SUMMARY REPORT

Background

The water network RésEAU, the Climate, DRR and Environment (CDE) Network and the Regional Hub in Lima of the Swiss Agency for Development and Cooperation SDC held webinars on the 11th and 13th of June 2024 to discuss an innovative technology to remove heavy metals from drinking water. The webinars aimed at:

- Sharing hands-on experience and lessons learned from using an innovative technology developed by the BluAct company to remove heavy metals from drinking water in Peru
- Showcasing the technology to inspire replication and establish a link between interested public and private sector professionals and BluAct.

Switzerland is committed to reducing the health risks of exposure to heavy metals in water, with a special focus on the most vulnerable populations. In this frame, SDC supported the validation of a new, cost-effective, and scalable technology for the removal of heavy metals from drinking water. The technology was developed by BluAct Technologies (an ETH Zurich spin-off) and consists of cellulose membrane filters, activated carbon and milk protein fibers, and its use requires no energy.

To validate this technology, SDC entrusted the Peruvian NGO SABAVida to conduct a study in four departments of Peru where the population consumes water with arsenic and lead at levels exceeding the maximum permissible limits (0.01 mg/l, see WHO; 2024). The webinar provided the opportunity to share valuable insights from the pilot study on how the filter technology performs in a real-world context, across household and collective water supply systems.

Introduction to heavy metals in drinking water as a public health problem

Setting the stage, **Laura Velasquez** and **Dr. Sara Marks** (from the Department Sanitation, Water and Solid Waste for Development, SANDEC - EAWAG) – outlined that heavy metal contamination in drinking water poses significant global health risks. Arsenic exposure can lead to hyperkeratosis, cancer, and other diseases and affects 226 million people in 56 countries, notably in South Asia, parts of Africa, and the Americas. Chronic fluoride exposure is linked to bone and joint deformities. Other concerning contaminants include lead, manganese, cadmium, and iron. Two common heavy metal removal technologies were highlighted:

- Removal by precipitation/coagulation, such as the Nalgonda technique (community scale): This fluoride removal system uses aluminium sulphate and calcium hydroxide to precipitate contaminants. Though inexpensive and using readily available chemicals, it requires significant labour, achieves moderate fluoride removal, and produces considerable waste.
- Removal by adsorption/precipitation, such as the SONO filter (household level): Widely used in Bangladesh, this arsenic removal system utilizes iron scraps for oxidation and adsorption, followed by filtration through sand and wood charcoal. It is cost-effective and easy to use but has a variable arsenic removal efficiency, struggles with water containing sulphate or phosphate, and is often inconsistently used.

Water purification using protein nanofibrils

Dr. Sreenath Bolisetty (CEO of BluAct and Lecturer at the Department of Health Sciences and Technology ETHZ) presented the innovative BluAct filtration technology, with protein nanofibrils. It consists of hybrid membranes made from amyloid fibrils and activated porous carbon. The amyloid is produced from milk proteins. It is a biodegradable, non-toxic, low-cost material with exceptional capacity to adsorb and extract heavy metal ions and cyanides from drinking water. BluAct technology removes over 99% of heavy metals, including arsenic, lead, and cadmium and operates using gravitational force, saving 89% energy compared to reverse osmosis. The technology has been proven highly performant at household, community, and municipal levels. The technology's high removal efficiency of multiple pollutants, and low energy requirements set it aside from existing technologies. Adaptability to any existing filter casing is an added advantage, as is its versatility in processing small and large water volumes, use of sustainable materials, and good regenerative capacity. A household water filter generally needs replacement every six months (efficiency decreases over time), with built-in alerts indicating when. The filter material can be regenerated 3-4 times using caustic soda, especially in large-scale facilities, but household cartridges are typically replaced. At the end of its life, the filter material should be disposed of in a landfill or could be used in brick and cement blocks.

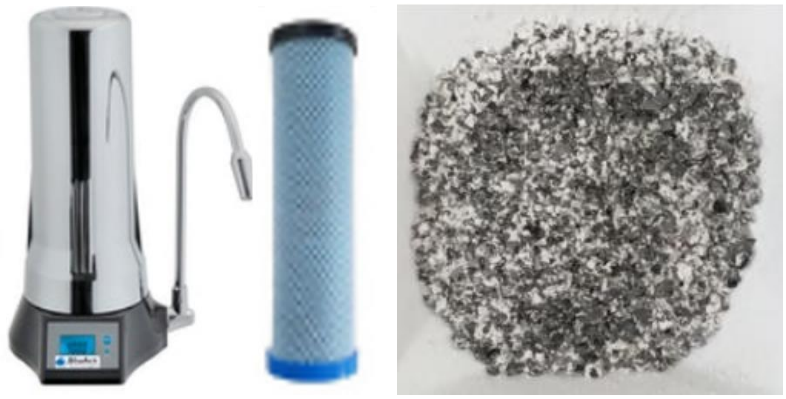

Figure 1. Household filter and granular filtration material by BluAct.

Experience in the implementation of technology to remove heavy metals from water in rural Peru

In Peru, over six million people are potentially exposed to arsenic and other heavy metals through drinking water. The Peruvian Ministry of Housing, Construction, and Sanitation has prioritised identifying and integrating technologies to address this issue. **Herberth Pacheco** (Director of the NGO SABAvida) presented the results of the pilot project that tested the effectiveness of the BluAct membrane-filter technology for the removal of heavy metals from drinking water in rural areas of Peru. The pilot focussed on two products: i) household filters and ii) granular filtration material for collective water supply systems.

Figure 2. BluAct household filter and community-level water systems in Peru.

Results demonstrated the high removal efficiency of heavy metals in drinking water at both household and community levels. Six new community water systems were subsequently established with private sector investment

following these promising results. Overall, this study confirmed the significant potential of the BluAct filters for heavy metal removal in rural water treatment systems. It is affordable, easy to use and maintain, and can be retrofit into existing infrastructure. Mr. Pacheco concluded with the following key lessons learned from the pilot project:

- Improved water quality increased community appreciation and valuation of water services.
- The BluAct technology is adaptable to both household and community systems, with economies of scale favouring collective use (the cost of household filters is 7 – 13 USD/m^3 versus 0.15 – 0.44 USD/ m^3 in collective filters)
- The filtration material can be regenerated (washed) and reused, extending its lifespan with some 5-10% loss of removal efficiency. Proper disposal of removed contaminants is essential.
- Local market availability of the technology is crucial for widespread adoption.
- Capacity building of families, operational staff, and project managers is vital for effective use and scaling.

Experience in the use of BluAct technology in India

Divya Kashyap Sharma (Deputy Head of Cooperation, SDC India) presented SDC India's experience in evaluating the long-term effectiveness of the BluAct technology for removing fluoride and arsenic from drinking water at household and community levels across India. The results were highly encouraging, with fluoride levels dropping from 4 ppm to below 1 ppm and arsenic levels from 70-100 ppb to below 10 ppb. Water samples over eight months confirmed the sustained high removal efficiency of BluAct's filtration systems.

The results sparked the interest of the Uttar Pradesh government, which invited BluAct to implement its technology in the water supply systems of 30 villages. Groundwater contamination affects around 35 million people in India, creating an urgent need for effective solutions. With India's mission to provide safe drinking water through individual household tap connections to all households in rural India, BluAct's technology stands out due to its ability to sustainably remove multiple contaminants without requiring significant energy or producing wastewater.

BluAct technology was found to be simple to install, operate, and maintain, making it an ideal solution for India's diverse needs. Positive results from the initial pilot have also led to plans for deploying the technology in the Himalayas, where mountain springs are often contaminated with heavy metals and biological pollutants. Unlike reverse osmosis, BluAct's energy-efficient absorption method is well-suited for regions with unstable electricity. The success in these regions could convince public sector entities to scale up its use.

Lessons learned

The webinar provided significant insights into heavy metal removal from drinking water using the BluAct technology, based on practical applications in Peru and India. **Rosa Maria Alcayhuaman** and **Helen Gambon** (SDC Peru) summarized the key lessons learned:

- **Global health risk:** Heavy metal contamination in drinking water poses severe health risks worldwide, particularly in South Asia, Africa, and the Americas. Effective monitoring and removal technologies are essential.
- **Efficient technologies:** BluAct technology, which uses cellulose membrane filters, activated carbon and lactose protein fibers, removes over 99% of heavy metals like arsenic, lead, and cadmium. It is adaptable, low-cost, energy-free, and sustainable, utilizing waste materials from cheese production.
- **Field tests in Peru and India** demonstrated that BluAct filters significantly reduce arsenic and fluoride levels in drinking water in field operation conditions. The regenerable granular material extends filter life and reduces costs. The technology is cost-efficient, with treatment costs significantly lower than conventional systems.
- **Community and government engagement:** Improved water quality enhances community appreciation and willingness to pay for water services. Government support is crucial for scaling up these technologies, as is market availability for widespread adoption.
- **Scalability and adaptability:** BluAct technology can be adapted for household and community systems, making it ideal for rural and vulnerable populations. It is easy to install, operate, and maintain, and can be retrofitted into existing infrastructure.
- **Potential for broader application:** Positive outcomes from pilot projects in Peru and India indicate significant potential for mitigating the health impacts of heavy metal exposure. Expanding the use of BluAct technology could provide a sustainable solution for safe drinking water globally.

The RésEAU Focal Point, **Daniel Maselli**, extends its gratitude to all the speakers and participants for contributing to this enriching and informative learning event.

Find out more

- Watch the recordings of the webinar held on June 11th (Spanish mainly) or on June 13th (English mainly) 2024 and access the **presentations** in Spanish and English.
- Read the pilot project capitalization document in English **Heavy metals in drinking water: a proposal for their removal**. Or in Spanish: Metales pesados en agua para consumo humano: una propuesta para su remoción. COSUDE, BluAct Technologies, SABAvida. Lima, Peru.
- Contact **BluAct:** sreenath@bluact.com
- Check out the **SDC network** pages and get engaged:
  RésEAU – https://www.shareweb.ch/site/Water and https://dgroups.org/sdc/reseau
  CDE – https://www.sdc-cde.ch/en and https://www.sdc-cde.ch/en/become-a-network-member