ORIENTAL JOURNAL OF CHEMISTRY
An International Open Free Access, Peer Reviewed Research Journal
www.orientjchem.org
Est. 1984
ISSN: 0970-020 X
CODEN: OJCHEG
2018, Vol. 34, No.(1):
Pg. 544-547

(Brief Communication)

Biological Enrichment of Chromite ore on Alkaline Roasting Using *Seidlitzia rosmarinus* ash

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http://dx.doi.org/10.13005/ojc/340162

(Received: June 07, 2017; Accepted: November 15, 2017)

ABSTRACT

The Eco-friendly methods have become a promising synthetic strategy in science and technology in recent years. The current study describes alkaline roasting of chromite ore using *Seidlitzia rosmarinus* ash and water leaching of resulting cake. The Formation of Na_2CrO_4 was confirmed by Existing of ligand to metal charge transfer (LMCT) band in the UV-visible spectrum in 270 and 370 nm. Rhombohedral structure of the product was investigated using the powder X-ray diffraction (PXRD). The X-ray Fluorescence Spectroscopy (XRF) shows Increasing in chromium percent from 44.94 to 65.07 and existing elementals as sodium, potassium, calcium and magnesium in *S. Rosmarinus* ash that can act as alkaline assistance in alkaline roasting.

Key words : Biological, Enrichment, Chromite, Seidlitzia rosmarinus.

INTRODUCTION

Chromium and its by products have broad applications as stainless steel production, chromic acid plating, corrosion control and etc.[1-3] chromium is present in many minerals, occasionally combined with iron oxides and other transition metal oxides such as manganese, titanium, vanadium, niobium and etc[4].

Chromite ore belongs to the spinel group with the general chemical formula of XY_2O_4 which X and Y represent divalent and trivalent metal ions .the natural mineral is usually represented by the general formula $(Fe^{2+},Mg)(Cr, Al, Fe^{3+})_2O_4$ with sometimes small quantities of Magnesium , Titanium and Vanadium[5].

Production of sodium chromate from chromite ore is requisite reaction for producing other products[6]. sodium chromate was manufactured by leaching of chromite ore using sodium hydroxide and sodium carbonate at temperatures 1000°C in an atmosphere of oxygen[7,8]. A process such as soda- ash roasting [9], acid leaching[10], alkaline leaching[11,12], alkaline roasting using sodium hydroxide, potassium hydroxide and water leaching[13], have been developed for the processing of chromite ore in order to produce sodium chromate.

The conventional methods such as Pyrometallurgy or Hydrometallurgy, are not economic and ecofriendly. therefore Bioleaching of minerals is a suitable way for solving these problems. recently bioleaching of ores using microorganisms was reported[14].

In this study, leaves and branches of *S. Rosmarinus* in oxidizing atmosphere was used as environmentally friendly and economical source for alkaline roasting of chromite and resulting solid cake was dissolved in distilled water to remove insoluble Iron (III) oxide and magnesium oxide from soluble chromates.

EXPERIMENTAL METHODOLOGY

The Concentrated chromite was obtained from a sabzan mine of faran, Kerman, Iran. The composition of concentrate sample used is given in Table. 1. Concentrate was sieved into 200 mesh. *S. Rosmarinus* Leaves was collected from desert of bajestan, Khorasan, Iran.

The *S. Rosmarinus* leaves were cleaned with double distilled water, shade-dried and ground to powder and stored for further study. 3.3 g of chromite ore and 6.6 g of grinding plant was wearing up and uniformed. The mixture was transferred to crucible and putting up in 1100 °C for 2 hours. Roasting mixture Chromite was cold and wear up in pounder and then mixed with water in 50 ml flask with fixed temperature 60 °C in presence magnetic stirrer.

The UV–vis spectrum was recorded on a double beam spectrophotometer (Shimadzu, model UV-2550) from 200 to 500 nm. The solution was filtered, concentrated and dried in an oven for further analysis. Element Analysis of solid sample was confirmed by ED 2000 belong Oxford company of England X-ray Fluorescence (XRF) Spectrometer. for evaluation of the mineral structure of sodium chromate, X-ray powder diffraction using Cu-Kα radiation over an angle (2θ) range of 5 to 90°. With step: 0.04 with the support of X' Pert software was used.

RESULTS AND DISCUSSION

Characterization of chromite ore

The original mineral phase in chromite is $FeCr_2O_4$ .also existence of trace of titanium. nickel and manganese has been proven[15].

The elemental analysis results of chromium have shown in Table. 1. this result shows that the most percentage of elements respectively belong to chromium, silicon, iron and magnesium.

Characterization of *S. Rosmarinus ash*

Chemical compositions of roasted plant in 1100 °C determined by XRF and were shown in Table 2. this result shows the existence of elements such as sodium, potassium, calcium, magnesium and strontium that confirmed alkaline assistance role of *S. Rosmarinus* ash.

The comparison, chemical composition of chromium, S. Rosmarinus and soluble chromates in table 1,2 and 3, show a large percentage of chromium has been belonging to SiO_2, that destroyed during the process. deletion of Fe_2O_3 and decreasing in the percentage of magnesium show formation of insoluble compound as Fe_2O_3 and MgO. Low change in the percentage of potassium and sodium, and increase in the percentage of chromium, confirm the formation of soluble chromates as Na_2CrO_4 and K_2CrO_4.

The Comparison chemical composition of *S. Rosmarinus* ash and soluble chromates in Table. 2 and 3 show decrease in the percentage of elements as calcium, strontium and magnesium, that Proves formation of insoluble chromates include $CaCrO_4$, MgCrO4 and $SrCrO_4$. This changes justified by equation 1 to 7.

Table. 1: Chemical composition of chromite by XRF

Compound	Cr_2O_3	SiO_2	Fe_2O_3	MgO	Al_2O_3	SO_3	P_2O_5	MnO	CaO	TiO_2	NiO
Percentage	44.94	20.47	18.89	10.06	2.91	0.56	0.55	0.45	0.22	0.16	0.16

Table. 2: chemical composition of *S. Rosmarinus* was determined by XRF

Compound	CaO	SiO_2	K_2O	Na_2O	MgO	SO_3	Cl	Fe_2O_3	Al_2O_3	SrO	TiO_2	MnO	other
Percentage	31.63	18.05	11.32	8.49	7.67	7.23	4.6	4.97	3.34	0.71	0.54	0.54	0.48

Roasting of chromite using *S. Rosmarinus* ash and leaching with water

Table. 3: Chemical composition of soluble chromates produced by roasting using *S. Rosmarinus* and leaching with water

Compound	Cr_2O_3	SO_3	Na_2O	K_2O	Cl	MgO	Al_2O_3	CaO	SiO_2	MnO	Sb_2O_3
Percentage	65.07	13.66	7.52	6.18	2.83	1.87	1.26	0.42	0.38	0.23	0.18

Meanwhile roasting of chromite, probable reaction was accrued that equation 1to 7 shows this process.

(M is Representative of alkali metals)

$$FeCr_2O_4 + 4MOH + \frac{7}{4}O_2 \rightarrow \frac{1}{2}Fe_2O_3 + 2M_2CrO_4 + 2H_2O \quad (1)$$

$$MgCr_2O_4 + 4MOH + \frac{3}{2}O_2 \rightarrow MgO + 2M_2CrO_4 + 2H_2O \quad (2)$$

$$FeAl_2O_4 + 2MOH + \frac{7}{4}O_2 \rightarrow \frac{1}{2}Fe_2O_3 + 2MAlO_2 + H_2O \quad (3)$$

$$MgAl_2O_4 + 2MOH \rightarrow MgO + 2MAlO_2 + H_2O \quad (4)$$

$$SiO_2 + 2MOH \rightarrow M_2SiO_3 + H_2O \quad (5)$$

$$Fe_3O_4 + 3MOH + \frac{1}{4}O_2 \rightarrow 3MFeO_2 + \frac{3}{2}H_2O \quad (6)$$

$$MgFe_2O_4 + 2MOH \rightarrow MgO + MFeO_2 + H_2O \quad (7)$$

equation 3-6 show possibility reaction of some of impurities as SiO_2, $FeAl_2O_4$ and

$MgFe_2O_4$ with MOH, but “G in equation 1 and 2 is more negative therefore the formation of chromates is more likely [16].

Analysis of UV-vis spectroscopy

The UV–vis pattern of Na_2CrO_4 in Fig.1 showed bands in 270 and 370 nm mainly attributed to ligand -to -metal charge transfer (LMCT) band[17].

XRD studies

Figure.2 shows XRD Pattern of sodium chromate. Intense peaks at the various angular position which indexed to JCPDS 22-1365 was attributed to Na_2CrO_4 with orthorhombic structure and network Parameters a=7. 1462 b=9.2635, c=5.864, existence a few impurities $Na_{0.2}K_{0.8}CrO_4$ with monoclinic structure and network parameters a=9. 939, b=5. 625, c=7. 163 were confirmed[18].

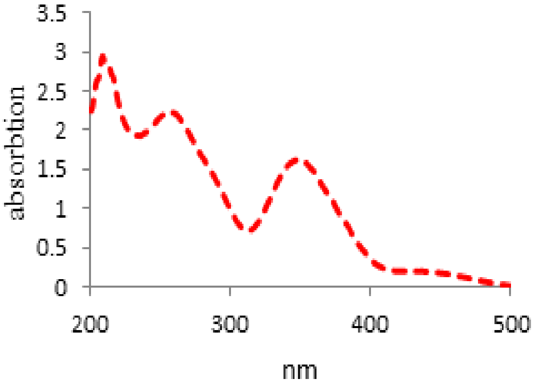

Fig.1. UV-Vis spectrum of sodium chromate

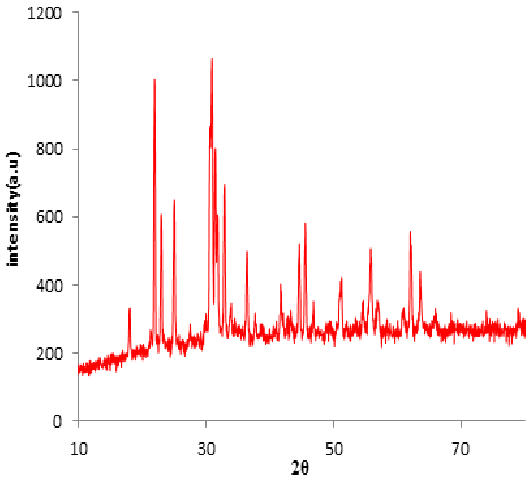

Fig. 2. XRD spectrum of Na_2CrO_4

CONCLUSION

In summary, the conversion of chromite ore to soluble chromates was achieved in two steps, alkali roasting by *S. Rosmarinus* ash and water leaching. XRF studies showed increases in the percentage of chromium from 44.94 to 65.07. Therefore *S. Rosmarinus* ash could act as Leach suppliers. UV-vis studies showed three picks due to charge transfers that confirmed formation of sodium chromate. The results obtained from XRD studies showed indicator picks due to orthorhombic structure of Na_2CrO_4.

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