**Advances in Environmental Research**, *Vol. 4, No. 3 (2015) 197-210*
DOI: http://dx.doi.org/10.12989/aer.2015.4.3.197 

# Removal of hexavalent chromium Cr (VI) by adsorption in blended lateritic soil

B.M. Sunil * and Saifiya Faziludeen [a]

*Department of Civil Engineering, National Institute of Technology Karnataka, Surathkal Srinivasnagar PO 575025, India*

(*Received July 03, 2015, Revised October 05, 2015, Accepted October 12, 2015*)

**Abstract.** Hexavalent chromium [Cr (VI)] adsorption on lateritic soil and lateritic soil blended with black cotton (BC) soil, marine clay and bentonite clay were studied in the laboratory using batch adsorption techniques. In the present investigation the natural laterite soil was blended with 10%, 20% and 30% BC soil, marine clay and bentonite clay separately. The interactions on test soils have been studied with respect to the linear, Freundlich and Langmuir isotherms. The linear isotherm parameter, Freundlich and Langmuir isotherm parameters were determined from the from the batch adsorption tests. The adsorption of Cr (VI) on natural laterite soil and blended laterite soil was determined using double beam spectrophotometer. The distribution coefficients obtained were 1.251, 1.359 and 2.622 L/kg for lateritic soil blended with 10%, 20% and 30% BC soil; 5.396, 12.973 and 48.641 L/kg for lateritic soil blended with marine clay and 5.093, 8.148 and 12.179 L/kg for lateritic soil blended with bentonite clay respectively. The experimental data fitted well to the Langmuir model as observed from the higher value of correlation coefficient. Soil pH and iron content in soil(s) has greater influence on Cr (VI) adsorption. From the study it is concluded that laterite soil can be blended with clayey soils for removing Cr (VI) by adsorption.

**Keywords:** blended lateritic soil; hexavalent chromium; batch tests; adsorption isotherms

## 1. Introduction

Chromium commonly enters the environment from the effluents of various industries such as metallurgical, refractory, chemical pigments, electroplating, tanning and many others (Diatta and Kocialkowski 1997). It will cause environmental pollution when it is released into soil and water. Among the two oxidation states of chromium [trivalent, Cr (III)] and hexavalent chromium, [Cr (VI)] hexavalent chromium is very toxic even at concentration as low as 0.05 mg/L in drinking water (Das *et al*. 2013). Cr (VI) is highly mobile and poses a great risk of ground water pollution (Babu and Gupta 2001). The risk of environmental pollution and also health impact due to the carcinogenic nature of Cr (VI) several treatment methods have been developed and implemented for its treatment purpose. Adsorption is one of the most popular treatment methods and this method is also applicable in landfill liners to reduce the mobility of contaminant to the groundwater (Das *et al*. 2013). Adsorption is a mass transfer operation in which substances present

*Corresponding author, Assistant Professor, Ph.D., E-mail: bmsunil@gmail.com
[a] Master Student, E-mail: saifiyafaziludeen4@gmail.com


http://www.techno-press.org/?journal=aer&subpage=7 ISSN: 2234-1722 (Print), 2234-1730 (Online)

in aqueous solution. Although the value of n shows a favorable adsorption, the $R^2$ values in Table 3 indicate that test results are not fit well for Freundlich model for high concentration Cr (VI) solutions.

Table 3 Frendlich adsorption parameters all test data (0.5-100mg/L)

| Soil | Freundlich isotherm | | |
|---|---|---|---|
| | $k_F$ (mg/kg) | n (kg/L) | $R^2$ |
| Lateritic soil | 6.14 | 1.51 | 0.892 |
| Lateritic soil + 10% BC soil | 4.94 | 1.51 | 0.982 |
| Lateritic soil + 20% BC soil | 3.97 | 1.66 | 0.981 |
| Lateritic soil + 30% BC soil | 4.95 | 1.76 | 0.836 |
| Lateritic soil + 10% marine clay | 9.97 | 2.83 | 0.754 |
| Lateritic soil + 20% marine clay | 22.23 | 2.09 | 0.938 |
| Lateritic soil + 30% marine clay | 40.36 | 1.81 | 0.941 |
| Lateritic soil + 10% bentonite | 12.55 | 1.58 | 0.988 |
| Lateritic soil + 20% bentonite | 6.14 | 1.51 | 0.892 |
| Lateritic soil + 30% bentonite | 4.94 | 1.51 | 0.982 |

$k_F$ - Freundlich capacity factor; $n$ - an empirical constant