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Treatment Of Tannery Effluent By Chemical Precipitation

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Abstract

Industrialization and population in crease is destroying the environmental quality. Chrome tanning discharges large quantities of effluent containing up to 180 mg/l of chromium while the permissible limit is 2.0 mg/l. along with the chromium other pollutants are also present Hexavalent chromium are highly toxic and accumulative in nature. Cr (vi) pollution has become one of the world's most serious environmental concerns due to its long persistence in the environment and highly deadly nature in living organisms. The hexavalent chromium is carcinogenic, genotoxic and mutagenic (1). The most economic and simple technique consists of alkali precipitation, lime, caustic soda and mixture have been used in the present study in the temperature range between 25 to 100^0C.

Key words: Hexavalent chromium, effluent, caustic soda, lime, temperature, permissible.

Introduction

Environment pollution is one of the major problems of the world and it is increasing day by day due to urbanization and industrialization. The current pattern of industrial activity alters the natural flow of materials and introduces novel chemicals into the environment composed of water bodies (2). The chemicals used in the industrial processes pass through the waste water in some form and get released to the ground and/or water sources ultimately polluting the ecosystem (3). Industries use large volumes of water during the manufacturing process and in the supporting operations. Two methods are adapted for tanning of raw hide/skin viz., vegetable tanning and chrome tanning. The production processes in a tannery can split into four main categories (1) Hide and skin storage and beam house operations, (2) tanyard operations, (3) post tanning operations and finishing operations (4). Industrial waste contains pollutions which are very toxic and having adverse effects have been known for centuries, Certain concentrations of these may even kill the living organisms (5). In humans the oral route exposure to Cr is due to contaminated well water (U.S.EPA, 1998). Certain effects have been reported live mouth, ulcers, indigestion, acute tubular necrosis, vomiting abdominal pain Kidney failure and even death (6,7).

Table-1: Composite effluent from chrome Tannery mg/l.

Industry	-	Chrome tannery effluent (mixed)
Location	-	Jajmau, Kanpur
Collection date	-	10-01-2022
Ambient temperature	-	21 ± 2^0C
Characteristics	value	Tolerance Limit (IS:2450)
Colour	yellow green	-
Temperature ^{0}C	20	

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pH	8.5	7.0-9.0
Total solids	20,080	200
BOD	3000	30
COD	9,050	250
Total chromium	7.5	2.0
Hexavalent chromium - Cr^{6+}	-	0.1
Suspended solids	19,758	100

Characteristics of waste water:

Characteristics of waste water was analysed using standard methods and results have been given in Table-1 for the effluent froma chrome tanning unit.

EXPERIMENTAL:-

Average composition of the composite waste water from chrome tan leather industry has been shoran in table. It may be observed that total chromium content of 7.5 mg/l is present whereas tolerance limit is 2.0 mg/l as given in table-1 (ISC, 1992). It means at least 73% removal of the initially present chromium has to be performed before discharging such effluent.

RESULT AND DISCUSSION:

The effect of temperature on chromium reduction. Increasing the temperature generally increases the rate of a chemical reaction. Thus precipitation which follows a chemical reaction should also increase when the temperature rises.

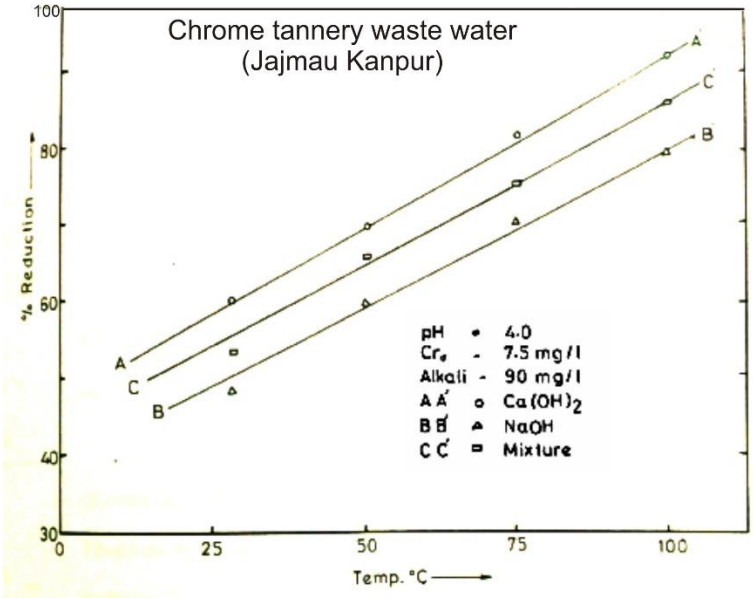

Figure:1 Effect of temperature on chromium reduction.

Experimental data for the effect of temperature on alkali reduction of chromium in the tannery waste water has been collected in the temperature range of 30 to 100^0C and presented in fig.1 The waste water initially containing 7.5 mg/l of chromium was treated with 90mg/l of the alkalies. The stoichiometric

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quantities are16.00 mg/l for lime and 17.31 mg/l for sodium hydroxide may be observed from figure 1 that the increase in temperature increases the percentage reduction in the case of all the alkalies utilized. The highest reduction in all temperature ranges is observed to be in case of calcium hydroxide and lowest in the case of sodium hydroxide as shown by the lines AA' BB' and CC' respectively. The percentage reduction with respect to the temperature show a linear relationship and may be represented for chromium as follows:

AA' $Ca(OH)_2$ Rer = 0.47 T+ 46.4 (1)

BB' NaoH Rer = 0.40T + 43.25 (2)

CC' Mixture Rer = 0.40 T+ 38.5 (3)

Where

Rer = Percentage chromium Reduction

T = Temperature ^0C

on an average 4.7% reduction/^0C rise of the temperature is observed in the case of line where as only 4% reduction/^0C is observed in sodium hydroxide and the mixture. In order to see the affect of temperature on precipitation, Arrhenius type plot of the same data where computed and have been shown in figure-2.

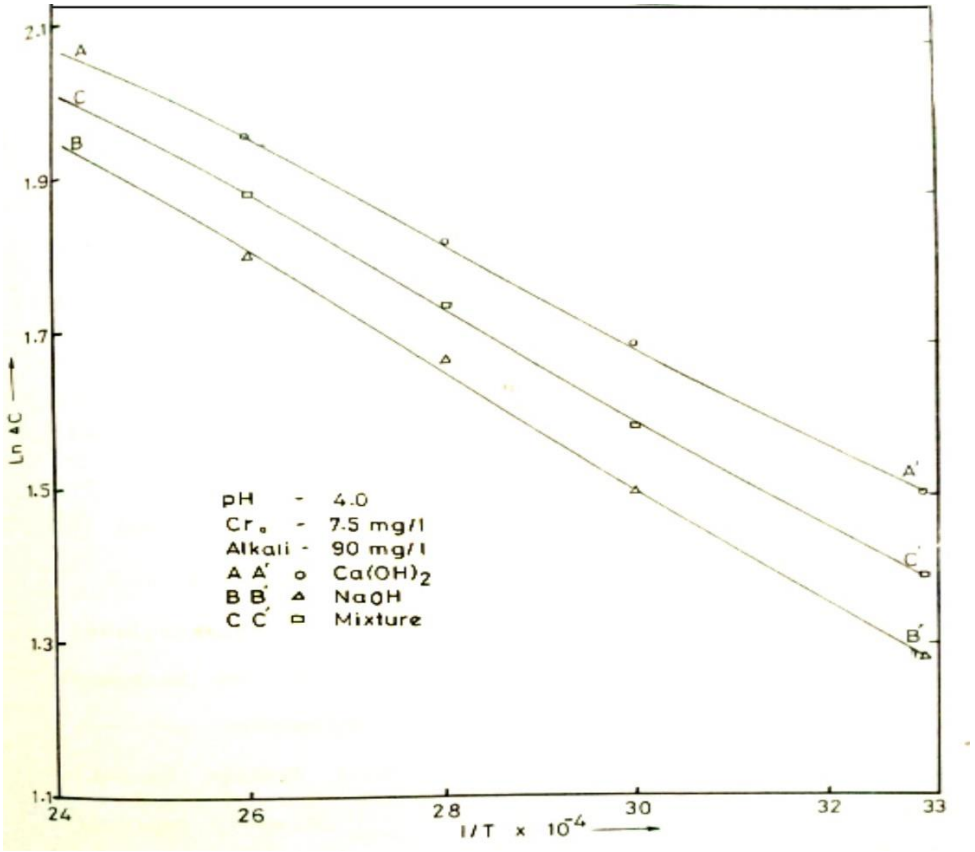

Figure:-2 Effect of temperature and initial concentration on chromium reduction (Arrhenius plot.)

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Three lines AA', BB' CC' represent $Ca(oH)_2$, NaoH the mixture, respectively. The Arrhenius type expression obtained were as follows:

AA' $Ca(OH)_2$ $\Delta C = 600\ e(-7.965/t)$ (4)

BB' NaoH $\Delta C = 750\ e\ (-7.029/t)$ (5)

CC' Mixture $\Delta C = 550\ e\ (-7.576t)$ (6)

Where ΔC = chromium concentration change.

T = Temperature, ^0K

The large negative exponential value in the equation 4 is -7.956 for $Ca(oH)_2$ indicate the lowest energy of activation required. The equation 4, 5 and 6 give an idea of chromium reduction capacity with the alkalies used in the temperature range studied which may be helpful in selecting the process conditions.

CONCLUSION:

Chemical precipitation is the most commonly employed and simple techniques for the reduction of metals and their compounds alkali concentrations and temperature effects were studied to optimise the Cr+3 reduction in waste waters of leather tannery (Archana Shukla et al. 1993) chemical precipitation method also studied for chromium removal and its recovery from tannery waste water in ethiopia (Fenta Minas et al. 2017)

The following conclusion may be drawn-

1. Increase in the reaction temperature in general increases the chromium reduction.
2. At lower quantities more of metal reduction takes place where lime is used.
3. Impurities present in the industrial effluent affect the required quantity.
4. More than the stoichiometric quantities of the alkali required and up to 98% metal reduction may be achieved.
5. Linear expressions were derived which may be helpful to obtain the metal reduction at other temperatures 100^0C in the range of 25 to 100^0C.

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