

It is estimated that during 1961 annual capacity of elemental sulphur will reach 1,500,000 tons. Until 1952, Canada's requirements for the elemental form were supplied by imports; today, large-scale exports are needed to market current production recovered as a by-product of natural gas processing.

Nickel-Copper-Iron Sulphide Ores

For more than 50 years, the nickel-copper-iron sulphide ores of the Sudbury district of Ontario have been the world's principal nickel source. Separation of copper from the nickel has been one of the major metallurgical problems in treatment of these ores. In the past, the bulk of the copper was removed by the Orford process. Now, much improved separation has been achieved by The International Nickel Company of Canada, Limited in the successful development of a process based on flotation and magnetic separation of slowly cooled bessemer matte to yield nickel sulphide, copper sulphide, and a metallic fraction containing the precious metals. This process, marking the first commercial application of mineral dressing principles to matte products, was established on a commercial scale at Copper Cliff in 1944, and by late 1948 all International Nickel matte was so treated.

Since the nickel sulphide was low in both copper and precious metals, it became possible to sinter part of it for direct production of nickel oxide sinter, without the previously required refining operations. Beginning in 1956, another portion of the nickel sulphide has been used in production of matte anodes for direct electrorefining of nickel and recovery of high-purity sulphur, selenium and cobalt. This new process eliminates traditional operations of high-temperature converting of reverberatory furnace matte to blister copper which is cast into anodes for electrorefining. Instead, the molten matte is cast directly into sulphide anodes and electrolyzed. At International Nickel's new plant at Thompson, Man., the molten matte is produced in electric furnaces.

High-iron content of nickel concentrates produced at Copper Cliff has been a controlling factor in nickel smelting capacity. Solution to the problem has been found by separating an iron concentrate of low nickel and sulphur content, with virtual elimination of copper, precious metals, and silicates.

A \$20,000,000 plant for separate treatment of 365,000 tons per year of pyrrhotite by the new process was constructed near Copper Cliff and its operation started early in 1956. It is the first unit of an installation which will have a capacity of more than 1,000,000 tons per year of pyrrhotite. Sulphur elimination is accomplished in fluid bed roasters, operating in closed circuit with cooling boilers and cyclones. Nickel is extracted by atmospheric pressure leaching in ammoniacal solutions, following selective reduction of the calcine to magnetite and nickel metal in a kiln using gases for reduction. The magnetite fines are agglomerated into one-inch balls by pelletizing on discs and firing on a travelling grate. This premium product has been used very successfully as open hearth charge ore by the steel industry in Canada and the United States.

The bringing into production of the Lynn Lake property in Manitoba by Sherritt Gordon Mines, Limited in 1953 added another important source of nickel to Canada's supply. The process used by Sherritt Gordon in the treatment of the Lynn Lake nickel-copper ore for the concentration, extraction and recovery of the metals is a radical departure from the usual practice of treating sulphide ores. After selective flotation of the ore to yield a copper-sulphide concentrate and a nickel-iron sulphide concentrate containing some copper and a small amount of cobalt, the process is basically chemical. The copper concentrates can be economically smelted and refined in the usual manner.

The nickel-copper-cobalt-iron sulphide concentrates are leached under pressure in stainless steel autoclaves with air and aqueous ammonia to dissolve the nickel, copper, cobalt and most of the sulphur, leaving the iron and other impurities in the tailings. The copper is first removed from the solution as a sulphide by boiling, the nickel is precipitated by hydrogen under pressure, the cobalt is removed by treatment with hydrogen sulphide, and the end solutions are evaporated to produce ammonium sulphate.