40 Years of Basic Oxygen Steelmaking Progress

1952—World's first LD melt shop is put into operation by Voest at Linz, Austria (2×30t). In 1953, a second LD plant is commissioned by Alpine at Donawitz, Austria.

1954—First BOF melt shop in North America is started up in October by Dofasco in Hamilton, Ont. (2×50t).

1954—First U.S. BOF melt shop is started up by McLouth Steel in December, at Trenton, MI.

1956—LD process is made adaptable to high-phos hot metal with injection of powdered lime with the oxygen stream through the lance (Arbed Dudelange-25T vessel). Process is named LD-AC (for Arbed-CRM) in 1959. A variation by Irsid-Sacilor is named OLP (oxygen lance powder) in 1957.

1957—First BOF shop in Japan started up by Yawata Steel (later becomes part of Nippon Steel) at Kukioka.

1959—First Oxygen Steelmaking Process seminar held by AIME in St. Louis.

1962—Multi-hole lance introduced in Japan.

1963—Nippon Kokan in Japan puts digital computer on-line for BOF operations.

1963—First disposable immersion samplers.

1965—Savard and Lee demonstrate that submerged injection of oxygen for refining hot metal can be carried out at commercially acceptable pressures by employing concentric pipes, injecting oxygen through inside pipe and shroud gas through annulus.

1967—Maximilianshütte, Sulzbach-Rosenberg, Germany, installs and operates first OBM process-based steel plant.

1970—First reliable oxygen probes for molten steel are introduced.

1973—Based on pilot plant test at South Works (30t), U.S. Steel converts LD plant under construction to OBM (3×235t). Process applied to low-phos hot metal is called Q-BOP.

1979—Ladle furnaces are integrated for first time in a BOF/con-cast facility by SOLLAC in France (2×240t vessels, 2×26-MVA furnaces, 2×2-strand slab casters).

1988—Startup of latest greenfield BOF shop by Ensidesa, Spain (2×250t)

1991—Geneva Steel, Provo, UT, starts up two revamped Q-BOPs (225t), replacing last open hearth shop in U.S. **MP**

North American Pioneers

The first steelmaker outside of Austria to operate a BOF was Canada's Dofasco, at the time a small steelmaker using electric arc furnaces. In the early 1950s, a severe scrap shortage developed in North America. Also, Dofasco had completed a new blast furnace in Hamilton, Ont., in 1951. Management was interested in finding a way to utilize the available hot metal and reduce dependence on scrap.

After hearing about the Austrian developments, Dofasco engineers rigged a 3-ton vessel from a foundry ladle. Tests were interesting enough that representatives visited Austria. Eventually, Dofasco licensed the technology and started up the first BOF in North America in 1954.

Dofasco beat out Detroit's McLouth Steel by a couple months for "first in North America" honors.

Japan Shows Interest

In Japan, NKK engineers showed interest in BOF steelmaking as early as 1951. They spearheaded an effort to secure a licensing agreement in 1956. Interestingly, this agreement, struck with Alpine, was for the entire Japanese steel industry.

While NKK took the lead in arranging a license, Yawata Steel was the first to start up a BOF operation in 1957. (Yawata merged with Fuji Steel in 1970 to re-form a "new" Nippon Steel Corp. In 1950, the original Nippon Steel was dissolved into Yawata and Fuji.) NKK followed with a BOF operation in 1958.

From the Bottom Up

One major development in basic oxygen steelmaking took place in Canada in 1965, when Savard and Lee demonstrated a method for blowing oxygen through the bottom of a steelmaking vessel. Their method eliminated the problem of rapid bottom deterioration encountered in earlier attempts to bottom-blow with oxygen.

They mounted special tuyeres in a removable bottom. The tuyeres are designed so that the stream of oxygen is surrounded by a "sheath" of another gas, typically a hydrocarbon gas such as propane or natural gas, which cools the tuyeres.

Two years later, Maximilianshütte in Germany started up the first commercial bottom-blown system, designated OBM for Oxygen Bottom Maximilianshütte, or Q-BOP in the U.S., for quick basic oxygen process.

In recent years, the desire to improve control of the process has led to development of various combined blowing processes. In these processes, 60-100% of the oxygen required to refine the steel is blown through the top-mounted lance (as in a conventional BOF), while additional gas, such as oxygen, argon, or nitrogen, is blown through bottom-mounted tuyeres or porous brick. Bottom-blowing improves mixing in the metal bath, the degree of mixing increasing with the gas flow rate.

The most recent basic oxygen facility to be started up actually is a relocation and revamping of two, late-1970s vintage Q-BOPs. Late last year, Geneva Steel in Provo, UT, started up two Q-BOPs to replace the last operating open hearths in the U.S. Of interest is the fact the bottom-blown units can use up to 100% scrap, enabling Geneva to maintain scrap usage similar to that of the open hearths that are being replaced. **MP**

Not Interested, Thank You

"Some engineers at U.S. Steel were interested in the BOF. Indeed, U.S. Steel engineers were among the first visitors to the Dofasco BOF in 1954. Joseph Stone, the U.S. Steel engineer who had been in charge of the side-blown experiments, carried out BOF experiments in a ladle in 1952 and 1953. In September 1954, while visiting Austria on vacation, Stone went to the Linz BOF plant and identified himself as a U.S. Steel employee. The Austrians showed him around their plant and gave him information. Stone submitted a report on what he had seen to his superiors at U.S. Steel, but his report was rejected and Stone was reprimanded for making an unauthorized visit. Stone later left U.S. Steel to work in the steel plant development department of Kaiser Engineers."—From *How Japan Innovates: A Comparison with the U.S. in the Case of Oxygen Steelmaking*, by Leonard H. Lynn, Westview Press, p. 162. **MP**