



The Role of Steel Scrap in Decarbonization

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Scrap as a De-Carbonization Lever



100 % scrap-based operations utilizing EAF technology already have a very low CO2 footprint



Footprint can be lowered through improvements in efficiency and Fe yield



Must understand the properties of scrap to optimize its' Value-in-use



Increasing levels of scrap residuals (Cu, Sn, Ni, Mo) are a concern and will require varying amounts of ore-based metalics to allow recycle

Scrap Challenges



Scrap Challenges



- Steel scrap doesn't have a zero CO2 footprint
- CO2 footprint dependent on scrap quality
- CO2 taxes will drive us to deliver a higher quality scrap product

Impact of 1 % Dirt in the Scrap



SUMMARY FOR A ONE MILLION TON PLANT						
<u>SUMMARY</u>			<u>difference</u>			
% Dirt	2%	1%	-1%	wt% of scrap		
Acids	40	20	-20	lbs/ton scrap		
Yield	91.5%	92.5%	1.0%	liq/scrap	\$/ton	For 1Mtpy Plant
Scrap Consumption	1,092,483	1,081,081	(11,402)	tons/yr	\$500	(\$5,700,904.89)
Dolo Lime Consumption	29,919	15,704	(14,215)	tons/yr	\$200	(\$2,842,908.24)
HiCal Lime Consumption	20,404	9,556	(10,847)	tons/yr	\$200	(\$2,169,403.30)
Total Flux Consumption	50,322	25,261	(25,062)	tons/yr	Scrap & Fluxes	(\$10,713,216.43)
<u>CO2 Emissions Summary (in metric)</u>			<u>difference</u>			
Transportation CO2eq	17	17	-1	kgCO2/tonne steel		
Melting Electrical CO2eq	156	154	-2	kgCO2/tonne steel		
Slag Electrical CO2eq	31	16	-15	kgCO2/tonne steel		
Calcination of Fluxes CO2eq	51	26	-26	kgCO2/tonne steel		
TOTAL CO2 Equivalency	256	213	-43	kgCO2/tonne steel		

True Scrap Circularity



VIU Analysis to Drive Scrap Requirements



Head to Head Commodity Analysis

ADD COMMODITY

Commodity	Price	Endpoint Control Method
Turnings	\$ 250.00 /S/GT	Adjust Oxygen Usage Adjust Inj C Usage
Bushelling	\$ 300.00 /S/GT	Adjust Oxygen Usage Adjust Inj C Usage
Russian HBI	\$ 320.00 /S/MT	Adjust Oxygen Usage Adjust Inj C Usage

SINGLE VIU | **GENERATE RESULTS**

Mass Analyzed	Resulting Liquid Metal	Yield	Electrical Consumption	HiCal Lime Consumption	Dolo Lime Consumption	dLance Oxygen	Electrode Consumption
1000 KG	836 KG	83.6%	276 KWH	51 KG	91 KG	1.6 M3	0.6 KG
1000 KG	865 KG	86.5%	374 KWH	4 KG	11 KG	0.3 M3	0.8 KG
1000 KG	840 KG	84%	409 KWH	29 KG	47 KG	0.4 M3	0.8 KG

Consumption per Liquid Tonne	Cost per Liquid Tonne
Electricity: 330 KWH/LIQ TONNE	Electricity: 13.2 \$/LIQ TONNE
HiCal Lime: 60 KG/LIQ TONNE	HiCal Lime: 6 \$/LIQ TONNE
Dolo Lime: 109 KG/LIQ TONNE	Dolo Lime: 15.63 \$/LIQ TONNE
dLance Oxygen: 1.9 M3/LIQ TONNE	dLance Oxygen: 5-0.13 \$/LIQ TONNE
Electrodes: 0.7 KG/LIQ TONNE	Electrodes: 55.93 \$/LIQ TONNE
Scrap: 1197 KG/LIQ TONNE	Scrap: 5294.44 \$/LIQ TONNE
	Total VIU: \$335.07 \$/LIQ TONNE
	Original Scrap Price: \$246.05 \$/CHARGE TONNE
	Relative Power On Time: 24 MINUTES

Consumption per Liquid Tonne	Cost per Liquid Tonne
Electricity: 386 KWH/LIQ TONNE	Electricity: 15.52 \$/LIQ TONNE
HiCal Lime: 4 KG/LIQ TONNE	HiCal Lime: 0.42 \$/LIQ TONNE
Dolo Lime: 11 KG/LIQ TONNE	Dolo Lime: 1.64 \$/LIQ TONNE
dLance Oxygen: 0.3 M3/LIQ TONNE	dLance Oxygen: 5-0.02 \$/LIQ TONNE
Electrodes: 0.8 KG/LIQ TONNE	Electrodes: 56.97 \$/LIQ TONNE
Scrap: 1037 KG/LIQ TONNE	Scrap: 5306.04 \$/LIQ TONNE
	Total VIU: \$330.56 \$/LIQ TONNE
	Original Scrap Price: \$295.26 \$/CHARGE TONNE
	Relative Power On Time: 28.2 MINUTES

Consumption per Liquid Tonne	Cost per Liquid Tonne
Electricity: 487 KWH/LIQ TONNE	Electricity: 19.46 \$/LIQ TONNE
HiCal Lime: 35 KG/LIQ TONNE	HiCal Lime: 3.43 \$/LIQ TONNE
Dolo Lime: 56 KG/LIQ TONNE	Dolo Lime: 8 \$/LIQ TONNE
dLance Oxygen: 0.5 M3/LIQ TONNE	dLance Oxygen: 5-0.04 \$/LIQ TONNE
Electrodes: 1 KG/LIQ TONNE	Electrodes: 58.74 \$/LIQ TONNE
Scrap: 1190 KG/LIQ TONNE	Scrap: 5380.73 \$/LIQ TONNE
	Total VIU: \$420.33 \$/LIQ TONNE
	Original Scrap Price: \$320 \$/CHARGE TONNE
	Relative Power On Time: 35.3 MINUTES

Impact of Average Cu Level in Scrap



% OBM Required in the charge to make various steel products											
Scrap Cu wt.%											
0.08	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.10	20.4%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.15	47.3%	33.8%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.20	60.6%	50.5%	25.3%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.25	68.5%	60.5%	40.3%	20.2%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A
0.30	73.8%	67.1%	50.3%	33.6%	16.8%	0.0%	N/A	N/A	N/A	N/A	N/A
0.35	77.6%	71.8%	57.5%	43.1%	28.7%	14.4%	0.0%	N/A	N/A	N/A	N/A
0.40	80.4%	75.4%	62.8%	50.3%	37.7%	25.1%	12.6%	0.0%	N/A	N/A	N/A
0.45	82.6%	78.1%	67.0%	55.8%	44.6%	33.5%	22.3%	11.2%	0.0%	N/A	N/A
0.50	84.3%	80.3%	70.3%	60.2%	50.2%	40.2%	30.1%	20.1%	10.0%	0.0%	0.0%
0.55	85.8%	82.1%	73.0%	63.9%	54.7%	45.6%	36.5%	27.4%	18.2%	9.1%	9.1%
0.60	87.0%	83.6%	75.3%	66.9%	58.5%	50.2%	41.8%	33.4%	25.1%	16.7%	16.7%
	0.08	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	
	Product Max Cu Wt. %										

Closing Remarks



- Must drive towards a “cleaner” raw material input to steelmaking
- Steel scrap plays a critical role
- Steps can be taken to improve scrap VIU
- Costs more than offset by reduction in CO2 footprint
- OBMs play important role by enabling greater scrap recycle