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Studies on Mineral Resources of Manganese

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Abstract

Manganese ore has been an important raw material and holds key positions in metallurgical industries. Production of various kinds of steel, ferroalloys, chemical and battery industries have utilized 97% of manganese ores India. Manganese ore process by hydrometallurgy methods is usual to establish that the primer element has separated from other gangue elements using acid or base solution. Thus, the usual hydrometallurgy method has inclusive of leachate procure, separation from gangue elements and refinement of primer elements. Processing method of manganese ore depends on its extent, featuring compose formative and respect to impurities. Suggestive issued hydrometallurgy being most suit-in-addendum technique based on ease of usage as upto nominal modifications applicable as chemicals and suggestive issued as upto physical data invariants to vary as upto merged scale of scheme.

Keywords: Manganese; Ore; Strength; Leach; Mineral

Introduction

Manganese is a chemical element with symbol Mn and atomic number 25. It is hard brittle silvery metal, and found in minerals in combination with iron. Manganese is transition metal and used as industrial alloy like stainless steels. Mn improves strength, workability, and resistance to wear. Manganese oxide is used as an oxidizing agent, and used as a rubber additive. Resourced raw manganese mineral has developed to optimize treat based on type of ore, e.g. pyrolusite (MnO_2), psilomelane ($BaMn_9O_{16}(OH)_4$), dan manganite ($Mn_2O_3H_2O$), hausmannite (Mn_3O_4), Rhodochrosite ($MnCO_3$), and dan Rhodonite ($MnSiO_3$). Associated minerals of Mn have been found with other minerals, e.g. quartz, kaolinite, dolomite, cordierite, hematite and lithiophorite. Usual studied methods of Mn ore extraction have been pyrometallurgy, hydrometallurgy and biometallurgy. Pyrometallurgy has deficits from high cost, energy consumption, less productivity and pollution. Hydrometallurgy is a technique within the field of extractive metallurgy to obtain metals from their ores. Hydrometallurgy involves the use of aqueous solutions for recovery of metals from ores, concentrates, and recycled or residual materials. Biometallurgy has been a method to extract metal from ore by activity of microorganisms. Primary mineral process has been separation of minerals by adopting different methods, henceforth, thorough understanding of various minerals present has suggested a prerequisite to separate one out of all minerals present in compose. Mineralogical examination of an ore has been a useful clue to assess suggestive methods for its beneficiation. Thereby various mineral processed derivatives have helped in improvement of efficiency in mineral processing. Suggestive scope of mineralogical experimentation has been microscopic studies, x-ray diffraction (XRD) and electron probe microanalysis (EPMA). Information about mineralogy, mineral chemistry and geochemistry of manganese ores containing high phosphorus, silica and iron have been a mandate to generate data, so forth has been interpreted in terms of evolving a suitable beneficiation technique.

Aim

Aim of this article is studies on mineral resources of manganese.

Objective

Objective is to study resources of manganese achievable both usual mining schemes as well as biologically originated. Type of ore and respective route under most economical and industrial feasibility has been subjected to evaluate competence among various methods. Hydrometallurgy has been most suited, in lieu as a compound mineral combination differential could be easily subsidized from changes in chemical used from dissolution, precipitation, etc.

Theme resources Mn (At. No. 25)

Selective methodical ease have descriptive issues to adjust constraints of hydrometallurgy that has studied as easiest route of extraction, e.g., methods inclusive from absence of toxic effluent, simplicity of plant, ease in maintenance, lower expenses and high selectivity in response to metal under consider. Simulation of extractive metallurgical steps have mandated so forth, to assure about methodical scripture. This has stated to scheme at each step from excavation of ore to extraction, thus mineral exploration in response to deviation in route by presence of additional element compose. Assessments under reducing atmosphere synergistic to pyro metallurgical steps have been studied to optimize time to time differential input by ore. Experimental reducing conditions have been synergistic to smelting/reduction conditions in ferroalloy furnace, which has given by phase composition of ore in temperature range 800-1200°C when ore has exposed to CO gas; under these conditions manganese oxides are reduced only to MnO.

Resources Mn (At. No. 25) Leach produce

Elucidated characterization of Sumbawa manganese ore and recovery of manganese sulphate as leaching products [1]. Leaching process of manganese ore has significance for high grade (15 mt) Indonesian manganese ore from Sumbawa, West of Nusa Tenggara. Characteristics of ore have been investigated by x-ray fluorescence (XRF) to adjust content composed of 78.8 % Mn, 17.77% Fe and balance as trace elements such as Si, Co, Ti, Zn, V and Zr contents. Analysis by x-ray diffraction has shown presence of Mn in composed form of pyrolusite (MnO_2), rhodonite ($MnSiO_3$), rhodochrosite ($MnCO_3$) and hematite (Fe_2O_3). Thermal analysis has been used to analyse manganese ore as well thermal decomposition character has been observed. Crystallization at a heating temperature of 200 °C has confirmed extract as manganese sulphate under XRD. Extract has processed by leaching in sulphuric acid (H_2SO_4, 6 M) at 90 ^{o}C for two hours, which has subsequently added of NH_4OH to control pH. Subjective recovery of mineral/ore proportion has been 87% after leach formation. Lean, low grade and complex ore has been processed by hydrometallurgical technique, which has been treated advantageous as method has suit-in-addendum, easy to control on each process step, reduce environmental pollution and acceptable for small scale industries. Leaching process has illustrative procure as from (a) using pickle liquors of $FeSO_4$, which has brought gelatinous residues that has been difficult to be separated; (b) Sulphuric acid leach using SO_2 aqueous, which has extracted 95% of manganese; (c) Sulphuric acid and oxalic acid leach has derived 98.4% of manganese; (d) Peroxide addition to reducing agent of manganese leach has resulted in recovery of 92% manganese; (e) Leach process with sulphuric acid gave $MnSO_4$ which has used as a precursor compound for many reactions adoptive in industries from pigment, pharmacy, textile and fertilizer assist; and (f) Suggestive scale has linked evaluation of manganese ore processing by manganese sulphate preparation has increased its value on economical basis. Subjected characteristic manganese ore has suggested extracting after the leaching process in sulphuric acid medium so as to obtain $MnSO_4$ as product of recovery.

Resources Mn (At. No. 25) Type of mineral in composes

The role of mineralogy, mineral chemistry and geochemistry in mineral processing: A case study for high phosphorus manganese ores of Nishikhal, South Orissa, and India [2]. Constituents of a mined ore body have been studied as follows: Mn ores have classed as high-grade siliceous and ferruginous. Manganese minerals have suggestive issues as cryptomelane, romanechite, pyrolusite, jacobsite, hausmannite, braunite, lithiophorite, birnessite and pyrophanite. Manganese associative opaque gangue minerals have been goethite, limonite, graphite, hematite, and magnetite. Mn associative silicate gangue minerals have suggestive issues as quartz, orthoclase, hyalophane, garnet, kaolinite, apatite, collophane, fibrolite, zircon, biotite and muscovite. Ferruginous manganese ores have suggestive issues from geochemical studies to link high amounts of phosphorus in the body of ore, which has been subjectively analysed by optical microscopy and electron probe microanalysis studies. Revealed schemes have furnished phosphorous containing ores in form of apatite inclusions within, e.g., quartz, orthoclase and garnet; amorphous calcium phosphate or collophane within, e.g., voids of garnet; and adsorbed component within manganese oxide and silicate phases as well as in iron oxide phase i.e. goethite. Schemes from magnetic separation studies on low- and off- grade bulk manganese samples have indicated that phosphorus has contributed by apatite to low (4.44-17.76%) content than held in adsorption (82.24-95.56%). Association of phosphorus in ores has suggested to exhibit adsorption thereby degrading the quality of ore. Dephosphorization has been studied to respond by reduction roasting followed by magnetic separation or roast alkali leaching method.

Resources Mn (At. No. 25) Pyrometallurgical forecast

Properties of manganese ores and their change in the process of calcination [3]. Properties of manganese ores and their change in process of calcinations in different gas atmospheres has descriptive issues to subject assessment for next process step, henceforth rated procured specimens of test have investigated using XRD, optical, SEM and EPMA analyses. Manganese ores have suggested differences in chemistry and mineralogy after formation of equilibrium phases in ores at temperatures of 800°C, 1000°C and 1200°C in different gas atmospheres. Suggested process of calcination of manganese ores in air has reduced MnO_2 to Mn_2O_3 and Mn_3O_4, while during calcination in reducing atmosphere manganese oxides have reduced to MnO and iron oxides to metallic iron. Liquid slag formed in ores at equilibrium has suggested success of treating ores at 1200°C in air and 1000-1200°C in a reducing atmosphere, henceforth limiting margin has suggested about no liquid slag forming equilibrium. Significant variation in chemistry and mineralogy of industrial manganese ores has a large influence on technique and efficiency of production of manganese alloys. Susceptibility to next processing affectability has thus, defined by their chemistry, mineralogy and physical properties. Strategies of melting and reduction behaviour of ores have schemed for streamlined composes, where changes in mineralogical abruption has affected as ore has heated in a reducing atmosphere in a ferroalloy furnace. Mineralogy and geology of manganese ores have been exposed usually, however change in ore chemistry and mineralogy upon heating has been studied to assess route originated subscriptive fallacy. Studied equilibrium phases have estimated from CaO-MnO-Al_2O_3-SiO_2 system, wherever a number of phases have identified to subscript system, e.g., slag of molten oxide phase, olivine, tephroite, monoxide, rhodonite, galaxite, anorthite, etc. depending on temperature and chemistry. Examination of equilibrium phases in CaO-MnO-Al_2O_3-SiO_2-K_2O system has cited that K_2O has strongly affected melting properties of the oxide system. These systems have analysed by equilibrating with a metal phase i.e. Mn or Mn-Si alloy at a given temperature in an inert atmosphere followed by quench.

Conclusion

Exceptional industrial applicability of manganese (Mn) as manganese-steel, catalyst and battery has demanded development in manganese mineral processing. Manganese ore has been an important raw material for use in metallurgical industries. 97% of manganese ores in India is used in industries for production of steel, ferroalloys, chemical and batteries. India has contained 56% of total manganese ore reserves composed from iron, silica and/or phosphorus i.e. beyond specified limits and has rendered unsuitable for iron and steel as well as ferromanganese industries. Phosphorus inclusive in particular has a deleterious effect on mechanical properties of iron and steel, hence, phosphorus content in manganese ores has been desired to be as low as possible. Therefore, adequate information on mineralogy and nature of association of phosphorus, iron and silica have been a prime fact before assessment of physical and/or chemical route of beneficiation of manganese ores.

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