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JOM *the*magazine

letters to the editor

One can theorize all one wishes, but what cannot be confirmed in the field will always remain only of academic interest.

Dear *JOM* Editor,

I noted the article in the July issue of *JOM* regarding "Moving Towards Better Recycling Options for Electric Arc Furnace Dust" by T. Suetens, K. Van Acker, B. Blanpain, B. Mishra, and D. Apelian.[1] I am sure the authors are aware that such a search has been going on for almost 25 years now and none of the "better options" has succeeded in meeting the goals they claimed. This conclusion applies to the ZincOx process mentioned, since by the authors' own reports in 2 1/2 years their KRP1 has yet to achieve 50% capacity for any consecutive three-month period. It has systemic problems which are its fatal flaws to ever achieving commercial success. Its performance is about like all the other rotary hearth furnaces (RHFs) attempted or still in operation, 50% or less. These RHFs include carbon steel electric arc furnace (EAF) dust plants and iron making (DRI) from ore or from waste oxides. They do not include the Inmetco/Horsehead Resource Development Company plant in Pennsylvania, which treats stainless steel dust and has far more revenue to keep it afloat.

As to the RHFs in Japan (iron making), show me published data on actual operations documenting production rate, product quality and iron yields—there is none. Information indicates they are not any better that those in the United States. They are more like a substitute for sinter plants for fines and zincy feeds. As proof, note Mesabi Nugget was licensed by Kobe, which built several RHF units in Japan and has been unable to improve its Minnesota plant. Further, consider the Iron Dynamics plant (a process much like Kobe's Fastmet) which after ten years of trying could not make it on iron ore. So they changed the feed (now waste oxides) and the goal (not making DRI) and called it success (but with a submerged arc furnace that also still limits the process and the plant still at only 50% of original design capacity).

Rather than repeat my evaluations which have been published and presented over 50 times, I will direct the reader to several articles. One is a review published in *JOM* in July 1998[2] that surveyed the status of dust processing to that date. Of interest would be the litany of failures of new processes. In the United States, unlike, for example, the EAF mills and industry association in South Korea, steel companies have learned from those examples not to trust process developers to deliver on sales pitches and promises of vast benefits. Updates of this review were published in *Steel Times International* in October 2008[3] and March 2010.[4] Also of interest is an article comparing waelx kilns and RHF EAF dust processing in the Indian journal, *Steel Tech*.[5] In this comparison, the RHF falls flat. Another analysis was presented at the Canadian Institute of Mining, Metallurgy and Petroleum's Conference of Metallurgists in 2012.[6] This paper also includes the sad story of the ScanArc technology—not delivering on promises (low dioxin emissions), not being able to produce a benign and useable residue (all they made was stored in an on-site landfill), never making a profit in five years of trying, and never making design capacity. Finally is a summary of the issues that ZincOx has encountered.[7]

My analyses have been developed not by hindsight but by thoroughly reviewing testing and design information, then confirmed by actual plant operations. One can theorize all one wishes, but what cannot be confirmed in the field will always remain only of academic interest. If the only success an EAF dust process can point to is in the lab, then that is not a success real steel mills are interested in. Good chemical engineering analysis and experience with commercializing first-of-a-kind plants can predict those flaws up front. I have critiqued the EAF recycling process presented in the July *JOM* article, as well as commercialization concept, for a client and did not see a good use for it.

Another thing steel companies do not trust is an inexperienced newcomer's ability to handle their hazardous waste obligations. ZincOx in the United States (their ZIRO project) went nowhere once they lost their hazardous waste partner, Envirosafe. On

their own, no steel mill would buy in. The sad part of this story was that ZincOx was still selling that partnership two months after Envirosafe had sold their dust contracts to Horsehead!

References

1. T. Suetens, K. Van Acker, B. Blanpain, B. Mishra, and D. Apelian, *JOM*, 66, 1119 (2014).
2. L.M. Southwick, *JOM*, 50 (7) 21–26 (1998).
3. L.M. Southwick, *Steel Times Int.* (October 2008), pp. 30–31.
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7. L.M. Southwick, "Walking the talk, or only talking the walk," comment to Process Failures, LinkedIn Mineral Processing Group (12 June 2014). Contact author at LMSouthwick.pe@att.net for a copy.

Sincerely,

Larry M. Southwick, P.E.
Cincinnati, Ohio

September 5, 2014

Dear *JOM* Editor,

We thank Dr. Southwick for his letter regarding the article "Moving Towards Better Recycling Options for Electric Arc Furnace Dust"[1] and drawing attention to some critical aspects of electric arc furnace (EAF) dust recycling. We appreciate the feedback, and also appreciate the opportunity to be able to respond and have our response appear with his letter in *JOM*. Such dialogue between practitioners and researchers is healthy.

Our claim that a rotary hearth furnace (RHF) would be a better solution for the recycling of EAF dusts than the traditional waelz kilns is based on an exergy efficiency analysis. The goal of our study was not to proclaim a better technology as this would have required economic and process stability studies. Our work has allowed us to calculate and compare the resource efficiency potential of different technologies purely from a thermodynamic standpoint. The methodology used for this comparison can be found in Reference 30 of our article. In early 2012, when we calculated the efficiencies, the ZincOx plant was still in the early ramp-up stage and besides some minor problems, it appeared promising. We were aware of the failures of previous RHF projects, but recent works by Nakayama[2] and Tateishi[3] suggested that solutions to the operational problems had been found.

Our work has allowed us to calculate and compare the resource efficiency potential of different technologies purely from a thermodynamic standpoint.

The study we did was based on clearly stated assumptions: "*Since the first commercial RHF plant is not operated at full capacity yet (ZincOx, 2012), the product stream compositions for a fully operational RHF process can only be estimated. The total zinc recovery rate and the amount of iron reporting to the zinc oxide product are also still uncertain. Therefore, the influence of these factors on the exergy efficiency was included in this study.*"[4] Throughout our work we considered the produced DRI as a product, which strongly contributes to the process efficiency. Your LinkedIn article "Walking the Talk, or only talking the walk"[5] clearly highlights the points of concern. However, as you mentioned in your *Steel Times International* (March 2010) article,[6] the failure of this type of project should also be attributed partially to the incomplete preparation of the project (human error) rather than solely on technology.

Your letter regarding our work mainly addresses the RHF technology in its recent ZincOx manifestation. The essential message of the article, however, lies in the drastically new in-process separation (IPS) technology. In our previous study we found that an alternative approach that eliminates EAF dust generation results in a drastic increase in exergy efficiency. Figure 3 in our article (reproduced as Figure 1 on the previous page) demonstrates that the difference between IPS and traditional high temperature metal recovery systems is more prominent than the difference between the

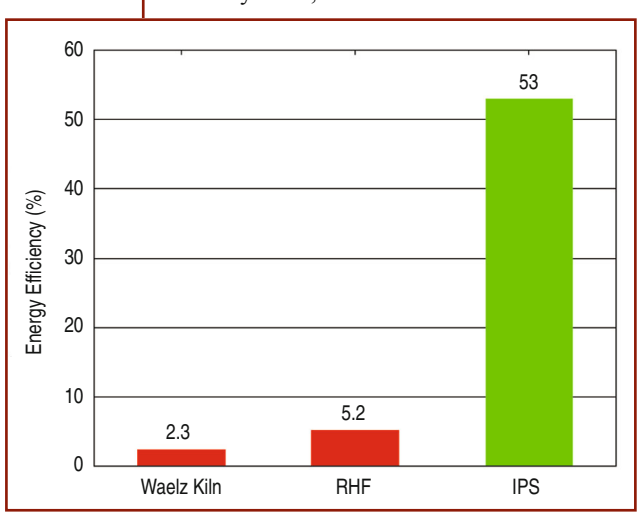

Figure 1: Exergy efficiencies of the waelz kiln, RHF, and IPS technologies.

waelz kiln and RHF process.

The complete off-gas composition of an EAF was the starting point of our exergy efficiency study of the IPS technology. All species that can be expected to be present in EAF dusts or separated streams were included in the thermodynamic equilibrium calculations (including ferrites, chlorides, etc.). We also want to point out that the Center for Resource Recovery & Recycling (CR^3) does not claim to have invented this technology, but rather initiated a project based on ArcelorMittal's patent US 8377175 B2.[7] The project carries strong support from CR^3's industrial members.

We completely understand that an unproven technology cannot be proclaimed to be "the" better recycling option, hence the "moving towards" section of our title. As an Industry & University Cooperative Research Program (I/UCRC), CR^3 is committed to being the premier cooperative research center focused on sustainable stewardship of the earth's resources. We consider it our duty to investigate options that can contribute to this goal. As Dr. Southwick stated, "the root problem appears to be a developer's conviction that the environmental benefit from their technology trumps metallurgical science and good engineering" (*Steel Times International* 2010).[8] When we recognized the drastic increase in resource efficiency potential of the technology, we decided to highlight this aspect in order to raise awareness with other researchers working on EAF dust recycling. We are currently investigating whether the metallurgical science goes hand in hand with the environmental benefit.

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Sincerely,

Thomas Suetens, Karel Van Acker, Bart Blanpain, Brajendra Mishra, and Diran Apelian

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