



## RESEARCH ARTICLE

### BASIC CHROMIUM SULPHATE AND WASTE MANAGEMENT

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#### ARTICLE INFO

##### Article History:

Received 18<sup>th</sup> November, 2024

Received in revised form

24<sup>th</sup> December, 2024

Accepted 25<sup>th</sup> January, 2025

Published online 27<sup>th</sup> February, 2025

##### Key words:

Basic Chromium Sulphate, Recycling and Waste Management.

#### ABSTRACT

To start production of basic chromium sulphate, raw chromium ore is brought from Ingassana area in form of rocks, crushed into small particles with particle size of nano structure. The chromium ore particles are roasted with soda ash to sodium chromate which is then oxidized to sodium dichromate. Sodium dichromate is reduced with molasses and sulphuric acid at 98% concentration to basic chromium sulphate. The basic chromium sulphate analysis are 26%Cr<sub>2</sub>O<sub>3</sub> and 33% basicity which is suitable for tanning of leather to wet-blue stage. After completion of the tanning process. The spent to chrome liquor is recycled after being topped with the required level and reused. The management of the spent chrome is very important and the recycling process protects the environment, saves chemicals, water and reduces the cost.

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## INTRODUCTION

Over the years chromium is known as an element with a symbol Cr and atomic number 24. It is widely used in the production of stainless steel and electroplating for resistance to corrosion. It is used in the production of pigments and other chemicals chromium helps to regulate blood sugar levels by improving insulin function. On the other hand, chromium three, when oxidized to chromium six would be very dangerous and toxic. Chrome ore is transformed to basic chromium sulphate and used for tanning of leather it has the ability to give very high shrinkage temperature of 100°C to the wet blue pelts. Chromiums when used for tanning, it will not be completely fixed to the leather, the remainder is discharged to the drain. Although technical research works reach very high exhaustion, but the remainder is still used to be eliminated from the waste water. In this work it is required to produce basic chromium sulphate for tanning of leather from chrome ore which is available locally in huge quantities with very high chromic oxide content the process starts by crushing the rocks of ore to nano particles size, roasted with soda ash, oxidized to chromate, reduced to basic chromium sulphate and concentrated in triple effect evaporator, then spray dried and packed. The leather industry in Sudan needs a lot of quantity of basic chromium for wet-blue pelts for export, the spent liquor needs to be treated and recycled.

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## Objectives of the study

### The objectives of this paper are

- Production of basic chromium sulfate for wet-blue leather for export.
- Management of waste through recycling and land-fill.

### Previous works

**Basicity of chromium sulphate:** this refers to number of hydroxyl ions (OH<sup>-</sup>) to that associated with the chromium ions (Cr<sup>+3</sup>) in the compound of basic chromium sulphate. This is a mixture of normal chromium sulphate (Cr<sub>2</sub>SO<sub>4</sub>) and varying amount of chromium hydroxide ions present in the compound and expressed as percentage such as follows:

- Degree of basicity =  $\frac{\text{number of hydroxy ions}}{6} * 100$
- Factor affecting the method of production of basic chromium sulphate, these are
- Purity of chrome ore
- Extraction method
- Particle size
- Operating temperature
- Residence time

These parameters affect directly the quality of the product. Type of reactors. The type of reactors used affect both the efficiency and basicity of basic chromium sulphate.

When chrome is used for tannage. The pH and basicity of basic chromium sulfate indicate the degree of tannage, fixation and shrinkage temperature. Use of basic chromium sulfate.

**Leather Industry:** Basic chromium used as tanning agent to produce pelts with high shrinkage temperature high tensile strength and soft leather.

**Textile industry:** Used to improve the quality and texture of the textiles due to stabilizing effect.

### Coating Industry

Used as stabilizer to improve coating properties.

PH

Basic chromium sulphate penetrates quite well into the leather at low PH of 3-5.

As the PH increases the chrome is very stringent and adsorb to the surface without. Penetration, if the PH increases the basicity also increase, at alkaline PH the basic chromium precipitates as  $\text{Cr}(\text{OH})_3$  with no tanning effect. Spent Basic chromium sulfate Management. Spent basic chromium sulphate may be reused, recycled or precipitated and reused. . It must be realized that chrome- shavings in the leather industry contain about 30%, these shavings have very high calorific value and used by brick- makers, transformed to chromium six which is toxic and cancerogenic.

Hence it is very important to extract chromium three from chrome- shavings, and reuse it.

## METHODOLOGY

### In this study the materials used are:

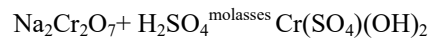
- Chromite particles
- Soda ash.
- Concentrated sulphuric acid.
- Sugar
- Molasses.

**Procedure:** Chrome is obtained from Ingassana, crushed into nanoparticles, roasted, transformed to sodium dichromate, and reduced to basic chromium sulphate. The PH and basicity are adjusted and the reduced liquor is used for tannage at 15%  $\text{Cr}_2\text{O}_3$ . The chrome liquor is concentrated in a triple- effect evaporator and spray dried with 26%  $\text{Cr}_2\text{O}_3$  and 33% basicity. Basic chrome sulphate is used for tanning pickled pelts, basified and checked for shrinkage temp, which must be 100°C indicating that, the tannage is complete- waste management. The spent solution is analyzed for pH,  $\text{Cr}_2\text{O}_3$  and salt content. These are adjusted for tanning and recycled- other methods of waste management are: precipitation, acidification and reuse. The chrome shavings are dried, extracted to remove  $\text{Cr}_2\text{O}_3$  and sent for incineration.

## RESULTS AND DISCUSSION

From the mathematical model derived the residence time of 8 minutes was determined, the inlet and out flow rates of  $0.09 \frac{\text{m}^3}{\text{min}}$ . the volume of CSTR was 0.72 m<sup>3</sup> and the reaction rate of  $0.06 \text{ m}^{-1}$ .

The reaction is first- order:



The basicity was adjusted using soda ash or caustic soda. The pH was also adjusted as the case might require. The hot solution of basic chromium sulphate was Introduced in a triple-effect evaporator to a concentration of 70% and spray dried to powder. The powder was analyzed to  $\text{Cr}_2\text{O}_3$  content, basicity PH and used for wet- blue production. The spent solution was filtered, precipitated and dried. The dried material was acidified to PH 1.5 and reused for tannage. Another method of waste- management is to recycle the spent solution after being topped with make- up basic chromium sulphate and salt (NaCl). The recycling was continued for ten times, then it was filtered and drained with the cake and sent to land- fill.

## CONCLUSIONS AND RECOMMENDATIONS

In conclusion basic chromium sulfate is produced from chromite ore through processes of grinding to nano particle size, roasting to chromate and dichromate. The product of basic chromium sulfate can be used for tanning of wet-blue for export. The spent solution is recycled ten times, the cake is sent to land-fill and the spent solution is used as float for the following new batch of recycling. This method would save chemicals, water and protects the environment. It is recommended that the chromite ore is to be grinded to nano particle size, roasted to sodium chromate and made into aqueous solution. The solution shall be filtered, the filtrate is concentrated in a multiple -effect evaporators. The concentrated solution is to be made into sodium dichromate, then reduced to basic chromium sulfate and spray dried.

## ACKNOWLEDGEMENT

The authors wish to Thank the college of graduate studies and Research of the Sudan University, for Science and Technology for giving us this chance for carry out this research for Ph.D. Thesis.

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