Westbrook Resources Ltd

Group Companies / Divisions:

Westbrook Metal Powders
Westbrook Light Alloys Ltd
Westbrook South Africa Ltd
Westbrook Resources Limited

Westbrook Resources Limited is a private UK based metallurgical company involved in the manufacture, distribution and trade of ferro alloys throughout the world.

We are both a producer and international trading company sourcing alloys, metals, minerals and ores from around the world, managing the supply chain from mine and producer to consumers worldwide. With expertise in logistics, finance, marketing and a focus on quality, we offer a world class service together with the products that we supply.

In the UK we support the foundry and steel making industry by supplying a wide range of over 50 products including ferro alloys, pure and minor metals and minerals.

We also have a reputation for innovation which has opened up opportunities around the world for us to produce and reclaim ferro alloys and ores from waste piles and redundant production plants, enhancing our production base while adding a positive contribution to the company's global environmental impact.

Our subsidiary company, Westbrook Light Alloys Ltd is a producer of Ferro Titanium in Sheffield where we can tailor the quality and specification of our product to suit your specific requirements.

Our aim is to be a reliable, long-term partner to our customers and suppliers by ensuring:

- Continuity of supply
- Consistent quality
- Market leading pricing
- Timely delivery
- Professional service
Westbrook Resources Limited

Facts and figures

- Westbrook Resources Limited was incorporated in 2000.
- In 2004, the company acquired Watsons Alloys and Metals.
- Watsons Alloys and Metals was an established brand with over 100 years of trading history.
- The Watsons business is the UK distribution arm of Westbrook Resources.
- The Group trades in over 50 metals and alloys from various origins.
- Our products are distributed within the Iron and Steel sectors of the UK, Europe, North and South America, Australasia and Asia.
- We have representation in China, Canada, UK, Africa, Australia, Americas, & Europe
- Annual Sales Volume of 28,000 MT
- Annual Group Turnover of $73 Million in 2013
- D&B Rating 2A2
Product Lifecycle

- Mine
- Ore
- Smelter
- Vessel

- Finished Product
- Steelworks & Foundries
- Warehouse, Packaging & Transport
Our Products

Westbrook Resources

- Silicon Alloys – FeSi, FSM, FeSiZr, SiC
- Manganese Alloys – FeMn (HC, MC, LC), SiMn, Ore, Nitrided Metal
- Chrome Alloys – FeCr (LC, MC, HC), Nitrided, Charge Cr
- Noble Alloys – FeMo, FeV, FeNb, MoO2, FeW, FeB, FeTi
- Nickel & Nickel Alloys – Ni, NiMg, NiB, NiCa, NiNb, NiV
- Nickel Alloy Plate/Bar – Alloy 330, Alloy 800H/HT, Alloy 601, Alloy 600, Alloy 625, Alloy 718, Alloy X
- Stainless Steel Plate/Bar – 310, 321, 410, 446
- Calcium Alloys – CaSiMn, CaSi, CaC2
- Pure Metals – Si, Mo, Mn, W, Cr, Cu, Al, Co, Sn, Pb, Bi, Mg, Ce, Fe
- Briquettes – Si, Mn, Cr
- Pig Iron – Hematite/Foundry Grade, Basic/Steelmaking Grade
- Aluminium – FeAl, Aluminium Deoxidants
- Miscellaneous - FeSu, FeP, C, Zr Sand, Cr Sand

Westbrook Light Alloys

- Ferro Titanium
- Copper

Westbrook South Africa

- Silicon Carbide Briquettes
- Atomised Ferro Silicon Powders - 15% Si, 45% Si

Westbrook Metal Powders (Division)

- Atomised Ferro Silicon Powders - 15% Si, 45% Si
- Milled Ferro Silicon Powders - 15% Si, 45% Si
- Silicon Metal – Lumps, Granules and Powders
- Silica Fume – Refractory & Cement/Concrete
- Titanium Minerals
Products & Specifications

The following specifications are to be used as a guide only. Please contact us or refer to your sales contract for a more specific analysis of available lots.
FERRO SILICON

Ferro Silicon is an atomised alloy, which is formed by combining iron and silicon with a silicon content of around 75%. Ferro Silicon is a universal "heat-blocker" used in the production of carbon and stainless steels. This additive is used with other ferro alloys in the deoxidising process of steel, as well as in the production of silicon itself. Ferro Silicon is used in the production of cast iron, as Ferro Silicon can accelerate graphitisation. Ferro Silicon replaces the need for ferro manganese, spiegeleisen and calcium silicides in the manufacturing process.

PROPERTIES OF FERRO SILICON

Ferro Silicon has a melting point of 1200°C to 1250°C with a boiling point of 2355°C and contains about 2% of calcium and aluminium. Ferro Silicon, as an additive to the production process of ferrous metals, will impart several desirable properties upon the resultant alloy. Some of the primary benefits of adding Ferro Silicon to an alloy is to improve the corrosion resistant properties of the new compound, as well as to add to the high temperature heat-resistance properties of the new alloy, for example, in the production of silicon steel for use in transformer cores.

PRODUCTION OF FERRO SILICON

A large portion of the global Ferro Silicon supply is manufactured in China, USA and India. The most basic definition of the Ferro Silicon production process would be that the silica (or sand) is mixed with coke, and then a reduction process takes place in the presence of mill scale, scrap or another source of iron. A blast furnace is employed for Ferro Silicon production, but for larger contents of silica, an electric arc furnace is used.
USES OF FERRO SILICON

There are many practical applications of Ferro Silicon to include carbon steel and stainless steel production, and when using the Pidgeon process to produce magnesium from dolomite. Applications in the production of other alloys include the manufacture of silicon steel for electro motors and cores, as well as coatings used during arc welding. One useful by-product of the production processes is silica fume, which is later added to concrete mixes to improve compressive and bonding strength.

FERRO SILICON MARKET

Since the start of 2009, the Ferro Silicon market has dropped across the board, and especially noted is the drop in the Chinese market. Most consider the drop there a serious slump that is outside predictable trends. Reasons for the slump is as follows:

1) EU anti-dumping impacting demand,

2) both Japan and South Korea imported a large quantity of FeSi before an export tariff rate increase, and

3) adequate amounts are currently stockpiled.

The China Ferro Silicon market remains weak due to governmental policy changes, where despite considerable mill profits, many mills are closing due to the strong competition from overseas.
FERRO SILICON SPECIFICATION

Chemical Analysis

Si  74-78%
Al  1.5% max
C   0.2% max
P   0.03% max
S   0.03% max

Packing:

• 1mt big bags

Sizing:

• 0-3 mm
• 3-10 mm
• 10-50 mm
• 10-80 mm
FERRO SILICON MAGNESIUM SPECIFICATION

Chemical Analysis

Si  40-50%
Mg  3-6.5%
Al  1% max

Packing:

• 25kg bags inside a drum on a pallet
• Drums on a pallet

Sizing:

• 2-6mm
• 2-12mm
• 3-10mm
• 3-20mm
• 5-40mm
FERRO SILICON ZIRCONIUM SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Min-Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>46-55%</td>
</tr>
<tr>
<td>Zr</td>
<td>25-40%</td>
</tr>
<tr>
<td>Al</td>
<td>1.5% max</td>
</tr>
<tr>
<td>Cr</td>
<td>0.5% max</td>
</tr>
<tr>
<td>Mn</td>
<td>0.5% max</td>
</tr>
</tbody>
</table>

Packing:

- Drums on pallets

Sizing:

- 10-50mm
SILICON CARBIDE (MET GRADE) SPECIFICATION

Chemical Analysis

SiC  88% or 90% min

Packing:

• 1mt bags or
• 25kg bags

Sizing:

• 0-10mm
• 1-10mm
SILICON CARBIDE (REFRACTORY GRADE) SPECIFICATION

Chemical Analysis

SiC  95% min

Packing:

• 1mt bags

Sizing:

• 0-1mm
• 1-3mm
• 3-5mm
MANGANESE ALLOYS

Manganese is the twelfth most abundant metal found within the Earth’s crust and derives its name from the Latin word Magnes which means Magnet. It is the fourth most used metal in terms of quantity behind iron, aluminium and copper. It was first used in the steel industry in Ancient Greece, the presence of manganese in the iron ore is most likely the reason that the weapons made by the Spartans were superior to their enemies. It was first isolated and recognised as an element in 1771 by a Swedish chemist called Scheele.

USES OF MANGANESE

Approximately 90% of all manganese consumed worldwide goes into the steel industry as an alloying element, and because of its relatively low price and technical benefits it has no real substitute. Apart from its uses in industry, trace amounts of manganese are very important to good health. It makes bones strong but flexible and it aids the body in absorbing Vitamin B12. It also acts as an important activator for the body to use enzymes. Manganese also has important uses in aluminium as an alloying element. It is a versatile addition to copper alloys and its largest non-metal application is in the form of portable dry batteries. It also has chemical applications and is used as a ceramic and brick colourant.

PROPERTIES OF MANGANESE

Widespread use of manganese in steel making began in the UK and France at the beginning of the 19th Century. At the time it was noted that manganese increased the hardness of iron without a reduction in its malleability or toughness. In modern steelmaking manganese is added in the form of manganese alloys because of its sulphur fixing, deoxidising and alloying properties. Nearly all steels contain some manganese, in proportions that vary from 0.05% to as high as 12%. There are numerous grades of steel each requiring a different amount of manganese. The average consumption of manganese is approximately 7-10kgs of manganese per ton of steel.
MANGANESE ALLOYS

PRODUCTION OF MANGANESE ALLOYS

Production of manganese ferro alloys is dominated by China, accounting for nearly half of worldwide production from a combination of domestic low grade manganese ores and imported high grade ores. Total worldwide production of manganese alloys peaked in 2008 at approximately 15 million tons, mostly as Silico Manganese and Ferro Manganese, with a number of higher grade alloys produced in lower volumes making up the difference. The various grades offered by Westbrook Resources Ltd are listed below.

FERRO MANGANESE

Ferro Manganese is produced by reduction of Manganese Oxide in blast furnaces or electric furnaces. It is a very flexible process in that the slags can be reprocessed into Ferro Silico Manganese which in turn can be further refined into Medium and Low Carbon Ferro Manganese. Ferro Manganese was invented in 1860 by Sir Henry Bessemer as a way to add Manganese during steel making with the advantage that a combination of Iron and Manganese Oxide results in a lower melting point for the alloy Ferro Manganese compared to pure Manganese Oxide. Standard Ferro Manganese (or High Carbon Ferro Manganese) is a commonly used alloy produced by the reduction of manganese ore in the presence of carbon. Typically it contains 75% manganese and 7% carbon. Worldwide production of Ferro Manganese in 2008 was approximately 4.5 million tons, with China being the world’s largest producer.
MANGANESE ALLOYS

SILICO MANGANESE

Silico Manganese is produced depending on the resources available, either from silicious manganese ores or from manganese rich slags that are a by-product of Ferro Manganese production. It is used in its own right as an additive in the steel industry as a deoxidant or utilised in the production of other manganese alloys.

Silico Manganese was first produced in the early 20th Century when Calcium Carbide furnaces were reconverted to produce ferro alloys. The typical chemistry of Silico Manganese is Manganese 65%, Silicon 14%-16%, and Carbon 2% or lower. Worldwide production of Silico Manganese exceeds that of Ferro Manganese of all grades and totals approximately 7.5 million tons.

Silicon reduces the solubility of carbon in manganese alloys so carbon contents are inversely proportional to the silicon content. Therefore Silico Manganese is also used as an intermediary product for further processing into refined lower carbon ferro manganese grades.

MEDIUM AND LOW CARBON FERRO MANGANESE

When liquid Silico Manganese is reacted with Manganese Ore or a high MnO rich slag, the silicon is oxidised increasing the Mn content of the alloy without an increase in the carbon content. This method is commonly used in South Africa to produce grades of refined (Medium and Low Carbon) Ferro Manganese with Mn 75%-80% and higher with varying carbon contents from 0.1% to 2%. The price of the alloys increases as the carbon content is reduced and unlike standard Ferro Manganese is usually sold per unit of manganese contained.
LOW CARBON FERRO MANGANESE SPECIFICATION

Chemical Analysis

Mn  85-98%
C   0.15% max

Packing:

• Drums on pallets

Sizing:

• 10-50 mm
• 5-50 mm
MEDIUM CARBON FERRO MANGANESE SPECIFICATION

Chemical Analysis

Mn  78-85%
C   1.5% max
Si  1% max
P   0.2% max
S   0.05% max

Packing:

• Drums on pallets

Sizing:

• 5-50mm
• 10-50mm
HIGH CARBON FERRO MANGANESE SPECIFICATION

Chemical Analysis

Mn  70% min (typically 75%)
C   8% max
Si  0.5% max
P   0.2% max
S   0.05% max

Low P available on request

Packing:

• Drums on pallets
• Bags on pallets

Sizing:

• 5-10 mm
• 5-50 mm
• 10-80 mm
SILICO MANGANESE SPECIFICATION

Chemical Analysis

Mn  65-70%
Si  15% min
C   2% max
P   0.2% max (low P available on request)
S   0.02% max

Packing:

• Big bags on pallets

Sizing:

• 3-10mm
• 5-10mm
• 10-80mm
MANGANESE ORE SPECIFICATION

Chemical Analysis

Mn  22-50%

Packing:

• Bulk
• Bulk bags

Sizing:

• Briquettes
• Lumpy
NITRIDE MANGANESE METAL SPECIFICATION

Chemical Analysis

Mn  89% min
N2  6-8%

Packing:

• 1mt big bags

Sizing:

• Briquettes
Chrome is the twenty first most abundant element in the Earth’s crust, its name is derived from the Greek word Chroma to mean colour due to the many colourful compounds made from it. Chrome does not occur free in nature, rather as the mineral Chromite. Chromite ore was first discovered in the Ural mountains of Russia in 1778 and chrome metal was subsequently isolated by Nicholas Louis Vauquelin in Paris, France in 1797. Initially it was incorrectly identified as being a lead compound due to its metallic red appearance. South Africa has 90% of the world’s economic chrome reserves and produces over 50% of the world's Chromite. Other producers are Kazakhstan and India with increasing amounts being produced in Turkey.

PROPERTIES OF FERRO CHROME

Over 80% of the world’s ferro chrome is utilised in the production of stainless steel, which is defined as a steel alloy with a minimum of 10% chrome by content, the average chrome content being 18%. Stainless steel depends on chrome for its appearance and its corrosion resisting properties. High Carbon Ferro Chrome is most commonly used in specialist applications such as engineering steels. Lower carbon ferro chromes are produced in smaller quantities for more specialised applications. A full list of the ferro chrome grades supplied by Westbrook Resources Ltd including Nitrided Ferro Chrome can be found in the adjacent tables.

PRODUCTION OF FERRO CHROME

The two main products of chromite refining are Ferro Chrome and Chrome Metal. For the production of Ferro Chrome the chromite ore is reduced, usually by coal and coke in a high temperature reaction to form the iron-chrome alloy. For production of pure chrome the iron has to be separated from the chrome in a two step roasting and leaching process. Over 80% of the world’s ferro chrome is utilised in the production of stainless steel, which is defined as a steel alloy with a minimum of 10% chrome by content, the average chrome content being 18%. Stainless steel depends on chrome for its appearance and its corrosion resisting properties.
CHROME ALLOYS

HIGH CARBON FERRO CHROME

With a chrome content from 60% minimum, there are several variations on High Carbon Ferro Chrome with carbon contents of:

<table>
<thead>
<tr>
<th>Carbon Contents %</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6% max</td>
<td>for use in engineering steels</td>
</tr>
<tr>
<td>7% max</td>
<td>for use in engineering steels</td>
</tr>
<tr>
<td>8% max</td>
<td>standard foundry material</td>
</tr>
<tr>
<td>8% min</td>
<td>for use in welding applications</td>
</tr>
<tr>
<td>9% min</td>
<td>for use in welding applications</td>
</tr>
</tbody>
</table>

Ferro chrome is often classified by the ratio of chrome to carbon it contains. The vast majority of ferro chrome produced is Charge Chrome. It has a lower Cr:C ratio and is most commonly produced in South Africa for use in stainless steel production. The second largest segment of the market is High Carbon Ferro Chrome which has a higher chrome content, being produced from higher grade chrome ore.

LOW CARBON FERRO CHROME

Low Carbon Ferro Chrome is produced by reducing chrome ore with Ferro Silicon Chromium, typically the chrome contents are minimum 60% with carbon contents ranging from 0.03% to 0.15% sometimes higher depending on the origin. It is used for trimming additions in stainless steel production as well as other specialist applications. It is added by stainless steel producers in the last stages of production to add precise amounts of chrome without affecting the carbon levels. An intermediate-carbon ferro chrome is produced by further refining of Charge Chrome by blowing oxygen and steam through hot molten Charge Chrome to reduce the silicon and carbon levels. Typically the carbon is reduced to below 1.5%.
LOW CARBON FERRO CHROME SPECIFICATION

Chemical Analysis

Cr  60% min
C  0.03% max or 0.06% max or 0.1% max or 0.15% max

Aerospace grade available on request

Packing:

• Drums on pallets

Sizing:

• 5-50mm
• 10-100mm
MEDIUM CARBON FERRO CHROME SPECIFICATION

Chemical Analysis

Cr  50-60%
C  1.5-3% or 2% max or 4-6%

Packing:

• Bags
• Drums on pallets

Sizing:

• 3-35mm
HIGH CARBON FERRO CHROME SPECIFICATION

Chemical Analysis

Cr  60-70%
C   6-8.5%
Si  4% max
S   0.6% max
P   0.4% max

Packing:

• Bulk bags

Sizing:

• 1-15 mm
• 5-10 mm
• 10-50 mm
• 30-50 mm
• 30-60 mm
• 10-100 mm
NITRIDED FERRO CHROME SPECIFICATION

Chemical Analysis

We deal with two grades of material as follows:

Cr  60% min  
N2  3-6%    
C   0.1% max

and

Cr  60% min  
N2  6% min  
C   0.1% max

Packing:

• Drums on pallets

Sizing:

• 10-50 mm  
• 5-100 mm
## Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr</td>
<td>50-60%</td>
</tr>
<tr>
<td>C</td>
<td>6-8%</td>
</tr>
<tr>
<td>Si</td>
<td>6% max</td>
</tr>
<tr>
<td>Mn</td>
<td>0.6% max</td>
</tr>
</tbody>
</table>
Noble metals are resistant to corrosion and oxidation in moist air. Noble alloys have a noble metal content of at least 25%. We trade in the following noble alloys.

- FERRO BORON
- FERRO NIOBIUM
- FERRO MOLYBDENUM
- FERRO TITANIUM
- FERRO TUNGSTEN
- FERRO VANADIUM
- MOLY OXIDE
Ferro Boron is an alloy, which is formed by combining iron and boron. Ferro Boron comes in several grades, although predominantly it is produced in two grades, these being 10% Boron and 17% Boron. Ferro Boron will typically be added to steel to form a very strong, highly durable and specialist steel for use across a variety of applications. Ferro Boron is usually supplied as a powder, making it an easy compound to add to any alloy manufacturing process. Although the uses of Ferro Boron as a steel additive are limited due to the relative high cost of production, it is still considered to be one of the most useful ferro alloys.

PROPERTIES OF FERRO BORON

Ferro Boron as an additive to the production process of amorphous metals will impart several desirable properties to the new alloy. One of the primary benefits of adding Ferro Boron to an alloy is in the fact that it can significantly increase the magnetic susceptibility of the final alloy, making it ideal for the production of Nd-Fe-B magnets. Additionally, the adding of Ferro Boron to an alloy can drastically increase the deep quench ability of the alloy which is finally produced. The final property that will be impacted by Ferro Boron when it is added to an alloy is that it will add a significant wash resistance.
PRODUCTION OF FERRO BORON

A large portion of the global Ferro Boron supply is manufactured in China, India and Turkey. The most basic definition of the Ferro Boron production process would be that a small amount of raw Boron is added to iron to create a ferrous alloy, although the actual methods used are somewhat more complicated. Typically the resulting alloy will be produced as either small nuggets, or as a finer powder, which will be packaged into 50kg, 100kg or even 1000kg units.

USES OF FERRO BORON

Ferro Boron is quite widely used in a variety of applications, although the predominant ones are hot spray painting and in the production of amorphous metals. There have been wide ranging experiments using Ferro Boron to produce prototype steel compounds, many of which were entirely successful, although not suitable for general manufacturing as other forms of steel are cheaper to produce. One of the more advanced uses of Ferro Boron is in the production of magnetic glass, where it will be added to the silicon compound, along with a small quantity of iron, during the initial production process. The most common use of Ferro Boron, aside from the steel industry is in the production of magnets, where it will add significant magnetic susceptibility to the final product.

FERRO BORON MARKET

Although the price of Ferro Boron remains fairly steady, it will often show small peaks and troughs that are in-line with major fluctuations in the price of steel. Although the Ferro Boron market does not follow the steel market entirely, due to the high percentage of Ferro Boron which is used outside of the steel production industry.
FERRO BORON SPECIFICATION

Chemical Analysis

B  17% min
Al  1% max
Si  2% max
C  0.5% max
P  0.05% max
S  0.05% max

Packing:

• Drums on pallets
• 1mt bags on pallets

Sizing:

• 0-2 mm
• 5-30 mm
• 5-50 mm
• 10-30 mm
• 10-50 mm
FERRO NIOBIUM

Ferro Niobium is an alloy, which is formed by combining iron and niobium with a niobium content range of 60-70%. Ferro Niobium is the number one alloying agent used for high-strength low-alloy (HSLA) steel and Ferro Niobium has captured 80% of the world market in HSLA. Ferro Niobium additives to HSLA steel (as well as to stainless steel) can be found in oil and gas pipelines, automotive bodies, tools, ship hulls, railroad tracks and a host of other specialist applications. Since Ferro Niobium can effectively double the strength and toughness, as well as reduce the weight of the alloy, it is a highly desirable compound.

PROPERTIES OF FERRO NIOBIUM

Ferro Niobium is an additive to the production process of amorphous metals, and will impart several desirable properties upon the resulting compound. One of the primary benefits of adding Ferro Niobium to an alloy is in its anti-corrosive properties (better than carbon steel). Additionally, the adding of Ferro Niobium to an alloy can make it more weldable and much stronger. With the addition of other elements such as Zirconium, Ferro Niobium-produced steel is perfect for directionally sensitive applications such as suspension bridges. Most SAE grade steels are Ferro Niobium treated, as Ferro Niobium increases high temperature resistance, corrosion resistance, oxidation resistance, creep resistance, as well as reducing erosion at higher temperatures.
PRODUCTION OF FERRO NIOBIUM

A large portion of the global Ferro Niobium supply is manufactured in Brazil and Canada. The most basic definition of the Ferro Niobium production process would be that the Niobium is first mined from Pyrochlore deposits, and is then processed into Niobium Pentoxide (Nb2O5). This oxide is mixed with iron oxide as well as aluminium, and then reduced in an aluminothermy reaction to Niobium and Iron. The resulting Ferro Niobium is purified by electron-beam melting, or used as is. For alloying with steel, the Ferro Niobium is added to molten steel before casting. Ferro Niobium is usually supplied in powder or briquettes (from 2mm to 50mm), in either bags or steel drums for shipping.

USES OF FERRO NIOBIUM

The largest practical application of Ferro Niobium is in the alloying process of HSLA steel. This steel is then in turn used in automobiles and trucks, bridges, construction cranes, amusement park rides and any other structure that needs to handle a large amount of stress or needs a good strength-to-weight ratio. But other uses of Ferro Niobium are also common. It is used in vacuum-grade products for super alloy applications such as land-based and jet aircraft engine turbine blades.

FERRO NIOBIUM MARKET

The market for Ferro Niobium has traditionally and logically followed the market for HSLA steel, and has also fluctuated with contributing variables: heavyweight construction, the superconductor market, the increase of magnetic levitation and propulsion systems construction, nuclear fusion reactor construction and aircraft production.
FERRO NIOBIUM SPECIFICATION

Chemical Analysis

Nb  63-70%

Low Al grades available

Packing:

• Drums on pallets

Sizing:

• 3-15 mm
• 5-50 mm
• 10-50 mm
FERRO MOLYBDENUM

Ferro Molybdenum is an alloy which is formed by combining iron and Molybdenum. Ferro Molybdenum is a hardening agent and is found in many alloy steels that are heat-treatable. Molybdenum prevents corrosion in stainless steels, and when mixed with iron, the Molybdenum also strengthens and hardens into austenite. Ferro Molybdenum comes in many grades, although predominantly it is produced in just two grades (one for US and one for EU) where the content of pure Molybdenum is between 60% and 75%.

PROPERTIES OF FERRO MOLYBDENUM

Ferro Molybdenum is an additive to the production process of amorphous metals and will impart several desirable properties into the new alloy. One of the primary benefits of adding Ferro Molybdenum to an alloy is its hardening properties that makes steel extremely strong and at the same time weldable, as Molybdenum is one of the top 5 melting-point metals. Additionally, the adding of Ferro Molybdenum to an alloy can increase corrosion resistance. Properties of Ferro Molybdenum make it suitable for a variety of protective films over other metals.

PRODUCTION OF FERRO MOLYBDENUM

A large portion of the global Ferro Molybdenum supply is manufactured in China, USA, Russia and Chile. The most basic definition of the Ferro Molybdenum production process would be that the Molybdenum is first mined and then transformed into Molybdenum (VI) Oxide MoO3. That oxide is mixed with iron oxide and aluminium and then reduced in an aluminothermy reaction. Electron-beam melting then purifies the Ferro Molybdenum, or the product can be packaged as-is. Typically the resulting alloy will be produced as either small briquettes or as a finer powder. Ferro Molybdenum is usually supplied in either bags or steel drums for shipping.
USES OF FERRO MOLYBDENUM

The largest practical applications of Ferro Molybdenum are its use in ferrous alloys, and depending on the molybdenum content range, it is suited for machine tools and equipment, military hardware, refinery tubing, load-bearing parts and rotary drills. Ferro Molybdenum is also used in cars, trucks, locomotives and ships. In addition, Ferro Molybdenum is used in stainless and heat-resisting steels that are employed by synthetic fuel and chemical plants, heat exchangers, power generators, oil-refining equipment, pumps, turbine tubing, ship propellers, plastics and inside acid storage containers. Tool steels, with a high percentage range of Ferro Molybdenum, are used in high-speed machining parts, cold work tools, drill bits, screwdrivers, dies, chisels, heavy castings, ball and rolling mills, rolls, cylinder blocks, piston rings and large drill bits.

FERRO MOLYBDENUM MARKET

The price of Ferro Molybdenum saw a major upturn since the start of WWII and a subsequent drop since the end of WWII. Today the market remains steady, but with a notable dip when Chile entered the market and continued to expand production of Ferro Molybdenum, as well as other alloys. Another factor in the history of the Ferro Molybdenum market was the breakup of the former USSR, where the single system of mining and production was severely disrupted.
FERRO MOLYBDENUM SPECIFICATION

Chemical Analysis

Mo  60-74%
Cu  0.5% max
Si  1.5% max
S   0.1% max
P   0.1% max

Packing:

- Drums on pallets
- 1mt bags

Sizing:

- 1-5 mm
- 5-50 mm
MOLYBDENUM OXIDE SPECIFICATION

Chemical Analysis

Mo  57% min

Packing:

• Drums on pallets

Sizing:

• Briquettes
FERRO TITANIUM

Ferro Titanium is used by stainless steel makers as a stabiliser to prevent chromium carbide forming at grain boundaries and in the production of low carbon steels for sheet production.

Titanium is named from the Latin word 'titan', being the first sons of the Earth. We manufacture Ferro Titanium in Sheffield, England, exporting materials to steelworks and foundries around the world on spot, formula and consignment stock basis.

Ferro Titanium is manufactured by melting titanium scrap (sponge, chips and solids) with iron in an induction furnace. We source titanium scrap worldwide from ISO 9001:2000 certified suppliers. Titanium scrap is mainly generated in machine shops, forge shops and fabricators. We have an extensive scrap processing operation to identify and control titanium scrap. All raw material is analytically tested by an independent assayer before despatch to the production plant. The ingot is tested and then verified after crushing to ensure accuracy of analysis.

Ferro Titanium is predominately sold via our subsidiary company, Westbrook Light Alloys Ltd.
FERRO TITANIUM SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti</td>
<td>68-77%</td>
</tr>
<tr>
<td>Al</td>
<td>5% max</td>
</tr>
<tr>
<td>V</td>
<td>3% max</td>
</tr>
<tr>
<td>Si</td>
<td>0.5% max</td>
</tr>
<tr>
<td>Sn</td>
<td>0.5% max</td>
</tr>
<tr>
<td>N₂</td>
<td>0.5% max</td>
</tr>
<tr>
<td>C</td>
<td>0.2% max</td>
</tr>
<tr>
<td>S</td>
<td>0.05% max</td>
</tr>
<tr>
<td>P</td>
<td>0.05% max</td>
</tr>
</tbody>
</table>

Packing:

- 1mt bags
- To your specification

Sizing:

- 0-2 mm
- 2-10 mm
- 5-30 mm
- 10-50 mm
TITANIUM SPONGE SPECIFICATION

Chemical Analysis

Ti  97.75% min  
Fe  1.9% max  
C   0.1% max  
N   0.1% max  
Cl  0.15% max  
O   0.1% max  

Packing:

• Drums on pallets

Sizing:

• 0-2 mm  
• 12-25 mm  
• 12-70 mm
FERRO VANADIUM

Ferro Vanadium is an alloy which is formed by combining iron and vanadium with a vanadium content range of 35%-85%. Ferro Vanadium is a universal hardener, strengthener and anti-corrosive additive for steels like high-strength low-alloy (HSLA) steel, tool steels, as well as other ferrous-based products. Ferro Vanadium was first used in the production of the Ford Model T and is still used in the automobile industry today.

PROPERTIES OF FERRO VANADIUM

Ferro Vanadium, as an additive to the production process of ferrous metals, will impart several desirable properties upon the resulting new compound. One of the primary benefits of adding Ferro Vanadium to an alloy is its stability against alkalis as well as sulphuric and hydrochloric acids. Additionally, the adding of Ferro Vanadium to an alloy can result in a steel product less susceptible to corrosion of any type. Ferro Vanadium is also used to reduce weight while simultaneously increasing the tensile strength of the material.
PRODUCTION OF FERRO VANADIUM

A large portion of the global Ferro Vanadium supply is manufactured in USA, China and Russia. The most basic definition of the Ferro Vanadium production process would be that the production of Ferro Vanadium employs an electric-arc furnace where scrap iron is melted first and then combined with a mixture of aluminium (V2O5), as well as flux (such as calcium oxide or calcium fluoride). The purification of Ferro Vanadium cake is by means of the Crystal Bar process (Jan Hendrik de Boer). Ferro Vanadium is usually supplied in 25lb bags in pallet boxes or shrink-wrapped on pallets or in super bags containing 1mt or 3,000lbs, or in 500lb drums.

USES OF FERRO VANADIUM

The largest practical application of Ferro Vanadium is in the alloying process of any hardened steel. That steel is then, in turn, used in gears, axles, crankshafts, bicycle frames and other highly critical steel components. Ferro Vanadium forms stable carbides and nitrides that will result in a significant increase in strength. High-carbon steel alloys (HSS) with a vanadium content range of 1%-5% is used for high-speed tool steels as well as in surgical tools and instruments. Ferro Vanadium also stabilises the beta form of titanium, which in turn increases the temperature stability of titanium. Mixed with aluminium in titanium alloys, Ferro Vanadium is also used in high-speed airframes and jet engines.
FERRO VANADIUM SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Minimum/Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>78-85%</td>
</tr>
<tr>
<td>C</td>
<td>0.25% max</td>
</tr>
<tr>
<td>Si</td>
<td>1.5% max</td>
</tr>
<tr>
<td>S</td>
<td>0.05% max</td>
</tr>
<tr>
<td>P</td>
<td>0.1% max</td>
</tr>
<tr>
<td>Al</td>
<td>1.5% max</td>
</tr>
</tbody>
</table>

Packing:

- Drums on pallets

Sizing:

- 5-50mm
NOBLE ALLOYS

FERRO TUNGSTEN

Ferro Tungsten is an alloy, which is formed by combining iron and tungsten with a tungsten content range in two grades (A and B) and the content ranges are 75%-82% and 70%-75% respectively. Ferro Tungsten is a remarkably robust alloy because of its high melting point, tungsten has the second highest melting point after carbon. By combining iron with tungsten, the tendencies towards brittleness are overcome from the raw state of tungsten, and Ferro Tungsten is often a major component of popular super alloys.

PROPERTIES OF FERRO TUNGSTEN

Ferro Tungsten as an additive to the production process of ferrous metals will impart several desirable properties upon the new alloy. One of the primary benefits of adding Ferro Tungsten to an alloy is to increase the alloy’s melting point, making it suitable for aerospace applications as well as welding applications. Additionally, by adding Ferro Tungsten to an alloy, one can take advantage of tungsten’s unique electrical capabilities as a conductor. For example, tungsten is used in field emission guns like electron microscopes and in IC chips, as well as metallic films that can replace conventional copper wiring.
PRODUCTION OF FERRO TUNGSTEN

A large portion of the global Ferro Tungsten supply is manufactured in China, Bolivia, Portugal and Russia. Tungsten is found in these minerals: wolframite, scheelite, ferberite and hübnerite. The most basic definition of the Ferro Tungsten production process would be that the minerals are mined and converted to tungsten oxide and then heated with hydrogen or carbon to produce a powdered form that is mixed with iron. Ferro Tungsten is usually supplied in particles between 5mm and 100mm and in steel drums of 100kgs each.

USES OF FERRO TUNGSTEN

A good example of Ferro Tungsten usage is in high-speed steel, which may contain as much as 18% pure tungsten. These super alloys that employ Ferro Tungsten are used in the production of turbine blades and other wear-resistant coatings and parts. Other applications requiring the high density of Ferro Tungsten alloys are heat sinks, counter weights, ballast keels, commercial aircraft tail ballast, and NASCAR and Formula 1 car ballast. In armaments, Ferro Tungsten is used in kinetic energy penetrators as an alternative to depleted uranium, but is also used in projectiles and grenades to create super-sonic shrapnel. Ferro Tungsten is also used in the manufacture of game darts for the popular bar game (the Ferro Tungsten creates darts yielding smaller diameters, thus tighter groupings during play). Ferro Tungsten is also found in fishing lures (as the Ferro Tungsten alloy beads sink rapidly).
FERRO TUNGSTEN SPECIFICATION

Chemical Analysis

W    74-80%
C    0.25% max
Si   2% max
Mn   0.5% max

Packing:

• Drums on pallets
• 1mt bags on pallets

Sizing:

• 5-50 mm
• 10-50 mm
NICKEL & NICKEL ALLOYS

NICKEL

Nickel is a transition metal and naturally occurs extensively in the earth’s crust although the majority of it lies within the earth’s core so cannot be mined. It is a silvery-white lustrous metal & is the fifth most common element on earth. Nickel occurs most often with Iron and is commonly found in iron meteorites as the alloys kamacite and taenite.

The bulk of the Nickel mined comes from two types of ore deposits; laterites and magmatic sulphide deposits. Nickel was first classified as a chemical element in 1751.

PROPERTIES OF NICKEL

Nickel is resistant to corrosion (due to its slow rate of oxidation at room temperature) and to most acids except nitric acid. It has a high melting point and is very ductile. It is also magnetic at room temperature.

PRODUCTION OF NICKEL

The largest producers of Nickel are Russia, Canada, Australia, Indonesia and the Philippines and Australia is considered to have the largest reserves. Nickel is extracted from its ores by extractive metallurgy including conventional roasting and reduction processes that yield a metal of greater than 75% purity. It can then be further purified using pyrometallurgical methods and then further refined to a final Nickel concentration of over 99% by removing copper by adding hydrogen sulphide and removing cobalt by solvent extraction.
USES OF NICKEL

The first uses of Nickel date back to ancient times (as far back as 3500BC) and was referred to as a “white copper” until it was recognised as a separate element.

The biggest use of Nickel is in alloying - particularly with chromium and other metals to produce stainless and heat-resisting steels. These are used for pots and pans, kitchen sinks as well in buildings, food processing equipment, medical equipment and chemical plants.

About 65% of the nickel which is produced is used to manufacture stainless steels. Another 20% is used in other steel and non-ferrous alloys - often for highly specialized industrial, aerospace and military applications. About 9% is used in plating and 6% in other uses, including coins, electronics, and in batteries for portable equipment and hybrid cars. In many of these applications there is no substitute for nickel without reducing performance or increasing cost.

As a chemical compound, Nickel is also an essential nutrient for plants and it is found naturally in most vegetables, fruits and nuts.

NICKEL ALLOYS

Any alloy containing Nickel as the chief alloying element or as the base metal is a Nickel Alloy. It used to raise the melting point of copper alloys and is added to brasses and bronzes for the colour effect and for toughening and strengthening the alloys. Nickel is added to both ferrous and non-ferrous alloys to produce heat-resistant and acid resistant metals.
NICKEL SPECIFICATION

Chemical Analysis

Ni  99.8% min

Packing:

• Drums on pallets
• 25kg bags

Sizing:

• 2”x2” cathode
• 4”x4” cathode
• Pellets
NICKEL MAGNESIUM 1A SPECIFICATION

Chemical Analysis

Ni  80-85%
Mg  15-17.5%
Si  2% max
C   0.5% max or 2% max
Fe  1% max

Packing:

• Drums on pallets

Sizing:

• 10-30mm
• 10-65mm
NICKEL MAGNESIUM 1M SPECIFICATION

Chemical Analysis

- Ni 80-85%
- Mg 15-17.5%
- Si 2% max
- C 2% max
- Fe 1% max
- Ce 0.5% max

Packing:

- Drums on pallets

Sizing:

- 10-30mm
- 10-65mm
Chemical Analysis

Ni  95% min
Mg  4-5%

Packing:

• Drums on pallets

Sizing:

• 800g half round pieces
Chemical Analysis

Ni  58% min
Mg  4-5%
Fe  33-35%

Packing:

• Drums on pallets

Sizing:

• Broken waffles
NICKEL BORON SPECIFICATION

Chemical Analysis

B  17% min
Ni  82% min

Packing:

• Drums on pallets

Sizing:

• 1-30mm
NICKEL CALCIUM SPECIFICATION

Chemical Analysis

Ni  93% min
Ca  5-6%

Packing:

• Drums on pallets

Sizing:

• 800g half round pieces
NICKEL NIOBIUM SPECIFICATION

Chemical Analysis

Nb  45-70%

Packing:

• Drums on pallets

Sizing:

• 3-50mm
NICKEL VANADIUM SPECIFICATION

Chemical Analysis

V 60% min

Packing:

• Drums on pallets

Sizing:

• 4-50mm
OUR SERVICE

We offer an extensive range of Nickel Alloys and Stainless Steel in plate or bar form with varying thicknesses, which can be cut to size using state of the art laser cutting to tight dimensional tolerances and to customers own drawings.

Our range of Nickel Alloys and the varying thicknesses we stock are listed below although other sizes are available:

PLATE

<table>
<thead>
<tr>
<th>Material Grade</th>
<th>Plate size</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2500 x 1250</td>
<td>1.2mm</td>
</tr>
<tr>
<td>Alloy 330</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Alloy 601</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Alloy 600</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Alloy 625</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Alloy 800H/HT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alloy 718</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alloy X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>310 Stainless</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>321 Stainless</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>410 Stainless</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>446 Stainless</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Other grades of material are also available. Please call our York office for availability and lead times. A wide range of offcuts are also available.
# Nickel Alloy & Stainless Steel Plate & Bar

## BAR

<table>
<thead>
<tr>
<th>Material Grade</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.5mm</td>
</tr>
<tr>
<td>Alloy 330</td>
<td>✓</td>
</tr>
<tr>
<td>Alloy 601</td>
<td></td>
</tr>
<tr>
<td>Alloy 600</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ indicates availability at the specified diameter.
CALCIUM ALLOYS

Calcium alloys are an important compound used in several large scale manufacturing processes. Although there are many permutations for creating calcium alloys, the main types produced are Lead Calcium Alloy, Lead Calcium Tin Alloy and Magnesium Calcium Alloy. Small amounts of copper or sulphur are often added to improve the casting properties and make the alloy less corrosive. Other, less common calcium alloys include Calcium Aluminium Alloy and Calcium Silicon Alloy.

Originally research into calcium alloys began in 1975, and between 1975 and 1980 the production of calcium alloys was underway. Calcium alloys of this kind are primarily used in the manufacturing of batteries and other electrical components that require similar electrodes.

Calcium alloys exhibit a fairly low mechanical strength. However, considering the applications for which they are mostly used (internal parts for large batteries), this is not usually an issue. The actual grain structure of calcium alloys, which are produced during the manufacturing process, is what makes them such a good anti-gassing compound when used in battery production. Most calcium alloys are also fairly lightweight and have a very high thermal resistance. The primary property of calcium alloys is exceptional energy transfer capability. Good quality calcium alloys can conduct electricity very efficiently.
CALCIUM ALLOYS

PRODUCTION OF CALCIUM ALLOYS

A very large percentage of the global calcium alloy supply is manufactured in developing economic nations such as China and India, although a significant quantity is also produced in the USA. Calcium alloy is produced by combining calcium with one of several secondary materials, which include magnesium, lead, tin and aluminium. Typically, the alloy produced will be cast into small ingots, which can then be added to a further manufacturing process quite easily. Actual quantities sold are quite small, as only a small amount of calcium alloys are used in the manufacturing process of the primary items made from it, namely deep cycle batteries.

USES OF CALCIUM ALLOYS

Calcium alloys such as tin calcium alloy and lead calcium alloy are primarily used in batteries, or other electrical equipment which requires a compound with exceptional energy transfer properties. The main use of calcium alloys is in the manufacturing of electrode grids in automotive batteries. Until several decades ago, antimony was used to manufacture these electrode grids, but during the early 1980s, calcium alloys became the materiel of choice for battery manufacturers. This resulted in longer lasting batteries, which discharge more evenly, and are able to be recharged many more times than the older antimony type batteries.
CALCIUM SILICO MANGANESE SPECIFICATION

Chemical Analysis

Ca  14-18%
Si  49% min
Mn  14-18%
Al  1.5% max
S   0.05% max
P   0.05% max

Packing:

• Drums on pallets

Sizing:

• 2-7mm
• 5-60mm
• 20-60mm
CALCIUM SILICIDE SPECIFICATION

Chemical Analysis

Ca  30% min  
Si  60% min  
C   1% max    
Al  1% max    
S   0.05% max  
P   0.05% max  

Packing:

• Drums on pallets

Sizing:

• 2-10mm
• 10-50mm
PURE METALS

SILICON METAL

Silicon Metal is known as a semi-metallic or metalloid, having several of the characteristics of metals. It is the second most abundant element in the Earth’s crust after oxygen, naturally occurring in various forms of silicon dioxide or silicates and very rarely in its pure form in volcanic exhalations. It takes its name from the Latin Silicus, which means flint.

Silicon can be found in the form of sand, quartz, rock crystal, amethyst, agate, flint and opal as an oxide.

Granite, asbestos, feldspar, clay, mica are a few examples of the numerous silicate materials. Silicon is abundant, relatively easy to mine and is one of Man’s most useful elements.

PROPERTIES OF SILICON METAL

Most metallurgical silicon metal is used as an alloying agent in the aluminium industry due to its ability to increase the strength of aluminium. Demand from the aluminium industry has grown steadily in recent years due to increased usage of aluminium in structural engineering, aircraft manufacture and the automotive industry. Aluminium alloys are lighter and more resistant to corrosion than carbon-steel and can be made by addition of metals such as copper, zinc, magnesium, manganese as well as silicon.
PRODUCTION OF SILICON METAL

On a commercial scale metallurgical silicon metal is produced by the carbothermic reaction of silica (quartz) in an electric arc furnace using carbon electrodes where the temperature in the main reaction zone exceeds 1800ºC. Commercially produced metallurgical grade silicon metal is typically Si 98% pure and is notably produced in China, Russia, Brazil, Norway, South Africa and USA.

USES OF SILICON METAL

Adding silicon metal to aluminium alloys makes them strong and light. As a result they are increasingly used in the automotive industry to replace heavier cast iron components. This allows weight reductions, a reduction in fuel consumption, increased efficiencies and subsequent benefits to the environment by reducing the greenhouse gas emissions and conserving fossil fuels.

There is increasing demand for silicon metal used in the manufacture of solar panels, currently a buoyant industry. Silicon based polymers are also used as alternatives to hydrocarbon based products. They can appear in many every day products such as lubricants, greases, resins, skin and hair products. Another common use of silicon is silicon chips, produced from semi-conductor grade silicon, which are components used in many every day electronic devices.
SILICON METAL SPECIFICATION

Chemical Analysis

Si  98.5% min
Al  0.4% max
Fe  0.4% max
Ca  0.1% max

Packing:

• 700kg – 1.2MT bulk bags
• 25kg bags
• Drums on pallets

Sizing:

• 0-0.5mm
• 0-1mm
• 0.5-6mm
• 0-2mm
• 0-5mm
• 0-8mm
• 2-10mm
• 1-12mm
• 10-100mm
• 200 mesh
MOLYBDENUM BAR SPECIFICATION

Chemical Analysis

Mo  99.7% min

Packing:

• Drums on pallets

Sizing:

• Bars
MANGANESE METAL SPECIFICATION

Chemical Analysis

Mn  99% min

Packing:

• 1mt bags

Sizing:

• Flakes
CHROME METAL SPECIFICATION

Chemical Analysis

Cr  99% min  
Si  0.3% max  
Fe  0.3% max  
Al  0.3% max

Packing:

• Drums on pallets

Sizing:

• 3-50 mm  
• 5-50 mm
COPPER SPECIFICATION

Chemical Analysis

Cu  99.7% min

Packing:

• 1 mt Bags
• 250kg bags
• Drums

Sizing:

• Granules
• Punchings
• Wire
Chemical Analysis

Al 97% min

Packing:

- 1mt bulk bag
- Palletised
- Drums

Sizing:

- Pellets
- 2kg notch bars
- 5kg ingots
- Sticks
- Stars
- Pebbles
COBALT SPECIFICATION

Chemical Analysis

Co 99% min

Packing:

• Bags

Sizing:

• Briquette
TIN SPECIFICATION

Chemical Analysis

Sn  99% min

Packing:

• 25kg bags
• 250kg drums

Sizing:

• Sticks
• Pellets
LEAD SPECIFICATION

Chemical Analysis

Pb  99% min
Chemical Analysis

Bi   99% min

Packing:

• Bags

Sizing:

• 5g pellets
• 10g pellets
Chemical Analysis

Mg  99% min
CERIUM MISCHMETAL SPECIFICATION

Chemical Analysis

TRE 98% min
Ce 50% of TRE

Packing:

• Drums

Sizing:

• 30g pieces
IRON BILLET SPECIFICATION

Chemical Analysis
Fe  99% min

Packing:
• 1mt big bags

Sizing:
• 300mm bars (70-80)
We offer a range of alloying briquettes with varying specifications. Please call for further information.

The following briquettes are available:

- Moly oxide briquettes
- Silicon briquettes
- Manganese briquettes
- Chrome briquettes
- Silico Manganese briquettes
PIG IRON

PIG IRON

Pig iron is produced from the first smelting of iron ore. The melt of the blast furnace is run off into rectangular moulds, traditionally in a branching structure running off a central runner with the moulds at right angles to each other. This configuration is similar to piglets suckling on a sow, hence the ingots are referred to as pigs.

Pig iron is either sand-cast or machine-cast. When it is sand-cast, it has sand adhering and fused into the surface giving more slag in the melting. Machine-cast pig iron is cast in steel forms and has a fine-grained chilled structure, with a lower melting point.

PROPERTIES OF PIG IRON

Pig iron has a high carbon content, typically 3.5% - 4.5% along with small percentages of silicon, sulphur, manganese and phosphorous. This makes it brittle and only really useful for resmelting to make cast iron, wrought iron or, nowadays, steel.

USES OF PIG IRON

Pig iron can also be used to produce gray iron and high purity pig irons can be used to produce ductile iron.

In modern steelmaking, pig iron/slag is transferred, in liquid form referred to as “hot metal”, from the bottom of the blast furnace into a steel-making vessel, typically with an electric arc furnace, induction furnace or basic oxygen furnace by burning off the excess carbon and adjusting the alloy composition.

We offer hermatite/foundry grade pig iron and basic/steel making grade pig iron.
Ferro Aluminium is an alloy which is formed by combining iron and aluminium. Ferro Aluminium is primarily used as a de-oxidation agent for steel, as well as for moulding in combination with scrap copper and carbon steel. For example, when Ferro Aluminium alloy is melted and poured into moulds containing scrap, the mixture becomes very fluid and flows into the interstices between spatially arranged pieces of scrap. So, while the matrix alloy is actually a 65% aluminium alloy, it has the properties of a 40% alloy in terms of density.

Properties of Ferro Aluminium

Ferro Aluminium as an additive to the production process of amorphous metals will impart several desirable properties upon the resulting alloy. One of the primary benefits of adding Ferro Aluminium to an alloy is to increase the new alloy’s sensitivity to heat. When a low melting point is needed, or when a high degree of combustibility is needed, more Ferro Aluminium is added. Additionally, Ferro Aluminium as Ferro Aluminium Thermite is an agent, that when ignited and mixed, can give off super extreme amounts of heat. Although this reactant is stable at room temperature, it will burn via an extremely intense exothermic reaction.
ALUMINIUM

PRODUCTION OF FERRO ALUMINIUM

A large portion of the global Ferro Aluminium supply is manufactured in countries where electric power is cheap and plentiful: Australia, China, Russia, USA and Canada. The most basic definition of the Ferro aluminium manufacturing process would be that the aluminium is produced from synthetic cryolite or bauxite and then transformed into Al2O3 through electrolysis (the Bayer Process). The resulting oxide is then mixed with iron oxide. The Ferro Aluminium is then purified, or can be packaged as is. Ferro Aluminium comes in several grades, where the content of pure Ferro Aluminium is between 30% and 75%. Ferro Aluminium is usually supplied in powder, granules or pieces.

USES OF FERRO ALUMINIUM

The largest practical applications of Ferro Aluminium are its use in ferrous alloys, and depending on the aluminium content range, use is best suited for deoxidisation, welding electrode manufacture and hard limited facing applications. In addition, Ferro Aluminium is used in Ferro Aluminium Thermite that is used in turn to cut or to weld metal. Ferro Thermite is made from 75% iron oxide plus 25% aluminium oxide. The iron oxide of Thermite is not rust (Fe2O3) but iron scale (Fe3O4) oxide. The chemicals are thoroughly mixed together and then compressed into a suitable container. A first-fire mix is then used to ignite the mixture. This reaction is used in welding applications, like the one used to join rail tracks in place. Thermites that employ Ferro Aluminium are pyrotechnic initiators, such as fireworks.
FERRO ALUMINIUM SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>35-40%</td>
</tr>
<tr>
<td>Cu</td>
<td>0.1-1%</td>
</tr>
<tr>
<td>Si</td>
<td>0.15-1%</td>
</tr>
<tr>
<td>Mn</td>
<td>0.5% max</td>
</tr>
<tr>
<td>C</td>
<td>0.1% max</td>
</tr>
</tbody>
</table>

Packing:

- 1mt big bags

Sizing:

- Standard pyramids
ALUMINIUM DEOXIDANTS SPECIFICATION

Chemical Analysis

Al  96% min or 99% min

Packing:

• On pallets

Sizing:

• 1kg bar
• 2kg bar
• 5kg bar
• Stars
• 1lb sticks
MISCELLANEOUS PRODUCTS

FERRO SULPHIDE

Ferro Sulphide comes in two types: Iron (III) \((\text{Fe}_2(\text{SO}_4)_3)\), and Iron (II) \((\text{FeSO}_4)\). Ferrous Sulphate compounds are the by-products of the steel finishing process. Prior to coating and plating, steel sheets are passed through pickling baths of sulphuric acid, and then Ferro Sulphide is produced. This by-product can then be used in other manufacturing processes, such as in the reduction of chromate during cement production. Ferro Sulphide can also be used to stain concrete, limestone and sandstone a rust colour (produces a yellowish tint). Woodworkers use Ferro Sulphide solutions to colour maple woods with a silvery hue.

PROPERTIES OF FERRO SULPHIDE

Ferro Sulphide of the Iron (III) variety is yellow in colour and a rhombic crystalline salt that is soluble in water at room temperature. Iron (II), when heated, first loses its water (crystallisation) and then the original green crystals convert to ones that become a dirty-yellow solid. When heated further the solid material releases sulphur dioxide, leaving the reddish-brown iron (III) oxide. Decomposition of the Iron (II) sulphate begins at about 480°C.
MISCELLANEOUS PRODUCTS

PRODUCTION OF FERRO SULPHIDE

During the steel finishing process (prior to the coating and plating) when the steel sheets are passed through pickling baths of sulphuric acid, the liquid heptahydrate of Ferro Sulphide (also called copperas or green vitriol), loses water to form the colourless monohydrate solid. Ferro Sulphide is produced by reactions of sulphuric acid in a hot solution of ferrous sulphate in conjunction with an oxidising agent (such as hydrogen peroxide or nitric acid). The production grade ferrous sulphate is packaged in dry short tons as well as in liquid form, usually packed in 55 gallon drums.

USES OF FERRO SULPHIDE

Ferro Sulphide, in alternate forms, is used for dyeing several base materials including wood and stone, and as a coagulant for industrial wastes. Ferro Sulphide is used in pigments and in the pickling baths for aluminium and steel. In medical applications, it is used as an astringent and styptic. Other uses include (in its dry form), animal feed, water treatment, fertiliser and catalysts.

In its moist form uses include iron oxide, water treatment, and catalysts. Together with other iron compounds, ferrous sulphate is used to fortify foods and to treat iron-deficiency anaemia. It has also been applied in the purification of water by flocculation and for phosphate removal in municipal and industrial sewage treatment plants. Other uses include treating wood panels on residential houses.
## FERRO SULPHIDE SPECIFICATION

### Chemical Analysis

<table>
<thead>
<tr>
<th></th>
<th>Sulphide 30</th>
<th>Sulphide 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>28-33%</td>
<td>45-52%</td>
</tr>
<tr>
<td>Fe</td>
<td>65% min</td>
<td>42% min</td>
</tr>
<tr>
<td>Si</td>
<td>0.5% max</td>
<td>2% max</td>
</tr>
<tr>
<td>Cu</td>
<td>0.01% max</td>
<td>0.01% max</td>
</tr>
</tbody>
</table>

### Packing:

- 1mt big bags

### Sizing:

- 2-10mm
- 10-50mm
- 20-40mm
MISCELLANEOUS PRODUCTS

FERRO PHOSPHOROUS

Ferro Phosphorus exists in many allotropic forms. Phosphorus (white) is used by the military for smoke generation as well as being used in commercial rodent poison. Red Phosphorus, which is comparatively harmless, is used in matchsticks. When combined with Lithium Iron, this material is used in the production of rechargeable batteries. Ferro Phosphorus, a combination of phosphorus with iron, is used as an ingredient in high-strength low-alloy steel and is used as a good dehydrating agent that can remove water during the alloy formation.

PROPERTIES OF FERRO PHOSPHORUS

Ferro Phosphorus, as an additive to the production process of ferrous metals, will impart several desirable properties upon the resulting alloy. One of the primary benefits of adding Ferro Phosphorus is that it will act as a drying agent which will remove water content from any nitric acid used during manufacturing. Additionally, adding Ferro Phosphorus to an alloy prevents oxidation and the later rusting of metals.
MISCELLANEOUS PRODUCTS

PRODUCTION OF FERRO PHOSPHORUS

Ferro Phosphorus is a by-product of the steel manufacturing process, as when pig iron is being converted, the conversion process will skim Ferro Phosphorus from the top of the slag. This was first done using the basic Bessemer process or the Thomas process.

USES OF FERRO PHOSPHORUS

By keeping varied amounts of Ferro Phosphorus in the process, the metal can be made more brittle if desired. For example, the use of phosphorus as an alloying element in powder metallurgy has been around since 1939. Sintered steel alloy with Ferro Phosphorus has improved strength, as compared to unalloyed sintered steel. Recent developments in Ferro Phosphorus powder has allowed sintered steels to have high strengths in combination with good ductility. Ferro Phosphorus is also used as a manufacturing drying agent.
FERRO PHOSPHORUS SPECIFICATION

Chemical Analysis

P  23% min
Si  1.5% max

Packing:

• 1mt bags

Sizing:

• 5-25mm
• 10-50mm
• 10-80mm
• 20-80mm
MISCELLANEOUS PRODUCTS

GRAPHITE

Graphite is an allotrope of Carbon. It is found naturally in veins in rocks and always contains some impurities. It comes in two forms; foliated and amorphous. Foliated graphite is infusible, a good conductor of heat and electricity, is resistant to acids and alkalies and is readily moulded. Amorphous graphite occurs as fine particles and is the result of thermal metamorphism of coal – the last stage of coalification. Crystalline graphite or flake granite contain a high graphite content and occur as flat, plate-like hexagonal particles.

Graphite is often purified at high temperatures to free it of silicon, calcium, aluminium and manganese and treated with a freon gas to eliminate boron and vanadium.

Graphite is commonly used as a lubricant, as “lead” in pencils, batteries, steelmaking, brake linings, foundry facings, and by refractories.

CERIUM MISCHMETAL

Cerium Mischmetal, also known simply as Mischmetal contains a combination of rare earth metals – predominantly Cerium and Lanthanum.

It is widely used to make Ferro Silicon Magnesium and in the preparation of virtually all rare earth elements. It is also used to produce ferrocerium which produces hot sparks and is used as the “flint” ignition device of many lighters and torches.
GRAPHITE SPECIFICATION

Chemical Analysis

C  99% min

Packing:

• 25kg bags

Sizing:

• Granules
FERRO ZIRCONIUM SPECIFICATION

Chemical Analysis

Zr  73-80%
Sn  1.5% min

Packing:

• Drums

Sizing:

• 0-50mm
CHROMITE SAND SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{Cr}_2\text{O}_3 )</td>
<td>46% min</td>
</tr>
<tr>
<td>( \text{SiO}_2 )</td>
<td>1% max</td>
</tr>
<tr>
<td>( \text{FeO} )</td>
<td>30% typ</td>
</tr>
<tr>
<td>Cr:Fe Ratio</td>
<td>1.5:1 typ</td>
</tr>
<tr>
<td>( \text{CaO} )</td>
<td>0.5% typ</td>
</tr>
<tr>
<td>( \text{MgO} )</td>
<td>10.5% typ</td>
</tr>
<tr>
<td>( \text{Al}_2\text{O}_3 )</td>
<td>15.5% typ</td>
</tr>
</tbody>
</table>

Acid Demand

- pH3: 8 max
- pH4: 6 max
- pH5: 6 max
- pH: 7.2 to 8.4

Turbidity NTU < 200

Packing:

- 1MT dried in Bulk Bags with inner plastic lining on pallets

Sizing:

45 to 50 AFS
SILICA FUME

Silica fume is a by product of producing silicon metal and other ferrosilicon alloys. These products are produced in an electric furnace and the smoke generated from the furnace is collected and known as silica fume or microsilica. This also helps reduce the carbon emissions of the producer.

Silica fume is made up of ultrafine particles with an average diameter of 150nm.

PROPERTIES OF SILICA FUME

Silica fume consists primarily of amorphous (non-crystalline) silicon dioxide. Due to its fine particles, large surface area, and the high silicon dioxide content, silica fume is a very reactive “pozzolan” (forms cementitious properties when mixed with water and calcium hydroxide) when used in concrete.

USE OF SILICA FUME

The most common use of silica fume is in the production of concrete in which its compressive strength, bond strength and abrasive resistance improve the properties of the concrete. As the particle sizes are 1/100th the size of a normal cement particle, the compressive strength of the cement is increased resulting in high-strength concrete capable of a compressive strength of over 15,000psi – useful in supporting high rise building structures.

It is also used widely in the monolithic refractory industry.

We now supply pure white undensified silica fume which is a co-product from fused Zirconia production.
## SILICA FUME SPECIFICATION 1

### Chemical Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>SF90 Grade</th>
<th>SF92 Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO$_2$</td>
<td>90% min</td>
<td>92% min</td>
</tr>
<tr>
<td>Al$_2$O$_3$</td>
<td>1% max</td>
<td>1% max</td>
</tr>
<tr>
<td>Fe$_2$O$_3$</td>
<td>2% max</td>
<td>2% max</td>
</tr>
<tr>
<td>CaO</td>
<td>3% max</td>
<td>3% max</td>
</tr>
<tr>
<td>MgO</td>
<td>3% max</td>
<td>3% max</td>
</tr>
<tr>
<td>C</td>
<td>3% max</td>
<td>3% max</td>
</tr>
<tr>
<td>Na$_2$O</td>
<td>3% max</td>
<td>3% max</td>
</tr>
<tr>
<td>K$_2$O</td>
<td>3% max</td>
<td>3% max</td>
</tr>
<tr>
<td>Moisture content @105° C</td>
<td>1.5% max</td>
<td>Not specified</td>
</tr>
<tr>
<td>Loss on ignition @ 950° C</td>
<td>6% max</td>
<td>6% max</td>
</tr>
</tbody>
</table>

### Grit size:

- >45 Micron 5%
- <45 Micron 90%

### Bulk density (densified):

- 600-750kg/m$^3$
- 500-700kg/m$^3$

### Bulk density (undensified):

- 280-350kg/m$^3$
- 250-400kg/m$^3$

### Packing:

- 25kg bags on pallets
- 1mt big bags
SILICA FUME SPECIFICATION 2

### Chemical Analysis

<table>
<thead>
<tr>
<th></th>
<th>SF95 Grade</th>
<th>SF95 White Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>95% min</td>
<td>95% min</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>1% max</td>
<td>1% max</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>1% max</td>
<td>0.8% max</td>
</tr>
<tr>
<td>CaO</td>
<td>1% max</td>
<td>1% max (inc MgO)</td>
</tr>
<tr>
<td>MgO</td>
<td>1% max</td>
<td>1% max (inc CaO)</td>
</tr>
<tr>
<td>C</td>
<td>1.5% max</td>
<td>0.2% max</td>
</tr>
<tr>
<td>Na₂O</td>
<td>1% max</td>
<td>0.8% max (inc K₂O)</td>
</tr>
<tr>
<td>K₂O</td>
<td>1.2% max</td>
<td>0.8% max (inc Na₂O)</td>
</tr>
<tr>
<td>Moisture content @105° C</td>
<td>1.5% max</td>
<td>Not specified</td>
</tr>
<tr>
<td>Loss on ignition @ 950° C</td>
<td>2.4% max</td>
<td>Not specified</td>
</tr>
</tbody>
</table>

### Grit size:
- >45 Micron 5%
- Not specified

### Bulk density (densified):
- 450-700kg/m³
- Not available

### Bulk density (undensified):
- 280-350kg/m³
- 300-450kg/m³

### Packing:
- 25kg bags on pallets
- 1mt big bags
ATOMISED FERRO SILICON

Atomised Ferro Silicon 15 is a specialised powder product formed by melting FeSi75 with scrap and casting into a high-pressure water jet. Particle size is typically between 212 microns and 20 microns. The principal properties of FeSi15% are magnetism, corrosion resistance and density.

Atomised Ferro Silicon 15% is mixed in water to create a dense medium and finds uses in the mining and scrap processing industries. Dense medium separation is a gravity separation technique which creates a medium with a specific density. This medium allows lights to float and heavies to sink, thus permitting separation due to density. The process typically separates aluminium, magnesium and mixed heavy metals such as copper alloys, thereby increasing overall scrap metal recycling rates. After sizing, the mixed feed is screened and then sent to a drum containing magnetite media which removes the lower density waste (rubber, plastic, etc) and light metals such as magnesium alloys. The heavy concentrated scrap is then directed to a second drum containing FeSi media which separates the aluminium from other metals. These two media, namely Magnetite and FeSi, create different media densities and can be adjusted, within certain limits.

The principal producers of Atomised Ferro Silicon 15% are located in Western Europe, China, Brazil and South Africa. Atomised Ferro Silicon 15% is usually supplied in big bags or in steel drums.

The EU Anti Dumping Duties on Ferro Silicon which were introduced in 2007 include this product.

Our expertise:

- 24 years experience of Atomised Ferrosilicon, production and marketing.
- Involved with plants in Norway, South Africa and China.
- Supplied product to Exarro.
- Secondary check chemistry size and magnetics. This data is controlled.
- Making South Africa a major base for production as well as sales.
# ATOMISED FERRO SILICON 15% DENSE MEDIA POWDERS SPECIFICATION

<table>
<thead>
<tr>
<th>Material</th>
<th>Atomised Ferro Silicon 15% - Cyclone 60 Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification</td>
<td>Fe &gt;80%, Si 14-16%, Mn &lt;0.80%, Cr &lt;0.60%, Cu &lt;0.50%, P &lt;0.10%, S &lt;0.05%</td>
</tr>
<tr>
<td>Size</td>
<td>-212 Micron 100%, -150 Micron 99-100%, -106 Micron 96-100%, -75 Micron 82-94%, -45 Micron 68-78%, -20 Micron 32-42%</td>
</tr>
<tr>
<td>Apparent Density</td>
<td>3.3-4.1g/cc</td>
</tr>
<tr>
<td>Pycnometric Density</td>
<td>6.7-7.1g/cc</td>
</tr>
<tr>
<td>Non Magnetics</td>
<td>0.5% Max</td>
</tr>
<tr>
<td>Magnetic susceptibility</td>
<td>58% Min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Atomised Ferro Silicon 15% - Fine Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification</td>
<td>Fe &gt;80%, Si 14-16%, Mn &lt;0.80%, Cr &lt;0.60%, Cu &lt;0.50%, P &lt;0.10%, S &lt;0.05%</td>
</tr>
<tr>
<td>Size</td>
<td>-212 Micron 97-100%, -150 Micron 90-96%, -106 Micron 74-88%, -75 Micron 60-75%, -45 Micron 42-50%, -20 Micron 15-25%</td>
</tr>
<tr>
<td>Apparent Density</td>
<td>3.7-4.1g/cc</td>
</tr>
<tr>
<td>Pycnometric Density</td>
<td>6.7-7.1g/cc</td>
</tr>
<tr>
<td>Non Magnetics</td>
<td>0.5% Max</td>
</tr>
<tr>
<td>Magnetic susceptibility</td>
<td>58% Min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Atomised Ferro Silicon 15% Coarse Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification</td>
<td>Fe &gt;80%, Si 14-16%, Mn &lt;0.80%, Cr &lt;0.60%, Cu &lt;0.50%, P &lt;0.10%, S &lt;0.05%</td>
</tr>
<tr>
<td>Size</td>
<td>-212 Micron 96-98%, -150 Micron 87-93%, -106 Micron 72-82%, -75 Micron 51-67%, -45 Micron 32-42%</td>
</tr>
<tr>
<td>Apparent Density</td>
<td>3.7-4.1g/cc</td>
</tr>
<tr>
<td>Pycnometric Density</td>
<td>6.7-7.1g/cc</td>
</tr>
<tr>
<td>Non Magnetics</td>
<td>0.5% Max</td>
</tr>
<tr>
<td>Magnetic susceptibility</td>
<td>58% Min</td>
</tr>
</tbody>
</table>
ATOMISED FERRO SILICON 45% SPECIFICATION

Chemical Analysis

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si</td>
<td>44-47%</td>
</tr>
<tr>
<td>C</td>
<td>0.1% max</td>
</tr>
<tr>
<td>S</td>
<td>0.01% max</td>
</tr>
<tr>
<td>P</td>
<td>0.04% max</td>
</tr>
<tr>
<td>Mn</td>
<td>0.5% max</td>
</tr>
<tr>
<td>Al</td>
<td>1% max</td>
</tr>
<tr>
<td>Ti</td>
<td>0.3% max</td>
</tr>
<tr>
<td>Cr</td>
<td>0.3% max</td>
</tr>
<tr>
<td>Fe</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

Reactivity   <15.0ml H₂ / 90min

Particle Size Distribution

<table>
<thead>
<tr>
<th>Particle Size (Microns)</th>
<th>Cumulative%</th>
</tr>
</thead>
<tbody>
<tr>
<td>+425</td>
<td>0</td>
</tr>
<tr>
<td>+355</td>
<td>0</td>
</tr>
<tr>
<td>+180</td>
<td>10-35</td>
</tr>
<tr>
<td>+90</td>
<td>45-80</td>
</tr>
<tr>
<td>+45</td>
<td>75-95</td>
</tr>
</tbody>
</table>
MILLED FERRO SILICON

- 16 years experience of milled ferro silicon market
- Acted as DMS Agent for the majority of this time
- Secondary independent lab chemical analysis, size distribution, bulk density, magnetic susceptibility and settling rate checks
- Production bases in UK & China
- The majority of our current customer base are within USA & Africa
- Our technical advisory staff have an established background in ore and mineral processing in addition to dense media operations
# MILLED FERRO SILICON 15% SPECIFICATION

**Chemical Analysis**

Si >11%, Fe typically 75%, Ti <8%

**Size distribution for 65D**

Particle size analysis in microns

<table>
<thead>
<tr>
<th>Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 212</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 212+150</td>
<td>0-3%</td>
</tr>
<tr>
<td>- 150+106</td>
<td>4-8%</td>
</tr>
<tr>
<td>- 106+75</td>
<td>9-17%</td>
</tr>
<tr>
<td>- 75+45</td>
<td>24-32%</td>
</tr>
<tr>
<td>- 45</td>
<td>47-55%</td>
</tr>
<tr>
<td>+ 20</td>
<td>75-85%</td>
</tr>
</tbody>
</table>

**Size distribution for 100D**

Particle size analysis in microns

<table>
<thead>
<tr>
<th>Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 212</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 212+150</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 150+106</td>
<td>1-4%</td>
</tr>
<tr>
<td>- 106+75</td>
<td>5-10%</td>
</tr>
<tr>
<td>- 75+45</td>
<td>20-28%</td>
</tr>
<tr>
<td>- 45</td>
<td>61-69%</td>
</tr>
<tr>
<td>+ 20</td>
<td>65-75%</td>
</tr>
</tbody>
</table>
## MILLED FERRO SILICON 15% SPECIFICATION (CONT’D)

Size distribution for 150D  
Particle size analysis in microns

<table>
<thead>
<tr>
<th>Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 212</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 212+150</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 150+106</td>
<td>0-2%</td>
</tr>
<tr>
<td>- 106+75</td>
<td>2-6%</td>
</tr>
<tr>
<td>- 75+45</td>
<td>13-21%</td>
</tr>
<tr>
<td>- 45</td>
<td>73-81%</td>
</tr>
<tr>
<td>+ 20</td>
<td>50-60%</td>
</tr>
</tbody>
</table>

Size distribution for 270D  
Particle size analysis in microns

<table>
<thead>
<tr>
<th>Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 212</td>
<td>0%</td>
</tr>
<tr>
<td>- 212+150</td>
<td>0%</td>
</tr>
<tr>
<td>- 150+106</td>
<td>0-1%</td>
</tr>
<tr>
<td>- 106+75</td>
<td>0-3%</td>
</tr>
<tr>
<td>- 75+45</td>
<td>7-11%</td>
</tr>
<tr>
<td>- 45</td>
<td>85-93%</td>
</tr>
<tr>
<td>+ 20</td>
<td>38-48%</td>
</tr>
</tbody>
</table>
SILICON CARBIDE BRIQUETTES

HISTORY AND DEVELOPMENT

Silicon Carbide is well known in the ferro alloy industry as a powerful reductant that can increase the performance of furnaces.

Its use has been limited because lumpy silicon carbide is difficult to use in the ferro alloy process:

- It can react too early in the production process. If the reaction takes place too high in the furnace its effectiveness is lost as heat is wasted, leaving the furnace as hot gas rather than being utilised to reduce the ore.

- The high cost of lumpy silicon carbide. The power consumed in production makes the cost of silicon carbide uneconomical when compared to carbon reductants.

Our briquette is a lower cost alternative to lumpy silicon carbide.

The briquette has been specifically designed and developed to overcome the inherent difficulties of using lumpy silicon carbide and the stability and strength of the briquettes has been improved continuously during product development.

HOW THEY WORK

Energy that would usually leave the furnace and be lost in the hot gases is utilised to produce a chemical reaction within the briquette.

The SiC crystals store the energy as they move into the smelting zone of the furnace where the energy is released to reduce the ore.

Redistributing and recycling energy that would usually be lost as waste gas back into the reactive zone.
REFERENCES 

SILICON CARBIDE BRIQUETTES

RESULTS RECORDED DURING TRIALS

- Higher operating power in the furnace resulting in higher daily metal output
- Silicon and sulphur content in alloy reduced
- Lower consumption of fixed carbon
- Higher chrome yield from ore to alloy
- Higher chrome content of the final product
- Lower unit power consumption

ADVANTAGES OF USING SiC BRIQUETTES TO REPLACE SOME FIXED CARBON

SiC Briquettes are a lower cost and more effective alternative to lumpy SiC.

They can replace some of the standard carbon reductants as well as some quartz. The optimum level of additions can fluctuate from furnace to furnace depending on the raw materials used and operating systems.

SiC briquettes allow for more efficient utilisation of energy in the furnace, which other reductants cannot do.
Contact us

Tel: +44 (0) 1246 292 292
Fax: +44 (0) 1246 292 293
Email: alloys@wbrl.co.uk
Website: www.wbrl.co.uk

Please contact our York office for enquires on Nickel Alloy/Stainless Steel Bar or Plate on:
+44 (0) 7887-687010