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LEACHING OF CHROMIUM, NICKEL, COBALT AND MANGANESE FROM ORES

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This invention relates to the recovery of chromium along with any of nickel, cobalt, manganese and other valuable metals from ores composed wholly or mostly of lateritic, limonite minerals containing said valuable metals along with substantial amounts of iron. These ores contain relatively small quantities of these valuable metals amounting to less, and in most instances very much less, than five percent each in combination with the iron.

Up to the present time, chromium has been recovered substantially only from high grade ores generally containing from 50–60% chromium, as chromic oxide, in combination with 12–25% iron, as ferrous oxide. As far as is known, no one has provided an economically acceptable process for the recovery of chromium from minerals or ores of very low grade, as those containing less than about five percent chromium, although numerous ores exist which contain this small chromium content, the chromium being in combination with three and a half to five times as much iron and with small amounts of other valuable metals which could be recovered.

An object of the invention is to recover the chromium in an economically acceptable process from these very low grade ores.

An object of the invention is to recover separately chromium and either nickel or cobalt or both from such ores while leaving the iron in the tailings.

A further object is to provide a process for the recovery of chromium, nickel, cobalt and other valuable metals from such high iron content ores which is highly effective in its selective action and is capable of providing tailings containing the iron in a condition sufficiently free of such other metals that it can be economically employed as a blast furnace feed, thereby to provide a process of materially increased over-all economic value in relation to prior nickel and cobalt recovery processes wherein the chromium was left in the tailings, rendering the same unacceptable as a blast furnace feed.

A final object is to provide a process for the separate recovery of manganese, chromium and other valuable metals from mixed ores, one of which is an ore, containing a manganic oxide mineral and the other of which is of the type hereinbefore described.

In broad concept, the process of the invention involves the selective dissolution of chromium from iron contained in lateritic, limonite ores by subjecting the ore in aqueous slurry form to the action of sulfuric acid or other suitable sulfating agent in an amount sufficient to dissolve the chromium content but not the iron content, at a temperature of at least 450° F. under superatmospheric pressure, and during the heating oxidizing the chromium present to a form soluble in the acid. When the dissolution of the chromium has taken place, the product liquor is separated from the tailings containing the iron.

As to a most important embodiment, the invention may be broadly described as involving processes for the selective dissolution and recovery of chromium with either nickel or cobalt or both and also other valuable metals if present from lateritic, limonite ores involving mixing said ore with a tetravalent manganic oxide mineral and with sulfuric acid and water in quantities which solubilize the chromium and other valuable metals to be recovered, heating the resulting slurry to a temperature of 475° F or slightly higher under superatmospheric pressure until the

dissolution of the valuable metals has taken place and separating the product liquor containing the dissolved valuable metals from the ore tailings containing the iron. The nickel, cobalt, chromium and manganese present in the mixture are extracted from the ore in good yields by this leaching operation and are present in the leach liquor in the form of soluble salts or ions. The tailings obtained, as by filtration, is composed of iron oxide in sufficiently pure state for use as blast furnace feed. The product leach liquor is thereupon treated to separate the valuable metals therefrom and from each other such that commercially saleable compounds or free metals are provided.

The invention is applicable to the treatment of lateritic, limonite ores in general such as are found in several parts of the world including Brazil, Venezeula, New Caledonia, Indonesia and the Philippines, and is particularly applicable to the Moa Bay or found in Cuba.

The manganic oxide minerals suitable for the practice of the present invention may be more or less concentrated or may be in combination with other minerals. Examples of suitable minerals include pyrolucite, ramsdellite, manganite, braunite and hausmannite.

In a preferred embodiment of the invention the manganic oxide mineral which liberates active oxygen on decomposition is supplied by a high manganese ore, or ore concentrate. A typical analysis of suitable concentrate is set out below following an analysis of a typical sample of Moa Bay ore.

Moa Bay ore:	
Ni	1.35
Co	0.146
Fe	47.5
Al	4.2
Mg	0.62
Mn	0.76
Cr	1.64
Cu	0.024
Zn	0.040
SiO_2	3.30
San Isidro concentrate:	
Ni	.25
Co	0.068
Fe	24.0
Al	4.13
Mg	0.15
Mn	18.4
Cr	0.09
Si	4.92
V	0.035

A suitable manganese ore is one found in the Three Kids District of Nevada having typically, the analysis:

MnO_2	56.04
MnO	7.08
Fe_2O_3	1.68
Al_2O_3	1.85
SiO_2	13.73
PbO	2.07
MgO	1.40
CuO	.49
H_2O	11.25
K and Na oxides	3.82

The amount of sulfating agent employed in the leaching operation depends upon the proportion of valuable metals which will be sulfated in the process. The amount of sulfuric acid required is related to the theoretical quantity required to convert the nickel, cobalt, zinc and copper content to the bisulfate form, the aluminum to the basic bisulfate form and the magnesium to the sulfate form. A small amount of additional acid is required if the chromium and manganese are present in appreciable amounts