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The History of Plastic and Injection Molding

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Theme: History

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When Alexander Parkes invented the first thermoplastic in 1856, he probably had no idea how pervasive his invention would become in the centuries that followed. Today, thanks to the invention of injection molding, plastic is used in almost any industry you can imagine, including manufacturing, packaging, construction, education, transportation, and healthcare.

The use of plastic in manufacturing has been expanding exponentially since it was introduced over one and a half centuries ago. For example, by 2018, the production of plastics on a global scale reached almost 360 metric tons. It is expected that over a billion metric tons of plastics will be produced by 2050.

From the numbers above, it's clear that plastic will continue to be an important part of the manufacturing process. Consequently, processes like injection molding will continue to play a significant role for those who want to manufacture thousands, if not millions, of products with plastic components.

In this article, we follow the history of plastic and injection molding. We start by focusing on the events that led to the invention of plastic as we know it today. The article will then focus on the invention of the first plastic molding machine and how the technology has progressed since then.

The First Condensation Polymer

The development of the first condensation polymer produced by Jacob Berzelius in 1847 paved the way for developing artificial commercial plastic about 15 years later. The first condensation polymer was polyester, made from tartaric acid and glycerin.

Jacob Berzelius was a Swedish chemist whom Britannica.com describes as one of the founders of modern chemistry. The same source reports that Berzelius "is especially noted for his determination of atomic weights, the development of modern chemical symbols,

his electrochemical theory, the discovery and isolation of several elements, the development of classical analytical techniques, and his investigation of isomerism and catalysis, phenomena that owe their names to him."

The First Artificial Commercial Plastic

Alexander Parkes registered the patent for the first thermoplastic in 1856 in the United Kingdom. He called the material Parkesine. This transparent material was produced by treating cellulose in nitric acid and then dissolving it in alcohol. The process resulted in a flexible material that could be molded into any shape when hot and would harden as it cools down.

As Parkesine became more popular, so did its uses. Its popularity also grew because it was cheaper and easier to work with than ivory, bone, and wood, which had been the primary materials for making such items as buttons, combs, and piano keys in the past.

The Plastics Hall of Fame reports that "Parkes' earlier work in natural rubber compounding was helpful in his later efforts to develop a plasticizer for cellulose nitrate." The same source adds, "He used a variety of solvents as well as camphor."

About four years after Parkes' patent registration, John Wesley Hyatt perfected the Celluloid. The Plastic Hall of Firm suggests that "Although Parkesine and its successors were never commercially successful, Parkes' work provided the path for Hyatt to make his breakthrough with plasticized cellulose nitrate as a substitute for ivory billiard balls and other groundbreaking applications."

Inventing the First Plastic Molding Machine

Following his work in perfecting Celluloid, John Hyatt partnered with his brother Isaiah Hyatt to patent the first plastic molding machine in 1872. Initially, the machine was used to produce billiard balls from Celluloid. When compared to the plastic injection molding machines of today, the inaugural machine was rudimentary.

Rudimentary as the Hyatt brothers' first molding machine was, it made the process of making things like billiard balls, hair combs, buttons, and piano keyboards much easier.

The Hyatt brothers had started working on the idea that finally came to fruition in 1868 when a billiard-making firm had requested them to come up with a way that would make it possible to create billiard balls in a way that was efficient and would result in more uniform balls.

Notwithstanding all the developments in plastic and injection molding in the second half of the 19thcentury, there was still a considerable challenge with the use of cellulose. It proved to be highly flammable, presenting a significant fire hazard. The fire hazard was solved by German scientists Arthur Eichengrun and Theodore Becker in 1903. Their efforts produced types of cellulose that were less flammable.

The First Truly Synthetic Plastic

As efforts continued to improve the qualities of plastic and make it safer to use, Leo Hendrik Baekeland created what is often called the first truly synthetic plastic: Bakelite. This was in 1912. Bakelite is called the first truly synthetic plastic because not a single molecule in the plastic can be found in nature.

Writing for ScientificAmerican.com, Susan Freinkel explains the conditions under which Bakelite became popular. She reports that Bakelite was invented when the demand for a scarce natural substance known as shellac started escalating because of its excellent electric insulation capabilities. At that time, the electrical industry was seeing a rapid expansion.

To show how popular Bakelite would later become, Freinkel quotes a 1924 issue of Time magazine: "Families gathered around Bakelite radios (to listen to programs sponsored by the Bakelite Corporation), drove Bakelite-accessorized cars, kept in touch with Bakelite phones, washed clothes in machines with Bakelite blades, pressed out wrinkles with Bakelite-encased irons—and, of course, styled their hair with Bakelite combs." Adding that Bakelite was a "material of a thousand purposes."

Many of the popular thermoplastics still in use today were invented in the 1930s and 1940s. Hundreds of polymers have been added over the years, increasing the use of plastic molding.

Spurred by the Economic Boom Following WW II

For almost seven decades after the Hyatt brothers patented Celluloid and plastic machine molding, the process remained relatively unchanged. However, by 1946, the World War II effort, which had just ended the previous year, had created an enormous demand for products that needed to be made cheaply in huge numbers. This demand fueled the economic boom that followed the war.

In response to the growing demand for cheap, mass-produced products in the post-war period, James Hendry produced the first screw injection molding machine in 1946, creating a seismic shift in the plastic industry. This made it possible to do things that would have not been possible before, like premixing and adding color before molding.

The screw injection molding machine allows the plastic material to flow under gravity onto a turning screw from the hopper. The screw supplies the mechanical energy that, together with the mechanical heaters, melts the resin. As the molten resin enters the mold, the screw retracts back in the direction of the hoper. Encyclopedia Britannica, in the diagram below, illustrates this process.

Introducing the Gas Plastic Injection Process

When Hendry invented the first extrusion screw injection machine in 1946, he did not go home to bask in the glory of his efforts. He continued his work in the plastic molding field.

In the 1970s, Hendry's efforts resulted in the introduction of gas in plastic molding, making it possible to create more complex plastic products. The stronger products that could be made using this process led to plastic taking over many of the roles previously played by other materials like steel.

Plastic Injection Molding Today

The improvements that have taken place in the plastic injection molding industry since the 19th century continue to this day. Almost any product today can be made from plastic or has a plastic component.

Plastic injection molding has become more pervasive because improvements over the years have turned it into a quick and affordable method of creating high-quality products.

Even though plastic injection molding still uses the same fundamental principles as those introduced by the inventors of the process, like the Hyatt brothers, centuries ago, computers have vastly improved contemporary processes and made it possible to rapidly and precisely create more intricate parts.

The Future of Plastics and Injection Molding

Learning about the history of plastics and injection molding provides us with a chance to peep into the technology's future.

Ronan Ye writes for the online digital magazine IndustryToday.com and predicts that plastic injection molding will continue to be a growing technology. This growth is spurred by industries like car manufacturing that turn to plastic because it is lighter and results in motor vehicles using less energy and, in the process, reducing the harm to the environment caused by the use of fossil fuels.

Ye also notes that the plastic molding industry will also benefit from continuous improvements in software, improving the accuracy of parts and lowering costs. He predicts a future where "the industry will continue to evolve with better technology, environmental conditions, and finer material specifications."

For those who are not yet using plastic injection molding, Ye has a prophecy: "Knowing the advantages of technology and the latest trends as well, it shouldn't take too much time before you implement plastic injection molding in your field of work."

The plastic injection molding industry may have started with two men getting a brief from a billiard ball-making firm that wanted to make better and more even balls, but today it has grown into an industry where much more serious stuff than billiard balls is at play.

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