FERRO ALLOYS

By Ian Robinson

The recovery in ferro-alloy markets, which had started in 2002, accelerated during 2003 as world steel and stainless steel production rose to record levels. However, in contrast to previous cycles when demand for alloys used in stainless steel production (alloys of nickel, chromium and molybdenum) has boomed whereas demand for alloys used in the production of carbon steel (alloys of manganese and silicon) has tended to remain flat, this cycle has been characterised by strong demand across the entire range of bulk ferro-alloys.

World steel production is rapidly approaching the milestone of 1,000 Mt/y as, according to the International Iron & Steel Institute (IISI), world crude steel production rose by 6.6% in 2003 to 962.5 Mt. This increase followed a 6.4% rise in 2002. The growth in 2003 was achieved despite stagnation in the developed world and IISI noted that China's share of global production rose from 20.1% in 2002 to 22.9%. China's production grew by 21.2% year-on-year to 220.1 Mt - almost double that of the world's second largest producer, Japan, which produced 110.5 Mt in 2003, an increase of 2.6%. This was the highest level which Japan had reached since 1980 when it established a record level of 111.4 Mt. However, it was especially significant for ferroalloy producers that the sector within the Japanese steel industry, which enjoyed the highest growth in 2003, was special steels (which consume larger quantities of ferro-alloys than carbon steels). The production of special steels rose by nearly 9% to 22.2 Mt.

Of the other top ten steel-producing countries - South Korea, Germany, Ukraine, India, Brazil and Italy - the Ukraine and India recorded the largest increases of 9.9% and 10.4% respectively, whereas production in Germany declined by 0.4%. The Chinese import demand is a major factor in sustaining high global production, with Japan, Korea and CIS countries being major beneficiaries.

World production of stainless steel also enjoyed a substantial increase for the second successive year. According to preliminary estimates, production in 2003 rose by 7.4% to 21.8 Mt, following an increase of 8.6% in 2002. The increases over the past two years have been well above the trend line of demand over the period 1993-2002 of 5.8% per year. Japan remains the world's largest producer of stainless steel and increased its production by 5.5% to over 4 Mt.

Similar to the situation with carbon steel, the growth of demand in China has acted as a major catalyst to world production and the most rapid growth in production has taken place in China itself and in countries in Asia which supply semi-finished products to China, particularly South Korea which registered an increase 27.8% in 2003. China has made a huge investment in

its stainless steel industry which raised production by 21.4% in the second quarter of 20O3 to over 1 Mt, and Chinese stainless steel production now comprises a large market for imports of ferro-alloys. This market will continue to grow rapidly as consumption of stainless steel in China is estimated at a level of about 4 Mt/y and the large shortfall in domestic production will drive continuous expansion.

Alloying additions to carbon steel

Manganese and silicon are the two major alloying elements in carbon steel. Approximately 95% of the total production of manganese is used for the desulphurisation and hardening of steel which produces a strong, resistant metal which is easy to machine, form or weld.

Silicon has three applications in steel production: as a de-oxidant, as a source of energy through exothermic reactions and as an alloying addition to confer specific properties on the steel. Silicon is used as a graphitising agent in the production of grey and ductile iron used for foundry applications.

The bulk manganese and silicon additions to steel are made in the form of the ferro-alloys: high-carbon (HC) or standard ferromanganese, silicomanganese and ferrosilicon. Smaller quantities of manganese are added to steel in the form of refined ferromanganese which has a carbon (C) content of less than 2%.

The choice of alloy for manganese additions to a steel melt depends on both economic and technical factors. Silicomanganese is usually favoured as an alloying additive in electric arc furnaces whereas HC ferromanganese is favoured in the blast furnace route to steel production. The process used to produce HC ferromanganese and silicomanganese is essentially the same and the difference lies in the ratios in which the ores are blended and the amount of quartz added.

Manganese alloys

There was a strong recovery in the manganese market during the second half of the year following many years of stagnant growth and excess alloy production capacity. The recovery was in response to the boom in world steel production, particularly in China, where steelmakers were forced to increase imports of manganese alloys due to a shortfall in domestic production resulting from shortages of power and coke.

Metal Bulletin quoted prices in Europe of both HC ferromanganese and silicomanganese in the range €500-550/t during the first half of the year. After softening slightly during the third quarter, prices rebounded in the final quarter due to interruptions in supplies from key producers. The rise in prices accelerated during the first quarter of 2004 and by the end of the quarter the quotations for silicomanganese and HC ferromanganese had more than doubled to the ranges of €1,250-1,350/t and €1,100-1,200/t, respectively.

According to estimates by BHP Billiton (BHPB) South African subsidiary Samancor and the International Manganese Institute (IMnI), world trade in

manganese alloys rose by over 6% in 2003 to 9.1 Mt contained manganese (Mn) units. China was the largest exporter of manganese alloys with a 31% share of world trade. The two largest suppliers based in the Western world are Eramet with a 10% share and BHPB with 8%. Smaller suppliers include Japan (6%), CVRD of Brazil (4%), Assmang of South Africa (2%) and Autlan of Mexico (2%).

Although producers increased capacity utilisation, little new capacity was brought on stream and production problems aggravated the world shortage of manganese alloys.

BHPB raised its production of alloys from both its South African and Australian operations during the financial year (FY) ended June 30, 2003. Total saleable production of manganese alloys was 737,000 t, an increase of more than 19% over FY 2002. Both alloy plants - Samancor's Metalloys in South Africa and Temco in Tasmania, Australia - were operating at full capacity by the end of FY 2003.

A fire at Metalloys' South Plant on August 10 resulted in the loss of several weeks production of silicomanganese, amounting to about 12,000 - 14,000 t.

The world's largest single producer of manganese alloys, French-based Eramet, was forced to rationalise its production in China and France during the year, and in September announced that it would embark on a programme to restructure its alloys division.

In mid-year Eramet closed its Shaoxing Comilog Ferro-Alloy plant in eastern China in response to pressure from the Chinese Government to move heavy industry out of the town. However, Eramet said that the Guilin Ferro-Alloy plant which it had acquired in September 2003 would cover the output lost through Shaoxing's closure.

Following an operating loss at its ferromanganese plant in Boulogne, France, during the first half of the year, Eramet decided to close the 350,000 t/y plant furnace by the end of the year. Eramet also experienced production problems at its Marietta plant in Ohio, US towards the end of the year and in early 2004.

Cia Vale do Rio Doce (CVRD) expanded its international alloy operations through its acquisition of Elkem's Rana ferrochrome plant in Norway in February. CVRD invested US$10 million to convert the Rana smelter to the production of manganese alloys, and its new wholly-owned subsidiary Rio Doce Manganese Norway (RDMN) started operations on the first furnace on June 30.

Assmang, South Africa's second largest producer of manganese ore and alloys after Samancor, increased its production of alloys during the year but by a smaller margin than the increase in its ore sales, reflecting the greater profitability of exporting ore from South Africa than alloy.

The world's largest manganese alloys smelter, Nikopol in the Ukraine, became fully privatised during the year when the state's 50% share was sold to private interests. The company embarked on an expansion programme to raise its production capacity from a level of about 800,000 t/y to 1.2 Mt/y.

Ferrosilicon

Power shortages in Scandinavia, which forced the closure of ferrosilicon plants, was the dominant factor in the market during the first half of 2003. The problems began in December 2002 when Norwegian producers announced cutbacks in production due to electricity price hikes which resulted from low reservoir levels following a combination of a hot summer in 2002 and the country's lowest level of rainfall since 1931.

The world shortage of ferrosilicon was exacerbated by cutbacks in production in China, the world's largest producer, where plants in southwestern China suffered power supply problems after an exceptionally cold winter. The power shortage was largely the result of the Chinese government's rationing policy, which permits the transfer of electricity from mountainous southwestern China to the cities of southeastern China.

The shortage of ferrosilicon resulting from the closure of plants in Scandinavia forced prices of standard grade 75% Si ferrosilicon in Europe to rise from levels of about €650/t at the beginning of the year to up to €800/t at the end of the first quarter.

Speaking at Metal Bulletin's 4th Asian Ferro-Alloys conference in Hong Kong in March, the founder and MD of Sweden's Sonaco Trading, Claes Lundman raised questions regarding the longer-term future of ferrosilicon. He described China's ability to sustain ferrosilicon production at its current high levels as “questionable” and said that the rapid increase in ferrosilicon prices in Europe during the first quarter of the year would encourage consumers to reduce their dependence on Norway - which provides the bulk of Europe's supplies of ferrosilicon.

As electricity prices normalised, Norwegian producers started to bring their plants back on stream from April onwards. In late April, Elkem started the single 40,000 t/y furnace at its Thamshavn plant and Finnfjord restarted production at its Smelterverk plant where its three furnaces have a combined capacity of 100,000 t/y. Finnfjord is the largest producer of standard-grade ferrosilicon in Norway.

Norway's Fesil and Sweden's Vargon Alloys also restarted production and prices fell back to the range €630-690/t by the end of June. In a major change to the marketing channels of Norwegian ferrosilicon production, Tinfos Nizi, the trading arm of the Norwegian ferro-alloys producer Tinfos, took over the marketing of Finnfjord's entire 100,000 t/y production of ferrosilicon from fellow Norwegian ferrosilicon producer Fesil with effect from June 26.

Fesil increased its ferrosilicon capacity at its Rana plant by up to 15,000 t/y through the reconstruction of its No 6 furnace, which had an original capacity

of 40,000 t/y. The furnace was re-opened in mid-August after it had been closed for reconstruction in early March. The plant's other furnace, with a similar capacity, continued to operate during the reconstruction period.

Prices, which had fallen further towards €600/t in Europe in the third quarter firmed towards €650/t at the end of the year as concern mounted about the possibility of further cuts in Norwegian production during the 2003/2004 winter.

Alloying additions to stainless steel

Chromium and nickel are the two major alloying elements in stainless steel. Stainless steel, which is defined as steel with a minimum Cr content of 12%, represents the largest application of both chromium and nickel.

Chromium may be added to the stainless steel charge in the form of the alloy, ferrochrome or in stainless steel scrap. Most ferrochrome is added as high-carbon (HC) grade or as charge chrome. HC ferrochrome, which has a Cr content of over 60% and 4-6% C, is produced from chromite ore ($FeO.Cr_2O_3$) with a high chromium: iron ratio, usually over 2:1. In contrast, charge chrome, which is produced from low-grade ores in South Africa and Finland, contains 50-55% Cr and 6-8% C.

Over 70% of world stainless steel production comprises austenitic grades with an average Ni content of about 8%. Nickel may be added in the form of different primary products - metal, oxide or ferronickel - as well as in the form of stainless steel scrap. The type of ore mined and the process route adopted determines which primary product is produced. Ferronickel is a preferred product for the addition of nickel to stainless steel because it contains a high proportion of iron, which is usually sold at a discount to iron contained in other materials.

Ferrochrome

South Africa continues to increase its dominance of world ferrochrome production. In a presentation on 'Ferrochrome - a South African Perspective' at the International Chromium Development Association Conference held in Johannesburg in April 2003, Xstrata's marketing manager (Chrome Division) Jeff McLaughlan forecast that world production of ferrochrome with a carbon content of over 6% (which includes charge chrome) would reach 4.4 Mt in 2003, of which South Africa would contribute about 2.8 Mt, representing a 63% share of the world total.

South African producers raised production through higher capacity utilisation to meet the increase in demand resulting from the rising levels of stainless steel production and also embarked on a new phase of capacity expansion including the prospect of a new producer entering the ranks.

Burdened by rising costs resulting from a stronger rand and higher power and freight costs, South African producers were able to demand higher prices. World prices of charge chrome nearly doubled from US$0.32/lb of contained

chromium at the beginning of the year to US$0.56/lb at the end of the year, and escalated still further to reach US$0.68/lb for the second quarter of 2004.

China and India, traditional sources of extra capacity in a tight market became net importers of ferrochrome.

Xstrata, which has overtaken BHP Billiton's Samancor Chrome to become the largest ferrochrome producer in the world, made two decisive moves to consolidate its leadership. In December it announced that it would build a new smelter on the site of its existing Vantech vanadium facility near Steelpoort in the province of Mpumalanga. The project, known as Project Lion, will comprise two 63 MVA closed submerged-arc furnaces and a pre-reduction kiln and will use Xstrata's exclusive Premus technology. The 330,000 t/y Lion Plant will become Xstrata's fourth ferrochrome smelter and will raise its annual production capacity to 1.63 Mt.

Xstrata made a second major strategic move to consolidate its position as world leader in the ferrochrome industry when it announced in February 2004 that it would merge its South African ferrochrome and chrome ore assets with SA Chrome. The latter had developed a 235,000 t/y ferrochrome project on a greenfields site near Rustenburg in the North West Province. The plant was commissioned in September 2002.

In the financial year ended June 30, 2003 (FY 2003) South Africa's second largest producer, BHP Billiton Samancor, increased its production of ferrochrome by 18% to 990,000 t as furnaces were recommissioned in response to the recovery in market demand. In September 2003 an upgrade of Furnace 4 at its Ferrometals smelter at Witbank was completed for Newsam, a joint venture between Samancor and Poschrome of Korea, to increase the furnace's production capacity from 100,000 t/y to 125,000 t/y.

In FY 2003, Assmang increased its sales of ferrochrome from its Machadodorp smelter by almost 30% to 244,000 t. This increase followed an upgrading of the existing plant and the installation of a fourth 54 MVA furnace with an Outokumpu pelletising and sintering line.

In April 2004, Hernic Ferrochrome announced that it would increase its production of ferrochrome by about 60% to 420,000 t/y by late 2005 and it has a longer term goal to reach a production level of 1 Mt/y.

South Africa's smallest ferrochrome producer, Chinese-owned ASA Metals, more than doubled its production capacity when it commissioned a second furnace at its Dilokong smelter in December. The completion of the 45 MVA furnace raised smelter capacity from 50,000 t/y to 120,000 t/y.

A potential new producer is preparing to enter the South African ferrochrome industry. Transvaal Ferrochrome would become South Africa's seventh ferrochrome producer - and the first South African specialist ferrochrome producer to be listed on the Australian Stock Exchange. It is planned to build

a smelter with two 63 MVA furnaces and an Outokumpu-route pelletising and sintering line.

The boom in demand for ferrochrome also stimulated interest in new projects in countries which have no history of ferrochrome production. Plans were formulated in both Canada and Australia to establish ferrochrome projects but the plans have not yet been proved to be feasible.

Ferronickel

Ferronickel's "fundamentals are stronger than nickel, based on stainless steel demand from China" said executive vice president Francois-Gabriel Sauvage of Eramet's nickel division at Metal Bulletin's 19th International Ferro-Alloys Conference in Monte Carlo in November. Sauvage was referring to the fact that ferronickel is the most cost-effective nickel-alloying addition in stainless steel production as it contains iron as well as nickel. In contrast to nickel metal which can be used in other applications, ferronickel's only application is in the production of stainless steel. However, whereas stainless steel production is expected to expand rapidly spearheaded by the dynamic growth in consumption in China (which is set to become the world's largest consumer of stainless steel by 2008), little new ferronickel capacity is planned between 2003 and 2008.

Indonesian nickel producer PT Aneka Tambang (Antam) proceeded with its plans to build a third ferronickel smelter at its Pomalaa plant in the southeastern part of Sulawesi Island. In early 2003, Antam finalised an agreement with PT International Nickel Indonesia (PT Inco) to develop the East Pomalaa deposit on the island. All the ore mined from the deposit which is owned by PT Inco will be delivered to the Antam smelters for further processing. The East Pomalaa deposit is adjacent to Antam's Pomalaa nickel mine and is less than 100 km from Antam's ferronickel plant.

Antam's FeNi III smelter will more than double the company's capacity to 26,000 t/y of contained nickel in ferronickel from a current level of about 11,000 t/y. The new smelter will be fed with about 1 Mt/y of ore from the East Pomalaa mine.

In November, Antam signed an engineering and procurement and construction contract with Wartsila Oy of Finland for the captive power plant which will support its FeNi III smelter. The smelter is being built by Japan's Mitsui and Kawasaki Heavy Industries and is scheduled to begin commercial production during the first quarter of 2006.

Noble ferro-alloys

The term 'noble alloys' refers to alloys used in smaller quantities and which are relatively expensive compared with the bulk alloys. They are sold in pound or kilogram units rather that tonnes and include ferro-molybdenum, ferrovanadium, ferroniobium, ferrotitanium and ferrotungsten.

The closure of two major Western vanadium producers during the year and a substantial decline in supplies from Russia resulted in an escalation in

ferrovanadium prices towards the end of the year and in early 2004. In February, Xstrata closed its Windimurra mine in Western Australia despite having reduced costs by over 50% over the two year prior to the closure. The mine had been producing at an annual rate of about 8-10 Mlb of vanadium pentoxide, about half of its design capacity of 17 Mlb. Although most of Windimurra's production was sent to Japan, the mine's closure helped to stabilise world prices of ferro-vanadium and prices in Europe during the first half of the year fluctuated around US$10/kg contained vanadium for 70-80% V ferrovanadium.

In November, Xstrata announced that it would close another of its operations – Vantech in South Africa – from the end of the year. The mine, which closed due to depletion of the orebody, removed a further 10 Mlb/y of vanadium pentoxide from a world market estimated at 150 – 160 Mlb. The reduction in supplies of vanadium pentoxide gradually brought the ferrovanadium market into balance and by the end of the year prices had risen to over US$13/kg in Europe.

In September 2003,South Africa Japan (SAJ) Vanadium, a joint venture between Highveld Steel & Vanadium (50%), Nippon Denko (40%) and Mitsui (10%), made its first shipment of ferrovanadium from the Highveld Steel works in South Africa to Japan. The start of deliveries from SAJ resulted in the closure of Nippon Denko's Hokuriku plant in Japan.

Output of ferrovanadium from another key player in the market, Russia's Tulachermet Vanadium, fell by about a quarter in 2003 because of ownership disputes. The company, which has the capacity to produce 100-120 t/mth of 80% ferrovanadium and 140-150 t/mth of 50% ferrovandium, derives its suppliers of slag feed material from the neighbouring Tulachermet pig iron plant. Production at the vanadium plant was suspended for several months from February, but resumed in mid-year when Tulachermet purchased the controlling stake in the vanadium plant.

In early 2004, marketing director of Tulachermet Vanadium Yuri Mishin stressed the important role of China in the vanadium market. China has switched from being an exporter to being a net importer, partly because of new building regulations in China which stipulate that steel reinforcing bars for the construction industry must contain vanadium. Mishin forecast that the shortage of vanadium supplies in 2004 could push prices of ferrovanadium up to record levels even exceeding the high levels of early 1998.

Prices of ferromolybdenum more than doubled during the year and escalated rapidly in early 2004. *Metal Bulletin* quoted prices of ferromolybdenum (basis 65-70%) in Europe at the beginning of the year in the range US$8.4-8.8/kg Mo. Prices rose throughout the year in response to supply interruptions from China, the world's largest exporter, and strong demand from the world steel industry and reached the range US$18.0 – 18.3/kg Mo by the end of the year.

Chinese production of ferromolybdenum suffered as a result of a persistent shortage of concentrates throughout the year. After mining had resumed early

in the year following a severe winter, a series of accidents affected production of concentrates in north east China. The accidents led to a safety drive by the Chinese Government which forced mines to buy new equipment and raised production costs. Flooding in the fourth quarter aggravated the shortage of concentrates and severe winter conditions forced some smelters to shut down.

Speaking at Metal Bulletin's 19th International Ferro-Alloys Conference in Monte Carlo in November, the president of Shangxiang Metals in China, George Song, highlighted the trend towards consolidation in the world molybdenum industry. He was referring to Chilean producer Molymet's acquisition of Sadaci in Belgium in February and several Chinese mergers and acquisitions involving miners and converters, including mines in Jilin, Luanchan and Huludao.

Molymet purchased Sadaci, Europe's largest toll converter of molybdenum concentrates (with the capacity to produce about 10,000 t/y of ferromolybdenum), from Eramet of France. Molymet's objective was to integrate Sadaci into Molymet's global operations, which include plants in China and a Mexican subsidiary, Molymex.