

Report on Field Visit of Joint Secretary (Water)
to Nadia district of West Bengal to Review
Arsenic Mitigation Measures – 11th and 12th
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Background:

It was in the 80's when Arsenic contamination in groundwater was detected for the first time in West Bengal. Soon after the detection of geogenic arsenic contamination of ground water, various short term measures like i) installation of hand pump tube wells at deeper aquifer ii) installation of arsenic removal units attached to the hand pumps iii) construction of new dug wells etc. were taken up. However, most of those short term measures failed because of complicated operation and maintenance issues and non-acceptance by the society. Afterwards it was felt that a comprehensive action plan has to be taken to combat the Arsenic menace and therefore a **Master Plan for Arsenic Mitigation** was conceived in the year **2006-07** to cover **6623 habitations**, at a cost of Rs. 2831 **Crores** (revised) under **Water Quality Submission** with a cost sharing of **75:25** between the **Centre** and the **State**. However this Water Quality Sub Mission was made an integral component of **National Rural Drinking Water Programme (NRDWP)** since 1.4.2009. The Master Plan comprising of **338 nos.** of new **Groundwater based Piped Water Supply Schemes**, **12 nos.** of new **Surface Water based Piped Water Supply Schemes** & **165 nos.** of **Arsenic Removal Plants (ARP)** in existing Groundwater based Schemes, is still under implementation under the NRDWP. Apart from the aforesaid Master Plan, arsenic mitigation programmes are also being implemented by the State under other programmes like, **Minority Sector Development Programme (MSDP)**, under the **Ministry of Minority Affairs**, **Border Outpost Programme under the Ministry of Home Affairs** etc.

Field visit was made to see different types of interventions, both short-term and long-term, undertaken by the State Government which is narrated below:

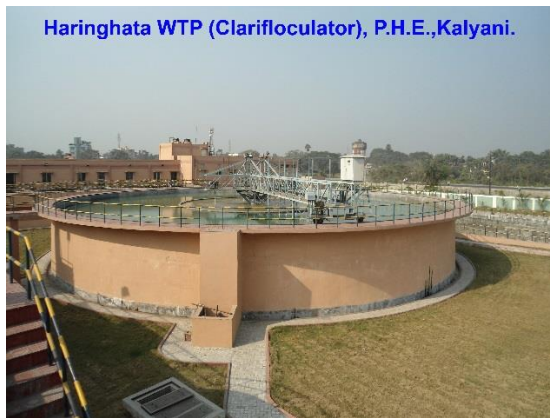
A) Mega Piped Water Supply Scheme based on River Water

Arsenic contamination of ground water in West Bengal is largely spread over the Gangetic Alluvium of West Bengal and therefore the State Government has taken up 12 (twelve) Mega Piped Water Supply Scheme based on River Ganges. One such scheme is named as "**Haringhata and Chakdah (Part)**" in the **Nadia District** which has been declared as the first ODF district in the State, very recently.

The Salient feature of this Surface Water Based Piped Water Supply Scheme is tabulated below:

- Name of the Scheme Surface Water Based Piped Water Supply Scheme for Arsenic Affected Areas of Haringhata and Chakdah (Part) Block of Nadia District
- Name of the Blocks Covered Haringhata & Chakdah (Part)
- Number of Villages covered RURAL: 129 Nos. Census Town: 1 Nos.
- Number of Rural Habitations 266 Nos. (Arsenic affected 155 habitations)

- Design Population (2028) Total: 4,86,904 [Rural: 4,68,376 and CT: 18,528]
- Command Area 24,379.42 Hectares
- Number of Zones 13 (Thirteen) Nos.
- Per Capita Service Level Rural- 49 lpcd (considering 30% population to be served through house connection @ 70 lpcd and 70% population to be served through street hydrants @ 40 lpcd)
- Daily Water Demand Raw Water: 33.39 MLD, Clear Water: 31.72 MLD, Net Water: 28.55 MLD
- Source of Water Surface water of River Hooghly
- Treatment Plant Capacity 33.39 MLD [7.35 MGD]
- Treatment Methodology Conventional Treatment (Coagulation and Flocculation, Clarification, Rapid Gravity Filtration and Disinfection)
- Over Head Reservoir (OHR) 12 (twelve) nos. new to be provided in each zone over and above existing 02 (two) nos.
- Sanctioned Estimated Cost Rs. 118.98 Crores (under NRDWP)
- Date of Commencement 24.12.2009
- Date of Commissioning June 2012.
- Cost of production of water Rs. 7/Kl



B) Multi Village Piped Water Supply Scheme based on Ground Water with Arsenic Removal Plants

The State is implementing **338** Ground Water based Piped Water Supply Schemes in arsenic affected areas, wherever Surface Water based schemes are not techno-economically feasible. A number of technologies have been adopted to treat the excess amount of Arsenic present in ground water. However, on 11.09.2015, the field visit was made to one Arsenic Removal Plant based on Nano technology as detailed below:

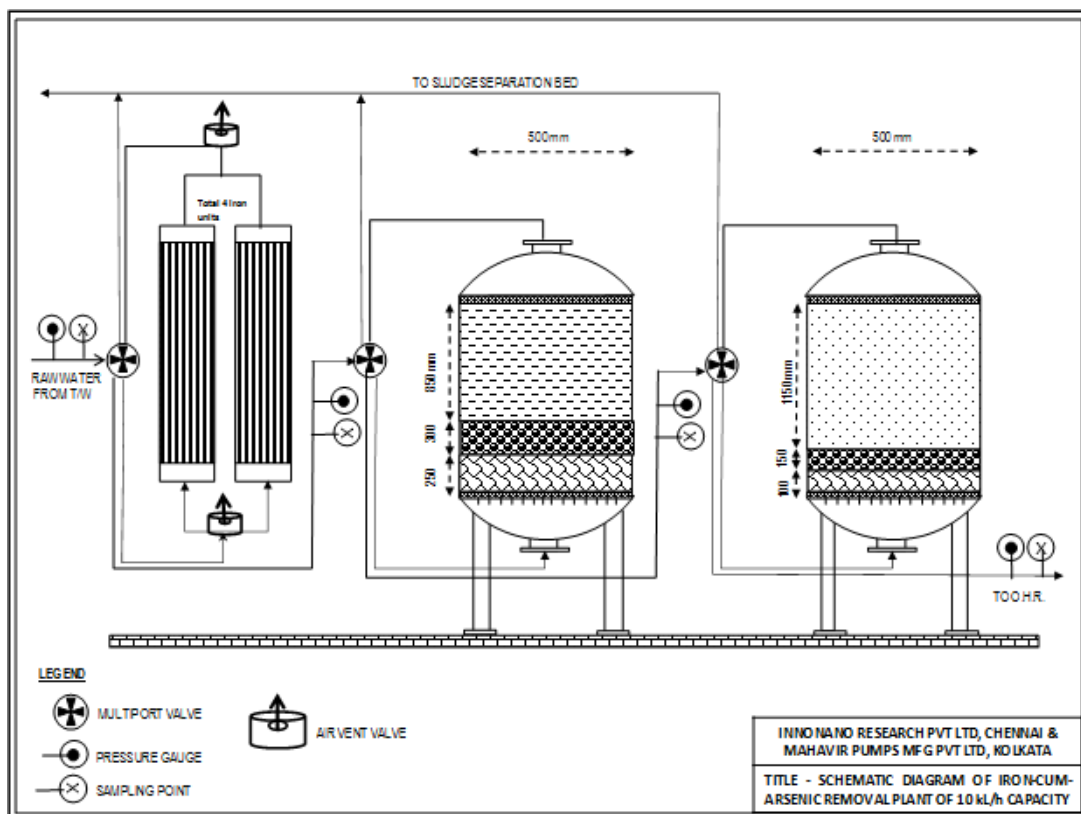
Arsenic Removal Plant Based on Nanotechnology - This nano-technology based Arsenic Removal Plant has been installed in **Umapur, Phulia, Block – Shantipur, District–Nadia**. The nanoparticles used in the Plant is Iron-oxy-hydroxide which reduces arsenic concentration to <10 ppb and iron to <100 ppb from influent concentration of arsenic and iron up to 500 ppb and 3000 ppb respectively. The treatment methodology is based on oxidation followed by iron and arsenic adsorption. The Arsenic present in raw water is adsorbed in the nanoparticles used as media in such a manner that there is little chance of leaching arsenic from the meager amount of sludge produced in the treatment process.

IIT Chennai has developed the technology and in order to promote this technology an incubation company was formed in which the professors, research students from IIT and others are the shareholders. This incubation company has tied up with one local company based in West Bengal who is the implementing agency engaged by the State Government or PRI.

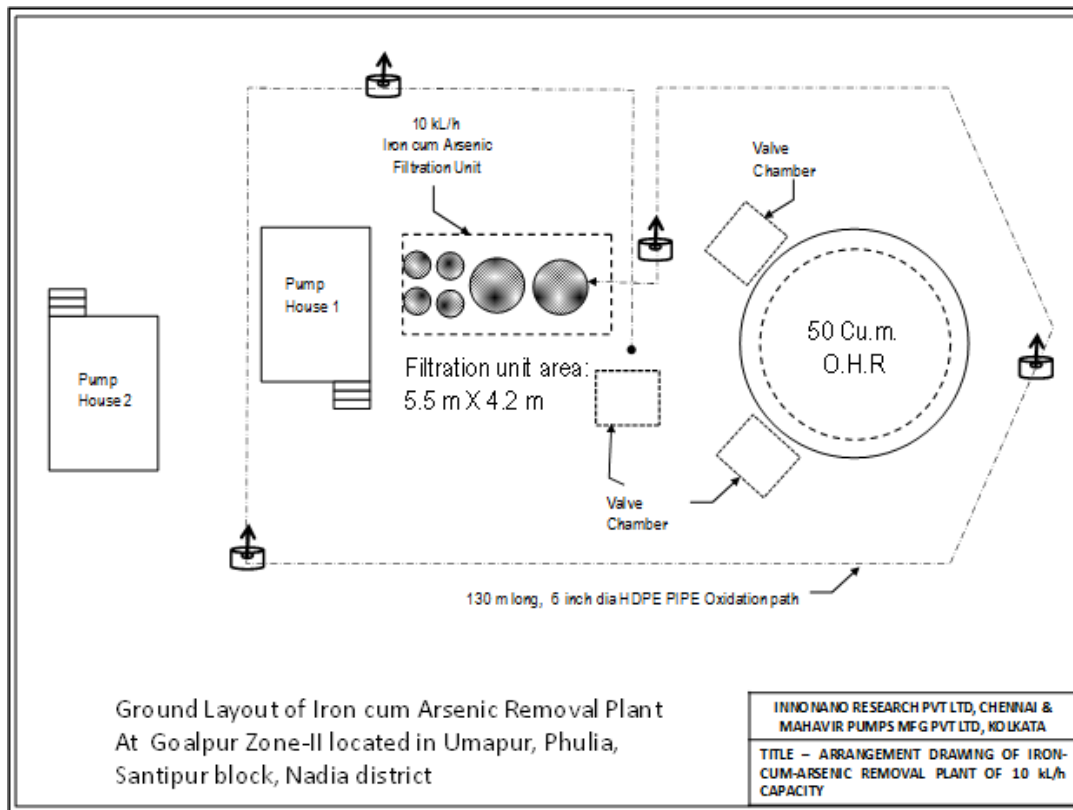
The Salient feature of the above scheme is furnished below:

- Name of the Scheme Ground Water based water supply scheme for Arsenic affected areas of Goalpur , Block Shantipur, District Nadia
- Number of Villages : 2 Nos.
- Number of Rural Habitations : 9 Nos. (Arsenic affected habitations = 4)
- Design Population (2032) Total: 5,693
- Command Area 300.63 Hectares

- Number of Zones 2 (Two) Nos.
- Per Capita Service Level Rural- 61 lpcd (considering 70% population to be served through house connection @ 70 lpcd and 30% population to be served through street hydrants @ 40 lpcd)
- Daily Water Demand 387 KLD
- No. of Tube Wells 4 Nos.
- Discharge of each Tube Well 2 nos. @ 13,750 liters/hour
2 nos. @ 10,437 liters/hour
- Over Head Reservoir (OHR) 2 (Two) nos.
- Sanctioned Estimated Cost Rs. 2.09 Crores (NRDWP)
- Year of Commencement 2009
- Year of Commissioning 2014
- Capacity of the Arsenic removal plant 17,000 litre/hr.
- Cost of production of water Rs. 4/Kl



Sectional view of Iron and arsenic removal plant based on Nano-technology



Ground layout of Iron and arsenic removal plant based on Nano-technology



Arsenic Removal Plant, installed in Umapur, Phulia, Block – Shantipur, District – Nadia

Other Technologies used for removal of Arsenic in Ground Water is also furnished below:

- a) Modified Sujapur–Sadipur Model - This technology is based on oxidation followed by co-participation through coagulation, flocculation, clarification, filtration and finally adsorption through activated Alumina chamber and solid/ liquid separation of sludge as mortar block. The capacities of these plants may vary be from 20m³/hr. to 100 m³/hr.
- b) Gobordanga Model – This model has also been adopted by the State which is for smaller capacities in the range of 5 to 20 m³/hr. This technology is based on oxidation

by chlorination in a designed path, adsorption through naturally available Red Hematite, Green Sand and polishing through Activated Alumina. Entire system is made in a closed pressurized system to reduce cost of land and installation time.

- c) Few other technologies based on Granular Ferric Hydroxide, Resins, In-situ remediation etc. has also been successfully adopted/ being adopted, to treat contaminated ground water.

C) Community Based Arsenic Removal Plant

Implementation of multi-village piped water supply schemes are time taking and of high cost. Therefore, the State has also taken up about 400 Community Purification Plants based on the technologies which are already functioning successfully for more than 2 years. These plants would cater to the drinking water needs @ 8 litres per capita for about 1000 persons. The cost of such plants is Rs.10.00 lakhs (approx.). VWSC or users' committee also collects fund from the users. One such plant based on Nano technology was visited at Nabadwip, District Nadia on 11.09.2015.

The Salient feature of this Community purification plant is -

- ❖ Location: Block Development Office Nabadwip, District- Nadia, West Bengal
- ❖ Runs on GRID powered can also be attached solar power based Submersible Pumping.
- ❖ Iron Removal: Based on Oxidation by MnO_2 & Green Sand and through filter sand.
- ❖ Arsenic Removal: Based on Nano scale Iron-oxy-hydroxide absorbent technology by IIT Madras.
- ❖ Bacteriological Removal: UV Filter.
- ❖ Treatment Capacity: 8,000 liter per day.





(Interaction of JS (Water) with Nabadwip villagers and PRI representatives)

(D) Hand Pump Attached Arsenic Removal Plant

Arsenic removal plants, comparatively on a smaller scale, have also been installed under other programmes like Border Area Development Programme, Minority Sector Development Programme etc. These plants are generally attached to the existing hand pump tubewells, yielding arsenic beyond permissible level and generally they cater to the drinking water need of school, madrasah, health centre etc. The technology is again based on nano adsorbent, developed by IIT, Chennai. Salient feature of 2 such models is detailed below:

Model 1:


- **Location:** Swami Vivekananda School Chapra Block – District Nadia.
- **User:** School Students & Local Community, approx 200 person.
- **Design:** Bamboo shaped which attracts people and especially the children.
- **Cost of Each Unit:** ₹ 72,000.00
- **Iron Removal:** Based on Oxidation by Resins (ISR) & Green Sand and other filter media.
- **Arsenic Removal:** Based on nanoscale iron oxyhydroxide adsorbent technology by IIT Madras.
- **Output:** 1000 liter per day.
- **Operation:** It is quite easy as with every stroke it delivers clean drinking water free of iron and arsenic through its lift & force option. It has option of drawing water for other purpose such as washing, bathing by using the normal mode of the handpump.



- **Maintenance/Backwash:** By turn of few valves the system can be backwashed for few minutes and the system is recouped back for normal use. After each back wash the system is rinsed before drawing of clean water. This periodic cleaning/backwash will depend on turbidity level/iron content in the input water. The Arsenic Absorbent Unit doesn't require any backwash as it simply needs to replace with new cartridge after the same is exhausted.

Total 330 such Units have been installed in the schools and some habitations, in the district of Nadia, Murshidabad

Model 2

- **Location:** Sealmara Madhyamik Siksha Kendra - Berhampore Block – District Murshidabad.
 - **Design:** Coconut shaped which attracts people and especially the children.
 - **Cost of Each Unit:** ` 95,000.00
 - **User:** School Students & Local Community, approx 250 person.
 - **Iron Removal:** Based on Terafil Filters.
 - **Arsenic Removal:** Based on nanoscale iron oxyhydroxide absorbent technology by IIT Madras.
 - **Output:** 1200 liter per day.
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- **Operation:** Easy to operate the system works on gravity flow principal. Only daily filling of water through a lift & force (it also has option of drawing water from other purpose such as washing, bathing) or through a electric mono block pump.
 - **Maintenance:** The Upper Tank of the systems storing raw water requires periodic cleaning depending on turbidity level/iron content in the input water. The filtrates clog the top surface of the Terafil over time hence flow rate drops. This requires cleaning/scrubbing the surface of the cake rigidity with a soft nylon brush / coir / or spay of water with the sprayer provided with the system. This will remove the sediments and open new pores for rejuvenation of filtration process. The Arsenic Absorbent media doesn't require any maintenance it simply needs to replace with new cartridge after specific interval.

Total 1000 such units are being installed in Schools/ Anganwadis/ Madrasah/ Health Centres/ Mosque/ Habitation etc. in the district of Murshidabad, West Bengal

Way Forward:

The total no. of identified arsenic affected habitations in the State was about **6586** considering the permissible limit of arsenic in groundwater as **0.05 mg/ltr**. Out of the above habitations about **645 nos.** are yet to be covered. Of late, there is a debate on reducing the limit of arsenic to **0.01 mg/lt**, which will result in the addition of affected habitations by **3610 nos** habitations. However, the State Government is poised to cover all the affected habitations by either of the above measures/ technologies as mentioned above by March, 2017. A majority of the affected habitations, lying within the range of 0.01 to 0.05 mg/lt, are already covered by the mega surface water or ground water based multi village piped water supply projects and some of the affected habitations (in the range 0.01 to 0.05 mg/lt) may also be covered by simply extending of distribution pipelines. However, the State Govt. is yet to take some action for providing house connection from piped water supply schemes. Therefore, in many areas where there is a piped water supply, rural people continue to drink contaminated water from private tubewells due to lack of awareness or reluctance. On this score, the Sate Government has taken up a slew of measures like red marking of tubewells, extensive awareness, training, water quality monitoring involving the GPs etc. State Government officials were advised to intensify the awareness programme involving the local PRIs and grassroot level ASHA and Anganwadi workers.
