

National Program for Rehabilitation of Polluted Site – A Case Study

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ABSTRACT

The National Program for Rehabilitation of a Polluted Site (NPRPS) is a framework for scaling up followed by the clean up and rehabilitation of polluted sites and facilitate the reduction of environmental and health risks associated with the legacy of polluted sites. The NPRPS reviews and updates the available information on polluted sites. This includes assessment of contaminated site. An inventory and database of contaminated sites is also maintained. The process involves field visits followed by data verification leading to prioritization of sites for rehabilitation. One such site which is probably contaminated is Pace city – 2 in Gurgaon which falls in the National Capital Territory of Delhi. Pace city - 2 is a water body where sediment has settled over time and lead to ground and surface water and soil contamination. The present paper presents the on-site investigations and the probable remedial measures for ground water and soil remediation for the site.

Keywords-*NPRPS, Pace city 2, hazardous waste, contaminated sites, rehabilitation*

1. INTRODUCTION

Hazardous wastes pose substantial threat to public health and/or the environment. Hazardous wastes are divided into two major categories: *characteristic wastes* and *listed wastes*. *Characteristic hazardous wastes* are materials that are known or tested to exhibit one or more of the following four hazardous traits: ignitability (i.e., flammable), reactivity, corrosivity and toxicity. *Listed hazardous wastes* are materials specifically listed by regulatory authorities as a hazardous waste which are from non-specific sources, specific sources, or discarded chemical products.

It is estimated worldwide by the United Nations Environmental Programme (UNEP) that more than 400 million tons of hazardous wastes are produced universally each year, mostly by industrialized countries (Schmit, 1999). Approximately 1% of this total hazardous waste is shipped across international boundaries, with the majority of the

transfers occurring between countries in the Organization for the Economic Cooperation and Development (OECD) (Krueger, 1999).

1.1 U.S Regulations

The hazardous waste is mostly regulated by the Resource Conservation and Recovery Act of 1976 (RCRA). This system was a 'cradle to grave' system of record keeping from the time the waste is generated until their final disposition. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) created a superfund for the cleanup and remediation of closed and abandoned hazardous waste sites. CERCLA does not specifically manage the hazardous wastes. The Underground Injection Control Program (UIC) is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal. Regulations issued by ASTM, American Concrete Institute, American Steel Institute, International Electrical Code should be complied with at all times. Apart from the above regulations, other water and air regulations also need to be wherever followed where applicable (USEPA,2012).

1.2 Regulations in India

In India, the protection and improvement of the environment is a prime responsible of the state. The Indian government promulgated The Environment (Protection) Act in 1986, which is umbrella legislation to protect and improve the environment and to regulate the management and handling of hazardous substances and chemicals (EPA, 1986). The Ministry of Environment and Forest (MoEF) continuously monitors the progress made by various state governments and union territories with respect the implementation of India's Hazardous Wastes Rules. Hazardous Waste management is presently regulated by the Hazardous Waste (Management and Handling) Rules of 1989 (January 2000 amendment and 2008 amendment), Manufacture, Storage and Import of Hazardous Chemicals Rules of 1989, Rules for the Manufacture, Use, Import, Export and Storage of

Hazardous Chemicals and Genetically Engineered Organisms or Cells, 1989. Additionally, the Forest (Conservation) Act of 1918, The Indian Forest act of 1927, The Factories Act of 1950, the Indian Penal Code of 1960 and The Public Liability Act 1991 are to be followed applicable.

As per MoEF, sites with confirmed presence of contaminants or substances caused by humans at concentrations that either pose a significant risk and/or impact to human health or the environment with regard to present or future land use plan is considered a Contaminated Site. The main criteria are that the contaminants shall be defined as per the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, and the site screening levels should be mentioned for contaminant land assessment (MoEF, 2011).

A Probable Contaminated Site is defined as Sites with alleged (apparent, purported) but not scientifically proven presence of constituents of contaminants or substances caused by humans at concentration and characteristics which can either pose a significant risk to human health or the environment with regard to present or future land use plan or exceeding specific concentrations or standards prescribed for human health and/or the environment.

The National Program for Rehabilitation of Polluted Sites was formulated for the scaling up followed by the clean up and rehabilitation of polluted sites and facilitates the reduction of environmental and health risks associated with the legacy of polluted sites as described in the next section.

2. NATIONAL PROGRAM FOR REHABILITATION OF POLLUTED SITES (NPRPS)

The National Program for Rehabilitation of Polluted Sites (NPRPS) has five main tasks as mentioned below:-

TASK 1- Review and update the available information on polluted sites. This includes collection of information from MoEF, CPCB, SPCB, NGOs, SEZs, etc, The collected data is processed and reviewed. The preliminary categorization and assessment of sites is conducted and an updated listed is generated along with a summary report.

TASK 2- Formulate approaches to identification and assessment of contaminated sites which includes review of international practices in identification, ranking and assessment of polluted sites.

TASK 3- Develop an inventory and database of contaminated sites.

TASK 4- Field visits, investigation and data verification/update of contaminated sites.

TASK 5- Prioritization of sites (CBIPM, 2011).

The preliminary categorization of the contaminated sites is done based on the geographical orientation, primary contaminants (chromium and heavy metals), current land use, source industry and industrial processes. After these factors human exposure and impacts on living beings is also recorded. Following completion of Task 3, a protocol is maintained for further investigations and site visits. The Site Investigation Protocol (SIP) is required to be followed before, during and after the site visit. SIP ensures that all information for the Datasheet is obtained. There is uniformity in data acquisition and reporting. Health and Safety protocols are followed responsibly. The Datasheet numbers in SIP tables are used for substantiating the reasons for contamination at the site.

The SIP stepwise approach includes desk study followed by risk screening and preparation for the site visit. Later the Site investigation on site and off site is completed. This is followed by analysis of the data and completion of the site investigation forms and finally completion of the Datasheet.

For completing the above listed tasks, few organizations are in partnership with NPRPS. These organizations provide their expertise in various fields. COWI India Private Limited provides clients with in-depth expertise in 2D and 3D mapping and engineering. This company is a member of Cowi A/S, Denmark. TAUW is an independent European consulting and engineering company specialized in the design, improvement and management of the natural environment, built up environment and infrastructure. TAUW is an expert and leading company in the field of environmental consultancy, spatial development, civil engineering and the monitoring of environmentally quality. Witteveen Bos is a Netherlands based company providing consultancy and engineering services in the fields of infrastructure, water, environment, spatial development and construction. Kadam Environment Consultants established in 1981 provides consultancy, engineering and laboratory services. Finally, Central Pollution Control Board (CPCB) serves as a field formation and provides technical services to the MoEF.

With the help of above partners involved in the NPRPS, in India, there have been 163 sites that have been identified as probably contaminated /

contaminated sites out of many sites that were investigated. It has been seen that Gujarat, Uttar Pradesh, Odisha, National Capital Territory (NCT) of Delhi, West Bengal and Maharashtra have the most number of contaminated sites in India. One such site is the Pace city 2 in Gurgaon, Haryana as described in the following section.

3. PROBABLE CONTAMINATED SITE PACE CITY 2

The probably contaminated site at Pace city-2, Gurgaon, is a water body where sediment has settled over time and lead to ground and surface water and soil contamination. A mixture of assorted material has settled to the bottom of the waterbody. It includes the shells and coverings of molluscs and other animals, transported soil particles from surface erosion, organic matter from dead and rotting vegetation and animals, sewage, industrial wastes, other organic and inorganic materials, and chemicals. Surface water has received discharges of various liquid and solid wastes from various sources. Many of these discharges contain toxic/hazardous materials that settle as sediment and persist in the environment because of their physicochemical properties. The contaminated sediment affects human health and the environment and causes losses of important resources such as drinking water. Figure 1 shows the present condition of the site.

After desk study was completed, the on-site investigation was carried out to gather information about the history of site and impacts on the residents by interviewing the dwellers in it's vicinity. Personal protective gear (PPE) was used during the site investigation and sample collection as contaminated sites are full of hazardous substances. It was observed that the water inside the pond is pinkish in colour probably due to chromide and other chemicals. Effluent was directly being discharged into the local sewers by the industries. There was negative effect on the flora of the region. Animals were grazing at the site. Municipal waste was also being dumped at the site. Toxic waste was lying open in the area (see Figure 2). Following the site investigation, samples of groundwater, surface water and soil from various points in the site were collected. Collected samples in plastic bottles were sent for analysis.



Figure 1: Present condition of the site



Figure 2: Hazardous waste at the site

Based on the site investigations and the sample analysis probable remedial measures are presently being formulated for the site. However, it should be noted that particle size and organic content significantly affect the selection of a remedy. The mineralogy of the particle also affects the remedy selection. The probable remedial techniques for the site are presented in the following section.

4. REMEDIAL OPTIONS FOR PACE CITY 2 SITES

The possible remedial measures proposed to treat the sediment and the contaminated water from the site include exsitu and insitu treatment processes. For groundwater remediation exsitu measure most commonly used is pump and treat method. The contaminated water is collected through extraction wells and a water treatment system is required to treat the water. A groundwater networking system is also part of the method. The water can be treated by air stripping, carbon adsorption, precipitation, chemical oxidation and/or bioreactors. Insitu options include monitored natural attenuation (MNA), bioremediation, permeable reactive barriers and physical barriers (slurry walls, sheet piling, etc.). Monitored natural attenuation and bioremediation is dependent on the contaminant properties. In Bioremediation anaerobic and aerobic processes can be used for the treatment of the contaminated water. Permeable reactive barriers are used where the geometry of aquifer and the groundwater flow directions are known. Most common type of reactive barriers is reactive iron whereas charcoal can be used for organic compounds. This system can be used in combination with impermeable barriers in 'gate and channel' configurations. Slurry walls and sheet pilings are used in shallow contaminated areas with limited areal extent.

Similar to groundwater remediation solutions, for soil remediation probable exsitu and insitu options are also available. The preliminary exsitu solution is to excavate the contaminated sediment followed by disposal in a designated landfill. Excavation is a very labour intensive procedure. Also, it is not a standalone option and requires treatment and/or disposal of the contaminated sediment later. Disposal in a designated landfill is a proven and readily implemented option. A landfill system comprises of the landfill area, liners, leachate collection system, impermeable covers and groundwater monitoring system. However, this option has a limitation that not all types of wastes can be placed in all landfills. Only, designated waste can be disposed in the designated landfills. Alternatively, stabilization and/or soil washing can also be carried out. Stabilization treatment processes convert contaminants to less mobile forms through chemical or thermal interactions. Bitumen, Portland cement and pozzolonic substances can be used. Soil washing is a water based process for scrubbing soils exsitu to remove contaminants. Insitu options include soil-vapour extraction and bioremediation methods. Bioremediation utilizes microbes to stabilize the organic matter. Once the remediation of the contamination groundwater and soil is completed, environmental clearance will be obtained for the site. At present, appropriate remedial measures for the site is being formulated.

5. CONCLUSIONS

The National Program for Rehabilitation of the Polluted Sites reviews and updates the data on polluted sites. Assessment of contaminated sites by site investigations and sampling is carried out. The data is analysed and the sites are prioritized for remediation. One such study prioritized for remediation is Pace city 2. The site has major sediment and water contamination. The site investigations and the sampling have been completed for the site. At present, appropriate remedial measures are being formulated for the site.

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