



Surface mining

Open pit mining is used to excavate iron ore that is close to the surface. The topsoil is removed and the ore is loosened by drilling and blasting. Haulage trucks move the ore to stockpiles. From there a conveyor belt system transports the ore to the crushers at the processing plant.

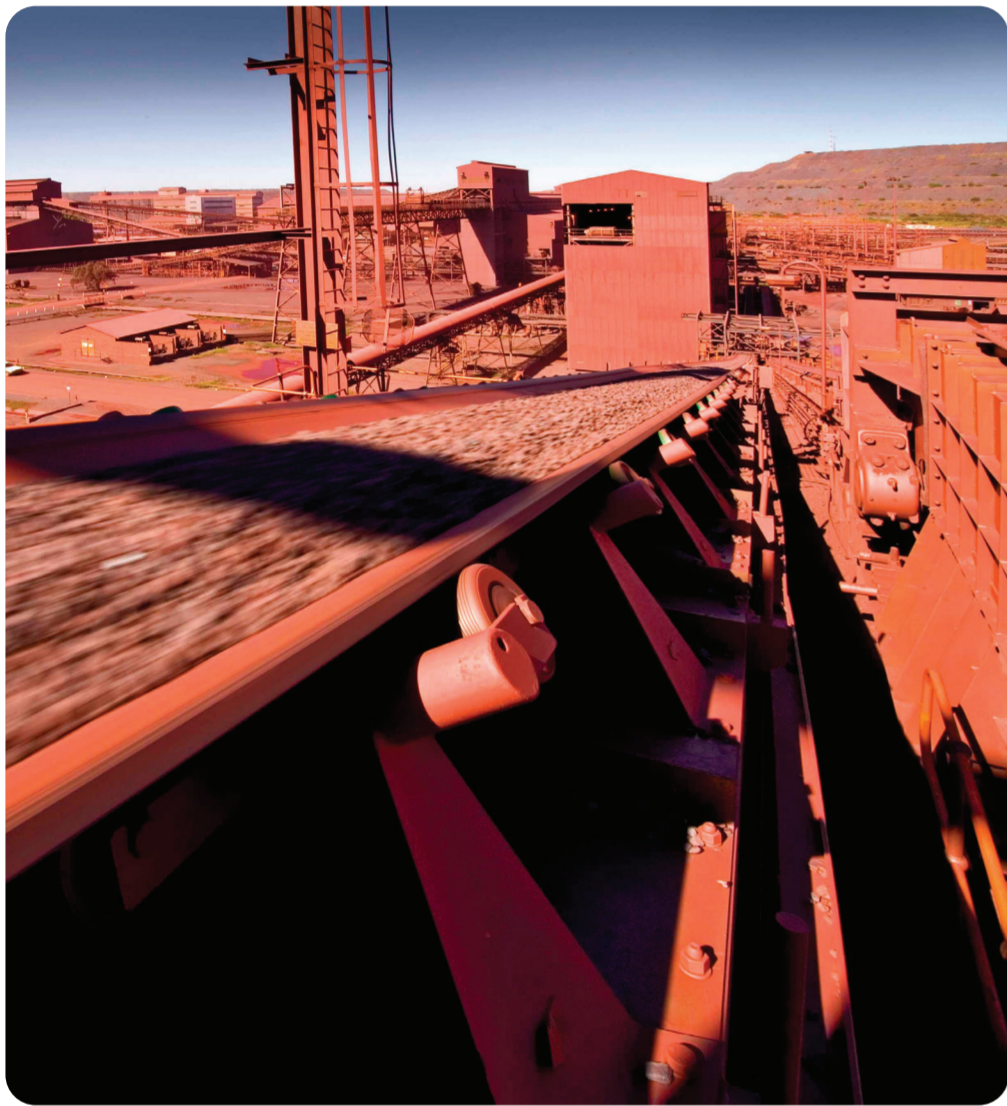
The ore undergoes a series of crushing steps to reduce the particle size.



Crushing



Washing and screening



Separation and classification

Iron ore is separated into the different grades using cyclones and drum separators.

Blending and dispatch

Iron Ore (65% Fe)

Coke (C)

Limestone (CaCO_3)

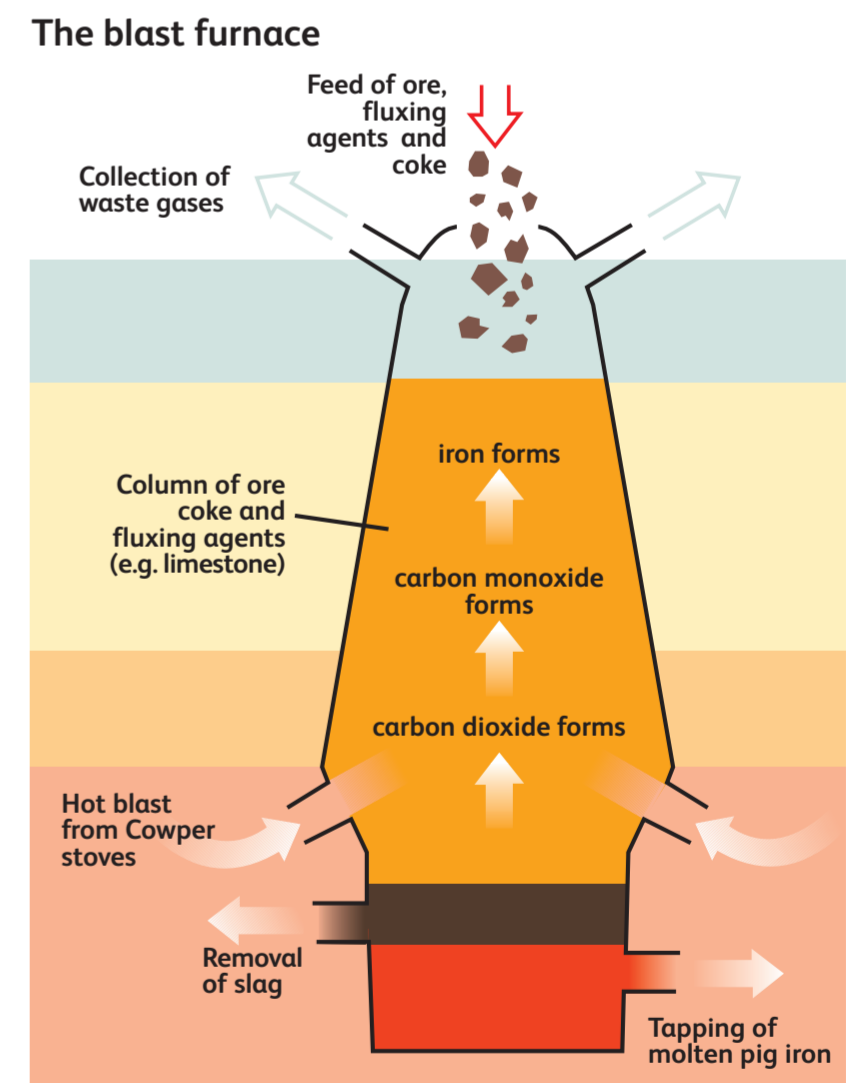
Hot Air

Blast furnace

Pig iron

Slag

Coke (carbon) is reduced:
 $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
 CO reacts with iron ore to form iron:
 $3\text{CO} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + 3\text{CO}_2$
 Flux (limestone) is added to remove impurities from the molten iron to form slag:
 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$ (slag)
 Molten slag floats on top of the molten iron.
 The blast furnace produces pig iron that is sent to steel manufacturers.



Steel manufacturing



Road construction / concrete manufacture

Open-pit mining (Foskor)

The phosphate mining process at Foskor receives phosphate rock from two sources: The Foskor open-pit mine and the Palabora Mining Company



Drilling and blasting

Primary crusher

Secondary and tertiary crushers

Milling

Phosphate Flotation

Filtration of concentrate

Drying

Dispatch to fertilizer company or processing plant

Ore from Palabora Mining Company (PMC)



Ore from PMC undergoes copper flotation to remove copper and magnetic separation to remove magnetite (iron) ore prior to phosphate flotation.

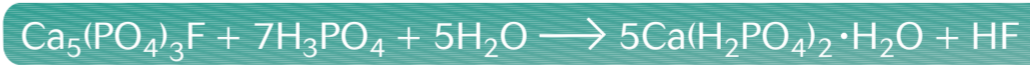
Tailings to tailings dam



Add sulfuric acid to make super-phosphate (mixture of calcium phosphate and calcium sulfate)



Add phosphoric acid to make triple-super-phosphate



Super-phosphates and triple-super-phosphates are used as fertilizers





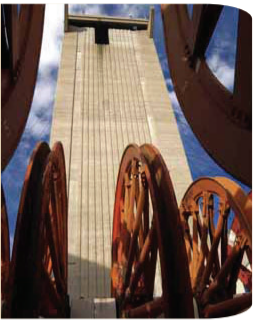
Gold Mining and Processing in South Africa

South African gold mines are deep level mines reaching depths of over three kilometres. Miners go underground in shaft cages and then walk or take trains to the work face.



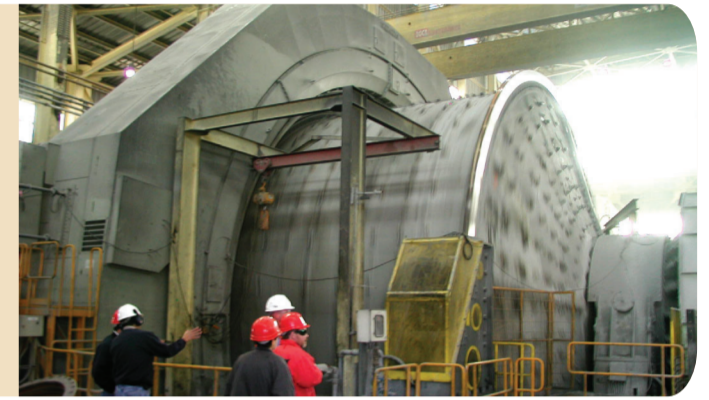
Underground mining

Ore is hoisted from the lowest underground level of the mine in skips and then transported to the surface by rail hoppers or conveyor belts.



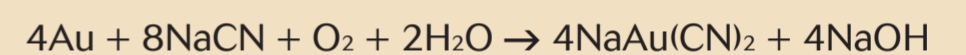
Comminution: crushing & milling

The ore undergoes a series of crushing and milling steps to reduce its size for further processing.



Leaching: cyanidation process

Gold is leached from the slurry by means of dilute cyanide solution. Gold has a high affinity for cyanide solution. The following reaction occurs:



Gangue rock goes to the tailings dam

Extraction: removing gold from solution



Unwanted rock (gangue) is filtered out and zinc dust is added to precipitate the gold. Zinc displaces gold in a redox reaction. Impurities such as silver, platinum, copper, lead and zinc also precipitate out.

Filtration & zinc precipitation



Carbon-in-pulp & electro-winning

Carbon is used to adsorb gold from the solution. This is called the 'carbon-in-pulp' process and involves three phases:

- Adsorption, where dissolved gold is loaded onto aerated carbon
- Elution, where gold is removed from carbon by an alkaline cyanide solution
- Electrowinning, where gold is removed & deposited on steel cathodes



Recovery: smelting

The gold is smelted in an electric furnace to produce gold bars of 99 % purity.

Refining

Flux is added and the gold is melted in a furnace to separate the gold from the impurities. The flux will oxidise the impurities, which will float on top of the molten gold and can be removed. Gold of 99,99% purity is produced.

Opencast mining is used to excavate shallow-lying coal seams. These seams are drilled and blasted prior to excavation. Shovels load the coal onto haul trucks, which take it to the tipping area. Conveyor belts transport the coal to the processing plant.

Surface mining



Underground mining

Bord-and-pillar method (65% recovery)
Rib-pillar method (90% recovery)
Longwall mining (90% recovery)

Crushing

Primary crushing takes place while the coal is still underground. Conveyor belts then transport the coal to the secondary and tertiary crushers at the processing plant.



Washing

The coal arrives at the coal washing plant by means of a series of conveyor belts.



Separation and classification

The coal is separated into different sizes, called grades.



Drying and dispatch

The coal is dried, ready for transport.



Local market (75%)

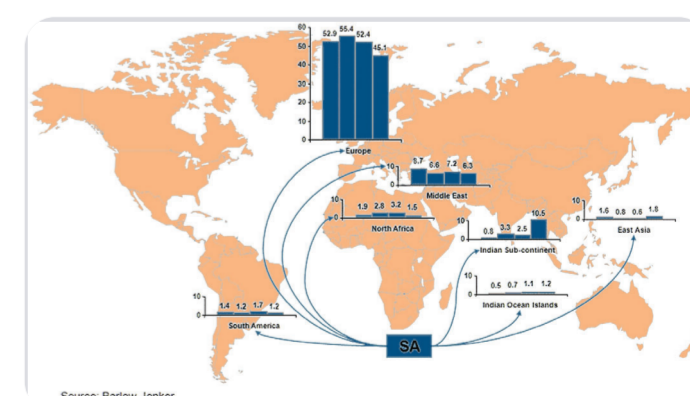
Export market (25%)

Household use (2%)

Electricity generation (53%)

Metallurgical industries (12%)

Petrochemical industries (33%)



Source: Anglo Coal video 2008; Powering South Africa the Anglo Coal way.