low cost and versatility of plastics made consumer goods more widely accessible and allowed for critical developments in innumerable fields. Plastics improved safety, with inventions like padded foam dashboards and bicycle helmets. Fuel efficiency got a boost from lighter cars. The use of plastics in medical devices and procedures led to advancements in medicine and widespread improvements in human health. Plastics also made possible the technological revolution that created cell phones and other high-powered computers. American standards of living have improved dramatically in the last half century—in large part because of plastics.

Innovators continue to explore new ways to make and use plastics. Recently, plastics made from plant sources like corn and sugar have been introduced. Scientists are also investigating ways to make truly biodegradable plastics that address disposal concerns. The possibilities for new developments in polymer science are endless. The incredible advances of the past century have been aided by government support, not by limits and regulations. To maintain the momentum of scientific advancement, innovation must be encouraged and supported.

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<sup>1</sup> Quoted in Stephen Fenichel, *Plastic: The Making of a Synthetic Century* (New York: Harper Collins, 1996), p. 115