

Expression of Interest (EOI)

For

Engagement of Transfer of the Technology for

Magnetic Arsenic Technology

**Designed and Developed by Bihar Bal Bhawan Kilkari,
Department of Education Government of Bihar, India**



Bihar Bal Bhawan Kilkari wishes to locate and shortlist manufacturers in various regions of the country in order to produce the magnetic removal unit, which is the USP of this removal method and/or technology, to deploy these units in widely across the nation. Expressions of interest (EOI) are requested from parties interested in licensing this technology under the Bihar Bal Bhawan Kilkari license. Interested parties must be a company, LLP, MSME, Partnership Firm or LLC incorporated in accordance with the relevant government act and notifications.

Interested parties may provide the following information in response to this EOI:

- There should be only 4 File Attachments.
 - The File Attachments should be named as (bold faced part):
1. **Audited balance sheets & Audit Report** of three immediate past preceding years', including profit and loss account and the Annual Report - The Attachment Filename to be prefixed with "Balance Sheet". 2022-23,2021-22.
 2. **Certificate of Incorporation, PAN, GST or any other certification (if available)**
 3. **Reference** list of similar engineering supplies of fabrication and services during the past two /three years - The Attachment Filename to be prefixed with "Services". The fabrication facilities must be owned and /or outsourced by the institution
 4. **Details of the fabrication facilities** available including area and tooling list and a short video or photographs - The Attachment Filename to be prefixed with "Fabrication".
 5. **List of quality certifications/accreditations** that are currently valid, with copies of such certificates - The Attachment Filename to be prefixed with "Certification". Letter from previous service beneficiary about satisfactory and quality services.

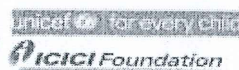
Name of the Technology: Magnetic Arsenic Removal Unit (MARU)

Current Stage of the Technology: TRL-8 (Ready for Commercialisation)

Cost of Water - 0.1 Paise per liter

Patent Number: Indian Patent -400679 IN ; PCT (International) - WO 2021/144815

Key Word: Molecular Repulsion; Magnetic Treatment; Arsenic Removal; Diamagnetism



Summary of the Product: / Technology

- Several technologies have been developed to address arsenic contamination in groundwater, but current methods like softening and coagulation require significant expenditure and maintenance. Bihar Bal Bhawan Kilkari has developed a Magnetic Arsenic Removal Unit (MARU), which uses Molecular Magnetic Treatment of Arsenic ($As+3, As+5$) in an environment friendly way. The technology involves filtration or separation, which separates the $As+3, As+5$ from the flowing water as it flows through an array of cones, surrounded by an intense magnetic field. As the diamagnetic particle flowing through the trajectory, the varying/non uniform magnetic field constantly applies a torque on it and creates a magnetic moment with negative magnetic susceptibility repelling it particles along vector field lines and making it adhere to the area beneath the cones.
- The MARU is simple to operate and maintain and provides quality drinking water. The technique has been scientifically validated through field trials and a multidisciplinary approach of engineering and sciences, conducted in nine severely arsenic-affected villages in Bihar, India with the partnership of the Research cum Training Centre, "PRANJAL" Public Health Engineering Department, Government of Bihar, supported by UNICEF and ICICI Foundation. The research has yielded positive results, demonstrated an innovative alternative with sustainable approach for arsenic removal with higher longevity.
- The technique utilizes a gravity-based continuous filtration process with zero wastage of water, works without electricity or any added chemicals/precipitating agents Adding to it, our filter generates negligible amount of sludge compared to other technologies which can be easily treated. The device has a long life since there are no moving parts and involves minimal maintenance.
- It is commercially expandable at community and municipal levels, making it a wide-ranging and feasible solution.



Technology removes contaminants.

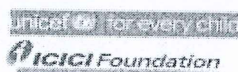
The efficient removal of Arsenic (+3,+5), Iron (ferrous), Sulphate, and other metallic contaminants can be removed by utilising magnetic properties. The structure is built with SS 302,318, to enable high scale removal of arsenic constituents.

Design Capacity:

- 800 Liter Per Hour- Community Scale Unit
- 5000 Liter Per Hour- Municipal Scale Unit for Ward Scheme

Technology Excellence:

- A proven and government-approved alternative technique for arsenic removal, utilizing a magnetic approach in a sustainable and cost-effective manner.
- Recommended and Impaneled by Technical Committee of Principal Scientific Advisor to the Government of India under Innovation Technologies for Drinking Water, Department of Drinking Water and Sanitation, Ministry of Jal Shakti Government of India.
- Approved by CSIR – IICT, CSIR –CGCRI validated during the field trials.
- No requirement of electricity or any consumables/chemicals, minimal maintenance and long lifetime
- Minimal sludge, waste, and residual separation, making it a cost-effective and environmentally friendly solution.
- Highly scalable method suitable for any capacity, ensuring flexibility and design adaptability.
- Cutting-edge technology for waste disposal, extraction method, and magnet cleaning, promoting sustainable practices and minimal maintenance.
- Technology for Arsenic Removal at a high flow rate with impressive results (@800 LPH - ~400ppb, @5000 LPH - ~2000, as recorded during the Pilot Trial of Phase 2 and 1, 2021-2023).



Pre-Treatment Protocol

Pre-filter to counteract turbidity, suspended particles, and bacterial development. Followed by activated carbon / with bactericidal properties to protect the main magnetic structure from contamination, and as a preventive measure. UV tube also be applicable at high scale unit to avoid unnecessary media dependency if not required media base pre-treatment (activated carbon).

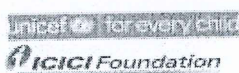
Post-Treatment Protocol:

There is no major post-treatment required in this process of eliminating arsenic.

Operations and Maintenance Cost and Protocol

Operation and maintenance costs are already included in the cost of water per liter (0.1 paisa per liter); the exact cost depends upon the capacity of the Magnetic Arsenic Removal Unit applied along with the concentration of arsenic and iron in raw water. It includes the cost of magnets, yearly replaceable pre-treatment media, i.e., activated carbon or any pre-treatment media if required, the operator cost for running the plant required in municipal scale only, its necessary consumables and electricity, and the cleaning device that is included in the package of devices. Community-scale units (800 LPH) and Municipal units are extremely feasible to operate and require one-time installation in Tube wells, ward-scale water supply schemes, hand pumps, and mini-piped Water Supply Schemes.

The magnets used in the device have a guaranteed life of 10 years (unless broken and/or exposed to temperatures above 800 °C). The operation and maintenance have been simplified through the Plug and Play Technique, which is a cutting-edge technology that simplifies filter maintenance with the use of the cleaning box. The arsenic gets collected in the bottom tank, which prevents leaching into the ground or any other form of contamination. After several cleanings, the powder needs to be disposed of in the designated, lined landfills. The process ensures safe disposal of remaining Arsenic by allowing the water in the box to evaporate under the atmospheric condition and disposing of it in designated fly-ash pits. Experience the convenience and effectiveness of the Plug and Play Technique for long-term, hassle-free maintenance. The treatment unit's operating protocol is straightforward. This allows for single-point operation for replacement and monitoring. It's crucial to prevent the iron scaling in the



magnets, so using a pre-filter unit that removes turbidity and suspended particles (ferric iron) in ground water is necessary.

Reject Management Cost and Protocol

This magnetic medium, known as the magnetic cone or structure, has been meticulously designed to achieve two primary goals: an extended lifespan and reduced maintenance costs. The technology employs affordable and easily accessible magnets, particularly NdFeB (Neodymium Iron Boron alloy sintered magnets), including various specialty magnets.

Remarkably, these magnets boast an extensive life expectancy of approximately 10 years, depending on factors like the concentration of arsenic and the design capacity. Their longevity is directly proportional to the removal capacity of the system. Should any physical damage occur or a loss in magnetic power be detected after this period, replacing the magnets is recommended. A cleaning device, resulting in dry powder, efficiently carries out the process of arsenic separation. Through a comprehensive two-year field experiment, it was observed that the remaining or separated sludge amounted to a mere 10 grams from all six 1:2 Scale Community arsenic removal units. This corresponded to a mass concentration of 10–33 percent (mass concentration of total sludge or remnant) of Arsenic. This astounding result significantly simplifies and reduces the cost of handling the rejects in the process. Embrace this innovative solution, where longer-lasting magnets and cost-effective arsenic removal merge seamlessly, promising enhanced performance and convenience for your needs.

Certification of Product

This technology's treatment approach, design, and procedure, as well as extra protocols, have been approved by or evaluated by relevant embraced as State Technology Jointly Validated by Training cum Research Centre “PRANJAL” Public Health Engineering Department and Bihar Bal Bhawan Kilkari Department of Education Government of Bihar.

Technology Validated by – CSIR –Indian Institute of Chemical Technology, and CSIR – Central Glass and Ceramic Research Institute , Kolkata.



Technology Recommended and Impanelled under Innovative Technologies for Drinking Water, by Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India

Interference by other Contaminants

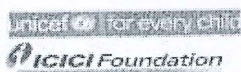
Contamination poses a challenge to the effectiveness of arsenic removal in the unit. The presence of ferric particles scaling on the magnetic structure leads to a deviation in the magnetic field, primarily intended for diamagnetic elements that could potentially saturate the magnetic structure. To overcome this obstacle, we propose the implementation of an iron removal medium and a non-aerobic water (raw-feed) supply system, which can be replaced either quarterly or when high potential issues arise.

Considering the maximum contamination limits for the community unit at 5mg/L and the municipal scale unit at 15mg/L, it becomes crucial to adopt specific approaches to address these interferences effectively. By incorporating the suggested methods, we aim to ensure the optimal performance of our arsenic removal technology, providing clean and safe water for communities and municipalities alike.

Pilot trials

The following pilot trials were conducted:-

S. No.	Location	Units Deployed	Duration of Trial	In Joint Partnership with
1	Maner, West Suarmarva Block Ward No. 9	1 Pilot Unit 3D Printed Structure Installed in Handpump	2020 (1 Month)	PH Division, East Patna Public Health Engineering Department, Govt. of Bihar Supported by the Bihar Council on Science and Technology, Department of Science and Technology, Govt. of Bihar



2	3 Middle schools and 2 Community places in 4 blocks of Bhojpur and Buxar	5 Pilot units 1:2 Scale 400 LPH 100 ppb arsenic removal capacity Installed in Force Lift Hand pumps	September 2021 to December 2022	PH Division Bhojpur and Buxar Supported by the Research and Training Centre PRANJAL, Public Health Engineering Department, Govt. of Bihar
3	5 Middle schools, in 4 blocks of Bhojpur	5 Pilot units 1:2 Scale 400 LPH 100 ppb arsenic removal capacity Installed as In-Line units	December 2022 to June 2023 (to conduct studies for its standardization and optimization for commercial usage)	PH Division Bhojpur and Buxar Supported by UNICEF Bihar and partnered with Research and Training Center PRANJAL, the Public Health Engineering Department, Govt. of Bihar
4	Udwanthnagar Block, Bhojpur	1 Municipal Scale Unit 5000 LPH 2000 ppb arsenic removal capacity Installed as In-line unit	June 2023-Ongoing	PH Division Bhojpur in KV High School and Middle School Chotta Sassram (Joint campus) Supported by the ICICI Foundation and partnered with the Research and Training Centre PRANJAL, Public Health Engineering Department, Govt. of Bihar

Competitors

There have been many attempts to solve this hazard by applying various methods, including adsorption, coagulation-precipitation, ion exchange, and various other processes, such as iron hydroxide, activated alumina, or various other feeds. However, frequent maintenance, a high initial investment, and the sludge caused by those methods make it difficult for needy communities to afford the same. With the increasing demand for water purification, it has become evident that outdated methods need to be phased out. The focus is now on implementing approaches with lower limits, higher kinetics, reduced cost, ease of maintenance,



long-lasting efficacy, and improved environmental friendliness. Our cutting-edge technology is designed to meet these challenges and aims to serve the most affected communities while ensuring cost-effectiveness. Embrace this advancement in groundwater treatment and join us in safeguarding the purity of water for communities and the environment.

About Inventors and Contributors

Arpit Kumar (Project Lead – Research and Development Lab, Science Section Bihar Bal Bhawan Kilkari, Department of Education Govt.of Bihar)

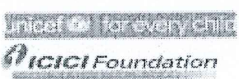
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8.	ICICI Foundation, Bihar		
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Interested parties may reply quoting that “Regarding the Application for Advertised Technology Transfer”

Technology Transfer Last Date – September 30th, 2023

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KILKARI

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Estd. by Dept. of Education, Govt. of Bihar

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unicef for every child

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