BLACKSMITH INSTITUTE

Project Completion Report:
Kanpur Pilot Remediation of Hexavalent Chromium-contaminated Groundwater

- **Project Details:**
- **Short title: Chromium Pollution in Kanpur, India**
- **Short Problem: An entire town built on a toxic sludge plume**
- **Short Solution: Chemically converting toxic chromium in the water supply into a harmless form**

  Quote: A first-of-its-kind project that can now go on to save lives throughout India

Location:	Noraiakheda, Kanpur, Uttar Pradesh, India
Contaminant:	Hexavalent Chromium
Project Duration:	Dec 2004 to April 2007
Project Cost:	Blacksmith: $30,000 to IIT Kanpur; $50,000 to GZA Inc USA
Implementing Partners	CPCP North Zone office Lucknow (along with IIT Kanpur, ITRC Lucknow & NBRI Hyderabad)
Other Partners:	GZA USA & Ecocycle Co. Japan

- **Problem:**
  Kanpur is the ninth-largest city in India, and one of its most severely polluted. Its eastern districts feature about 350 industrial leather tanneries, many of which discharge untreated waste into local groundwater sources and the Ganges River. These pollutants include toxic levels of metal contaminants such as chromium, mercury, and arsenic. Chromium is the most worrisome of these: popular in the tanning industry because it

makes leather goods stronger, its waste form--hexavalent chromium or Cr VI--is known to cause lung cancer, liver failure, kidney damage, and premature dementia. Noraiakheda, a settlement of 30,000 people within Kanpur, has developed right on top of a plume of Cr VI emitted by toxic sludge from an old chemical plant that had supported the tanneries. The sludge is a source of pollution and a danger to human health. Flammable methane trapped inside the sludge catches fire during the hot summer months, releasing harmful toxins into the air. Summer heat and winds also distribute dust particles from the sludge containing Cr VI and other toxins that are harmful when inhaled. Chromium from the sludge leaks into the river, subsoil, and groundwater - the primary source of drinking water for the surrounding community. A 1997 study conducted by the Central Pollution Control Board on the groundwater quality in Kanpur revealed Cr VI levels of 6.2 mg/L; the Indian government places the limit at .05 mg/L.

- **Solution Implemented**

Highly toxic Cr VI can be converted to a much more innocent form, Cr III (trivalent chromium), by introducing an electron-donating chemical that will cause a reduction reaction. In addition to being safer for human exposure, the newly-created Cr III would also bind more easily with subsurface rocks in order to keep it out of the water supply altogether. Though proven in laboratories and at other work sites, this technique had never before been used in India.

Blacksmith's two-pronged approach aimed at both chemically neutralizing the chromium and also warning locals of the hazards. For the awareness-raising campaign, Blacksmith supported Ecofriends, a local environmental NGO in Kanpur. For chemical remediation of the chromium, Blacksmith worked with Ecocycle/GZA (engineering consultants who could supply some of the needed materials) and the Central Pollution Control Board in order to undertake the first such project in India's history. Other collaborators included the Industrial Toxicology Research Center, Indian Institute of Technology-Kanpur, and National Geophysical Research Institute.

As part of the remediation, Blacksmith and its partners dug four new wells in a portion of the contaminated groundwater system. One of the wells was an injection well used to introduce the electron donor chemical, and the other three were water quality monitoring stations that would test for 16 health criteria including metal concentrations. Once baseline samples had been taken, the chemical was added through the injection well and then the monitoring sites sampled the water quality in 5 later series.

- **Results:**

From a public awareness perspective, the intervention from Blacksmith and Ecofriends succeeded in installing two new submersible water pumps that would supply the Noraiakheda area with safe, potable drinking water.

The chemical remediation was also successful, with levels of Cr VI dropping at all the

test sites, sometimes to levels so low as to be undetectable.

- **Outcomes and Follow-up:**
  Blacksmith has now proven that its techniques for chemically treating toxic chromium will work in Indian sites. The next step will be to expand implementation throughout broader areas as needed. GZA has prepared an action plan for a larger-scale remediation throughout Kanpur, expected to cost $2-4 million. This project may be undertaken by the World Bank as part of its planned support for a national-level hazardous waste project in collaboration with the Indian government.

- **Pictures:**