History of Plastics

In today's world, life without plastics is incomprehensible. We all know the many ways that plastics contribute to our health, safety and peace of mind. But how did the material plastic come about? Who were the key individuals in its development and use?

Parkes Invents First Man-Made Plastic

The first man-made plastic was unveiled by Alexander Parkes at the 1862 Great International Exhibition in London. This material -- which the public dubbed Parkesine -- was an organic material derived from cellulose that once heated could be molded but that retained its shape when cooled. Parkes *claimed* that this new material could do anything that rubber was capable of, but at a lower price. He had discovered a material that could be transparent as well as carved into thousands of different shapes. But Parkesine soon lost its luster when investors pulled the plug on the product due to the high cost of the raw materials needed in its production.

Celluloid™ Makes Its Debut

During the latter part of the 19th century, a rush was on to find a replacement for ivory in billiards balls. The game became so popular that hundreds of elephants were killed a day so that their valuable ivory could be obtained. John Wesley Hyatt, an American, finally came upon the solution in 1866 with celluloid. Hyatt, upon spilling a bottle of collodion in his workshop, discovered that the material congealed into a tough, flexible film. He then produced billiard balls using collodian as a substitute for ivory. But due to its highly volatile nature, the billiard balls would explode once they hit each other. The solution to this challege was the addition of camphor -- a derivative of the laurel tree. This addition made celluloid™ the first thermoplastic: a substance molded under heat and pressure into a shape it retains even after the heat and pressure have been removed. Celluloid™ went on to be used in the first flexible photographic film and for still and motion pictures.

The Story of Bakelite

The first completely synthetic man-made substance was discovered in 1907, when a New York chemist -- Leo Baekeland -- created a liquid resin which he named Bakelite. Baekeland had developed an apparatus -- which he called a Bakelizer -- which enabled him to vary heat and pressure precisely so as to control the reaction of volatile chemicals. Using

this pot-like apparatus, Baekeland developed a new liquid (bakelite resin) which rapidly hardened and took the shape of its container. Once hardened the resin would form an exact replica of any vessel which contained it. This new material would not burn, boil, melt, or dissolve in any commonly available acid or solvent. This meant that once it was firmly set, it would never change. This one benefit made it stand out from the previous "plastics" which were produced. Previously, celluloid-based substances could be melted down innumerable times and reformed. Bakelite was the first thermoset plastic which would retain its shape and form under any circumstances.

Bakelite could be added to almost any material -- such as softwood -- and instantly make it more durable and effective. Numerous products began to be manufactured based on this new material. One of the sectors of society most interested in its development was the military. The US government saw Bakelite as opening the door to production of new weaponry and light-weight war machinery that steel could not match. In fact, Bakelite was a key ingredient in most of the weapons used in the Second World War.

Bakelite was also used for domestic purposes such as an electrical insulator, and it proved to be more effective than any other material available. So effective, that it is still used as such today. Bakelite was electrically resistant, chemically stable, heat-resistant, shatter-proof and, would neither crack, fade, crease, nor discolor from exposure to sunlight, dampness or sea salt.

Rayon and Cellophane

Rayon -- another modified cellulose -- was first developed in 1891 in Paris by Louis Marie Hilaire Bernigaut, the Count of Chardonnet. He was searching for a way to produce man-made silk. After studying silkworms, Chardonnet noticed that the worm would secrete a liquid from a narrow orifice that would harden upon exposure to air and turn into silk. He deduced that if he could find a liquid that would have similar characteristics to silk before being secreted, he could then pass it through a man-made apparatus to form fibers that could be spun and feel like silk. The only problem with his new invention was that it was highly flammable. This problem was later solved by Charles Topham.

Cellophane was discovered by Dr. Jacques Edwin Brandenberger, a Swiss textile engineer, who came upon the idea for a clear, protective, packaging layer in 1900. Brandenberger was seated at a restaurant when he noticed a customer spill a bottle of wine onto the tablecloth. The waiter removed the cloth replacing it with another and disposed of the soiled one. Brandenberger swore that he would discover someway to apply a clear flexible film to cloth, which would keep it safe from such accidents and allow it to be easily cleaned with the swipe of a clean towel. He worked on resolving this problem by utilizing different materials until he hit pay dirt in 1913 by adding Viscose (now known as Rayon).

Brandenberger added viscose to cloth but the end result was a brittle material that was too stiff to be of any use. Yet Brandenberger saw another potential for the viscose material. He developed a new machine that could produce viscose sheets, which he marketed as Cellophane. With a few more improvements, Cellophane allowed for a clear layer of packaging for any product -- the first fully flexible, water-proof wrap.

The Discovery of Nylon

The 1920s witnessed a "plastics craze", as the use of cellophane spread throughout the world. One of the industry leaders -- DuPont -- became a hotbed for innovation concerning plastics. Wallace Hume Carothers, a young Harvard chemist, became the head of the DuPont lab. The company was responsible for the moisture-proofing of Cellophane and was well on its way to developing Nylon, which at the time they named Fiber 66. Carothers saw the possible value that a new tough plastic, such as Fiber 66 could possess. The fiber replaced animal hair in toothbrushes and silk stockings. The stockings were unveiled in 1939, to great public acceptance. H. Staudinger in Germany was the first to recognize the structural nature of plastics, but Carothers built upon this theory. As demonstrated by Carothers, by substituting and inserting elements into the chemical chain, new materials and uses could be developed. During the 1940s, the world saw the use of such materials as nylon, acrylic, neoprene, SBR, polyethylene, and many more polymers take the place of natural material supplies that were becoming exhausted.

PVC, Saran, and Teflon

Another important plastic innovation of the time was the development of polyvinyl chloride (PVC), or vinyl. Waldo Semon, a B.F. Goodrich organic chemist, was attempting to bind rubber to metal when he stumbled across PVC. Semon later discovered that this material was inexpensive, durable, fire-resistant, and easily molded. Vinyl found a special place in the hearts of Americans as an upholstery material that would last for years in the average family's living room.

In 1933, Ralph Wiley, a Dow Chemical lab worker, accidentally discovered yet another plastic -- polyvinylidene chloride (better known as Saran). Saran was first used to protect military equipment, but it was later discovered that it was perfect for food packaging. Saran would cling to almost any material -- bowls, dishes, pots and even itself; thus, it became the perfect tool for maintaining the freshness of food at home.

A DuPont chemist named Roy Plunkett discovered Teflon, in 1938. Teflon today is widely used in kitchenware. Plunkett discovered the material accidentally by pumping freon gas into a cylinder left in cold storage overnight. The gas dissipated into a solid white powder. Teflon is unique because it is impervious to all acids in addition to both cold and heat. Teflon is now best-known for its slipperiness -- which makes it highly effective in pots and pans for easy cooking and cleaning.

Polyethylene

In 1933, two organic chemists working for the Imperial Chemical Industries Research Laboratory were testing various chemicals under highly pressurized conditions. In their wildest imaginations, the two researchers E.W. Fawcett and R.O. Gibson, had no idea that the revolutionary substance they would come across -- polyethylene -- would have an enormous impact on the world.

The researchers set off a reaction between ethylene and benzaldehyde, utilizing two thousand atmospheres atmospheres of internal pressure. The experiment went askew when their testing container sprung a leak and all of the pressure escaped. Upon opening the tube they were surprised to find a white waxy substance that greatly resembled plastic. When the experiment was carefully repeated and analyzed the scientists discovered that the loss of pressure was only partly due to a leak; the greater reason was the polymerization process

that had occurred leaving behind polyethylene. In 1936, Imperial Chemical Industries developed a large-volume compressor that made the production of vast quantities of polyethylene possible. This high-volume production of polyethylene actually led to some history-making events.

For instance, polyethylene played a key supporting role during World War II -- first as an underwater cable coating and then as a critical insulating material for such vital military applications as radar insulation. This is because it was so light and thin that it made placing radar onto airplanes possible; something that could not be done using traditional insulating materials because they weighed too much. In fact, the use of polyethylene as an insulating material reduced the weight of radars to 600 pounds in 1940 and even less as the war progressed. It was these lightweight radar systems, capable of being carried onboard planes, that allowed the out-numbered Allied aircraft to detect German bombers under such difficult conditions as nightfall and thunderstorms.

It was not until after the war, though, that the material became a tremendous hit with consumers and from that point on, its rise in popularity has been almost unprecedented. It became the first plastic in the United States to sell more than a billion pounds a year and it is currently the largest volume plastic in the world. Today, polyethylene is used to make such common items as soda bottles, milk jugs and grocery and dry-cleaning bags in addition to plastic food storage containers.

Velcro® and the Development of Silly Putty

A plastic that has struck the fancy of many youngsters over the years is plastic putty -- better known as silly putty. James Wright, a GE engineer, came upon the material by mixing silicone oil with boric acid. The compound possessed some rather unique qualities. It acted very much like rubber in its ability to rebound almost 25 percent higher than a normal rubber ball. This "Nutty Putty" was also impervious to rot and unable to maintain a shape for more than a short period of time. It could be stretched many times its length without tearing. This material also would copy the image of any printed material that it was pressed upon. In 1949, the material was sold under the name of Silly Putty, selling faster -- at that time -- than any other toy in history with over $6 million in sales for the year.

The birth of Velcro®, yet another unique plastic product which has impacted nearly all of our lives occurred in 1957. A Swiss engineer named George de Maestral was impressed with the way that cockleburs -- a type of vegetation -- would use thousands of tiny hooks to cling to anything with which they came into contact. He devised a product, using nylon, that replicated this natural phenomenon. The result, Velcro®, could be spun in any required thickness, would not rot, mold or naturally degrade -- and it was relatively inexpensive.

Since the 1950s, plastics have grown into a major industry that affects all of our lives -- from providing improved packaging to giving us new textiles, to permitting the production of wondrous new products and cutting edge technologies in such things as televisions, cars and computers. Plastics even allow doctors to replace worn-out body parts, enabling people to live more productive and longer lives. In fact, since 1976, plastic has been the most used material in the world and was recently voted one of the top 100 news events of the century. None of the applications and innovations we take for granted would have been possible if it weren't for the early scientists who developed and refined the material. Those pioneers made it possible for us to enjoy the quality of life we do today.

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