# Wastewater Treatment for Chromium Removal- a Review

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*Abstract*—**Wastewater treatment for heavy metal treatment is gaining importance because of the increase in pollution and scarcity of water. Chromium is one such heavy metal emitted from electroplating, lather, iron and steel industries. In the present review, the research carried out for chromium removal is summarized. The study was carried out on the aspects such as percentage removal, efficiency and economy.**

***Index Terms*—removal, biological methods, adsorption.**

## I. INTRODUCTION

Pure water is not easily available to all. Most of us consume contaminated water. As human needs are increasing day by day and civilization changes, the industries are born and grown, the problem of wastewater discharge is become more and more severe. Process waste streams like mining, electroplating, iron and steel industries, metal plating contain heavy metal concentration exceeding the discharge limit. These streams contain chromium, nickel, cadmium and copper. They are not removed without using specialized treatment. Chromium is one of the most common metal present in the effluents. Chromium is dominant in most of effluent stream compared to other metal ions. It leads to liver damage, pulmonary congestion, oedema, and causes skin cancer. There are various methods employed to remove the chromium such as adsorption method, biological electro-coagulation.

## II. VARIOUS METHODS USED FOR CHROMIUM REMOVAL

Damirdas et.al has carried research onkinetics of adsorption for the removal of chromium from aqueous solution on activated carbon prepared from the agriculture waste [1]. Study on the batch removal from of chromium from aqueous solution using low cost adsorbents such as cornelian cherry, apricot stone and almond shell under different experimental condition was carried out by them. The effects of initial chromium ion concentration (20 to 300 mg.l),pH( 1 to 4) and particle size have been reported. Baral et.al carried research on hexavalent chromium removal from aqueous solution by adsorption on treated sawdust [2]. Their study included adsorption based on parameters such as contact time, amount of adsorbate and initial concentration. They observed that the percentage removal increased with the decrease in pH. Sawdust was proved to be efficient adsorbent for removal of chromium. Pandhram and Nimbalkar carried out research on removal on chromium from industrial waste water by using neem leaves as low cost adsorbent [3]. Their study was aimed at exploring the neem leaves for wastewater treatment. It was revealed that maximum removal efficiency was up to 85% for biosorbent prepared from neem leaves. The adsorbent was prepared by washing neem leaves with water and drying the leaves in dryer to remove the moisture. Wanees et.al carried out the research on adsorption studies for removal on chromium from contaminated water[4]. The batch was carried out for 120 minutes. The removal percentage was satisfactory. Ramakrishnaiah and Pratibha carried out research on the chromium removal by industrial waste by chemical precipitation method[5]. The study was conducted in 3 phases. Sodium metabisulphite was used as a reducing agent. The chromium removal using calcium hydroxide and sodium hydroxide was found to be 99%.

Siraj et.al. investigated the removal of chromium from tannery effluent using chitosan-charcoal composite[6].The composite was prepared by simple solution evaporation method. To know the chromium removal capacity of charcoal, chitosan and the composite, known amount (20 g/l) of chitosan, activate charcoal and composite were added to 10 ppm of chromium solution in three different polyethylene tubes.The chromium removal was observed to be 90%.Qazi et.al carried out the research on biological chromium removal at low PH[7]. Bacterial growth was suppressed amongst the benefit using the thermophilic bacteria for biotechnological processes such as bioremediation. Many effluent samples were characterized by high or low pH, thermal pollution and high contents of other substances. To detoxify one or more notorious pollutants in such an environment through eubacteria, first requirement was to render conditions near to the optimum levels for the microbes for the remediation process. Samuel, et.al carried research on chromium reduction from waste water[8]. Tougan natural mixed clays for chromium (III) removal from aqueous solution were used as a cheap and environmentally friendly method. The TOU clay was alkaline with pH value of 8.21.Chromium(III) was sorbed on the natural mixed clay. Chang carried research on chromium removal from waste water [9]. Three sets of chemicals were tested for the chrome reduction and precipitation. The one with metabisulfite/ferric chloride and another with ferrous sulphate. Ferric chloride can reduce the total chromium concentration below the discharge limit when suitable

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dosages of chemicals were used. Ilhan et.al carried out research on removal of chromium from industrial waste [10]. In this the study, selective biosorption of chromium by micro - organism from industrial waste was investigated. Micro - organism was isolated from soil and for research bacterium staphylococcus saprophyicus was identified. The effects pH, temperature was also investigated. The optimum value was thus estimated. Talokar studied removal of chromium from waste water adsorption using low cost agriculture biomass as adsorbent[11]. The study was aimed at efficiency evaluation of non-convectional low cost adsorbents such as flyash powder, bagasse, w.straw dust, coconut shell compared to activated carbon for removal of aqueous solution. The experiment was carried in aqueous solution by dissolving potassium dichromate.

Abdulla et.al carried out research on chromium removal from tannery waste water using chemical and biological techniques aiming zero-discharge of pollution[12]. In this process waste water was collected from tanneries. The process was done by using various methods like chemical precipitation, reverse osmosis, membrane process. Chemical biological treatment was more economical than other treatments. Lime was good precipitating agent for removal of chromium from tanning waste water. Optimum pH for precipitating chromium was 7.7-8.2 with lime concentration (29/100ml) and effective settling rate was 20 minute. Dermentzis et.al carried out research on removal of nickel, copper, zinc and chromium from synthetic and industrial waste water by electro coagulation[13].According to them electrocoagulation was faster, safe and most efficient process. They observed that the best capacity of removal for all studied metals was in the pH range 4-8 and best removal was achieved at density of 40Ma/$cm^2$. The efficiency of electro coagulation process was largely affected by the value of pH. According to them the electro coagulation process was the most efficient method for removing of metallic as well as organic pollutants from electroplating industries.

Hossini et.al conducted research on optimization of chromium reduction and sludge production by bipolar electro coagulation using response surface methodology (RSM) [14]. Several operating parameters like current density, running time, pH and initial chromium concentration were examined during the process of RSM by them . During their investigation, at the conditions of current density=0.27A, running time=-70min, Ph=4.62 and initial concentration 156mg/l, the removal of chromium and sludge production were obtained was 0.9374% and o.889% respectively. The chromium species were in the different forms such as dichromate, hydro chromate or chromate depending upon the pH values. Hosseini et.al carried research on electrochemical removal of hexavalent chromium from waste water using platinum-Iron/Iron carbon nanotubes bipolar electrodes[15]. The operating parameters such as pH(3-9),hexavalent chromium concentration (50-300mg/l), supporting electrolytes such as NaCl, KCl, $Na_2CO_3$ and $KNO_3$ and its dosage, oxidation reduction variation, sludge production rate and current density (2.20mA/cm^2) were examined. According to their experimental data optimum conditions were observed to bet ime duration of 20-120 min, pH of 3, NaCl concentration 0.5% and initial concentration of chromium,100mg/l. 100% of chromium removal was achieved in 120 min and optimum conditions. Mahvi et.al carried out research on performance evaluation of electrcoagulation process for removal of chromium from synthetic chromium solutions using iron and aluminium electrodes[16]. During the research it was observed that at higher voltage, the amount of aluminum oxidized increases.They concluded that the method was reliable, efficient & cost effective. Bulter et.al carried out research on electro coagulation in waste for the removal of chromium from water treatment[17]. Electro coagulation- electro flotation (ECF) technology was the process of applying electric current to flocculate contaminants without adding coagulations. Using the principles of electrochemistry, cathode was oxidized.It was noted that ECF was capable of having high removal efficiencies of colour, COD, BOD.

Dermentzis et.al carried out investigation on removal of hexavalent chromium from electroplating wastewater by electro coagulation with iron electrodes[18]. The waste from electroplating may contain up to 2500 mg/l $Cr^6$& which is to be controlled. KCl, $K_2Cr_2O_7$&NaOH of analytical grades were used. Removal rate of chromium increased by the increase in current density. This process was more effective at beginning when concentration was higher than that at the end. Vlachou et.al investigated effect various parameters in removing Cr & Ni from model wastewater by using electro coagulation[19]. They studied the performance of ECF for removal of Cr & Ni from wastewater using Al & Fe electrodes with an effective surface area of 13.8 $cm^{2.}$.It was observed that, the increase in initial concentration favored removal rate. They performed experiments by using an ordinary 1 lit beaker, placed on magnetic converter at 100 rpm. They concluded that heavy metals exhibited faster rates at higher concentrations. Also lower residual concentrations were observed at lower initial concentrations.

## III. CONCLUSION

The summery of research carried out for removal of chromium is presented. It was observed that many chemical, physical and biological treatment methods have been tried by different researchers for chromium removal. The percentage removal upto 99-100 was obtained. There is still scope for research in order to render economy and effectiveness to the treatment. The chromium removal efficiency using calcium hydroxide and sodium hydroxide combination was found to be 99.7% The adsorption was also very effective method in removal of chromium from waste water.

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