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Story of Welding

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This document tries to explain the evaluation of welding process in preference to the hitherto used Riveting Method highlighting the advantages of the welding process.

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the *weld puddle*) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.

This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

Arc welding

Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, underwater and in space.

Regardless of location, however, welding remains dangerous, and precautions must be taken to avoid burns, electric shock, poisonous fumes, and overexposure to ultraviolet light.

Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join metals by heating and pounding them.

Arc welding and oxyfuel welding were among the first processes to develop late in the century, and resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like shielded metal arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as gas metal arc welding, submerged arc welding, flux-cored arc welding and electroslag welding.

Developments continued with the invention of laser beam welding and electron beam welding in the latter half of the century. Today, the science continues to advance.

Robot welding is becoming more commonplace in industrial settings, and researchers continue to develop new welding methods and gain greater understanding of weld quality and properties.

History

The Iron Pillar in Delhi.

The history of joining metals goes back several millennia, with the earliest examples of welding from the Bronze Age and the Iron Age in Europe and the Middle East. Welding was used in the construction of the Iron pillar in Delhi, India, erected about 310 and weighing 5.4 metric tons.

The Middle Ages brought advances in forge welding, in which blacksmiths pounded heated metal repeatedly until bonding occurred. In 1540, Vannoccio Biringuccio published *De la pirotechnia*, which includes descriptions of the forging operation.

Renaissance craftsmen were skilled in the process, and the industry continued to grow during the following centuries. Welding, however, was transformed during the 19th century—in 1800, Sir Humphry Davy discovered the electric arc, and advances in arc welding continued with the inventions of metal electrodes by a Russian, Nikolai Slavyanov, and an American, C. L. Coffin in the late 1800s, even as carbon arc welding, which used a carbon electrode, gained popularity.

Around 1900, A. P. Strohmenger released a coated metal electrode in Britain, which gave a more stable arc, and in 1919, alternating current welding was invented by C. J. Holslag, but did not become popular for another decade.

Resistance welding was also developed during the final decades of the 19th century, with the first patents going to Elihu Thomson in 1885, who produced further advances over the next 15 years.

Thermite welding was invented in 1893, and around that time, another process, oxyfuel welding, became well established. Acetylene was discovered in 1836 by Edmund Davy, but its use was not practical in welding until about 1900, when a suitable blowtorch was developed.

At first, oxyfuel welding was one of the more popular welding methods due to its portability and relatively low cost. As the 20th century progressed, however, it fell out of favor for industrial applications. It was largely replaced with arc welding, as metal coverings (known as flux) for the electrode that stabilize the arc and shield the base material from impurities continued to be developed.

World War I caused a major surge in the use of welding processes, with the various military powers attempting to determine which of the several new welding processes would be best. The British primarily used arc welding, even constructing a ship, the *Fulagar*, with an entirely welded hull.

The Americans were more hesitant, but began to recognize the benefits of arc welding when the process allowed them to repair their ships quickly after German attacks in the New York Harbor at the beginning of the war.

Arc welding was first applied to aircraft during the war as well, as some German airplane fuselages were constructed using the process.

During the 1920s, major advances were made in welding technology, including the introduction of automatic welding in 1920, in which electrode wire was fed continuously. Shielding gas became a subject receiving much attention, as scientists attempted to protect welds from the effects of oxygen and nitrogen in the atmosphere. Porosity and brittleness were the primary problems, and the solutions that developed included the use of hydrogen, argon, and helium as welding atmospheres.

During the following decade, further advances allowed for the welding of reactive metals like aluminum and magnesium. This, in conjunction with developments in automatic welding, alternating current, and fluxes fed a major expansion of arc welding during the 1930s and then during World War II.

During the middle of the century, many new welding methods were invented. 1930 saw the release of stud welding, which soon became popular in shipbuilding and construction. Submerged arc welding was invented the same year, and continues to be popular today.

Gas tungsten arc welding, after decades of development, was finally perfected in 1941, and gas metal arc welding followed in 1948, allowing for fast welding of non-ferrous materials but requiring expensive shielding gases.

Shielded metal arc welding was developed during the 1950s, using a flux coated consumable electrode, and it quickly became the most popular metal arc welding process.

In 1957, the flux-cored arc welding process debuted, in which the self-shielded wire electrode could be used with automatic equipment, resulting in greatly increased welding speeds, and that same year, plasma arc welding was invented. Electroslag welding was introduced in 1958, and it was followed by its cousin, electrogas welding, in 1961.

Other recent developments in welding include the 1958 breakthrough of electron beam welding, making deep and narrow welding possible through the concentrated heat source. Following the invention of the laser in 1960, laser beam welding debuted several decades later, and has proved to be especially useful in high-speed, automated welding. Both of these processes, however, continue to be quite expensive due the high cost of the necessary equipment, and this has limited their applications.

Courtesy: - Wikipedia