

The steelmaking process in New Zealand

James Cook first noted the dark sands on the coast of the west coast of the North Island. The dark sands he noted were dark because of the presence of iron and formed due to volcanic activity.

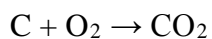
Numerous attempts were made in the late 19th century to the 1950's to obtain the iron from these iron sands. There was limited success and it was uneconomic. In 1959 the New Zealand government established New Zealand steel Limited to investigate further an economic way to obtain this iron and hence steel. This resulted in a steel mill at Glenbrook near Auckland. This mill produces 90% of New Zealand's steel needs. The rest is exported.

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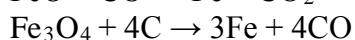
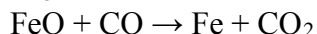
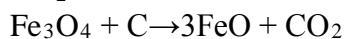
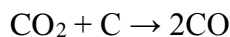
The mill at Glenbrook contains multi hearth furnaces, rotary kilns, and melters, in addition to further ladles. The set up at Glenbrook is unusual as in most places in the world a blast furnace is used to obtain iron from iron ore. The technology at Glenbrook was developed because of the makeup of the New Zealand iron sands. These iron sands contain a larger than normal amount of titanium, vanadium, and silica type compounds. These compounds cause a problem in blast furnaces as they make the slag (waste products of the steel making process) difficult to separate from any molten iron.

The iron sand concentrate from the mine is fed into the multi hearth furnaces, with some coal and lime. When the concentrate leaves the multi hearth furnaces it is now dry and the coal has been converted to char. Char is coal that has had its more volatile content driven off. The heat produced from this process is used to help make electricity. This char is therefore mainly just carbon which is used in the rotary kilns to reduce the iron sand concentrate.

The reactions that occur in the kiln are



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It is the carbon and the carbon monoxide that is formed that reduces the different types of iron oxide. The carbon monoxide is formed by the reaction of the carbon in the char with the oxygen. The amounts of carbon (char) and oxygen that is fed into the rotary kiln is controlled so that the required amounts of carbon monoxide are present to reduce the iron oxides. This is reduction because the iron oxides have oxygen removed by the carbon and carbon monoxide which are oxidised (gain of oxygen).

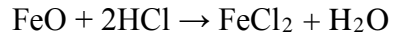
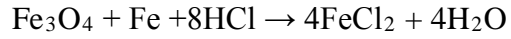
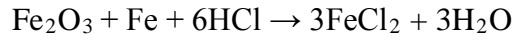
The lime is added as it breaks up into calcium oxide with heat. This calcium oxide is added to help form the slag and also react with any acidic oxides that are formed from sulfur and phosphorous that were present in the coal.

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The product of this is known as reduced primary concentrate and it is poured into melters and ladles which is further refined to steel. The steel is cut into slabs and coils.

These slabs and coils are then processed further and it at this stage that scale forms on the surface of the steel. Scale is oxidised iron from the steel. It is formed from this iron reacting with oxygen from the air.

This scale needs to be removed. The process of removing the scale is called “pickling”. Hydrochloric acid is used to remove this scale. The process is carried in three deep bath tanks. The following three reactions occur depending on the type of iron oxide formed.



In the first two reactions the iron is from the steel under the scale. The amount of iron that reacts needs to be controlled or too much of the iron is lost in the process. This is done by using inhibitors. If the acid cannot react with this iron then the reaction is much slower. These reactions occur faster at higher temperatures but there is a “trade off” here as if the temperature is too high the acid breaks down into hydrogen chloride vapour. It has been found that the best way to control this process is to vary the time that the steel is pickled for.