The First Nobel Prize in Process Control[1]

The most recognized prize to the general public is the Nobel Prize, which has been awarded in the areas of physics, chemistry, physiology or medicine, literature, and peace since 1901. Each year these prizes are announced with great fanfare, and the Nobel Prize recipients become celebrities who can have a strong influence on the public's perception of technical disciplines.

A fact that does not appear to be well-known is that the Nobel Prize has recognized some engineering accomplishments, including an accomplishment in process control in 1912 when Nils Gustaf Dalén received the Nobel Prize in Physics for his "invention of automatic regulators for use in conjunction with gas accumulators for illuminating lighthouses and buoys." The precise invention is the design of the control system for a particular chemical reacting system.

In the late 1800s Dalén studied engineering at Chalmers Institute of Technology in Gothenburg, Sweden, and then did research in the dynamics and control of high-pressure water turbines at the Polytechnische Hochschule in Zurich, Switzerland. Dalén returned to Sweden to work on steam turbines and later became chief engineer of a manufacturer and distributer of acetylene in Sweden in the first decade of the 1900s. One of the applications of acetylene was for lighting, and one of the major commercial needs for lighting at the time was for lighthouses and light buoys on the seacoasts along shipping routes.

[1] Adapted from Richard D. Braatz. The first Nobel Prize in control engineering. *IEEE Control Systems*, 33(4):6-7, 2013.

Acetylene gas produced a much brighter white light for lighthouses in 1900s to 1960s than competing gas and liquid fuels, but is highly explosive. Dalén designed a clever flow control valve, called the *sun valve* or *solar valve*, which greatly reduced gas usage and increased safety by incorporating feedback control regulation within its design. The base design consisted of multiple metal rods enclosed by a glass tube, with a central blackened rod surrounded by polished rods arranged along the circumference of a circle. In the morning, sunlight would fall onto all of the rods but the blackened rod would preferentially absorb the light to heat up and expand until it cut off the gas supply. This design ensured that no acetylene gas would be released or burned when the sun was out. When the sun went down or was sufficiently obscured by heavy clouds, the central rod would cool until it was the same length as the polished rods, which would open the gas supply. This gas was lit by a very small always-burning pilot light located near the rods. Dalén's lighthouse system reduced capital costs by more than an order of magnitude and reduced annual maintenance costs by more than a factor of 400.

The Nobel Prize in Physics was awarded for a process control contribution.

Caption: The lighthouse at Caldey Island, which is south of Wales, taken on July 3, 2008. The lighthouse is powered by acetylene gas, switched on by a sun valve. Photograph courtesy of Humphrey Bolton.

There can be no doubt that this Nobel Prize was awarded for a process control contribution, in that the control system was designed to control a chemical reacting system. Decades later, the control of chemical reacting systems became of primary interest to numerous chemical engineers including Rutherford Aris and Neal Amundson at the University of Minnesota.

In 1912 the Nobel Prize committee selected Dalén for the Prize in Physics from a pool of candidates that included Max Planck and Albert Einstein, who received Nobel Prizes for their scientific contributions some years later.

Readers interested in learning more about Nils Gustaf Dalén's life and accomplishments in control engineering are referred to [1–3].

–Richard D. Braatz

Reference

[1] Niels Hugh de Vaudrey Heathcote, *Nobel Prize Winners in Physics 1901–1950*, Henry Schuman Inc., New York, 1953.

[2] Robert N. Clark, "Nils Gustaf Dalen (1869-1937): Inventor, experimenter, engineer, and Nobel laureate," *IEEE Control Systems*, vol. 23, no. 4, pp. 68–70, August 2003.

[3] Thomas B. Greenslade, Jr. "Nils Gustav Dalén, The unknown Nobel Prize winner," *The Physics Teacher*, vol. 47, no. 1, p. 37, January 2009.