Letter to the Editor

Dear Editor,

The engineers of the steelmaking and nonferrous metal-making industries and their academic colleagues have long dreamed of an ideal smelting machine, continuously converting ore into metal in a single vessel—saving metal, energy and the environment. For its successful design, there is much to gain in creativity by more active cross-fertilization of ferrous and nonferrous metal-making knowledge and imagination. Let's look at the record!

The oxygen flash smelting copper furnace (Inco) went on stream commercially in Canada on January 2, 1952. The nonferrous industry led the way in this pioneering, massive application of tonnage oxygen. The top-blown oxygen steel converter (Linz-Donawitz) soon followed, going on stream commercially in Austria in November of the same year. It was followed by the top-blown rotary oxygen steel converter (the late Kaldo) in Sweden, which is still very alive as the top-blown rotary converter (TBRC) in nonferrous applications pioneered by Inco in 1958. A Thomas converter using Savard-Lee oxygen injectors from Canada (the oxygen-bottom blown Maxhuette process) followed in Germany in 1968. Also in the sixties, a trailblazing, top-blown, smelting-converting furnace for direct metal making [the late Worner/Conzinc Riotinto of Australia (WORCRA) process] was developed in Australia, and another—side-blown—in Canada (Noranda); unfortunately, the ultimate target was missed.

In August 1974, a high-intensity smelting, bottom-blown, horizontal, cylindrical reactor of radical design appeared on the cover of *Journal of Metals:* the Q-S (Queneau-Schuhmann) continuous oxygen converter. This American invention—rejected by the copper and lead industries at home—demonstrated its direct lead-making merits abroad, assuring its future in copper. The simple, strongly stirred, in-bath smelting Queneau-Schuhmann-Lurgi (QSL) reactor for conversion of lead ore flotation concentrate to metal, using Savard-Lee oxygen injectors and pulverized coal, is commercially on stream in a new plant of Berzelius Metallhütte in Germany. It replaces the sinter machines, blast furnaces and coke ovens of the primary lead industry—now dinosaurs. Development of the direct ironmaking Hlsmelt, bottom-blown, horizontal cylindrical reactor (Klöckner-CRA) followed in Germany in the eighties.

Vertical-mode (Linz-Donawitz), direct ironmaking is presently being investigated in the American Iron and Steel Institute-Department of Energy Research Program. It can be extended to steelmaking by coupling top-blown converters in a manner similar to Australian Isasmelt direct lead making. Alternatively, horizontal mode operation can be investigated in a modified WORCRA-CIMAS furnace. Better, the Q-S converter can be modified for direct steelmaking, as I observed publicly in 1977 and many times since (*JOM,* December 1989). It can make steel continuously from ore, or preferably from hot, pre-reduced, wustite-rich ore concentrate. The horizontal-mode operation appears superior to vertical-mode direct iron and steelmaking in respect to: (1) flexibility; (2) capacity/residence time; (3) slag/metal ratio; (4) carbon in steel vs. iron in slag; (5) desulfurization; (6) heat and mass transfer geometry with regard to stirring and interfacial contact areas of reactants; (7) control of turbulence, foaming, short-circuiting and dusting.

I believe our nation's metalmaking industries, to regain eminence in technology, should strive for broader-based, more comprehensive, shared-credit teamwork, all the way from top management to ivory tower theoreticians to skilled hot metal operators who smell their own sweat. Let's all try!

Paul E. Queneau
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Correction

A recent letter from Professor Hans Conrad has alerted us to some potential sources of confusion in his research summary "Electroplasticity—The Effect of Electricity on the Mechanical Properties of Metals," which appeared on pages 28–33 in the September 1990 *JOM.* On page 29, in the last line of the second paragraph, an equal sign was omitted. The correct expression for electron wind push coefficient (B_{ew}) is:

$$B_{ew} = K_{ew} e n_e = F_{ew}/v_e$$

On page 30, some of the terms in the equations are not rigorously correct, and a pair of brackets was omitted from Equation 5. In Equation 4, the term ΔH^* should be replaced with ΔH_0^*, which is the activation enthalpy and zero force and is equal to ΔU^*, the activation energy (neglecting the $p\Delta V$ term, where p is the hydrostatic pressure and ΔV is the change in volume).

Equation 5, with a corrected activation enthalpy term and the appropriate brackets, should read as follows:

$$\dot{\gamma}_j = \dot{\gamma}_{0,j} \exp\left[\frac{-(\Delta H^*_{0,j} - A_j^* b\tau^*)}{kT}\right]\left[\exp\frac{A_j^* F_{ew}}{kT} + \exp\frac{-A_j^* F_{ew}}{kT}\right] \quad (5)$$

Equation 6, given by dividing Equation 4 by Equation 5, is correct as published. In Equation 7, the equal sign should be replaced with an "approximately equal to" sign.

To be consistent with these corrections, the definition of $\delta\Delta H^*$ on page 30 should read as follows:

$$\delta\Delta H^* = \Delta H_j^* - \Delta H^* = (\Delta U_j^* - \Delta U^*) - (A_j^* - A^*)b\tau^* - A_j^* F_{ew}$$

Finally, the corrected headings for the last four columns in Table I (page 30) are:

$$\exp\left[\frac{-(\Delta U_j^* - \Delta U^*)}{kT}\right] \quad \exp\left[\frac{(A_j^* - A^*)b\tau^*)}{kT}\right] \quad \exp\left(\frac{A_j^* F_{ew}}{kT}\right) \quad \exp\left[\frac{-(\Delta H_j^* - \Delta H^*)}{kT}\right]$$

The author and editors regret any confusion these errors may have caused.

Letter to the Readers

Dear Readers,

As outlined in my editorial for the October *JOM* (page 2), *JOM* wants to know your opinion why, according to an NSF report quoted in *The Wall Street Journal,* "some 42% of those who enter college professing interest in science or engineering careers drop out of the sciences after [their] freshman year, and another 23% defect before graduation"?

If you have not yet written a letter to the editor on this subject, I encourage you to take advantage of the fact that you still have time to do so. We will print your responses in a special edition of Campus Notebook during the winter.

Send your comments, observations and opinions to me at *JOM,* 420 Commonwealth Drive, Warrendale, PA 15086.

James J. Robinson
Managing Editor, JOM