Environmental Information System
Collect Collate Disseminate
INDIA

ISSN No.: 0972-1266

ENVIS Newsletter

Vol. 16 | No. 1 | February 2009

Special issue: Inorganic Contaminant "Chromium"

CSIR-INDIA

INDIAN INSTITUTE OF TOXICOLOGY RESEARCH
(Formerly Industrial Toxicology Research Centre, Lucknow)

IN THIS ISSUE

ODDS & ENDS 1
An assessment of heavy metal contamination in vegetables grown in wastewater-irrigated areas of titagarh, west bengal, india 1
Distribution of heavy metals in the surface water of Ranipet industrial area in Tamil Nadu, India.. 1
Biological removal of Cr (VI) by bacterial isolates obtained from metal contaminated sites.. 1
Heavy metals in industrial waste-water, soil and vegetables in Lohta village, India 1
Immunosuppressive effect of subchronic exposure to a mixture of eight heavy metals, found as groundwater contaminants in different areas of India, throughdrinking water in male rats 2
Trace elements removal from water using modified activated carbon. 2 Soil contamination of heavy metals in the Katedan Industrial Development Area, Hyderabad, India 2
Cancer mortality in a chinese population exposed to hexavalent chromium in drinking water. 3
NTP Toxicology and Carcinogenesis Studies of Sodium Dichromate Dihydrate (CAS No. 7789-12-0) in F344/N Rats and B6C3F1 Mice (Drinking Water Studies). 3
Novel biofiltration methods for the treatment of heavy metals from industrial wastewater 4
These nipples are dangerous 5
Removal of chromium (VI) through biosorption by the *Pseudomonas* spp. isolated from tannery effluent. 5
Extractive separation and determination of chromium in tannery effluents and electroplating waste water using tribenzylamine as the extractant 5
Recovery and reuse of chromium from chrome tanning waste water aiming towards zero discharge of pollution 5
Investigating DNA damage in tannery workers occupationally exposed to trivalent chromium using comet assay 6
Bioleaching of chromium from tannery sludge by indigenous *Acidithiobacillus thiooxidans* 6
Occupational health risks among the workers employed in leather tanneries at Kanpur 6
Phytoremediation of chrome-VI of tannery effluent by *Trichoderma* species 6
Involvement and interaction of microbial communities in the transformation and stabilization of chromium during the composting of tannery effluent treated biomass of *Vallisneria spiralis* L. 7
Removal of chromium (VI) using poly (methylacrylate) functionalized guar gum 7
Multivariate analysis of selected metals in agricultural soil receiving UASB treated tannery effluent at Jajmau, Kanpur (India) 7
Impact of long-term application of treated tannery effluents on thee mergence of resistance traits in rhizobium sp. isolated from *Trifolium alexandrinum*. 7
Eco-friendlier leather from India 8
DID YOU KNOW ? 8
OCCURRENCE OF CHROMIUM IN WATER SOURCES AND ITS REMOVAL BY LOW COST MATERIALS 8
CURRENT CONCERNS 11
REGULATORY TRENDS. 11
ON THE LIGHTER SIDE 12
ON THE WEB 12
BOOK STOP 12
CONFERENCES. 13
MINI PROFILE OF POTASSIUM DICHROMATE. 14

EDITORIAL

"Chromium", widely used in industries such as tanning, corrosion control, plating, pigment manufacture and nuclear weapons, poses a serious environmental threat. Leather production is a major industry in India, which makes significant contribution to the country's economic growth and provides employment opportunities to about three million people. On the other hand tannery effluents are ranked as the highest pollutants among all the industrial wastes. Unregulated disposal of chromium containing effluent has led to the contamination of soil, sediment, surface and ground waters. Exposure to chromium occurs by intake of contaminated food, water and (breathing contaminated) air. It leads to various disorders, including cancer, allergic diseases, liver damage, and lung irritation.

Government of India is aware of these problems and has started looking into the remedial measures to clean some of the highly contaminated surface water bodies. Involvement of very high cost of remediation will make this process slow and therefore, it is essential that the contamination of water bodies is controlled rather than remediated. Usage of chromium compound with precaution under the guidelines set by regulatory agencies should be practised. Where ever possible it should be replaced by eco-friendly compounds like use of vegetables dyes for tanning. Chromium should be recovered from effluents & reused. Consideration of certain parameters can help in reducing the pollution load connected with liquid and solid wastes from the tanning industry as well as recovery of economical resources. Protect environment and save humans from exposure of hazardous chemicals is in accordance with the saying that "Precaution is better than cure".

Editorial Team :
Dr. P. Kakkar
Mr. Shailendra K. Gupta
Dr. Anvita Shaw
Dr. Abha Sharma

Published by :
Distributed Information Centre on Toxic Chemicals
Environmental Information System (ENVIS)
at IITR, Lucknow

ODDS & ENDS

An assessment of heavy metal contamination in vegetables grown in wastewater irrigated areas of Titagarh, West Bengal, India

The effects of municipal wastewater irrigation on the accumulation of heavy metals (Pb, Zn, Cd, Cr, Cu and Ni) in soil and vegetables were investigated by monitoring waste-water-irrigated agricultural field of Titagarh, 24-Parganas (North), West Bengal, India. The mean concentrations of Pb, Ni, Cu in the irrigation water and the mean Cd content in soil were much above the recommended level. The concentrations of Pb, Zn, Cd, Cr and Ni in all the examined vegetables were beyond the safety limits. The study reveals that heavy metal-contaminated vegetables grown in wastewater-irrigated areas may pose public health hazards.

Bull Environ Contam Toxicol 2008, 80:115–118.

Distribution of heavy metals in the surface water of Ranipet industrial area in Tamil Nadu, India.

Water pollution is a major problem related to the economic/industrial growth of any country. The number of industries in India, (during the last decade) have grown more than ten times and accordingly the problems related to environmental degradation have also increased. There is a need for sustainable development of economic growth and industries. Some of the industries release their effluents either on the open land or in surrounding surface water body contaminating the soil, surface water and ultimately groundwater. Dissolved chromium reaches concentration levels of some g/kg due to anthropogenic pollution from tanneries, which is generally linked to the use of Cr (VI) compounds in several industrial applications such as plating, metallurgy, pigments, and leather tanning. Ranipet industrial area is about 120 km from Chennai on Chennai-Bangalore highway and is a chronically polluted area identified by Central Pollution Control Board of India. It is one of the biggest exporting centers of tanned leather in India. The total number of industries located in and around Ranipet town are 240 tanneries along with ceramic, refractory, boiler auxiliaries plant, and chromium chemicals. Studies were carried out to find out the contamination of surface water bodies due to industrial effluents. The results reveal that the surface water in the area is highly contaminated showing very high concentrations of some of the heavy/toxic metals like Cadmium ranging from 0.2 to 401.4 µg/l (average of 51.1 µg/l), Chromium 2.4-1,308.6 (average of 247.2 µg/l), Copper 2.1-535.5 µg/l (average of 95.5 µg/l), Nickel 1.6-147.0 µg/l (average of 36.7 µg/l), Lead 6.4-2,034.4 µg/l (average of 467.8 µg/l) and Zinc 20.8-12,718.0 µg/l (average of 3,760.4 µg/l). The concentration levels of these metals are much above the permissible limits in surface water and are hazardous to health especially for the people working in the tannery industries. It was observed that the people in the area were seriously affected and suffering from occupational diseases such as asthma, chromium ulcers and skin diseases.

Environ Monit Assess. 2008,136(1-3):197-207.

Biological removal of Cr (VI) by bacterial isolates obtained from metal contaminated sites.

Present study demonstrates the application of indigenous bacteria and pure culture of Azotobacter for removal of Cr (VI) from the aqueous solution and industrial effluents. Minimum inhibitory concentration (MIC) was determined for 3 bacterial isolates (B1, B2, B3) and pure culture of Azotobacter. The effect of various parameters such as initial Cr (VI) concentration, biomass dose, and time were examined to study the biosorption and bioaccumulation separately using live and dead cells, respectively. It was found that bacterial isolate B2 showed maximum Cr (IV) removal capacity (102 mg g (-1) biomass, dry weight) at initial Cr (VI) concentration of 150 mg/L. Langmuir and Freundlich isotherm model was applied, which gave a good representation of the experimental equilibrium concentrations for the biosorption of Cr (VI). During bioaccumulation process live bacterial strain B2 showed maximum accumulation i.e.,106 mg $g^{(-1)}$ at initial Cr (VI) concentration of 150 mg/L at pH 4.0. Bioaccumulation process was found to be time dependent since removal of Cr (VI) increased with time and equilibrium state was reached at 72-96 hours. This study demonstrates the potential of indigenous bacterial strains isolated from the contaminated site for evolving eco-friendly treatment of small-scale industrial effluents.

J Environ Sci Health A Tox Hazard Subst Environ Eng. 2008,43(4):419-23

Heavy metals in industrial waste-water, soil and vegetables in Lohta village, India

A field study was conducted at four major sites that were irrigated by either treated or untreated waste-water in the Lohta village of Varanasi, India which was receiving the discharged water from DLW (Diesel Locomotive Works) sewage treatment plant. Samples from irrigation water, soil and the edible portion of various vegetables were collected monthly during summer and winter seasons. Heavy metals present in wastewater used for irrigation while organic matter, electrical conductivity, pH and nitrate–nitrogen in soil samples were analysed. Various vegetables were sampled in Lohta village and screened for Cd, Cr, Cu and Zn by inductively coupled plasma emission spectrometry and inductively coupled plasma mass spectrometry. These local food products are the basis of human nutrition in this region and are also of great relevance to health, especially in developing countries. The results revealed that members of Brassicaceae (e.g. turnips, cabbage and radish) can efficiently accumulate the heavy metals henceforth, assessment of health risk should be explored.

Toxicological & Environmental Chemistry 2008, 90(2):247–257.

Immunosuppressive effect of subchronic exposure to a mixture of eight heavy metals, found as goundwater contaminants in different areas of India, through drinking water in male rats

Heavy metals are non-biodegradable environmental pollutants and their levels in different environmental compartments (air, water and food) are gradually increasing due to industrial and agricultural practices. Growing pollution of the environment with metals contributes to various disorders including cancer, hemato-toxicity, allergic diseases, and immu-notoxicity. Immunotoxicity is an important health hazard of heavy metal exposure. Because the risk of combined exposure in the population cannot be neglected, we examined whether subchronic exposure to a mixture of metals (arsenic, cadmium, lead, mercury, chromium, nickel, manganese, and iron) via drinking water at contemporary Indian ground-water contamination levels and at concentrations equivalent to the WHO maximum permissible limit (MPL) in drinking water can induce immunotoxicity in male rats. Data on groundwater contamination with metals in India were collected from literature and metals were selected on the basis of their frequency of occurrence and contamination level above the MPL. Male albino Wistar rats were exposed to the mixture at 0, 1, 10, and 100 times the mode concentrations (the most frequently occurring concentration) of the individual metals in drinking water for 90 days. In addition, one group was exposed to the mixture at a concentration equal to the MPL of the individual metal and another group was used as positive control for immune response studies. The end points assessed were weight of organs, hematological indices, humoral and cell-mediated immune response and histopathology of skin and spleen. The MPL and 1x doses did not significantly affect any of the parameters and none of the doses induced any significant changes after 30 days of exposure. The mixture at 10x and 100x doses increased the relative weight of the spleen, but that of thymus, adrenals and popliteal lymphnodes were increased with the 100x dose. After 90 days, 10x and 100x doses decreased serum protein and globulin contents and increased the albumin:globulin ratio. The albumin level was decreased only with the 100x dose. After 60 days, the total erythrocyte count (TEC), hemoglobin (Hb) level, and packed cell volume (PCV) were decreased with the 100x dose, whereas after 90 days, 10x and 100x doses reduced the TEC, total leukocyte count, Hb level, PCV, mean corpuscular volume, and mean corpuscular hemoglobin. With the 100x dose, the lymphocyte count was decreased after 60 and 90 days but the neutrophil number was increased after 90 days. Antibody titer was decreased after 75 days with the 100x dose but after 90 days it was decreased with both the 10x and 100x doses. In delayed-type hypersensitivity response, these two doses decreased ear thickness after 24 and 48 h and skin biopsies showed a dose-dependent decrease in inflammatory changes. Histologically, the spleen revealed depletion of lymphoid cells and atrophic follicles with reduced follicular activity with higher doses. the findings suggest that hematopoietic and immune systems are toxicologically sensitive to the mixture which could lead to anemia and suppression of humoral and cell-mediated immune respon-ses in male rats at 10 and 100 times the mode concentrations of the individual components in contami-nated groundwater.

Arch Environ Contam Toxicol. 2007,53(3):450-8.

Trace elements removal from water using modified activated carbon.

Arsenic and chromium are two of the most toxic pollutants introduced to natural waters from a variety of sources and causing various adverse effects on living bodies. The performance of three filter bed methods was evaluated in the laboratory. Experiments were conducted to investigate the sorption of arsenic and chromium on carbon steel and removal of trace elements from drinking water with a household filtration process. The affinity of the arsenic and chromium species for Fe/Fe_3C (iron/iron carbide) sites is the key factor controlling the removal of the elements. The method is based on the use of powdered black carbon, powdered carbon steel and ceramic spheres in the ion-sorption columns as a cleaning process. The modified powdered black carbon is a satis-factory and economical sorbent for trace elements (arsenite and chromate) dissolved in water due to its low unit cost of about $23 and compatibility with the traditional household filtration system.

Environ Technol. 2008,29(2):123-30.

Soil contamination of heavy metals in the Katedan Industrial Development Area, Hyderabad, India

Studies on quantitative soil contami-nation due to heavy metals were carried out in Katedan Industrial Development Area (KIDA), south of Hyderabad, Andhra Pradesh, India under the Indo-Norwegian Institu-tional Cooperation Programme. The study area falls under a semi-arid type of climate and consists of granites and pegmatite of igneous origin belonging to the Archaean age. There are about 300 industries dealing with dyeing, edible oil production, battery manufacturing, metal plating, chemicals etc. Most of the industries discharge their untreated effluents either on open land or into the ditches. Solid waste from industries is randomly dumped along roads and open grounds. Soil samples were collected throughout the industrial area and from down-stream residential areas and were analysed by X-ray Fluorescence Spectrometer for fourteen trace metals and ten major oxides. The analytical data shows very high concentrations of lead, chromium, nickel, zinc, arsenic and cadmium through out the industrial area. The random dumping of hazardous waste in the industrial area could be the main cause of the soil contamination spread by rainwater and wind. In the residential areas the local dumping is expected to be the main source as it is difficult to foresee that rain and wind can transport the contaminants from the industrial area. If emission in air by the smokestacks is significant, this may contribute to considerable spreading of contaminants like As, Cd and Pb throughout the area. A comparison of the results with the Canadian Soil Quality Guidelines (SQGL) shows that most of the industrial area is heavily contaminated by As, Pb and Zn and local areas by Cr, Cu and Ni. The residential area is also contaminated by As and some small areas by Cr, Cu, Pb and Zn. The Cd contamination is detected over large area but it is not exceeding the SQGL units Natural background values of As and Cr exceed the SQGL values and contribute significantly to the contamination in the residential area. However, the availability is considerably less than anthropogenic contaminants and must therefore be assessed differently. The pre and post-monsoon sampling over two hydrological cycles in 2002 and 2003 indicate that As, Cd and Pb contaminants are more mobile and may expect to reach the groundwater. The other contaminants seem to be much more stable. The contamination is especially serious in the industrial area as it is housing a large permanent residing population. The study not only aims at determining the natural background levels of trace elements as a guide for future pollution monitoring but also focuses on the pollution vulnerability of the watershed. A plan of action for remediation is recommended.

Environ Monit Assess. 2008,140(1-3):313-23.

Cancer mortality in a chinese population exposed to hexavalent chromium in drinking water.

China, reported that mortality rates for all cancers, like stomach and lung cancer in 1970-1978 were higher in villages with hexavalent chromium (Cr^{+6}) contaminated drinking water than in the general population. The investigators reported rates, but did not report statistical measures of association or precision. Using reports and other communications from investigators at the local Jinzhou Health and Anti-Epidemic Station, we obtained data on Cr^{+6} contamination of groundwater and cancer mortality in 9 study regions near a ferrochromium factory. We estimated: (1) person-years at risk in the study regions, based on census and population growth rate data, (2) mortality counts, based on estimated person-years at risk and previously reported mortality rates, and (3) rate ratios and 95% confidence intervals.

The all-cancer mortality rate in the combined 5 study regions with Cr^{+6}-contaminated water was negligibly elevated in comparison with the rate in the 4 combined study regions without contaminated water (rate ratio = 1.13; 95% confidence interval = 0.86-1.46), but was somewhat more elevated in comparison with the whole province (1.23; 0.97-1.53). Stomach cancer mortality in the regions with contaminated water was more substantially elevated in comparison with the regions without contaminated water (1.82; 1.11-2.91) and the whole province (1.69; 1.12-2.44). Lung cancer mortality was slightly elevated in comparison with the unexposed study regions (1.15; 0.62-2.07), and more strongly elevated in comparison with the whole province (1.78; 1.03-2.87). Mortality combined from other cancers was not elevated in comparison with either the unexposed study regions (0.86; 0.53-1.36) or the whole province (0.92; 0.58-1.38) while these data are limited, they are consistent with increased stomach cancer risk in a population exposed to Cr^{+6} in drinking water.

Epidemiology 2008,19(1);12-23.

NTP toxicology and carcinogenesis studies of sodium dichromate dihydrate (CAS No. 7789-12-0) in F344/N rats and b6C3F1 mice (drinking water studies).

Sodium dichromate dihydrate is one of the of inorganic compounds containing hexavalent chromium (CrVI), found in drinking water supplies as a contaminant resulting from various industrial processes including electroplating operations, leather tanning, and textile manufacturing. Due to lack of adequate experimental data on the toxicity and carcinogenicity of hexavalent chromium ingested orally (as it is present in drinking water) the California Congressional Delegation, the California Environmental Protection Agency, and the California Depart-ment of Health Services nominated hexavalent chromium to the National Toxicology Program for study. Results of 3 month toxicity studies in F344/N rats and B6C3F1, BALB/c, and am3-C57BL/6 mice were reported earlier in NTP Toxicity Report 72. In the current study, male and female F344/N rats and B6C3F1 mice were exposed to sodium dichromate dihydrate (greater than 99.7% pure) in drinking water for 2 years. 2-Year Study in Rats: Groups of 50 male and 50 female rats were exposed to drinking water containing 0, 14.3, 57.3, 172 & 516 mg/L sodium dichromate dihydrate (equivalent to 0, 5, 20, 60 & 180 mg/L chromium) for 2 years (equivalent to average daily doses of approximately 0.6, 2.2, 6 & 17 mg sodium dichromate dihydrate/kg body weight for males and 0.7, 2.7, 7 & 20 mg/kg for females). Survival of exposed groups was similar to that of the control groups. Mean body weight of 516 mg/L males and females were less than those of the controls throughout the study. The lower body weights were partly attributed to poor palatability of the dosed water and consequent reduction in water consumption. Water consumption by 172 and 516 mg/L rats was less than that by the controls throughout the study. Exposure to sodium dichromate dihydrate caused microcytic hypochromic anemia in rats that ameliorated with time. Exposure to sodium dichromate dihydrate resulted in the development of neoplasms of the squamous epithelium of oral mucosa and tongue. The incidences of squamous cell carcinoma in the oral mucosa of 516 mg/L male and female rats were significantly greater than those of the controls. The incidence in 172 mg/L females exceeded the historical control ranges for drinking water studies and for all routes of administration. The incidences of squamous cell papilloma or squamous cell carcinoma (combined) of the oral mucosa or tongue of 516 mg/L male and female rats were significantly greater than those of the controls. Exposure concentration-related non-neoplastic liver lesions were observed in males and females exposed to 57.3 mg/L or greater. These included histiocytic cellular infiltration, chronic inflammation, fatty changes (females), basophilic focus (males), and clear cell focus (females). Increased incidences of histiocytic cellular infiltration also occurred in the small intestine (duodenum), mesenteric lymph node and pancreatic lymph node of males and/or females exposed to 57.3 mg/L or greater. 2-Year Study in Mice: Groups of 50 male mice were exposed to drinking water containing 0, 14.3, 28.6, 85.7, or 257.4 mg/L sodium dichromate dihydrate (equivalent to 0, 5, 10, 30, or 90 mg/L chromium) for 2 years (equivalent to average daily doses of approximately 1.1, 2.6, 7, or 17 mg sodium dichromate dihydrate/kg body weight). Groups of 50 female mice were exposed to drinking water containing 0, 14.3, 57.3, 172 or 516 mg/L sodium dichromate dihydrate (equivalent to 0, 5, 20, 60, or 180 mg/L chromium) for 2 years (equivalent to average daily doses of approximately 1.1, 3.9, 9, or 25 mg/kg). Survival of exposed groups was similar to that of the control groups. Mean body weight of 257.4 mg/L males were less than those of controls from 2-6 months of the study, but by the end of the study, the mean body weight of 257.4 mg/L males was only slightly less than that of the control group. Mean body weight of 172 mg/L females were less than those of the controls from months 3 through 12 of the study, and mean body weights of 516 mg/L females were less than those of the controls from month 2 until the end of the study. By the end of the study, the mean body weight of 172 mg/L females was 8% less than that of the controls, and the mean body weight of 516 mg/L females was 15% less than that of the controls. The lower body weights were partly attributed to poor palatability of the dosed water and consequent reductions in water consumption. Water consumption by 85.7 and 257.4 mg/L males and 172 as well as 516 mg/L females was less than that of the controls throughout the study. A treatment related microcytosis occurred in exposed mice however, mice were less affected than the rats. The incidence of neoplasms of the small intestine (duodenum, jejunum, or ileum) was increased in exposed groups of male and female mice. The incidence of adenoma of the duodenum in 257.4 mg/L males and in 172, 516 mg/L females were significantly greater than those in the control. The incidence of carcinoma of the duodenum was significantly increased in 516 mg/L females. The incidence of adenoma of the jejunum in 516 mg/L females was significantly increased compared to that in the control. When the incidence of adenoma and carcinoma were combined for all sites of the small intestine, the incidence was significantly increased in 85.7, 257.4 mg/L males and 172, 516 mg/L females compared to those in the control. The incidences in 57.3 mg/L females exceeded the historical control ranges for drinking water studies and for all routes of administration. The incidence of diffuse epithelial hyperplasia was significantly increased in the duodenum of all exposed groups of male and female mice. The incidences of histiocytic cellular infiltration were significantly increased in the duodenum of 85.7, 257.4 mg/L males and in 172, 516 mg/L females. In the jejunum, the incidence of diffuse epithelial hyperplasia and histiocytic cellular infiltration were significantly increased in 516 mg/L females. The incidence of histiocytic cellular infiltration in the liver of all exposed groups of females, in the mesenteric lymph node of all exposed groups of males and females, and of the pancreatic lymph node of 85.7, 257.4 mg/L males, 172 and 516 mg/L females were significantly increased. Tissue distribution studies showed that total chromium concentrations tend to increase with increasing exposure concentration and duration of exposure. Under the conditions of 2-year drinking water studies there was clear evidence of carcinogenic activity of sodium dichromate dihydrate in male and female F344/N rats based on increased incidences of squamous cell neoplasms of the oral cavity. There was clear evidence of carcinogenic activity of sodium dichromate dihydrate in male and female B6C3F1 mice based on increased incidences of neoplasms of the small intestine (duodenum, jejunum and ileum). Exposure to sodium dichromate dihydrate resulted in histiocytic cellular infiltration in the liver, small intestine, pancreatic and mesenteric lymph nodes of rats and mice while diffuse epithelial hyperplasia in the small intestine of male and female mice only.

Nati Toxicol Program Tech Rep Ser *2008,546:1-192*.

Novel biofiltration methods for the treatment of heavy metals from industrial wastewater

Most heavy metals are well-known toxic and carcinogenic agents. When discharged into the wastewater, they represent a serious threat to the human population and the fauna-flora of the receiving water bodies. In the present review, the sources have discussed the industrial source of heavy metals contamination in water, their toxic effects on the flora-fauna and the regulatory threshold limits of these heavy metals. The various parameters of the biofiltration processes, their mechanism for heavy metals removal along with the kinetics of biofilters and its modeling aspects have been discussed. The comparison of various physico-chemical treatment and the advantages of biofiltration over other conventional processes for the treatment of heavy metal contaminated waste-water have also been discussed. The applications of genetic engineering in the modification of the microorganisms for increasing the efficiency of biofiltration process for heavy metals removal have been critically analyzed. The results show that the efficiency of the process can be increased three to six folds with the application of recombinant microbial treatment.

J Hazard Mater. 2008,151(1):1-8

These nipples are dangerous

Presence of migrated heavy metals was found in pacifier samples. When a baby cries, a mother tries to stop him with a feeding bottle. If the baby keeps crying, she puts a pacifier in the baby's mouth. The baby calms down. Later, the child is introduced to the

teether. Apart from engaging the baby, the teether alleviates the pain. But the next time your baby cries, think again before putting any such infant toy in his mouth. Pacifiers, teethers and nipples may contain toxic metals that are hazardous for your little one. The Consumer Education and Research Society (CERS), Ahmedabad tested a range of pacifiers, teethers and nipples for the presence of migrated heavy metals (lead, cadmium and chromium), considering their high toxicity. The findings are so alarming that CERS published the report without testing larger sample sizes.

Scientists and experts have opinion that the presence of metals like lead, cadmium and chromium, even in the minute amounts, is hazardous to health. Even the faint trace of these metals in pacifiers, teethers and nipples, meant for sucking and biting can pose a health risk to infants. The lead content in toys has become a global issue. In India, the Bureau of Indian Standards (BIS) has framed standards for the maximum amount of migrated lead, cadmium and chromium in toys. But there are no separate standards for infant toys like pacifiers, nipples and teethers. Infant toys cannot be clubbed with children's toys. These toys are meant for sucking and biting over a period of time, owing to which the toxic elements easily leak out in the saliva and enters into the body. Besides, the BIS standards are also not mandatory for toy manufacturers. A total of eight samples of pacifiers, teethers and nipples were tested for migrated element like lead (Pb), cadmium (Cd) and chromium (Cr). The results revealed that none of the toy samples was free from lead. The migrated lead content varied from 2.7 to 9.6 ppm (parts per million). Although this figure complies with the standards set by the BIS, the presence of lead is not acceptable, particularly in infant toys. Traces of chromium were found in all the samples tested. The amount of migrated chromium varied from 0.4 to 5.0 ppm. Highly toxic Cr (VI) may cause irritation and asthma attacks. Youngster may be more susceptible to toxic effects of chromium than adults.

CERS recommends that the BIS revise the standard for safety requirements for toys, particularly the limits for toxic metals like lead, cadmium and chromium. A separate category for infant toys like teethers, pacifiers and nipples should also be made. The revised standard as well as other standards should be made mandatory for toy manufacturers and importers.

http://www.telegraphindia.com/1080728/jsp/atleisure/story_9610775.js

Removal of chromium (VI) through biosorption by the *Pseudomonas* spp. isolated from tannery effluent

Heavy metal contamination of the rivers is a world wide environmental problem and its removal is a great challenge. Kanpur and Unnao two closely located districts of Uttar Pradesh,India are known for their leather industries. The tanneries release their treated effluent in the near by water bodies containing Cr metal that eventually merges with the river Ganges. Untreated tannery effluent contains 2.673 ± 0.32 to 3.268 ± 0.73 mg l^{-1} Cr. Microbes were isolated, keeping the natural selection in the view, from the tannery effluent since microbes present in the effluent exposed to the various types of stresses and metal stress is one of them. Investigations include the exposure of higher concentrations of Cr(VI) 1.0 to 4.0 mg l^{-1} to the bacteria (presumably the *Pseudomonas* spp.) predominant on the agar plate. The short termed study (72 h) of biosorption showed significant reduction of metal in the media especially in the higher concentrations with a value from 1.0 ± 0.02, 2.0 ± 0.01, 3.0 ± 0, and 4.0 ± 0.09 at zero h to 0.873 ± 0.55, 1.840 ± 1.31, 2.780 ± 0.03 and 3.502 ± 0.68 at 72 h respectively. The biosorption of metal show in the present study that the naturally occurring microbes have enough potential to mitigate the excessive contamination of their surroundings and can be used to reduce the metal concentrations in aqueous solutions in a specific time frame.

Journal of Basic Microbiology 2008, 48: 135–139

Extractive separation and determination of chromium in tannery effluents and electroplating waste water using tribenzylamine as the extractant

A simple extractive separation method has been developed for the determination of chromium based on the extraction of Cr (VI) as its ion-pair with tribenzylamine (TBA). The ion-pair is extracted at acidic pH using toluene as the diluent. The concentration of chromium in the organic phase was measured spectrophotometrically at 309 nm. The influence of experimental variables such as pH, sample volume, equilibration time, diverse ions etc. has been studied in detail. The extracted chromium (VI) could be stripped to the aqueous phase using NaOH as the stripping agent. The extracts were characterized using FT-IR spectroscopy. A detection limit of 0.08 ì g mL^{-1} could be achieved and the validity of the method was checked in real tannery effluent, electroplating waste water and spiked water samples.

Journal of Hazardous Materials in press

Recovery and reuse of chromium from chrome tanning waste water aiming towards zero discharge of pollution

An attempt has been made to recover the chromium present in spent tan liquor using neutralized wattle extract. The wattle extract at different pH conditions (pH 7, 8, and 9) was used for recovery of chromium. The neutralized wattle extract was made to react with chromium in the spent liquor and allowed to settle for a period of 6 h. Major amount of chromium settles at the bottom leaving minimal amount in the supernatant. The chrome was recovered and reused for tanning the pelt. The wattle extract that was left in the tanning bath was reused for post-tanning process as a retanning agent. Therefore, complete utilization of the chromium and wattle extract has been achieved in this work. It has also been noticed that increased level of chrome exhaustion of 85% and 87% (precipitate and supernatant) in experimental leather could be obtained in comparison with the exhaustion of 74% in control sample. The physical strength and color properties of the experimental leather were comparable to the control leather. The overall results show that the recovered chromium can be well used for tanning purpose to obtain the leather of comparable properties.

Journal of Cleaner Production 2008,16/16:1807-1813

Investigating DNA damage in tannery workers occupationally exposed to trivalent chromium using comet assay

DNA damage of peripheral lymphocytes in 60 workers occupationally exposed to trivalent chromium [Cr (III)] in a tannery was studied using comet assay. The urinary and blood chromium levels were detected as a biomarker of internal exposure. The 90 subjects were divided into three groups: (i) exposure group I included 30 tannery workers highly exposed to chromium from tanning department; (ii) exposure group II included 30 tannery workers with moderate chromium exposure from finishing department; (iii) control group included 30 individuals without exposure to physical or chemical genotoxic agents. No significant difference was found among the three groups for age and smoking. The results showed that the medians of blood and urinary Cr of two exposure groups were significantly higher than those of control group ($P < 0.01$). The medians of blood and urinary Cr of exposure group I were significantly higher than those of exposure group II ($P < 0.05$ or $P < 0.01$). The medians of mean tail length (MTL) of the three groups were 5.33 (2.90–8.50), 3.43 (2.31–8.29) and 2.04 (0.09–3.83) ì m, respectively; The medians of mean tail moment (MTM) of the three groups were 6.28 (2.14–11.81), 3.41 (1.25–11.07) and 0.53 (0.13–3.29), respectively. The MTL and MTM of two exposure groups were significantly higher than those of control group ($P < 0.01$). The MTL and MTM of exposure group I were significantly higher than those of exposure group II ($P < 0.01$). The results of the present investigation suggest that occupational exposure to trivalent chromium can lead to a detectable DNA damage of human peripheral lymphocytes. Moreover, DNA damage was associated with chromium levels in blood. DNA damage may serve as a valuable effective biomarker and total chromium in blood may serve as a useful internal exposure biomarker in the population occupationally exposed to trivalent chromium.

Mutation Research/Genetic Toxicology and Environmental Mutagenesis 2008,654/ 1:45-51

Bioleaching of chromium from tannery sludge by indigenous *Acidithiobacillus thiooxidans*

Chromium in tannery sludge causes serious environmental problems and is also toxic to organisms. The acidophilic sulfur-oxidizing *Acidithiobacillus thiooxidans* can leach heavy metals form urban and industrial wastes. This study examined the ability of an indigenous sulfur-oxidizing *A. thiooxidans* to leach chromium from tannery sludge. The results showed that the pH of sludge mixture inoculated with the indigenous *A. thiooxidans* decreased to around 2.0 after 4 days. After 6 days incubation in shaking flasks at 30 °C and 160 rpm, up to 99% of chromium was solubilized from tannery sludge. When treated in a 2-l bubble column bioreactor for 5 days at 30 °C and aeration of 0.5 vvm, 99.7% of chromium was leached from tannery sludge. The results demonstrated that chromium in tannery sludge can be efficiently leached by the indige-nous *A. thiooxidans*.

Journal of Hazardous Materials 2007, 147/1-2, 319-324

Occupational health risks among the workers employed in leather tanneries at Kanpur

The purpose of the study was to investigate the adverse health effects of exposure to basic tanning pigments (both trivalent and hexavalent chromium salts), organic solvents and other chemicals used in the leather tanning industries at Kanpur In a cross-sectional study, random samples of 197 male workers drawn from different sections of 10 leather tanneries in Kanpur were selected for the assessment of health risks. A control group comprising of 117 male subjects belonging to a similar age group and socioeconomic strata, who never had any occupational exposure in the leather tanneries, were also examined for the comparison purpose. The findings revealed a significantly higher prevalence of morbidity among the exposed workers in contrast to that observed in the controls (40.1% vs. 19.6%). The respiratory diseases (16.7%) were mainly responsible for a higher morbidity among the exposed workers whereas the gastrointestinal tract problems were predominant in the control group. The urinary and blood samples collected from the exposed group showed significantly higher levels of chromium, thereby reflecting the body burden of Cr in the exposed workers as a result of a high concentration of environmental Cr at the work place.

IJOEM 2008,12/ 3;132-135

Phytoremediation of chrome-VI of tannery effluent by *Trichoderma* species

The tannery effluent carrying hazardous Cr (VI) species due to the oxidation of Cr (III) species was found to pollute the soil and the ground water of Jajmau area of Kanpur city where a large number of tanneries are located. We have studied the phytoremediation of Cr (VI). Biosorption of the chromium ion Cr (VI) onto the cell surface of Trichoderma fungal species in aerobic condition was investigated. Batch experiments were conducted with various initial concentrations of chromium ions to obtain the sorption capacity and isotherms. The results obtained at pH 5.5 of chromium solution were 97.39% reduction by non pathogenic species of Trichoderma. It was found that the sorption isotherms of fungi for Cr (VI) appeared to fit Freundlich models.

The results of FT-IR analysis suggested that the chromium binding sites on the fungal cell surface were most likely carboxyl and amine groups. The fungal surfaces showed efficient biosorption for Chromium in Cr(VI) oxidation state. Best results for sorption were obtained at 5.5–5.8 pH, at low or high pH values, Cr (VI) uptake was significantly reduced.

Desalination 2008, 222/ 1-3 255-262

Involvement and interaction of microbial communities in the transformation and stabilization of chromium during the composting of tannery effluent treated biomass of *Vallisneria spiralis* L.

Tannery effluent treated with aquatic macrophyte *Vallisneria spiralis* L. for 14 days showed significant improvement in physico-chemical properties and reduction in Cr concentration. Accumulation of Cr was found maximum in roots (358 ì g g^{-1}dw) as compared to shoot (62 ì g g^{-1}dw) of the plant. A laboratory scale composter was designed with the objectives to investigate the physico-chemical changes and role of microbes in stabilization and transformation of Cr in the composting material. Results revealed that the composting process was quick within 7–21 d as indicated by peak time for various physico-chemical parameters and drop in C/N ratio up to acceptable limit. The profile of microbial communities indicated that population of anaerobic, aerobic and nitrifying bacteria increased quickly at the initial phase, and reached a peak level of 4.2×10^{6}, 9.78×10^{8} and 9.32×10^{9} CFU g^{-1}, respectively at 21 d; while population of actinomycetes and fungi was found maximum i.e. 3.29×10^{7} and 9.7×10^{6} CFU g^{-1}, respectively, after 35 d of composting. Overall bacterial population dominated over the actinomycetes and fungi during the composting process. Cr(VI) was transformed to Cr(III) due to the microbial activity during the process. Sequential extraction of Cr fractionation showed its stabilization via changing into organic matter-bound and residual fractions during the composting.

Bioresource Technology 2009, 100/7: 2198-2203

Removal of chromium (VI) using poly (methylacrylate) functionalized guar gum

Using persulfate/ascorbic acid redox pair, poly(methylacrylate) was grafted on to guar gum and the conditions for the grafting were optimized. The copolymer sample having maximum %G was evaluated for the removal of Cr (VI) and the sorption conditions were optimized. The sorption was found pH dependent, pH 1.0 being the optimum value. Sorption data at pH 1.0 were modeled using both the Langmuir and Freundlich isotherms where the data fitted better to Freundlich isotherm. The equilibrium sorption capacity of 29.67 mg/g was determined from the Langmuir isotherm. The sorption followed a pseudo-second-order kinetics with a rate constant 2.5×10^{-4} g mg^{-1} min^{-1}. The grafted product was also evaluated for Cr (VI) removal from local electroplating industrial waste water. The regeneration experiments revealed that the guar-graft-poly (methylacrylate) could be successfully reused for five cycles. In the present study conductivity measurements were used instead of conventional photometric method for determining Cr (VI) concentration in the equilibrium solutions. The results obtained have been compared with photometric method. Optimum Cr (VI) binding under highly acidic conditions indicated significant contribution of non electrostatic forces in the adsorption process.

Bioresource Technology 2009, 100/6; 1977-1982

Multivariate analysis of selected metals in agricultural soil receiving UASB treated tannery effluent at Jajmau, Kanpur (India)

Tannery effluents and soils samples were collected from 12 different sites of an agricultural area receiving treated tannery wastewater near Kanpur city (India). The samples were analyzed for heavy metals (Fe, Cr, Zn, Mn, Cu, Ni and Pb) content with a view to assess the impact of industrial wastewater on agricultural soils. The results revealed elevated levels of Fe and Cr in agricultural soils irrigated with treated tannery effluents. Cluster analysis of tannery effluent and soil datasets yielded two groups of the metals and demonstrated their relationship in each media. Principal component analysis performed on two datasets yielded two significant factors each for the effluents and soils, suggesting tanneries as the probable sources of metals in the soils.

Bull Environ Contam Toxicol (2007) 79:577–582

Impact of long-term application of treated tannery effluents on the emergence of resistance traits in rhizobium sp. isolated from Trifolium alexandrinum

A total of 35 Rhizobium sp. were isolated from the root nodules of *Trifolium alexandrinum* (Egyptian clover) irrigated with treated tannery effluents and characterised on the basis of morphological, cultural and biochemical characteristics. Rhizopheric soils and plant parts were also analysed for metal concentrations by atomic absorption spectrophotometry. The test soil samples were contaminated with a high level of chromium and also with other heavy metals, i.e. Ni, Zn, Cu, and Cd. The heavy metal analysis of *Trifolium alexandrinum* plant parts revealed different accumulation of these metals in different plant parts, such as root, stem, and leaf. *Trifolium alexandrinum* roots accumulated the highest amount of these metals and this was followed by leaves. All the isolates of Rhizobium sp. were tested for their resistance against Cr^{3+}, Cr^{6+}, Cd^{2+}, Cu^{2+}, Zn^{2+} and Ni^{2+}. The highest minimum inhibitory concentration (MIC) of 1600 ì g/ml was observed against Cr^{3+} in 37.1% of the isolates.

Some of the metal resistant isolates that showed maxi-mum resistance were also tested for their resistance against 6 commonly used antibiotics, namely tetracycline, ampicillin, gentamycin, kanamycin, chloramphenicol and nalidixic acid. 40% of Rhizobium *sp.* isola-tes were resistant against nalidixic acid and 33.3% were resistant to chloramphenicol and tetracycline.

Turk J Biol 2008, 32:1-8

Eco-friendlier Leather from India

India has developed a more environment-friendly and cost-efficient method for tanning leather. Raghava Rao and a group of researchers at the Central Leather Research Institute (CLRI) in Adyar have found a simple way to reduce the amount of chemical pollutants involved in tanning by merely reversing the order of tanning and post-tanning steps. By doing so, they were able to cut the amount of chemicals released by 82% and increased energy efficiency by 40% without observable reduction in quality. Tanning is an otherwise intensely chemical process which transforms decomposable dead animal skins into leather, but not without discharging serious pollution into water – In India, toxic tanning pollutants end up in the Ganges and Yamuna rivers, posing a great health risk to both aquatic eco-systems and humans.

In all, around 250 chemicals are used in tanning, with chromium sulfate being the most dangerous. Other chemicals include alcohol, coal tar, degreasing agents, dyes, emulsifiers, formaldehyde, formic acid, lead, lime, resin blenders, sodium chloride, sodium sulfate, sulfuric acid, waxes, and zinc. Skins are transferred from vat to vat, soaked, treated and dyed. Due to lower labour costs and more lax environmental controls, the tanning industry has grown in countries such as China, India, Pakistan and Bangladesh capturing 60% of the world's leather production. As Rao rightly points out, "The significance is tremendous in the context of environmental challenges being faced by the leather industry."

http://www.treehugger.com/files/2008/01/eco-friendly_leather.php

DID YOU KNOW ?

- Chromium (VI) is much more toxic than chromium (III) for both acute and chronic exposures.
- No proven antidote is available for chromium poisoning.
- Chromium VI is mutagenic, carcinogenic and teratogenic.
- Sukinda valley in Orissa is the India's largest chromite reservoir.
- Avoid smoking (Chromium is a component of tobacco smoke) in enclosed spaces like home or car in order to limit exposure to children and other family members.

OCCURRENCE OF CHROMIUM IN WATER SOURCES AND ITS REMOVAL BY LOW COST MATERIALS

Shashi Prabha Dubey and Krishna Gopal
Aquatic Toxicology Division,
Indian Institute of Toxicology Research, Lucknow

Water Pollution: An Introduction

'*Water water everywhere but not a drop to drink.*'

The hardest thing to explain is the glaring evidence which everybody has decided not to see. A saying that we heard in the past as a mere quote has turned into the very stark reality of the present. Everybody knows that pollution refers to the contamination of the environment with harmful and undesirable wastes. Pollution has now become at par with the conventional crimes. As water is scarce and its demand is likely to increase further, it needs more attention. After air pollution, water pollution is the most serious threat faced by the whole world. According to World Health Organization (WHO) report (1998) till 1970 only about 38% of 2.5 billion people in the developing countries has access to safe drinking water while in 1980 the water supply coverage in urban areas of developing nations was about 75% and in rural areas it was 46%. A major share of the infectious disease burden could be related to water, sanitation and hygiene. There are 2.2 million diarrhoeal death, 4 billion cases of diarrhoea per year along with intestinal worm infection, which affect about 500 million people, schistosomiasis affecting 200 million people and 6 million are blind from the trachoma (WHO/UNICEF, 2000). In India,maximum population in rural and slum areas has no access to safe drinking water. The water quality deterioration is mainly due to biological, physical and chemical contaminants. The contaminants are mostly pathogenic microorganisms, chemicals, toxic heavy metals, pesticides and their metabolites, as a consequence of industrial as well as agricultural activities (Singh and Kumar, 2004).

The body requires approximately 70 friendly trace heavy metals, but other 20 metals (toxic) such as Arsenic, Chromium, Lead, Mercury,Cadmium, Nickel, etc., are emitted into the environment in quantities that pose risks to human health. Heavy metals may get into the body via inhalation, ingestion, and skin absorption. If heavy metals enter and accumulate in body tissue faster than the body's detoxification capability a gradual buildup of these toxins will occur (Kortenkamp et. al., 1996).

Chromium and its health hazards:

Chromium occurrs in nature associated with rocks, soil, plants, animals, volcanic dust and gases. Chromium element has three main forms chromium (0), chromium (III) and chromium (VI). Chromium (III) compounds are stable and occur naturally. Chromium (0) does not occur naturally and chromium (VI) occurs only rarely. Chromium compounds have no taste or odour.

Cr (III) is an essential micronutrient that assists the body in metabolising sugar, protein and fat. While Cr (III) is relatively innocuous and immobile, Cr (VI) moves readily through soils and aquatic environments and is a strong oxidizing agent capable of being absorbed through the skin (Park and Jung, 2001).

Hexavalent chromium introduced to the water ecosystem is an important issue due to its toxic effects. Its concentrations in industrial effluents range from 0.5 to 270.00 mg/L (Patterson, 1985). It is present in the electroplating wastewater as Cr (VI) in the form of oxyanion, such as chromates (CrO_4^{2-}), dichromates ($Cr_2O_7^{2-}$), and bichromates ($HCrO_4^-$) depending on pH and Cr concentration (Ramos et al., 1994; Kotas and Stasicka, 2000). Cr (VI) is a skin and mucous membrane irritant and some of these hexavalent compounds produce an allergic contact dermatitis characterized by eczema (Hassmanova et al., 2000; Kanerva et al., 2000); it is also recognised as a pulmonary carcinogen (Barceloux, 1999; Hassmanova et al., 2000). Hexavalent chromium is considered by the World Health Organization and the USEPA as a human carcinogen. It has been linked to increased levels of lung cancer. Ingesting large amounts of it can cause kidney and liver damage and skin contact is known to lead to skin ulcers. The tolerance limit for Cr (VI) for discharge into inland surface waters is 0.1 mg/L and in potable water is 0.05 mg/L (EPA, 1990). In order to comply with this limit, it is essential that industries treat their effluents to reduce the Cr (VI) to acceptable levels.

Occurrence of Chromium in water sources:

Chromium is used in manufacturing chrome – steel or chrome – nickel – steel alloys (stainless steel) and other alloys, bricks in furnaces, dyes and pigments, for increasing resistance and durability of the metals as well as in chrome plating, leather tanning and wood preserving. Manufacturing, disposal of products or chemicals containing chromium, or fossil fuel burning releases chromium into the water. Pollution of water resources, both surface and under-ground, by indiscriminate discharge of spent wastes of chromium-based industries has become a serious global concern, for it has created an acute scarcity of safe drinking water in many places. In Ludhiana and Chennai, India, chromium levels in underground water have been recorded at more than 12mg/L and 550 – 1500mg/L, respectively (Chandra et al., 2004). Other chromium polluted places in India are Bichhri (Rajasthan), Dandeli (Karnataka), Duarala, Meerut & Kanpur (Uttar Pradesh), Durgapur (West Bengal), Panipat (Haryana), Ranipat (Tamilnadu) and Sukinda Valley (Orissa).

A study done by IIT Kanpur during September, 2002 on profile of pollutants in near by Tanneries at Kanpur show that chromium (VI) is found 87.92 (mg/L) in intermediate pumping station Jajmau (chromium in the raw domestic sewage of main pumping station points to the fact that the industrial effluents are entering the domestic waste water lines), 80.87 (mg/L) in sewage irrigation water channel, 42.7 mg/L in post treated water from CETP, Unnao.

A study conducted by Central Pollution Control Board during 1997 on the ground water quality in Kanpur revealed Cr (VI) levels of 6.2 mg/L.

The tanneries in Kanpur discharge their toxic waste with Cr (VI) into the sewage system. This effluent is carried through the main drainage system to the centralized treatment plant for forming irrigation or released directly in to the Ganges.

Removal of chromium from low cost materials:

A wide range of physical and chemical processes is available for the removal of Cr (VI) from drinking water, such as electrochemical precipitation, ultrafiltration, ion exchange and reverse osmosis (Rengaraj et al., 2001; Benito et al., 2002; Yurlova et al., 2002). As one of the most promising techniques for removal of chromium from industrial wastewaters, adsorption technology has been employed for many years and the effectiveness of various adsorbents has been demonstrated (Lazaridis et al., 2003).

There are several adsorbents mentioned which can remove chromium from drinking water viz., coconut tree sawdust carbon (Selvi et al., 2001), chemically impregnated fireclay (Bajpai et al., 2001), quaternized wood (Low et al., 2001), sawdust, used tyres carbon (Hamadi et al., 2001), cactus, olive stone/cake, wool, charcoal, pine needles (Dakiky et al., 2002), sulfuric acid-treated wheat bran (Demirbasa et al., 2004), hazelnut shell carbon (Kobya, 2004), coconut shell charcoal, commercial activated carbon modified with oxidizing agents and/or chitosan (Babel et al., 2004), micro-alloyed aluminium composite (MAlC) (Bojic et al., 2004), activated rice husk carbon and activated alumina for chromium (Bishnoi et al., 2004), *Rizopus nigricans* (Bai et al., 2005), chemically-treated biomass of Ecklonia species (Parka et al., 2005), biological wastes, vermiculite (Sumathi et al., 2005), chitosan coated acid treated oil palm shell charcoal (Saifuddin et al., 2005), Powder carbon,(Campos et al., 2005), eucalyptus bark (Sarin et al. 2006) and synthetic adsorbents (Gasser et al., 2007) have been reported in the literature.

The use of groundnut husk and other agricultural waste materials with surface modifications by chemical impregnation to improve its metal mitigation performance would add its economic value. Batch and column study experiments depict the effectiveness of prepared low cost adsorbents. Different isotherm models give idea of adsorption capacity and nature of adsorption. Kinetic study give idea of dynamic nature of reaction processes while feasibility, spontaneity along with heat transfer during reaction process are evaluated by thermodynamic study (Dubey et al, 2007; Dubey et al, 2008).

References:

1. Babel S. and Kurniawan T.A., 2004. Cr (VI) removal from synthetic wastewater using coconut shell charcoal and commercial activated carbon modified with oxidizing agents and/or chitosan. Chemosphere 54, 951–967.
2. Bai S.R. and Abraham T.E., 2005. Continuous adsorption and recovery of Cr (VI) in different types of reactors. Biotechnol. Prog. 21, 1692 - 1699.
3. Bajpai S.K., 2001. Removal of hexavalent chromium by adsorption onto fireclay and impregnated fireclay. Sep. Sci. Technol. 36, 399–415.
4. Barceloux D.G., 1999. Chromium. J. Toxicol. Clin. Toxicol. 37, 173-94.
5. Benito Y. and Ruiz M.L., 2002. Reverse osmosis applied to metal finishing wastewater. Desalination 142, 229 – 234.
6. Bishnoi N.R., Bajaj M., Sharma N. and Gupta A., 2004. Adsorption of Cr (VI) on activated rice husk carbon and activated alumina. Biores. Technol. 91, 305–307.
7. Bojic A. Lj., Purenovic M. and Bojic D., 2004. Removal of chromium (VI) from water by micro-alloyed aluminium composite (MAIC) under flow conditions. Water S.A. 30, 353-360.
8. Campos V. and Buchler P.M., 2005. Removal of chromate from drinking water using powder carbon steel. Environ. Geol. 47, 926–930.
9. Chandra P. and Kulshrestha K., 2004. Chromium accumulation and Toxicity in aquatic vascular plants. The Botanical Review 70, 313 – 327.
10. Central Pollution Control Board Report, 1997.
11. Dakiky M., Khamis M., Manassra A. and Mereb M., 2002. Selective adsorption of chromium (VI) in industrial wastewater using low – cost abundantly available adsorbents. Adv. Environ. Res. 6, 533 – 540.
12. Demirbasa E., Kobyab M., Senturkb E. and Ozkana T., 2004. Adsorption kinetics for the removal of chromium (VI) from aqueous solutions on the activated carbons prepared from agricultural wastes. Water S.A. 30, 533.
13. Dubey S.P., and Gopal K., 2007. Adsorption of chromium (VI) on low cost adsorbents derived from agricultural waste material: A comparative Isotherm study. J. Haz. Mat., 145, 465 – 470.
14. Dubey S.P., and Gopal K., 2008. Application of natural adsorbent from silver impregnated Arachis hypogaea based thereon in the process of hexavalent chromium for the purification of water. J.Haz.Mat., *In Press*.
15. EPA (Environmental Protection Agency) Environmental Pollution Control Alterations, 1990. EPA/ 625/ 5 –90/025, EPA/ 625/ 4 – 89/ 023, Cinacinnati, US.
16. Gasser M.S., Morad G.H.A. and Aly H.F., 2007. Batch kinetics and thermodynamics of chromium ions removal from waste solutions using synthetic adsorbents. J. Haz. Mater. 142, 118–129.
17. Hamadi N.K., Chen X.D., Farid M.M. and Lu M.G.Q., 2001. Adsorption kinetics for the removal of chromium (VI) from aqueous solution by adsorbents derived from used tyres and sawdust. Chem. Eng. J. 84, 95 – 105.
18. Hassmanova V., Vaneckova J. and Bousova K., 2000. Occupational diseases caused by chromium and its compounds. Acta Medica (Hradec Kralove) Suppl. 43, 33-6.
19. IIT Kanpur, 2002. (Pollution from Leather Industries as we know and Pollution from Leather Industries we do not know: Urgent Need for a Comprehensive Investigation at Kanpur: An Eco Friends Report).
20. Kanerva L., Jolanki R., Estlander T., Alanko K. and Savela A., 2000. Incidence rates of occupational allergic contact dermatitis caused by metals. Am. J. Contact. Dermat. 11, 155-160.
21. Kobya M., 2004. Adsorpion, kinetic and equilibrium studies of Cr (VI) by hazelnut shell activated carbon. Adsor. Sci. Technol. 22, 51 – 64.
22. Kortenkamp A., Casadevall M., Faux S.P., Jenner A., Shayer R.O.J., Woodbridge N. and O'Brien P., 1996. A role for molecular oxygen in the formation of DNA damage during the reduction of the carcinogen chromium (VI) by glutathion. Archives of Biochem. Biophy. 329, 199-208.
23. Kotas J. and Stasicka, Z., 2000. Chromium occurrence in the environment and methods of its speciation. Environ. Poll. 107, 263–283.
24. Lazaridis N.K. and Asouhidou D.D., 2003. Kinetics of sorptive removal of chromium (VI) from aqueous solutions by calcined Mg–Al–CO3 hydrotalcite. Water Res. 37, 2875.
25. Low K.S., Lee C.K. and Lee C.Y., 2001. Quaternized wood as sorbent for hexavalent chromium. Appl. Biochem. Biotechnol. 90, 75 – 87.
26. Park S. and Jung W. Y., 2001. Removal of chromium by activated carbon fibers plated with copper metal. Carbon Sci. 2, 15 – 21.
27. Parka D., Yunb Y.S. and Parka J.M., 2005. Studies on hexavalent chromium biosorption by chemically-treated biomass of Ecklonia sp.

28. Patterson J.W., 1985. Industrial wastewater treatment technology. (2nd edn.) Butterworth – Heinemann, London.

29. Ramos, R.L., Martinez, A.J. and Coronado R.M.G., 1994. Adsorption of chromium (VI) from aqueous solutions on activated carbon. Water Science & Technology 30/9, 191–197.

30. Rengaraj S., Yeon K.H. and Moon S.H., 2001. Removal of chromium from water and wastewater by ion exchange resins. J. Hazard. Mater. 87, 273-287.

31. Saifuddin F.N. and Kumaran P., 2005. Removal of heavy metals from industrial wastewater using chitosan coated oil palm shell charcoal. Electron. J. Biotechnol. 8, 43-53.

32. Sarin V. and Pant K.K., 2006. Removal of chromium from industrial waste by using eucalyptus bark. Biores. Technol. 97, 15-20.

33. Selvi K., Pattabi S. and Kadirvelu K., 2001. Removal of Cr (VI) from aqueous solution by adsorption onto activated carbon. Biores. Technol. 80, 87 – 89.

34. Singh R.K.B. and Kumar D., 2004. Electron delocalization in disordered films induced by magnetic field and film thickness. Phys. Rev. B 69, 115420, (12 pages).

35. Sumathi K.M.S., Mahimairaja S. and Naidu R., 2005. Use of low-cost biological wastes and vermiculite for removal of chromium from tannery effluent. Biores. Technol. 96, 309–316.

36. WHO, 1998. Preventing and managing the global epidemic. WHO Expert Consultation, Geneva.

37. WHO/UNICEF, 2000. Global water supply and sanitation assessment 2000 report, Geneva, Switzerland.

38. Yurlova L. and Kryvoruchko A., 2002. Removal of Ni (II) ions from wastewater by micellar – enhanced ultrafiltration. Desalination 144, 255-260.

CURRENT CONCERNS

Heavy metal contamination of the environment (air, water & soil) is a world wide environmental concern. Regulatory bodies set standards for toxic chemicals in drinking water, food, soil, air & effluent release from the industries. Annually, 25,000 tonnes of chromium salt is used, out of which around 10,000 tonnes is discharged into the waste water, causing environmental pollution and making waste water treatment and sludge disposal complicated and costly. It is, therefore, worthwhile to recover the chromium being discharged down the drain and reuse it for tanning.

Chrome recovery and reuse methods have become the compulsory recovery methods in the leather industry.

REGULATORY TRENDS

Standards and Regulations for Chromium

Agency	Focus	Level
American Conference of Governmental Industrial Hygienists	Air: workplace	10 µg/m^3 as Cr 50 µg/m^3 as Cr 500 µg/m^3 as Cr
National Institute for Occupational Safety and Health	Air: workplace	500 µg/m^3as Cr
Occupational Safety and Health Administration	Air: workplace	100 µg/m^3 as CrO_3 500 µg/m^3 as Cr 1,000 µg/m^3 as Cr
U.S. Environmental Protection Agency	Air: environment	Not applicable
	Drinking water	100 µg/L
Bureau of Indian Standard 10500 : 1991	Drinking water	0.05 mg/lit

GENERAL STANDARDS FOR DISCHARGE OF CHROMIUM

S. No.	Parameter	Inland surface water	Public sewers	Land for irrigation	Marine/co astalareas
1.	Hexavalent chromium (as Cr^{+6}),mg/l, max.	0.1	2.0	-	1.0
2.	Total chromium (as Cr) mg/l, max.	2.0	2.0	-	2.0

STANDARDS FOR DISCHARGE OF TANNERY EFFLUENT TO THE SURFACE IN INDIA

S. No.	pH	COD mg/l	Suspended solids mg/l	Sulfide, (S2-) mg/l	Chromium, total mg/l
1.	6.5-9.0	250	100	2	2

ON THE LIGHTER SIDE

One day after sleeping badly, an anatomist went to his frog laboratory and removed from a cage one frog with white spots on its back. He placed it on a table and drew a line just in front of the frog. "Jump frog, jump!" he shouted. The little critter jumped two feet forward. In his lab book, the anatomist scribbled, "Frog with four legs jumps two feet."

Then, he surgically removed one leg of the frog and repeated the experiment. "Jump, jump!" To which, the frog leaped forward 1.5 feet. He wrote down, "Frog with three legs jumps 1.5 feet."

Next, he removed a second leg. "Jump frog, jump!" The frog managed to jump a foot. He scribbled in his lab book, "Frog with two legs jumps one foot."

Not stopping there, the anatomist removed yet another leg. "Jump, jump!" The poor frog somehow managed to move 0.5 feet forward. The scientist wrote, "Frog with one leg jumps 0.5 feet."

Finally, he eliminated the last leg. "Jump, jump!" he shouted, encouraging forward progress for the frog. But despite all its efforts, the frog could not budge. "Jump frog, jump!" he cried again. It was no use; the frog would not response. The anatomist thought for a while and then wrote in his lab book, "Frog with no legs goes deaf."

ON THE WEB

www.intertek-cb.com

Hexavalent Chromium Tests

Materials Analysis for Hex Chrome

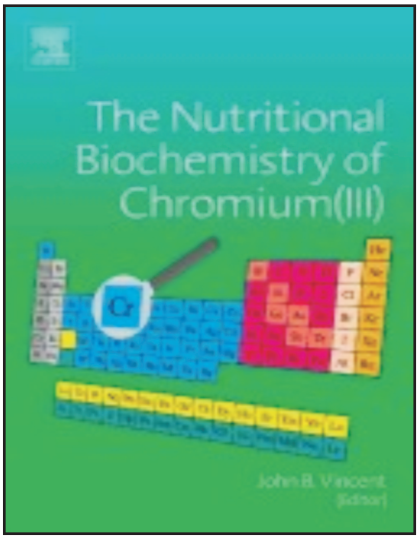
Trace Analysis Laboratories

www.evenbetternow.com

Heavy Metal Toxicity, Remove heavy metal toxicity using safe and natural detox therapies.

BOOK STOP

The Nutritional Biochemistry of Chromium (III)



Author: John Vincent

Publisher: Elsevier

ISBN 0444530711, 9780444530714

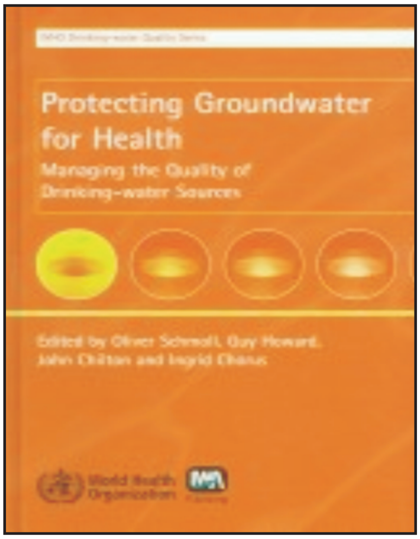
Pages: 279

The aim of The Nutritional Biochemistry of Chromium (III) is to examine the four most controversial areas of chromium nutrition and biochemistry:(I) Is chromium an essential element for humans and are chromium nutritional supplements of value?(II) - what biochemical role, if any, does chromium play in the body(III)can large doses of chromium(III) be used to treat symptoms of Type 2 diabetes, cardiovascular disease, and related medical conditions(IV) is the use of chromium(III) supplements a health concern.

Protecting Groundwater for Health: Managing the Quality of Drinking-water Sources

Editor's: O Schmoll, G Howard, J Chilton, I Chorus

Publisher: World Health Organization



ISBN: 9241546689, 9789241546683

Pages: 678

Protecting groundwater for health provides a structured approach to analyzing hazards to groundwater quality, assessing the risk they may cause for a specific supply, setting priorities in addressing these, and developing management strategies for their control. This book presents tools useful for local and technical staff to senior managers so as to assist them in developing and implementing strategies to protect groundwater for health.

Children's Health and Environment: Developing Action Plans

Author's: Lucianne Licari, Leda Nemer, Giorgio Tamburlini,

Publisher: World Health Organization

ISBN: 9289013745, 9789289013741

Pages: 88

This publication contains guidance on the development of national action plans suited to each countrys circumstances, priorities and resources, whilst still addressing region-wide environmental risk factors.

Industrial Innovation and Environmental Regulation

Editor's: Saeed Parto and Brent Herbert-Copley,

Publisher: United Nations University

ISBN: 9280811274, 9789280811278

Pages: 305

This book examines political and industrial trends and the responses to these challenges. The authors conclude that the complexities of environmental and economic relationships disallow universal solutions, and they stress the need for context-specific perspectives on the role of regulatory measures in environmental innovation.

CONFERENCES

ISA-RC-24- International Conference on Water, Environment, Energy and Society - 28 to 30 June 2009

Organized by: S. R. K. (P.G.) College, Firozabad, Agra University, India

Deadline for abstracts/proposals: 31 May 2009

Website: http://www.environment-societyisa.org

International Conference on Emerging Technologies in Environmental Science and Engineering – 19 to 21 October 2009

Venue: Aligarh, Uttar Pradesh, India

Organized by: Department of Civil Engineering and University of Toledo, USA

Deadline for abstracts/proposals: 31 May 2009

Website: http://www.amu.ac.in/shared/linkimages/toledo.pdf

Event is covering the emerging areas of environmental engineering.

4th International Congress of Chemistry and Environment ICCE 2009-30 October 2009 to 1 November 2009

Venue: Tianjin, China

Organized by: Research Journal of Chemistry and Environment and Institute of Agro Environmental Protection, China

Deadline for abstracts/proposals: 31 July 2009

Website: http://www.chemenviron.org

Focal theme is agriculture and environment. One can submit abstracts/papers/postes on any subject related to agriculture science, chemical science, soil science and environmental science.

International Conferences on Plants and Environmental Pollution-7-10th February 2010

Venue: National Botanical Research Institute, Lucknow, India.

Organized by: International Society of Environmental Botanists and National Botanical Research Institute, Lucknow (India)

Website: http://isebindia.com/icpep-4/icpep-4.html

The Conference is expected to cover following areas/disciplines: Bio-indication & Bioremediation, Environment & Biotechnology, Environmental education, Mass awareness and Legislation, Environmental Impact Assessment and Eco-auditing, Environment and Biodiversity and more other topics also.

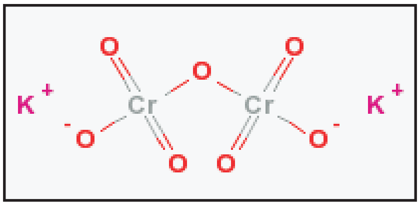
MINI PROFILE OF POTASSIUM DICHROMATE

Synonyms: Potassium bichromate, Chromic Acid, Dipotassium Salt, Dipotassium Dichromate, Potassium Bichromate, Potassium Dichromate (VI)

CASRN: 7778-50-9

Molecular Formula: $K_2Cr_2O_7$

Molecular Structure:



Molecular Weight: 294.185

Properties: Bright orange-red crystals, M.pt:398°C, B.pt: 500°C, Odourless

Uses: Tanning leather, dyeing, painting, printing; decorating porcelain, photolithography, pigment-prints; bleaching palm oil, wax and sponges; waterproofing fabrics; oxidizer in manufacturing organic chemicals, corrosion inhibitor; depolarizer for dry cells, in electric batteries; pharmaceutics' aid, oxidizing agent.

Toxicity Data:

SCN-MUS LD_{LO} :100 mg kg^{-1}

IVN-RBT LD_{LO} :28 mg kg^{-1}

ORL-GPG LD_{LO} :163 mg kg^{-1}

ORL-RAT LD_{50}: 177 mg kg^{-1}

Acute ORL-Rat LD_{50}: 25 mg kg^{-1}

Acute dermal-RBT LD_{50}:14 mg kg^{-1}

ORL-Man LD_{LO}: 143 mg kg^{-1}

ORL- Child LD_{LO}: 26 mg kg^{-1}

Handling and Storage: Store in a cool dry place. Do not get in eyes, on skin, on clothing. Wash thoroughly after handling. Store away from incompatible materials.

Route	Symptoms	First Aid	Target Organ
Inhalation	May cause nasal irritation, lung irritation, coughing, chest pain, ulceration and perforation of the nasal septum.	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.	Respiratory tract
Ingestion	May cause violent gastroenteritis, diarrhoea, fever, liver damage, hemorrhagic diathesis, vertigo, muscle cramps, coma and renal failure.	If swallowed, induce vomiting immediately after giving two glasses of water. Never give anything by mouth to an unconscious person.	Gastrointestinal tract
Contact	Contact with skin may cause painless, penetrating, slow healing lesions and dermatitis. Contact with eyes may cause pain, irritation, redness and blurred vision.	Wash eyes with plenty of water for at least 15 minutes, lifting lids occasionally. Seek Medical Aid.	Skin and Eye

ENVIS QUERY FORM

Name : ______________________________

Designation : ______________________________

Address : ______________________________

Phone: ________________ Fax: ________________

E-mail: ______________________________

Field of specialisation : ______________________________

Type of organisation : ______________________________

Views on our Newsletter : ______________________________

____

____

____

Views on Scope of improvement : ______________________________

____

____

____

Any additional comments : ______________________________

____

____

I would like information on the following :

Subject	Keywords		
Health & Toxicology	________	________	________
Pollution	________	________	________
Toxic Chemicals	________	________	________
Environment	________	________	________
Others	________	________	________

Signature:

Please mail to : Project Coordinator, ENVIS Centre,
Indian Institute of Toxicology Research

Post Box# 80, Mahatma Gandhi Marg, Lucknow- 226 001 India.
Phone : (0522) 2284 591, Fax : (0522) 2628227 Email: itrc@envis.nic.in
web : http://www.itrcenvis.nic.in; http://www.envisiitr.org.in

L

O

To keep you abreast with the effects of chemicals on the environment and health, the ENVIS Centre of Indian Institute of Toxicology Research, deals with:

Maintenance of toxicology information database on chemicals

Information collection, collation and dissemination

Toxic chemical related query response service

Preparation of monograph on specified chemicals of current concern

Publishing Abstract of Current Literature in Toxicology

for further details do write to

Scientist In-Charge

ENVIS CENTRE

INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

(Formerly Industrial Toxicology Research Centre)

Post Box# 80, Mahatma Gandhi Marg, Lucknow-226 001, India

Phone : {0522} 2284591, Fax : {0522} 2628227

E-mail : itrc@envis.nic.in

web : http://www.itrcenvis.nic.in; http://www.envisiitr.org.in