

AMM Scrap Conference

November 12-14, 2007

Hyatt Regency Scottsdale Resort & Spa at Gainey Ranch
Scottsdale, AZ



Why HBI?

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Hot Briquetted Iron Association (HBIA)

- **Direct Reduced Iron (DRI)** - Iron oxide pellets and/or lump ores or fines that have been reduced (i.e., oxygen removed) without reaching the molten stage resulting in a high purity, metallic product. Classified by IMO as DRI (B) Pellets, Lumps, and Cold Molded Briquettes.
- **Hot Briquetted Iron (HBI)** – An enhanced form of DRI that has been compacted at a temperature greater than 650° C at the time of compaction and has a density greater than 5.0 grams per cubic centimeter (g/cm³). Classified by IMO as DRI (A) Hot Molded Briquettes.
- **Metallization (% Met)** – The percentage of metallic iron ÷ the percentage of total iron x 100

- **Partial Briquettes** – The result of breakage during processing, handling, and screening. Particle size typically ranges from 12-25 mm. Classified by IMO as DRI (A) or HBI for shipping purposes.
- **Chips and Fines** – The result of physical degradation of iron oxide pellets/lump ore during reduction or HBI during handling and screening. Particle size ranges up to 12 mm with metallic iron content of 1-88% by weight. Classified by IMO as DRI (B) for shipping purposes.
- **Scrap Supplements** – Collective term for HBI, DRI, and merchant pig iron. Often mistakenly called “scrap substitutes.”

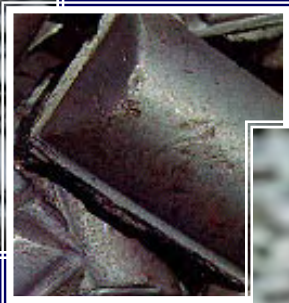
DR-Grade Oxide Pellet (Ranges by % wt.)

Fe	67.00	SiO ₂	0.70
			1.65
Al ₂ O ₃	0.20	CaO	0.60
	0.80		0.95
MgO	0.10	MnO	0.04
	0.65		0.13
P	0.02	S	0.002
	0.06		0.005
Cu, Ni, Cr, Mo, Sn, Pb, V			Trace

HBI (Ranges by % wt.)

Total Iron (Fe)	90.00	
	94.00	
Gangue (oxides not in metallic form)	1.95	
	5.10	
P	0.02	
	0.11	
S	0.003	
	0.030	
C	0.8	
	1.7	
Cu, Ni, Cr, Mo, Sn, Pb, V		Trace

- **Weight:** 0.5 to 1.5 kg (1.0-3.5 lbs)
- **Apparent Density:** $>5.0 \text{ g/cm}^3$ ($>310 \text{ lbs/ft}^3$)
- **Bulk Density:** 2.88 metric tons/ m^3 (180 lbs/ ft^3)
- **Size:**
 - ✓ Length = 90-130 mm (3.5-5.0 in)
 - ✓ Width = 48-110 mm (1.9-4.5 in)
 - ✓ Thickness = 20-50 mm (0.75-2.0 in)



- **Less reactive with water (reoxidation)**
- **Higher thermal & electrical conductivity**
- **Less fines generation**
- **Safer for ocean and inland transport**
- **Safer to handle and store in all types of weather**
- **Easier to handle with scrap handling equipment**

Manufactured Product

- **Guaranteed Specifications (quality certificate)**
- **Year-round production (no “collection season”)**
- **Low residual content (Cu, Ni, Cr, Mo, Sn, Pb, V)**
 - ✓ **Blend with scrap (lower residual content)**
 - ✓ **Blend with other metallics (total charge economics)**
- **Adjustable carbon content**

➤ **ISO product quality standards followed for HBI**

QUALITY ASSURANCE AND PROCEDURES FOR HBI		
DESCRIPTION	ANALYSIS METHOD	ISO STANDARD
Total Fe	Stannous chloride reduction and potassium dichromate titration	2597-1-1994
Metallic Fe	Bromine methanol and potassium dichromate titration	5416-1997
Carbon	Infrared absorption method by induction furnace	9686-1992
Sulfur	Infrared absorption method by induction furnace	9686-1993
Phosphorus	Molybdenum ammonium spectrophotometer method	4687-1992
Silica	Gravimetric method	2598-1-1992
Bulk density	Bulk density	3852-1988
Appearance density	Water immersion	15968
Sample preparation	Preparation for chemical analysis	7764-1998

➤ **Other quality assurance procedures (ISO): Physical test: 3082-1988, 1010835-1985, 4701-1999, 3271-1995, Chemistry : 4688, 10204, 10203**

- Check the weather (avoid loading in heavy rain)
- Sample and monitor cargo temperature (should be $< 65^{\circ}$ C)
- Inform captain of cargo description and handling and shipping guidelines
- Inspect cargo and vessel for compliance with IMO BC Code

- Test that cargo holds are watertight
- Verify holds are clean and dry
- Inspect hatch covers and other entryways



- Review written loading plan and sequence
- Open active hold and open others slightly
- Load hold evenly
- Use soft loading device if available to reduce breakage
- Monitor temperature in hold and cargo pile
- Close and secure hold



- Smoking, burning, welding, cutting and other sources of ignition should not be allowed
- Keep holds closed and free of seawater



- Ensure surface ventilation is effective
- Monitor hold hydrogen content ($\leq 1\%$) and cargo temperature ($\leq 65^{\circ}\text{C}$)
- Check bulkheads in adjacent holds for heating
- Use oxygen monitor to check hold or cargo compartment if entry is necessary

- **Compatible with any system or equipment for bulk materials**
 - ✓ **Crane with grabber or clamshell bucket**
 - ✓ **Conveyor**
 - ✓ **Front-end loader**
 - ✓ **Magnets**



- Truck bed should be clean and dry
- Load close to truck bed to limit breakage
- Check temperature of bed at several points
- Cover bed with tarp to avoid spillage



- Cargo area should be clean and dry
- Evenly distribute HBI, make pile as flat as possible
- Load close to cargo area to limit breakage
- Load in all types of weather
- Cover not needed for river transport

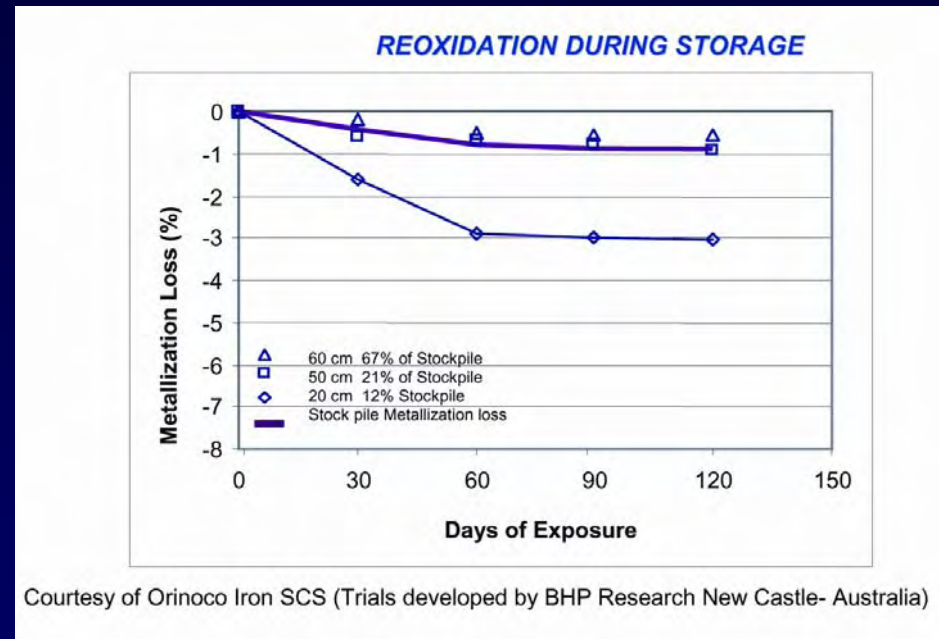


- **Shape, size ideal for conventional material handling equipment**
- **High impact strength limits breakage and fines generation**
- **HBI density minimizes water pick-up**
 - ✓ **75% less than DRI**
 - ✓ **Slower reoxidation**
 - ✓ **Less metallization loss**



Excellent Weathering Characteristics

- Uncovered pile
- 120 days exposure
- 27° C air temperature
- 70% relative humidity
- 3% metallization loss



- **Store in area with adequate drainage**
- **Covered storage not required**
- **Handled similar to scrap and pig iron**
 - ✓ **Crane with grabber or clamshell bucket**
 - ✓ **Conveyor**
 - ✓ **Front-end loader**
 - ✓ **Magnets**



Meet the HBIA



To promote hot briquetted iron (HBI) as a preferred source of high quality, merchant iron units and to assist the global steel industry in the effective use of HBI

**To inform ship owners and charterers,
terminal operators, metallics traders,
and users of HBI of the methods for
safely handling, shipping, and storing
HBI and other direct reduction
products**



Promotion

Transportation

Technical



Why HBI?



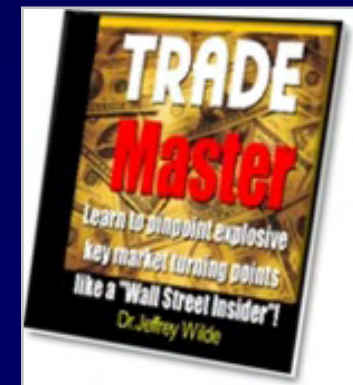
Producers



Associates



Traders



- **COMSIGUA**
- **CVG Ferrominera Orinoco**
- **Lebedinsky GOK**
- **MATESI**
- **Orinoco Iron**
- **VENPRECAR**
- **Vikram Ispat**

Capacity: 8.8 million metric tons
1.4 million tons in commissioning

- **Cleveland-Cliffs Inc.**
- **Compañía Operadora del Puerto de Palúa (COPAL)**
- **Kobe Steel Ltd.**
- **Köppern Maschinenfabrik**
- **LKAB**
- **Midrex Technologies Inc.**
- **Outotec**
- **Phoenix Bulk Carriers**
- **Progress Rail Services**
- **Quebec Cartier Mining**
- **Samarco Mineração**
- **Ship Management & Transport**
- **Siemens VAI**
- **Tenova HYL**
- **Torvald Klaveness**

- **BHP-Billiton Marketing Asia Pte. Ltd.**
- **Commodities & Minerals Enterprise Ltd.**
- **David J. Joseph Company**
- **Duferco S.A.**
- **National Materials Trading**
- **Sims Group Global Trade Corporation**
- **Sojitz Corporation of America**
- **Stemcor UK Ltd.**
- **Tube City IMS Corporation**

- **Suppliers of more than 90% of all DR plants**
- **Leading supplier of hot briquetting machines**
- **Production capacity more than 10 million tons**
- **More than 50 million tons shipped safely**
- **Creator of soft loading process and equipment**
- **Worldwide shipments ranging from 20,000-60,000 tons**



HBI-The Premium Quality Raw Material for Steelmakers

**Thank you for your
attention**

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