Bessemer and Open Hearth Steelmaking Costs Compared

by James Mitchell

BLAST furnace iron with over 1.5 pct P is regarded on the Continent as a basic Bessemer iron. The last few years have seen such a rapid development in the evolution of the basic Bessemer process that this process should have serious consideration as an alternative steelmaking method to the basic open hearth. It is now possible with no more control than is normally applied to open hearth operation to secure results from the basic Bessemer process which are equal in all respects, so far as quality is concerned, to those obtainable by the open hearth.

The production of low nitrogen, deep-drawing steels and materials of similar grades in large tonnages is now established practice. The average nitrogen content of the steels produced is about half that in ordinary commercial open hearth material.

Relative Costs

The Bessemer process cost for fluxes and fettling is almost four times that of the open hearth, but the open hearth is substantially higher in fuel, maintenance, and mixer costs. Taking all variables into account, there is a difference in conversion costs today, ignoring capital charges, of at least \$4.20 per long ton (2240 lbs). If it is assumed that the Bessemer yield is 90 pct and the open hearth yield 100 pct, the two processes would break even in ingot cost at an iron cost of approximately \$42.60 per long ton.

In so far as scrap is employed in the Bessemer process additions up to 20 pct are now quiet practicable with oxygen enrichment. With the newer oxygen enrichment practices oxides can be used in the converter thus bringing the yields into line with the open hearth. These figures are, of course, approximations, but it should be stressed that the saving in the Bessemer process can cover, under

suitable conditions, the difference in yields which favors the open hearth. Below a certain iron cost, therefore, the Bessemer process gives a cheaper product than the open hearth, but a very careful assessment is required of material available and practice employed before a final decision could be arrived at in favor of the one or the other process on economic grounds.

Duplexing

Experience shows that a blown metal can be delivered to the open hearth for finishing at about \$4.20 per long ton less than the cost of basic Bessemer ingot made from the same iron, but it is doubtful if companies would be prepared to operate an open hearth furnace and make finished steel for \$4.20 per long ton of product even with blown metal as the starting point. In other words, the duplex ingot will inevitably be higher in cost than the

Table II. Production Using Blown Metal in Electric Furnaces

Charge	Long Tons Per Hr*	Kw-hr Per Ingot Ton
Cold scrap	3.6	740
Blown metal	4.7	420

* One long ton equals 2240 lb.

Bessemer ingot made directly from the same iron. There are cases, notably in electric furnace practice, where the savings achieved in power and electrode cost, make the system attractive although these disappear when low cost scrap is available.

Table I gives the results obtained on a series of campaigns varying the charge on furnaces normally working on a scrap or cold pig iron basis. In 20-ton electric furnaces, blown metal of a similar nature was substituted for good cold scrap. The results, average figures on campaigns of considerable length, are shown in Table II. The furnaces are employed on a special product, requiring special casting pit arrangements, and no doubt higher figures could be obtained in normal steelmaking. These figures serve to show the order of gain in output which may be obtained if one is prepared to accept the extra cost of blown metal.

A study of production cost in almost any conceivable combination of two-stage processes shows that, unless the two stages can be carried out in one furnace unit, the final ingot cost will be higher than with the more orthodox methods of operation even with iron involving high metallurgical loads. The savings achieved by reducing the final open hearth or, for that matter, electric furnace finishing times are not great enough to pay for the additional operating cost incurred in using two furnaces.

Table I. Comparison of Duplexing Practices Using Basic Converter and Fixed Open Hearth

Heat	Charge in Long Tons*		Cold Iron 0.3 to 0.4 Pct P	Good Ingot Per Hr	Therms Per Long Ton
	Blown Metal**	Scrap			
A	—	98	42	10.2	57
B	49	49	42	13.4	44
C	73	25	42	16.1	38
D	100	—	42	21.4	35
E†	75	—	—	26.3	34

* One long ton equals 2240 lb.

** Practically pure iron except for 0.1 to 0.2 pct P.

† 50 tons only partially blown (1.5 pct C and 1.75 pct P).

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