Value-in-Use of Ore Based Metallics (OBM's) in EAF Steelmaking

Direct Reduced Iron

Hot Briquetted Iron

Pig Iron

Granulated Pig Iron

For detailed information about individual Ore Based Metallics, please refer to the respective Fact Sheets.

For many years, pig iron, direct reduced iron and hot-briquetted iron – so-called ore based metallics – were categorised as 'scrap substitutes' or 'alternative iron units' and sometimes still are. One of the principal objectives of the International Iron Metallics Association (IIMA) is to promote recognition of the true value-in-use of ore-based metallics relative to steel scrap as well as the fact that they should not be regarded just as scrap substitutes, but rather as scrap supplements, because they have a value which is greater than that of their intrinsic iron content.

Conventional scrap cost models are usually aimed at providing least cost scrap charge to meet specified residual levels and do not take into account process parameters, environmental considerations and other important scrap characteristics. These models do not capture true "value in use".

EAF charge and operating practices clearly vary from one steel plant to another, depending on a number of factors, not least of which is the available scrap supply (its volume, quality and price), so there is no "one size fits all" solution to selection of charge materials. Of course, the common goal is to minimise steel production cost, commensurate with required steel product specifications and operational constraints.

From the perspective of EAF steelmaking, value-in-use (VIU) is a concept that recognizes that the value of ferrous feedstock materials goes beyond their cost. How a material's characteristics affect steel manufacturing cost is its Value-in-Use (VIU). This consists of the material's contribution of Fe to the steel bath and the impact of residual metallic impurities and also recognition that all of the non-metallic components impact the steelmaking process.

These include:

- extraneous materials – affects yield
- low metallic iron content – energy and reductant required to recover Fe units
- low yield – more material required to make a ton of steel
- environmental issues
- large fluctuations in slag chemistry – instability of operations, greater flux requirement, higher yield losses

IIMA's Value-in-Use model

IIMA has developed a VIU model that takes into account: differences in metallic iron content; carbon content and its effect on charge carbon; gangue content and its effect on flux requirements to maintain a given basicity; overall metallic yield (taking into account slag losses); recovery factor for iron oxide; fines losses in pig iron, DRI and HBI; moisture content and its impact on energy requirements; and copper content. From an economic standpoint, IIMA's model aggregates the costs and benefits for each feedstock material. It can compare the equivalent costs on a head-to-head basis or calculate the break-even price of one material against another and thus if its price is higher or lower relative to the reference material from a value-in-use perspective.

Some direct reduction plant operators have had to use blast furnace pellets in their plants. This results in a DRI/HBI product that is higher in gangue content. Previous work done by HyL indicates that the cost of 1% more SiO_2 in the DRI can increase steelmaking costs by $15/tonne. Calculations made by CIX indicate that for every additional kg of SiO_2 in the slag, the resulting iron yield loss is approximately 1.75 kg. Thus the VIU of higher gangue pellets will result in a product that will impact steelmaking costs. The VIU model allows for the evaluation of this impact and will allow steelmakers to better design their metallics strategy.

As material specifications and prices change – frequently where prices are concerned – it makes sense to run the model at each decision point. Value-in-use, of course, is just one consideration among many in raw material selection and purchasing decisions. IIMA's model is available on request via our website and considers many of the typical evaluation parameters. However, it is not exhaustive and may not consider all parameters of concern to a particular OBM user. Screenshots of model inputs and assumptions are shown below.

Base Productivity Conditions		
P-On time	34	minutes
Power	380	KwH/tonne
Slag FeO	28.0%	
Slag CaO	34.0%	
MgO Target	9.0%	
Productivity cost	1.00	$/%
% of OBM in Charge	10.0%	

Cost Data	$/unit	
Cu cost	$ 1.75	per pt.
Lime	$ 110.00	tonne
Dolo-lime	$ 110.00	tonne
Carbon	$ 255.00	tonne
Power	$ 0.05	kWh
T-T-T		min

Operating Data		Range
C recovery	50%	30 to 80%
Energy Efficieny	50%	40 to 60 %
Fines losses < 4 mm	100%	30 to 100%
Fines losses 4 - 8 mn	30%	30 to 100%
FeO recovery	50%	30 to 100%

Flux Data	CaO	MgO
Lime	92.3%	1.1%
Dolo-lime	60.1%	30.1%
Slag Basicity - B3	1.80	

Material Name	Prime Scrap	DRI 1	HBI 1	Pig Iron
$/tonne	$ 314.50	$ 235.00	$ 255.00	$ 365.00
Fe Tot	97.200%	91.113%	89.700%	94.300%
Fe Met	95.500%	85.646%	83.900%	94.300%
Metallization	98.25%	94.00%	93.53%	100.00%
C	0.080%	2.500%	1.500%	4.100%
SiO2	0.500%	1.755%	4.210%	0.200%
Al2O3	0.500%	0.810%	0.800%	0.100%
MgO	0.000%	0.135%	0.325%	
CaO	0.000%	0.945%	0.890%	
S		0.040%	0.008%	0.020%
P		0.020%	0.009%	0.060%
Si	0.010%			0.500%
Al	0.020%			
Mn	0.700%			0.700%
Fines < 4 mm	0.000%	3.000%	2.000%	0.500%
Fines < 8 mm			2.000%	0.000%
FeO	2.19%	7.03%	7.46%	0.00%
Metallic Fe	95.50%	85.65%	83.90%	94.30%
H20	0.500%	0.500%	0.500%	0.000%
Cu wt%	0.080%	0.002%	0.002%	0.000%
Other	0.503%	1.116%	0.896%	0.02%
C req'd to reduce 100 % FeO	0.37%	1.17%	1.25%	0.00%