

# Fluoride Removal in Ethiopia

**To date, no appropriate fluoride removal technology has yet been successfully implemented in the Ethiopian Rift Valley. Filtration with bone char is known to be an efficient process in removing fluoride. However, is its use also compatible with religious beliefs in Ethiopia?** Michael Jon Mattle, Kim Müller, Esayas Samuel, Feyisa Lemma, Annette Johnson

Esayas Samuel, Feyisa Lemma, Annette Johnson

According to estimates by the Ethiopian Ministry of Water Resources [1], 14 million Ethiopians are potentially at risk of developing fluorosis; an illness caused by excess fluoride intake predominantly from drinking water. Fluorosis ranges from damaged teeth to crippling skeletal deformities in severe cases.

Though different defluoridation methods have been implemented in Ethiopia, a field visit in 2008 revealed that none of the defluoridation units were operational. Lack of maintenance, high costs and technical breakdowns were the main reasons for failure [2].

Bone char filtration is a relatively cheap and efficient method to remove fluoride from drinking water. However, Tekle-Haimanot et al. (2006) [4] reported that locally produced bone char was unacceptable to Ethiopian communities for religious reasons. According to a personal communication, bone char used in that study had caused taste and odour problems as a result of poor charring.

A collaborative team of researchers and practitioners (box) thus decided to re-evaluate the acceptability of bone char filters, using high-quality bone char produced by the Catholic Diocese of Nakuru (CDN) in Kenya.

## First steps

A total of 121 households from two different communities took part in the pilot project. Several information and awareness raising campaigns and trainings on operation and maintenance preceded implementation of the household filter buckets (Photo 1). Each household contributed 10% to cover the total filter costs.

Monitoring activities included interviews with the beneficiaries to assess user perception and acceptability of the treatment, together with regular sampling to quantify filter performance.

## Success and challenges

One year after introduction of the filters, 90% were still in use – a clear sign of high acceptability. Only one beneficiary refused

to use the filter, the others readily accepted bone char as a filter material, as it was more important for them to see their children grow up in good health rather than strictly adhering to old religious beliefs. Interestingly, the village elders regarded bone char as a type of medicine to prevent the development of fluorosis. The interviews also revealed that the beneficiaries were well aware that bone char was not some kind of sand or other material but a processed animal product.

Fluoride removal efficiency was satisfactory, since fluoride concentrations as high as 23 mg/L could be reduced below the international WHO guideline of 1.5 g/L. However, the filters' lifespan was limited to a few months due to the high water demand and elevated fluoride concentration.

Development of odour in the treated water was one of the initial problems with the household buckets. According to field laboratory experiments, bad odour was mainly attributed to the use of highly turbid and organic-rich lake water combined with irregular filter usage. In refresher courses, the beneficiaries were told to use groundwater whenever possible. They were also instructed on how to best wash the filter material to avoid organic degradation with minimal disturbance of the material layers. Furthermore, a two-bucket filter-design with sand filtration followed by a defluoridation step reduced the problems, especially for households depending on water from shallow wells.



Photo 1: Training session in Weyo Gabriel, Ethiopia.

It can thus be concluded that bone char is a very promising fluoride removal option also for Ethiopian communities. Minimal maintenance, simple operation and efficient fluoride removal are the main advantages of this technology. However, bone char will only be accepted if it does not create bad odour and/or taste to the treated water, irrespective of religious or cultural aspects. This pilot study also revealed the need for a participatory approach, appropriate training and frequent monitoring to contribute to sustainable project development.

## Future strategy

As the positive response of the community supports project upscaling, community-based filters will be tested jointly with the setting up of an Ethiopian production of high quality bone char and filter units. These implementation activities will be closely linked to a new research project of Eawag and Addis Ababa University on optimising fluoride removal treatment (page 25).

Project Manager and Implementor: Oromo Self-Help Organisation, Ethiopia (OSHO) and Swiss Interchurch Aid (HEKS).  
Project Advisor: Catholic Diocese of Nakuru, Kenya (CDN) and Eawag, Switzerland.  
Contact: annette.johnson@eawag.ch

- [1] The Daily Monitor (6th March 2008): Over 14 Million at Risk of Fluorosis – Ministry.
- [2] Merga, M., Mattle, M.J. (2008): Pilot phase of bone char implementation in the Ethiopian Rift Valley. Technical Report, pp. 50.
- [3] Esayas, S., Mattle, M.J., Feyisa, L. (2009): Household Water Treatment: Defluoridation of Drinking Water by Using Bone Char Technology in Ethiopia. Accepted in Proceedings of 34<sup>th</sup> WEDC International Conference, Addis Ababa, Ethiopia.
- [4] Tekle-Haimanot, R., Melaku, Z., Kloos, H., Reimann, C., Fantaye, W., Zerihun, L., Bjorvatn, K. (2006): The geographic distribution of fluoride in surface and groundwater in Ethiopia with an emphasis on the Rift Valley. *Science of the Total Environment*, 367(1): 182–190.