



Chromium-Removal from Waste Water

Chromium is found in two forms in waste streams-hexavalent and trivalent. Hexavalent chromium is found in the waste streams of plating operation, aluminum anodizing, paint and dyes operation and other industries. Trivalent chromium is found in the waste streams of textile dyeing, the ceramic and glass industry and photography.

The usual chromium limits for most effluents are less than 0.05 mg/l for hexavalent chromium and 0.5 mg/l for trivalent chromium.

Treatment for chromium usually consist of a two stage process: first the reduction of hexavalent chromium to the trivalent form and second, precipitation of the trivalent chromium. for this reason, chrome-bearing streams are segregated and treated separately, particularly in the reduction in the reduction of hexavalent to the trivalent form.

The reduce chrome bearing stream can then be blended with other metal bearing streams for further treatment. waste can be treated either batch-wise or continuously. For a continues flow through system, equalization of the raw waste flow, by mean of a holding tank with several hours detention as a first step in the treatment process, is most important.

Hexavalent Chrome Reduction to Trivalent

The reduction of hexavalent chromium is accomplished at a pH of 2 to 3.

The PH can be adjusted either by manual measurement or by an automatic pH control unit with the addition of sulfuric or hydrochloric acid.

The level of pH controls the rate of reaction.

- At the pH 2, the reduction reaction is almost instantaneous,
- while at a pH of 3, the reaction takes about 30 minutes.

After the pH is adjusted a reducing agent most commonly used are sodium dioxide and sodium meta-bisulphate.

The amount of reducing agent added may be controlled, based on oxidation-reducing potential (ORP) reading or by analyzing of the hexavalent chromium remaining in solution. Sulfur di oxide gas is toxic, so adequate venting and safety precautions must be provided.

Typical relationship between ORP and Cr⁺⁶ is as follows

ORP	Cr ⁺⁶
590	40 ppm
570	10 ppm
540	5 ppm
330	1 ppm
300	0 ppm

The relationship should be confirmed by field tests.



Trivalent Chrome Reduction

Trivalent chrome is removed by precipitation as Hydroxide .

Usually lime or caustic is added to increase the pH to between 7.5 and 8.5 for minimum solubility of chromium hydroxide.

The solubility start to increase as the pH goes below 7 on the low side and as it goes above 9 on the higher side . therefore ,careful pH control in the range of 7.5 to 8.5 is important . as pointed out above , other metals in the waste stream will also precipitate in this step .

Theoretical Chemical Dosages

For Hexavalent Chrome Reduction

The theoretical chemical requirements per Kg of Cr are :

For reducing with sulfur dioxide ,

- 2 Kg SO₂ plus 35 mg for each liter of water treated or .

for reducing with sodium meta-bisulfite ,

- 3 lb Na₂S₂O₅ and 1 to ½ Kgs H₂SO₄

Using Sodium Hydro Sulphide

- Under alkaline condition , sodium hydrosulfite can be used for the reduction of hexavalent chrome and requires 5 mg/l for each mg/ l of chrome + 5 mg/ l for each mg/l for each mg /l of dissolve oxygen present in the water

Using Ferrous Sulphate :

Ferrous Sulfate will reduce hexavalent chrome and jointly precipitate the trivalent chrome and ferric hydroxide at pH 8.5

Approximately 17 parts of ferrous sulfate for each part of hexavalent chrome . this process is then the conventional process of pH reduction and use of SO₂ ,

The overall economics of Hexavalent Chrome Reduction are dependent upon the quantum the hexavalent chrome content present in the waste water .

Usually Ferrous Sulphate could be methods of choice when the Hexavalent Chrome concentration is less than 10 mg/l and probably it will be the system of choice when the content is less then 5 mg/l

For precipitation of Trivalent Chrome as Hydroxide ,

- 2.2 Kg Ca(OH)₂ or
- 2.5 Kg of Na₂OH or
- 3 Kg Na₂CO₃.