

MAGMA

Efficient and clean steel production

Introduction

The MAGMA furnace is a continuous unit for coke-free production of hot metal suitable for small and medium steelmaking plants.

The MAGMA furnace is used in the first stage to produce pig iron with Fe content of 95% and without harmful impurities, directly from iron ore.

The technology does not require coke or coking coals and can use ordinary iron ore instead of sinter, pellets or hot-briquetted iron.

In the context of India market, MAGMA offers 25-30% cost reduction and 30-50% reduction in CO₂ emissions compared to a blast furnace or rotary kiln.

100,000 - 1,000,000 tons
target capacity

Applications:

- Steel production without coking coal
- Processing of low-grade iron ore, ore fines or ore with harmful impurities
- Recycling of converter slag and other metallurgical wastes

The developer of MAGMA is Metals technology group of companies (Russia, Kazakhstan).

Liquid-phase reduction - new approach in the steel industry

MAGMA is an evolution of existing liquid phase reduction technologies.

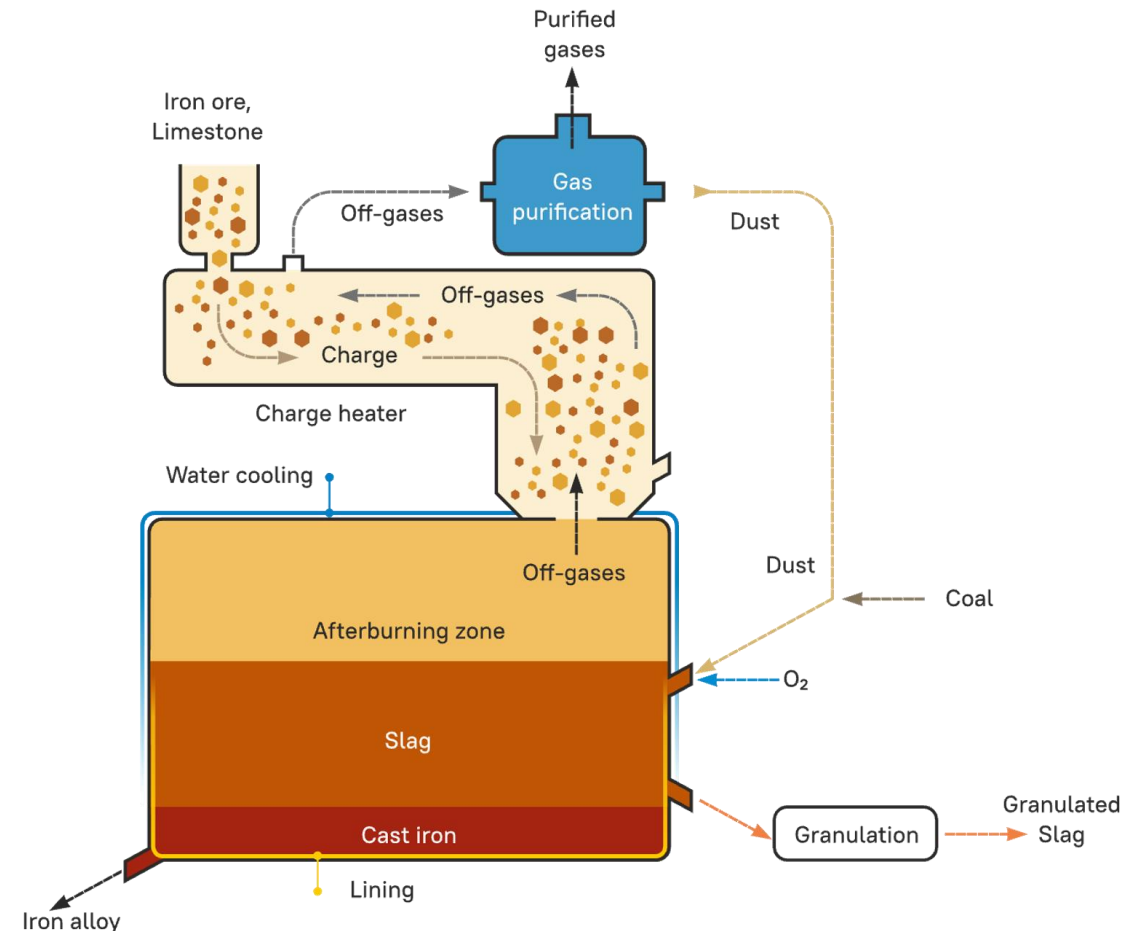
The technology involves complete remelting of the feed materials and metal reduction reactions in the liquid state and at high temperatures. This reduces the requirements for the initial quality of the raw materials used.

The best known liquid phase reduction technologies are Corex, Finex, HIs melt, Hisarna and Romelt, used in the production of ferrous products and steel, and the Ausmelt and Vanyukov technologies, used in non-ferrous metallurgy for processing copper and nickel ores and concentrates.

More than 30 liquid phase reduction furnaces have been installed worldwide.

MAGMA technology is based on the experience of existing technologies and incorporates a number of innovations to improve production efficiency and reduce coal and oxygen consumption.

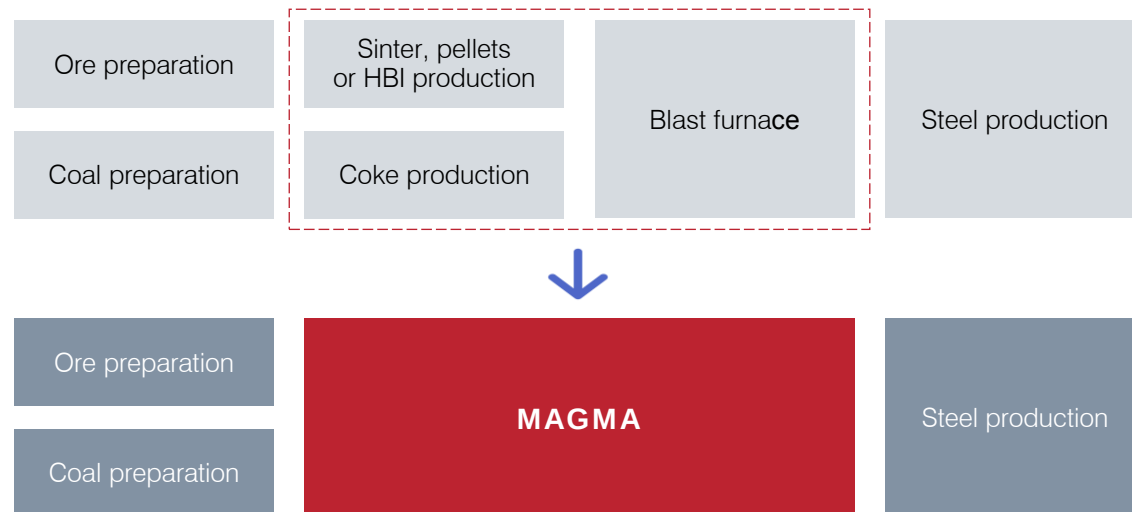
Simplified process flow diagram of the MAGMA process



MAGMA in steel production

The technology does not require the use of coke or expensive iron-containing intermediates (sinter, pellets), which are required in other technologies involving the recovery of Fe in the solid phase (blast furnace, DRI production with rotary kiln).

MAGMA reduces cost of charge material preparation



MAGMA produces pig iron of the same quality as pig iron produced in a blast furnace.

It also does not contain the harmful impurities that may be found in sponge iron, as most of the harmful impurities are transferred to the slag during the liquid phase reduction process.

Cast iron is well suited for steel production or can be sold externally for the production of iron castings.

The further processing of pig iron into steel is carried out by the classical methods: basic oxygen furnace or electric arc furnace with oxygen purging.

Chemical composition of pig iron

Fe	C	Mn	Si
95 %	4,3-4,5%	0,05-0,11%	0,06-0,11%

Production characteristics

MAGMA can operate with any iron ore (hematite or magnetite) with an Fe content of 55 - 63% and any size, including ore fines (0-50 mm).

Non-coking coal of almost any quality (from 40% fixed carbon and no more than 20% ash) can be used as a reducing agent without significant particle size limitations.

Both coal and a combination of coal and natural gas can be used as energy source and Fe-reducing agent. In this case the use of natural gas is optional, but if available it will help to improve process performance and reduce CO₂ emissions.

Enriched oxygen injection will be required to provide charge heating and liquid phase reduction. A VPSA or cryogenic system can be used as the oxygen source.

Average specific material and energy consumption

Item	Unit	MAGMA (coal)	MAGMA (coal and natural gas)
Iron ore (62% Fe)	t/t	1.63	1.63
Non-coking coal	t/t	0.6-0.8	0.4
Fluxes	t/t	0.17	0.17
Natural gas	m ³ /t	-	225
Oxygen (equivalent of 100% O ₂)	m ³ /t	600-750	400-550

MAGMA in comparison with DRI production in a rotary kiln

Advantages of MAGMA technology over DRI production in rotary kilns :

- Higher Fe recovery.
- Lower coal consumption and lower coal quality requirements
- Lower total iron ore consumption due to the absence of screening and the ability to process fines, which are cheaper than lump ore.
- A more suitable product for the production of high quality steel, free from harmful impurities and phosphorus.
- Lower overall energy consumption in steel production compared to processing DRI in an EAF or induction furnace.
- Environmental - friendly production with low dust generation and lower emissions of harmful pollutants.

20-30%

lower cost of steel production
compared to rotary kiln & induction furnace

Key characteristics:

Item	MAGMA (coal)	Rotary kiln
Fe content in the product (metallised)	94-96%	78-84%
Effective iron ore consumption	1.6 t	2.0-2.2 t (including screening 25%)
Iron ore size requirements	0-50 mm	5-20 mm
Ore screening and fines production	None	up to 25%
Coal consumption	0.6 – 0.8 t any quality	0.9 – 1.1 t (imported) 1.4 – 1.6 t (domestic)
Total electricity consumption for steel production	400 - 450 kWt (incl. EAF and O ₂ production)	800 - 950 kWt (incl. induction furnace)
CO ₂ emissions per 1 t of steel	1.6 – 1.8	2.0 – 2.8

Competitive operating costs

The use of cheaper materials and ordinary coal in MAGMA significantly reduces the operating cost of producing 1 tonne of steel while maintaining high product quality.

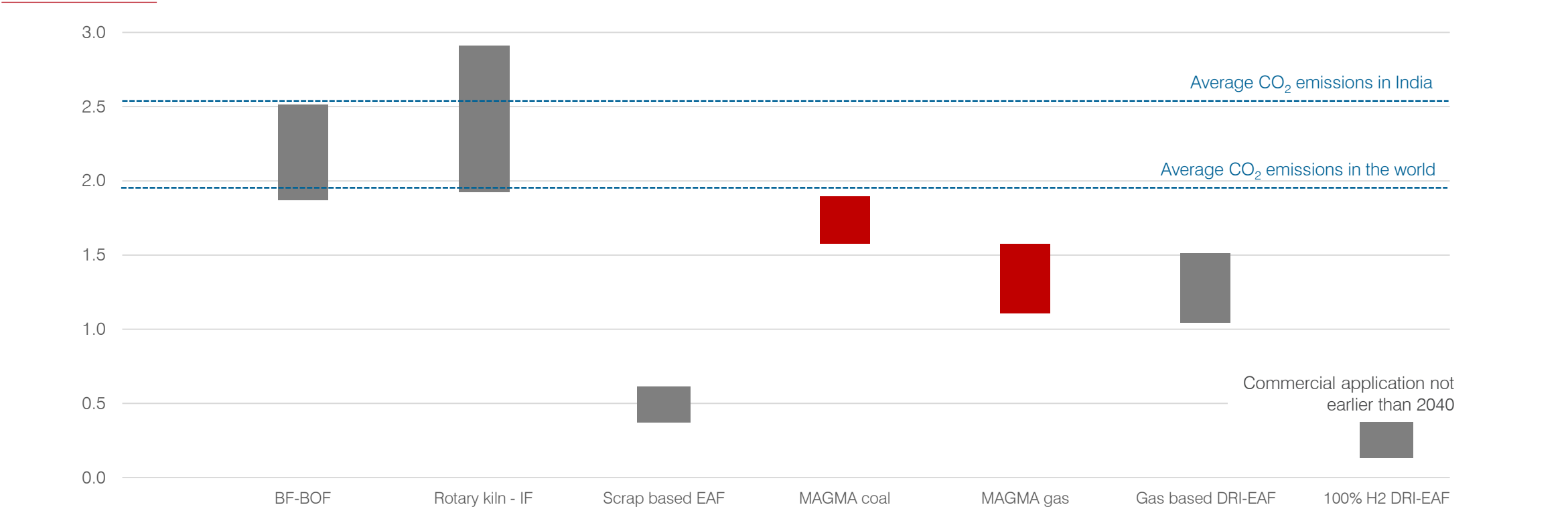
Item	Unit	Price,	Blast furnace & BOF		Rotary kiln & IF		MAGMA (coal) & EAF	
		USD / unit	Consumption	Cost, USD	Consumption	Cost, USD	Consumption	Cost, USD
Pellets (62% Fe)	t	110,00	1,05	115,50	-	-	-	-
Iron ore (62% Fe)	t	80,00	0,60	47,92	1,80	144,00	1,63	130,40
Fluxes	t	50,00	0,05	2,50	0,15	7,50	0,17	8,25
Coke	t	354,00	0,50	177,00	-	-	-	-
Non coking coal	t	120,00	0,10	12,00	0,90	108,00	0,80	96,00
Natural gas	m ³	0,54	-	-	-	-	-	-
Oxygen	m ³	0,07	40,00	2,93	-	-	700,00	51,24
Electricity	kWt	0,11	130,00	13,78	75,00	7,95	100,00	10,60
Operational expences	USD	-		20,00		40,00		30,00
Cost of conversion of semi-product to steel	USD	-		80,00		207,50		90,00
Cost of liquid steel before CCM	USD			471,63		514,95		416,49

Competitive CO₂ emissions

The reduction of CO₂ emissions is one of the most important competitive factors, as carbon taxes and tariffs on imports of goods with a high CO₂ footprint are expected to be introduced in the near future.

By eliminating coke and reducing the number of preparation operations, MAGMA reduces CO₂ emissions by more than 20% compared to a blast furnace and up to 40% compared to DRI production in a rotary kiln.

CO₂ emissions per 1 t of steel



Sources: Greening the Steel Sector in India 2024 (Ministry of Steel India); Iron and Steel Technology Roadmap 2020 (IEA); Company data

Why MAGMA is suitable for India



Cost efficiency

10-20% lower compared to blast furnace production and 30% lower compared to DRI production in rotary kiln



Flexibility in the use of charge materials

MAGMA can process different grades of iron ore and use cheaper coal instead of coke



High quality products

In the form of hot metal (pig iron), with Fe content >95% and low sulphur and phosphorus content compared to DRI production in rotary kiln



Effective steel production

Ability to produce high quality steel grades with low energy costs



Simple production process

Fewer operations for charge and coal preparation, ability to work on unprepared charge material



Ecology

Environmentally friendly production with low pollution
Low CO₂ emissions

Contact

Metals
Technology

Metals technology LLC

 +7 (351) 217-10-15

 mail@metalstech.ru

Representative in India

GoodRich MAGMA Industrial Technologies Limited

Mr. I.R. Rao

 +91.99458 74078

 +91.99802 14065

 goodrichmagma@gmail.com
rao@goodrichmagma.com