Ferroalloys

in

1949

by R. G. Knickerbocker

A MOST important research and development item on ferroalloys in the calendar year of 1949 was the increase of interest in the recovery of secondary manganese. Owing to the importance of manganese to the nation's welfare, it is most necessary that all possible avenues of research and development on the recovery of this vital metal be investigated.

The principal objective of this new development is to recover manganese from steel furnace slags. Steel furnace slags contain a total of approximately 772,000 tons of metallic manganese which is compared to the 680,000 tons of metallic manganese as ferromanganese that is estimated to be used by the steel industry, annually, at this time.

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To those who are interested in the recovery of primary manganese from low-grade domestic

ores containing less than 35 pct manganese, it will be encouraging to know that these slags, containing 5 to 9 pct manganese, are being subjected to considerable research and development work.

The low heat of formation, low viscosity and low specific gravity characteristics of the manganese sulphide-oxide mattes were utilized in Europe during World War II in the treatment of slags and low-grade manganese materials for the recovery of manganese. This is one avenue of investigation of possible value in the program of recovery of domestic primary and secondary manganese.

Results of research work on the influence of temperatures above 1350° C indicate that the affinity of sulphur for copper, manganese and iron is in the order given. Attention is called to the fact that the sulphur in the steel bath is higher when the scrap charge contains copper because of the removal of sulphur from the furnace atmosphere by the copper. That brings up the question of the solubility of copper and manganese sulphides.

The Federal Bureau of Mines initiated new work on the conservation of manganese during the year. Three targets were set up, (1) reduction of sulphur in steel to reduce the necessity for manganese, (2) recovery of manganese from openhearth slags, and (3) development of substitutes for manganese in the making of steel. The steel producers through the American Iron and Steel Institute have furnished the Bureau with \$50,000 for these investigations.

A very valuable contribution by the Carnegie Illinois Steel Corp. was made this year covering the details of research work on the removal of sulphur, the effect of the scrap charge, the use of flush-off slags, the importance of distinguishing between the sulphur as introduced by the scrap charge and that introduced in the pig-iron charge in the open-hearth; the effect of time between the pig-iron tap and the openhearth molten bath as regards the sulphur content and the use of manganese ores in the blast furnace. The statement was made that the mechanism for the removal of sulphur was as manganese sulphide in the flush-off slag.

Work on a process for recovering manganese from low-grade domestic ores by leaching with waste pickle liquor, which is produced in large volume in certain steel operations, was reported.

The Standard Mining Co., a subsidiary of Standard Ore and Alloys Corp., started to process manganese ore in the Cushman field near Batesville, Ark., during 1949. The "Potashnick" gravity concentrator which operated during World War II is being utilized for the milling of low-grade manganese ore.

Production of ferromanganese at the Anaconda Copper Mining Co.'s new ferroalloy plant in Anaconda, Mont., was initiated in February 1949.

Electrolytic manganese production and sales were not so good as in 1948 but better than any year prior to 1948. Although no new uses were developed for electrolytic manganese during the past year, the increasing acceptance of the higher purity metal in established fields, particularly for stainless steels, is noteworthy at this time.

The seriousness of the manganese supply problem was recognized by the highest levels in government and in March 1949 the National Security Resources Board, at the request of the President, established the Interdepartmental Manganese Coordination Committee with James Boyd, Director of the Bureau of Mines, as chairman. This committee was assigned the responsibility of coordinating efforts of industry and government to attain a satisfactory balance between total domestic requirements and supplies from all sources.

The imports of manganese to the United States in the first ten months of 1949 from Russia were only 6 pct of the total manganese imported into the country.

In terms of manganese ore plus the ore equivalent of ferromanganese, the African Gold Coast was the largest source in 1949, furnishing approximately 450,000 short tons. India was expected to supply approximately 425,000 short tons and the Union of South Africa is estimated to exceed 300,000 short tons. Inadequate transportation facilities held Brazil's shipments to 144,000 short tons. Total imports of manganese ore during the first ten months were 1,201,240 short tons. Domestic production of manganese ore is estimated as 115,000 short tons—which is slightly less than 1948. Shipments of ferruginous manganese ore and manganiferous iron or containing 5 to 35 pct manganese are estimated at 1,000,000 short tons during 1949.

Ferromanganese consumption decreased 15 pct in 1949 approximating the extent of the lower steel production rate. Imports of 60,000 tons of ferromanganese were received this year.

The price for standard manganese ore rose from approximately 70¢ per long ton unit to about 82¢ in November; standard ferromanganese rose from \$160 per gross ton, in carload lots, to \$172 per ton in November.

Ferrochromium

A new chemical method for the treatment of low-grade chrome ore has been developed in Australia which makes use of a sulphuric-chromic acid solvent and electrolytic oxidation. The product contains 95 pct Cr_2O_3 and represents a possible recovery of 75 pct of the chromium in the ore.

A surface-chromizing process has been introduced into this country by the Diffusion Alloys Corp. of New York. This is a British metallurgical development. A pack-carburizing method uses containers with a ferrochromium base material and a suitable catalytic agent. Temperatures range from 1700° to 1850° F, depending upon the carbon content of the steel to be carburized. Chromium penetration in low-carbon steels is about 0.03 to 0.35 in., while in high-carbon steels penetration is 0.003 to 0.005 in.

Important data pertaining to chromium-carbon oxidation and temperature relations have been reported this year by the Union Carbide & Carbon Research Laboratory, Niagara Falls.

The Mead Ferrochrome reduction works of the Chromium Mining & Smelting Co., in the state of Washington, offered to purchase domestic chrome ores during the year. Minimum specifications were 45 pct Cr_2O_3 content, 2.5 to 1 chrome-

iron ratio. This does not allow the use of the submarginal Montana chrome ores since the chrome-iron ratio in these concentrates is not high enough. Considerable investigation of the beneficiation of Montana chromite by reducing roast and sulphuric acid leaching of the iron to correct the ratio discrepancy has been conducted.

Some of the African Transvaal chrome ores are reported to require beneficiation of a similar nature and although the detail of the process has not been given, the cost has been stated as approximately 15 shillings per ton.

Imports of chromite during the year were nearly twice the consumption rate and are estimated to have totaled 1,200,000 short net tons. Philippine Republic supplied 30 pct of the total chromite imports and was the largest exporter of chromite to the U. S. Nearly all of the Philippine chromite was of refractory grade. Turkey supplied 24 pct of the total, all of which was metallurgical grade. Domestic production of chromite was estimated to be 300 tons.

The ferrochromium consumption for the first 9 months of 1949 was at a rate of 93,800 tons per year compared with 122,753 tons in 1948.

Cobalt

The Rhokana Corp. in Northern Rhodesia expects to double its present output of 362 tons of cobalt per year. They plan to produce electrolytic cobalt.

The Howe Sound Co. of New York continued exploration and development work on their cobalt property in Idaho and there has been an appreciable increase in the ore reserves there as a result of this work. Preliminary construction was initiated and is planned to be continued through 1950.

The International Nickel Co. of Canada is reported producing at the rate of 15 tons of cobalt monthly. This is cobalt from the nickel ore of the Sudbury Basin.

The Falconbridge Nickel Mines, Ltd. report that they will be producing substantial quantities of cobalt in 1951. This is also from the Sudbury Basin nickel ore.

The Reduction & Refining Co., Kenilworth, N. J., is processing government-owned cobalt ore and subgrade metal.

Union Miniere du Haut Katanga, Belgian Congo, is enlarging their concentrators and the electrolytic plant for copper and cobalt. Hydroelectric power developments are being enlarged to take care of this work.

The Bethlehem Steel Co. was again the only producer of commercial domestic cobalt ore in the United States.

Imports of cobalt into the U. S. for the first nine months of 1949 were 15 pct less than in the corresponding period of 1948.

Effective April 1, 1949 the price of cobalt metal—97 to 99 pct cobalt—was raised to \$1.80 per lb.

Exothermic Alloys

Considerable progress has been made in the use of exothermic alloys; they have a definite place in the steel industry and utilize low-grade domestic ores. The use of high-carbon "Chrom-X" now amounts to approximately one-third of

the high-carbon ferrochrome used. A "Chrom-Sil-X" is finding considerable use in the cleaning of slags and the making of stainless steel.

Nickel

A report was issued this year on the five years' operation of the Nicaro Nickel Project, a wartime project in Eastern Cuba initiated in February 1942 and concluded in March 1947. Production amounted to 63.5 million lb of nickel chiefly in the oxide form. This oxide was acceptable for use in the iron-steel industry and as such was a substitute for ferronickel.

The International Nickel Co. of Canada reported in June this year a geological exploration revealed nickel was widespread in the Lynn Lake area of Manitoba and two provinces of Venezuela. A new ore body at the Creighton mine, Sudbury district, was largely responsible for increasing ore reserves at the end of 1948 to the all-time record of 246,177,000 short tons.

Imports from Canada, the chief source of supply, were 8 pct less in the first 10 months of 1949 as compared to 1948. This was because of the substantial decline in the output of nickel alloy steels, the steel strike and the production loss in stainless steel.

Molybdenum

Numerous research and development programs have been proposed and are active both on molybdenum metal and as an alloying element to conserve nickel, chromium and manganese in steels. The later programs are based on the plentiful supply of molybdenum which is produced from extensive reserves in Colorado and as a by-product from the copper industry, coupled with the highly satisfactory service the molybdenum alloy steels gave during the recent emergency. Most of the NE or national emergency steels contained 0.15 to 0.25 pct molybdenum.

Advancements made in the melting and fabrication of molybdenum metal has progressed to a commercial stage and the metal is being processed into chemical ware as a replacement for platinum crucibles, etc. Considerable interest continues in the use of molybdenum and high-molybdenum alloys for high-temperature applications since the strength (over 100,000 psi) of the metal does not materially decrease at temperatures as high as 1600°F.

Consumption of molybdenum was 16,201,800 lb in the first nine months—a drop of 8 pct as compared to the same period in 1948.

Tungsten

The Bradley Mining Co. has completed its new tungsten mill to serve the Ima Mine in Idaho. The plant is expected to be in full production during 1949.

Important deposits of tungsten and molybdenum in Guanajuato, Mexico have been discovered.

Brazil has reported possibilities of increasing its production of tungsten, beryllium and tantalite in the northeast section.

There was a 28 pct loss in consumption of tungsten concentrates in the first nine months of 1949 as compared to the same period of 1948.

The Tungsten Mining Corp. of North Carolina was the largest domestic producer.

Columbium, Tantalum and Vanadium

The Electro Metallurgical Div. of Union Carbide & Carbon Corp. reports new and increased uses for ferrocolumbium have made it necessary to determine the extent to which tantalum, vanadium and other carbide-formers could be used together with, or in place of, columbium. It has been found that tantalum can be satisfactorily used in the high-temperature alloys where strength at temperature is the major consideration. Vanadium can also be used, but the oxidation resistance of the alloy is affected adversely if the vanadium addition exceeds about half of one percent. The use of tantalum and vanadium for purposes of eliminating susceptibility to intergranular corrosion is possible but these elements are not as effective as columbium. Information on these subjects was available many years ago but had to be reconsidered in the light of new developments and new alloy compositions now being used. Stainless steels very low in carbon (0.03 pct maximum) have proved to be suitable for many uses where the grades containing columbium or titanium were formerly used.

Titanium

The forecast potentialities of titanium and titanium alloys in the not too distant future are of particular interest to the ferroalloy industry. The principal characteristics of the metal are its attractive weight: strength ratio and outstanding corrosion resistance. In the latter respect it compares favorably with platinum as shown in various sea water tests. This new commodity may be expected to gradually replace some of the stainless steels in special applications. Added interest in titanium relations to the steel industry arises from the development of the 36 pct iron ores (containing 32 pct TiO_2) of the Allard Lake area. This reserve of iron ore with titanium byproducts is being processed by the Quebec Iron & Titanium Corp. Its production plant is reported to be able to turn out 175,000 tons of high-grade pig iron and 225,000 tons of titanium slag annually, and tentative plans have already been made to expand capacity.

At least until the titanium commodities have become well established, the metal will remain closely allied with paint pigments, electrode coatings and ferroalloys. In this connection the National Lead Co. acquired certain assets of the Titanium Alloy Mfg. Co. during 1949. Also during the year, Allegheny Ludlum Steel Corp., E. I. du Pont Corp., and Dominion Magnesium, Ltd., announced the production of titanium-metal ingots weighing 25 to 400 lb.

Estimated domestic production of rutile in 1949 was 11,600 tons. Imports of rutile from Australia were 2750 tons for the first 10 months of the year, or slightly more than one-third of receipts for the same period in 1948. Ilmenite prices decreased from \$20 per ton to \$14-16 during the year. Further exploitation of titanium metal may be expected to materially benefit the economic and production status of these minerals.