IUPAC Advancing Worldwide Chemistry

Division VI – Chemistry & the Environment Project 2003-017-2-600

Remediation Technologies for the Removal of Arsenic from Water and Wastewater

1. PROJECT TASK GROUP MEMBERS

H. Garelick, UK, (chair)
J.C. Bollinger, France
D.H. Caussy, India
A. Dybowska, UK
J.B. Ellis, UK
J. Feldmann, UK
H Jones, UK
B. Khoda, Bangladesh
N. Priest, UK
Y. Shevah, Israel
E. Valsami-Jones, UK
P Visoottiviseth, Thailand

2. INTRODUCTION

Arsenic currently threatens millions of people in West Bengal and Bangladesh, as a result of their exposure to contaminated groundwater. High levels of arsenic in drinking water have also been found elsewhere in Asia (e.g. Cambodia, China) as well as in the USA and South America. The WHO and USEPA recommended limit for arsenic in drinking water is currently 10 μg/L. It is not so much the difficulty of removing arsenic from water, as the extremely low levels to which it must be reduced to ensure safety, that presents the challenge to water treatment initiatives, especially in developing countries where the issues of cost and expertise often make 'high-tech' solutions impractical.

The challenge is to find cheap and efficient treatment technologies, aiming at the purification of water supplies for the thousands of isolated point sources supplying the hinterland and the rural population

Million $ Challenge

Finding a sustainable solution for the removal of arsenic from point of use sources would attract a million $ award from the US National Academy of Engineers.

3. PROJECT OBJECTIVES

The aim of this project is to provide practical advice to local decision makers at local and government level in developing countries who face the problem of arsenic contamination in water supplies. It aims to:

- *Produce a critical and independent evaluation and assessment of available technologies, with respect to the effectiveness for remediation*
- *Conduct critical analysis of appropriate methodologies and evaluate their appropriateness for different situations*
- *Address the transferability of specific technologies which are currently associated with local conditions*
- *Coordinate with the related IUPAC project 2003-050-1-021 "Solving the problem of arsenic contamination in water in Bangladesh" which is conducting workshops.*

4. METHODOLOGY: Critical review of available solutions/ technologies and their relationship with local conditions; and the use of multi-criteria analysis to assess solution/ technology transferability

Source term
- Natural sources
- Anthropogenic sources
- Behavior of arsenic in the environment
- Concentrations in the environment
- On-site analysis of arsenic.
- Assessment of commercially available field kits compared to reliable lab-based methods
- Reliability of industrial measurements particular very low concentrations

Solutions/ Technologies
(detailed examples in Table 1)
- Low cost technologies
- Advanced technologies
- Case Studies

Health effects
- Toxicological profile
- Health risk assessment
- Risk mitigation

Table 1: Multi-criteria analysis for decision making

Decision making will be carried out based on criteria identified by the team. The table maps out identified criteria and indicators against the available solutions as a means of supporting the assessment of available remediation technologies. Each of the indicators will be allocated a threshold or bench value. This can be either numerical, YES/NO or High/ Medium/Low. Each indicator is allocated a utility score and weighted to obtain a summed total.

Criteria (CRI)	Indicators (IND)	Deep Aquifer	Alternative Tube-Well Source	Raw Surface Waters	Rainwater Harvesting	Chemical Treatment: Precipitation/ Coagulation/ Absorption	Chemical Treatment: Membrane Technology	Chemical Treatment: Ion Exchange/ Reverse Osmosis	Bioremediation	Physical Treatment: Solar Still	Physical Treatment: Filtration	Physical Treatment: Rapid/Slow Sand Filters	Hybrid Technologies: Hybrid Technology (a)	Hybrid Technologies: Hybrid Technology (b)	Weighting: IND	Weighting: CRI
Source Exposure Vector	Groundwater supply															
	Airborne sources: (Mining; Smeling; Coal burning)															
	Soil & Surface Waters															
Health Risk	Toxicology (Behaviour/Form)															
	NOAEL Body burden and aqueous levels (Cancer & Non-Cancerous)															
Cost	Capital cost															
	O&M costs including Arisings disposal															
Community Attitudes	Technology acceptance															
	Organisational capability															
Technical Skill Base	Local competence															
TOTAL SCORE	sum score of x weight															

5. TIMETABLE

Team meeting: January 2005 → Literature review: January 2005 (completed) → Draft contributions April 2005 (Partially completed) → Full draft September 2005 → Final report January 2006

6. FURTHER INFORMATION

Project Leader: Hemda Garelick, School of Health and Social Sciences, Middlesex University, Queensway, Enfield, Middlesex EN3 4SA, UK.
Tel: +44 (0)20 4115719, Email: h.garelick@mdx.ac.uk.

Project Description on IUPAC Web Site: http://www.iupac.org/projects/2003/2003-017-2-600.html

Open Call: Contributors or suggestions are Welcome