

Information and Procedures of Direct Reduction Iron Ores

BIBLIOGRAFIA

Revistas Trimestrales Midrex: 1998 - 2018

<https://www.midrex.com/news-literature/direct-from-midrex-newsletter-archive>

Clasificación y Descripción de los Distintos Procedimientos

J.L. Arana. Desarrollo en Procesos Avanzados de Producción de acero. Ed. J.L. Arana, Servicio de Publicaciones Escuela Superior Ingeniería de Bilbao, 1998, Cap. 2 y 3, pp. 26-106.

A. Conejo Nava. Revisión y evaluación de procesos alternativos al horno alto. Rev. Metal. Madrid, 36, 2000, pp. 420-434.

R.N.Dash*, Chinmay Das. Recent Developments in Iron and Steel Making Industry. Journal of Engineering Innovation and Research. 1, 1, January-March 2009, pp. 23-33.

Process	Smelting Reduction		Direct Reduction	
Reducing Agent →	Coke	Coal	Natural Gas	Coal
Ore Charge ↓				
Lump Ore/ Sinter/Pellets	Blast Furnace, Submerged EAF	Corex	Midrex,HYL, MidrexOXY+AREX	Rotary Kiln
Ore Fines	Star Furnace	Romelt, Primus, Hismelt,Finex,Dios, Ausmelt	Fior, Finmet Circored, Iron Carbide	Circofer, Comet,HI-QIP
Ore-coal pellets/ Briquettes		Fastmelt, Tecnored		Dry Iron, Fastmet, Inmetco, Itmk3

Table-1

R.N.Dash*, Chinmay Das.1,1, 2009 pp. 24

Fundamentos Físico – Químicos y Metalúrgicos. Procesos Industriales.

L. Von Bogdandy, H. J. Engell. The Reduction of Iron Ores, Scientific Basis and Technology. Ed. Spring-Verlag 1970,ISBN 3-540-05056-6, pp. 1-576.

International Iron and Steel Institute. Present economics of direct reduction challenges the blast furnace route to steel. Volume II: Direct reduction processes with special emphasis on the melting of sponge iron. April 1979 Rio de Janeiro, Brazil, pp.1-219.

Stanley Shuye Sun. A Study of kinetics and mechanism of iron ore reduction in iron/coke composites. Thesis for the Degree Doctor of Philosophy, Mc. Master University June 1997, pp. 1-198.

Direct Reduction Iron. Technology and Economics of Production and Use. Ed. Jerome Feinman and Donal R. Mac Rae, Pub. Iron & Steel Society, I&SS, Warrendale, PA, USA, 1999, ISBN 1-886362-31-9, pp. 1-237.

The Making Shaping and Treating of Steel. Ironmaking volume 11th Edition. Chapter 11, J. Feinman, Direct Reduction and Smelting processes, David H. Wakeling Ph.D. editor. The AISI Steel Foundation, 1999, Three Gateway Center Suite 1900, Pittsburgh, PA, USA, ISBN 0-930767-03-9, pp. 763-801.

O. Abildgaard, Y. de Lassat, G. Malgarini, M. Mirabile, C. Borgianni, A. Poos, P. Vannson, R. Steffen, B. Welbourn. European direct steel feasibility study, Technical Steel Research, European Commission, EUR 17824 EN, ISSN 1018-5593, ISBN-92-828-1707-5, 1997, pp. 1-689.

Scrap & Substitutes Alternative Ironmaking V, 2008 Specialty Training Conference, November 2-4, 2008 Baltimore, Md, USA. AIST Association for Iron & Steel Technology, 186 Thorn Hill Road, Warrendale PA 15086 USA.

Amit Chatterjee. Beyond the Blast Furnace. Chapter 9 Alternatives Avenues of Ironmaking pp. 181-189, Published Boca Raton: CRC Press, USA, 1994, ISBN 0849366763, pp. 1-244.

Ammit Chatterjee, Ramesh Singh, Banshidhar Pandey, Metallics for steelmaking, Production & Use. Allied Publishers Ltd, India, 2001, ISBN 81-7764-130-1, pp. 1-731. (Published by Sunil Sachdev and printed by Ravi Sachdev at Allied Publishers Ltd.)

Amit Chatterjee. Sponge Iron Production by Direct Reduction of Iron Oxide. Ed. Asoke K. Ghosh, PHI Learning Private

Limited, New Delhi-110001, India, 2010, ISBN 978-81-203-3644-5, Printed Jay Print Pack Private Limited New Delhi-110015. pp. 1-353.

ESTUDIO DE LOS DISTINTOS PROCESOS INDUSTRIALES

Proceso Midrex:

Carga: Sinter, pelets, esponja de hierro.

Reductor : Gas

En 2017 este Proceso produjo el 64.8% de la producción mundial de DRI

Midrex

<http://www.midrex.com//>

Variantes de Midrex

DRI production using natural gas : MIDREX NG™

<https://www.midrex.com/technology/midrex-process/midrex-ng/>

Using Syngas from coal to make DRI : MXCOL_R

<https://www.midrex.com/technology/midrex-process/mxcol/>

Near future (transition) NG/H2 and futureH2

<https://www.midrex.com/technology/midrex-process/midrex-h2/>

Midrex : Estadísticas de Producción y Comparativas con Otros Procesos

https://www.midrex.com/wp-content/uploads/Midrex_STATSbookprint_2018Final-1.pdf

https://www.midrex.com/wp-content/uploads/MidrexStatsBook2017.5_.24_.18_.pdf

Midrex : Listado de Plantas 1969 - 2020

<https://www.midrex.com/about/midrex-plants/>

<http://www.midrex.com/wp-content/uploads/Midrex-Plants-Sheet2019.pdf>

Midrex DRI : Products & Applications Brochure

https://www.midrex.com/wp-content/uploads/MidrexDRI_ProductsBrochure_4-12-18-1.pdf

Midrex : Last News and Resources

<https://www.midrex.com/news-resources/>

Midrex : Bibliografía específica

<https://search.kobelco.co.jp/?site=EJ4JC91U&charset=UTF-8&design=2&group=1&query=Midrex>

Midrex : Videos

<https://www.youtube.com/watch?v=GP2IWLQFuS4&t=29s>

<https://www.youtube.com/watch?v=USbZMBxuZJE&t=12s>

<https://www.google.com/search?client=firefox-b-ab&q=The+HBI+direct+reduction+process+-+voestalpine+in+Texas>

Proceso HYL Y ENERGIRON:

Carga: Sinter, pelets.

Reductor : Gas

Precursor del Midrex (EL proceso HYL)

En 2017 estos Procesos produjeron el 16.9% de la producción mundial de DRI

HYL III

<http://millennium-steel.com/wp-content/uploads/articles/pdf/2006/pp43-45%20MS06.pdf>

<http://ispatguru.com/hyl-process-for-direct-reduction-of-iron-ore/>

<http://ietd.iipnetwork.org/content/hyl-iii-process>

HYL III : Bibliografía específica (News)

https://www.tenova.com/fileadmin/user_upload/2014_MARCH_HYLNEWS.PDF

https://www.tenova.com/fileadmin/user_upload/HYLNEWS_-_JULY_2014.pdf

https://www.tenova.com/fileadmin/user_upload/tenova_products/steel_making_direct_and_pre_reduction_technologies/hylnews_-_july_2015.pdf

https://www.tenova.com/fileadmin/user_upload/HYLNEWS_-_DECEMBER_2015.pdf

https://www.tenova.com/fileadmin/user_upload/HYL_NEWS_DECEMBER_2016.pdf

https://www.tenova.com/fileadmin/user_upload/HYL_NEWS_May_2017.pdf

https://www.tenova.com/fileadmin/user_upload/HYL_NEWS_December_2017.pdf

Proceso HYL – ENERGIRON

<https://www.tenova.com/product/iron-reduction-technologies/>

<https://www.metalbulletin.com/events/download.ashx/document/speaker/7962/a0ID000000X0kHrMAJ/Presentation>

<http://www.energiron.com/>

http://media.wix.com/ugd/f57d32_28ce2763206049ebb5d22d41fe964abf.pdf

HYL – ENERGIRON : Bibliografía Específica

https://www.tenova.com/fileadmin/user_upload/tenova_products/steel_making_direct_and_pre_reduction_technologies/energiron_-_the_smart_choice.pdf

<https://www.tenova.com/#energiron-zr-plant-single-module-of-2-5-mtpy-in-louisiana>

HYL – ENERGIRON Plantas Industriales

<https://www.highbeam.com/Search?searchTerm=energiron>

<http://www.spongeironindia.in/presentations/AndresVilla.pdf>

<https://www.youtube.com/watch?v=vIYiQUYpO88>

HYL – ENERGIRON Videos

<https://www.youtube.com/watch?v=vIYiQUYpO88&t=9s>

<https://www.youtube.com/watch?v=fvrF4mLLEqw>

Proceso ROTARY KILN (COAL – BASED):

Incluye los Procesos SL/RN, Codir, Accar, DRC, TDR, SHL, Jindal.

Carga: Mineral, Sinter/pelets y caliza

Reductor : Carbón

Primer proceso empleado

En 2017 este Proceso produjo el 17.6% de la producción mundial de DRI

ROTARY KILN (COAL – BASED)

<http://ispatguru.com/coal-based-direct-reduction-rotary-kiln-process/>

https://www.researchgate.net/publication/269107176_COMPARISON_OF_DIFFERENT_COAL_BASED_DIRECT_REDUCTION_PROCESSES

<http://www.outotec.com/products/direct-and-smelting-reduction/slrn-process/>

https://ibm.gov.in/writereaddata/files/06062017101255Iron%20and%20Steel%202020_6.pdf

ROTARY KILN : Bibliografía Específica

<https://www.sciencedirect.com/science/article/pii/S2405896316300982>

<http://ethesis.nitrkl.ac.in/3879/1/Thesis-Tapash.pdf>

http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2225-62532015000500014

<http://www.iosrjournals.org/iosr-jmce/papers/vol12-issue6/Version-5/L0126598103.pdf>

<http://www.iosrjournals.org/iosr-jmce/papers/vol13-issue5/Version-6/G1305064954.pdf>

<http://www.welspunsteel.com/content.asp?Submenu=Y&MenuID=3&SubmenuID=60>

<http://eprints.nmlindia.org/6284/1/461-463.PDF>

<http://ijsetr.org/wp-content/uploads/2016/01/IJSETR-VOL-5-ISSUE-1-153-158.pdf>

<https://open.library.ubc.ca/cIRcle/collections/ubctheses/831/items/1.0096744>

ROTARY KILN: Plantas Industriales

<http://www.seil.co.in/sponge.html>

Nota: No entraremos a considerar los procesos de reducción directa en base a finos de mineral de hierro; Procesos Fior, Finmet, Circored, Circofer, y HI-QIP, ya que el conjunto de ellos representaron en 2017 solamente el 0.7% de la producción mundial mediante Reducción Directa que osciló alrededor de 87.1 MTm en dicho año.

Procesos FASTMET e ITmk3

Carga: Mineral de hierro (óxidos) más Reductor (carbón) → Peletización

Reductor : Carbón

Producto : Iron nuggets

http://www.kobelco.co.jp/english/ktr/pdf/ktr_33/001-007.pdf

http://www.kobelco.co.jp/english/ktr/pdf/ktr_26/092-097.pdf

FASMET e ITmk3 : Bibliografía Específica

http://www.kobelco.co.jp/english/ktr/pdf/ktr_29/077-084.pdf

<https://www.energy.gov/eere/amo/itm3-high-quality-iron-nuggets-using-rotary-hearth-furnace>

<http://haresengineering.net/itm3-iron-making-plants>

<https://www.midrex.com/process-technologies/fastmet-fastmelt>

<http://ispatguru.com/itm3-process-of-making-iron-nuggets/>

<https://www.midrex.com/process-technologies/itm3>

<http://haresengineering.net/>

FASMET e ITmk3 : Planta Industrial (Primeras Plantas Comerciales)

<http://www.kobelco.co.jp/english/products/ironunit/itm3.html>

http://www.kobelco.co.jp/english/releases/2010/1182907_14776.html

<https://www.metalbulletin.com/Article/2063066/Mukand-Steel-to-build-ITmk3-iron-nugget-plants-in-India.html>

FASMET e ITmk3 : Videos

https://www.youtube.com/results?search_query=FASTMET+Process+for+DRI+ironmaking

<https://www.youtube.com/watch?v=EqrKOg2id8o>