



13th IWA
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Small Water and Wastewater
Systems

5th IWA
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Resources-Oriented Sanitation

Comparing mixed media and conventional slow sand filters for arsenic removal from groundwater

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Outlook

- Background: arsenic contamination of groundwater in Bangladesh
- Methods
- Setup design
- Results
 - As removal efficiency
 - Vertical As concentration profiles
 - Raman analysis of F2 media
- Conclusions



Arsenic contamination of groundwater in Bangladesh

- Arsenic in drinking water via hand tube wells
- Chakraborti *et al.* (2010):
 - 36 million people \rightarrow As $> 10 \mu\text{g L}^{-1}$ (WHO guideline)
 - 22 million people \rightarrow As $> 50 \mu\text{g L}^{-1}$ (Bangladesh government)
- Health risks:
 - Skin lesions
 - Lung irritation
 - Cancer (skin, bladder...)
- Solution:
 - SSF augmented with iron



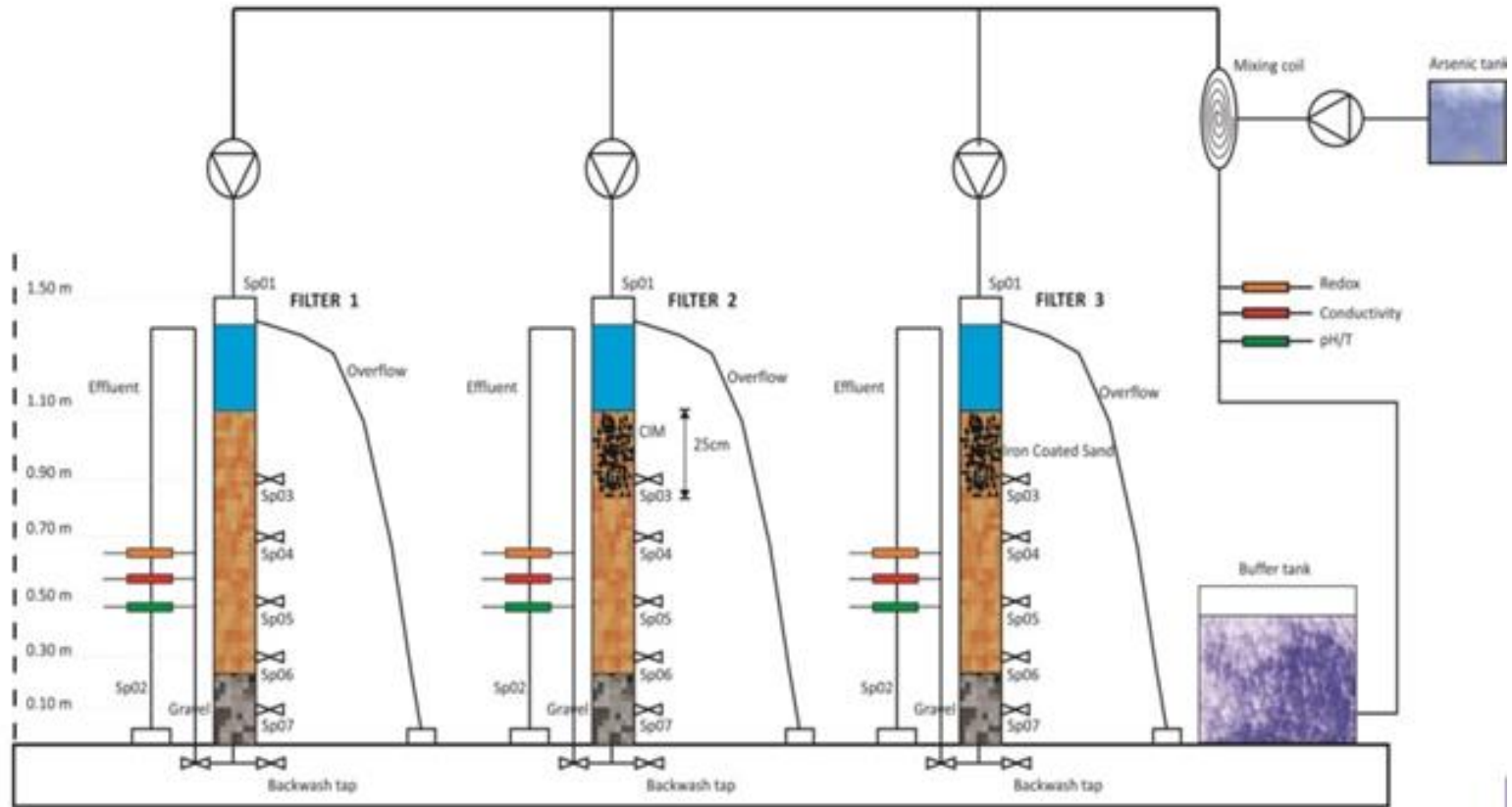
Chakraborti et al. (2010) Status of groundwater arsenic contamination in Bangladesh. A 14-year study report. Water Research 2010, 44 (19), 5789-5802

Methods

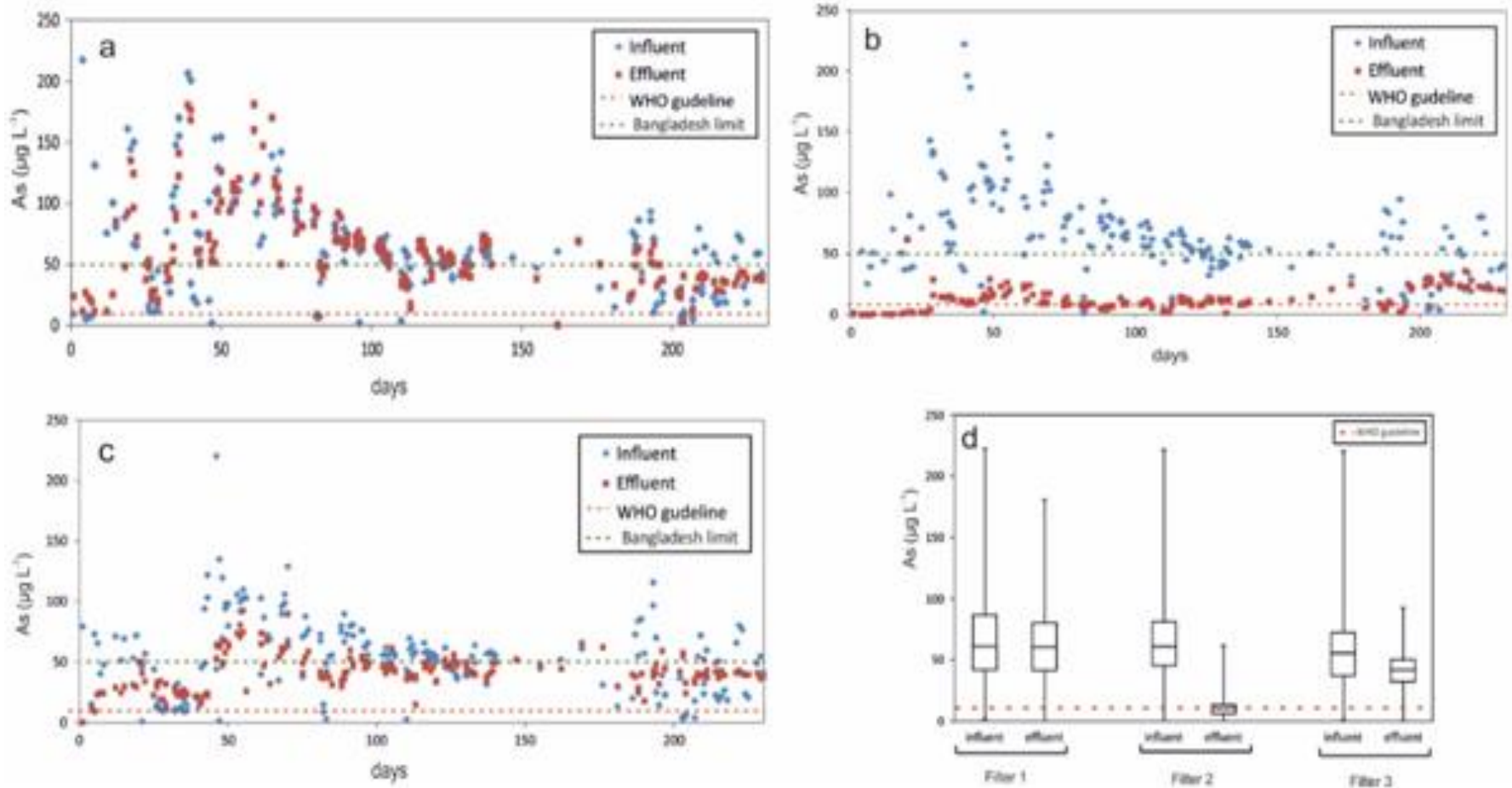
- Three filters:
 - F1: Conventional (reference)
 - F2: Corrosive iron matter (CIM)
 - F3: Iron coated sand
- Filtration rate: 6 L h⁻¹
- Continuous operation for 260 days
- Inlet As concentration: 70 µg L⁻¹
- Constant temp. 26°C
- Online measurements:
 - pH
 - Redox potential
 - Electrical conductivity
- Total As analysis in inlet and outlet twice per day
- Total As samples along the filter column
- Raman analysis of solid filter media



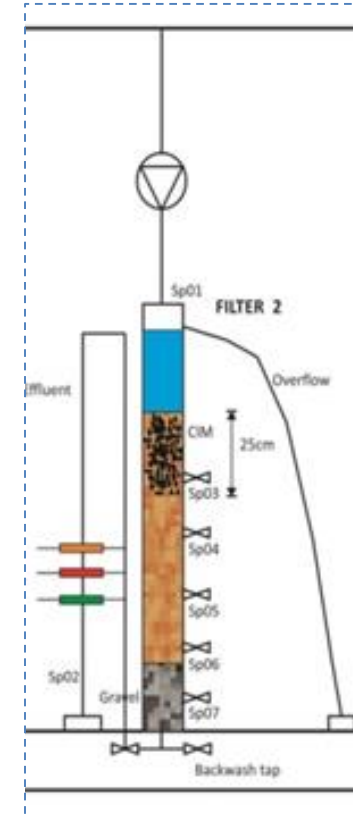
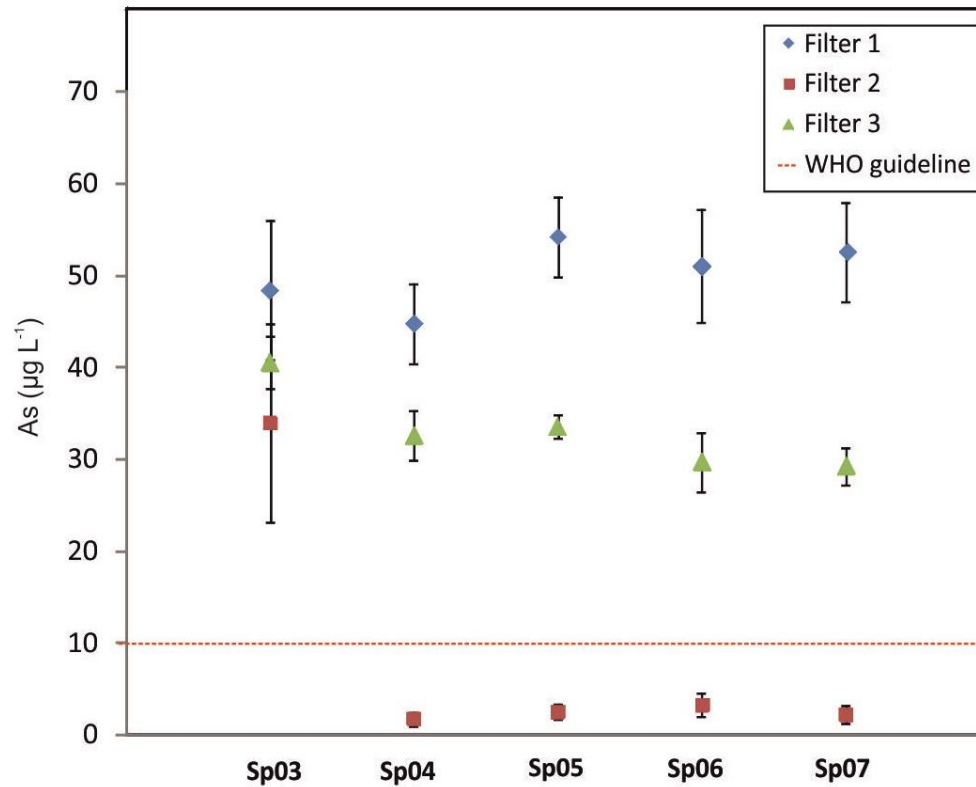
Setup design



As removal efficiency



Vertical As concentration profiles



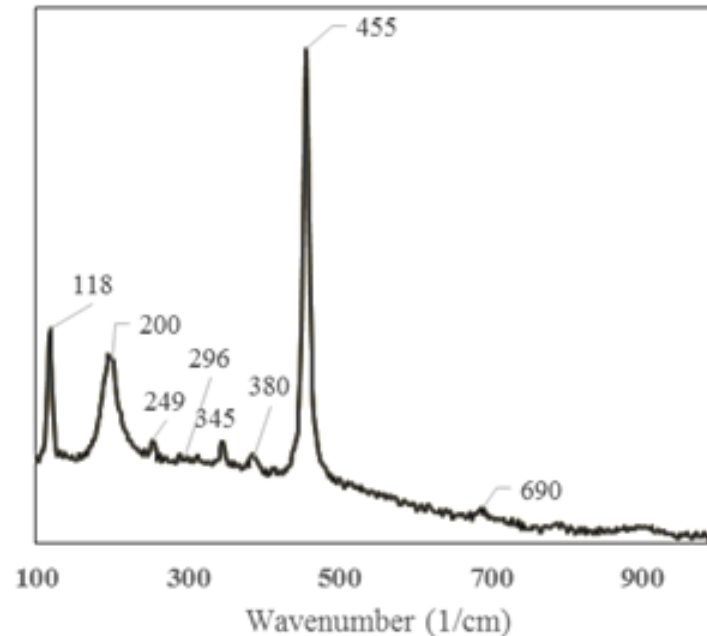
Raman analysis of F2 media

Raman spectroscopy:

- 80% lepidocrocite (γ -FeOOH)
- 20% hydrous ferric oxides
- traces geothite (α -FeOOH)
- no magnetite

Mass balance DO and Fe:

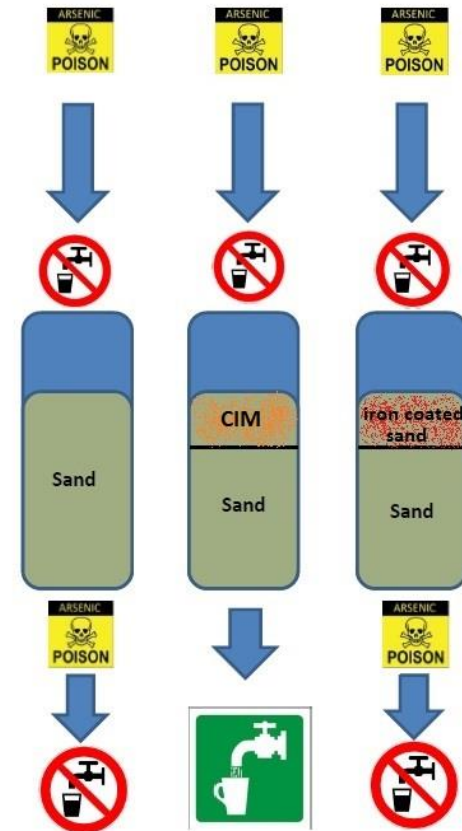
- 80% CIM oxidized



F3: lower As removal efficiency due to PO_4^{3-} , CO_3^{2-} occupying surface sites

Conclusions

- SSF augmented with CIM could efficiently remove As below the $10 \mu\text{g L}^{-1}$ WHO guideline for a prolonged time of continuous operation (200 days, 6 L d^{-1})
- As removal occurred inside CIM layer
- 80% CIM oxidized to lepidocrocite and HFO
- Active sites in iron coated sand occupied by PO_4^{3-} and CO_3^{2-} during retreatment, preventing efficient As removal



Acknowledgements



Thank you very much!



Questions?

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