Laterite for water treatment

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SUSTAINABILITY OF WATER AND SANITATION SYSTEMS

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OCCURRENCE OF EXCESSIVE Iron, Manganese in both shallow and deep ground water has created immense social problems. In many cases the water users had completely or partially rejected the source or were compelled to use it with reluctance. Further to this the occurrence of excessive fluoride in water has been a major health nuisance with the presence of two main types of Fluorosis diseases in dry zone areas of the country.

Many different technologies had been tried out in this connection to remove the above excess amounts and bring the water quality to acceptable levels. Studies carried in many years had shown that laterite could be used for effective removing of iron and manganese in water and very recent studies shows that fluoride also could be removed effectively using the laterite.

Laterite is a weathered rock available in some coastal and interior parts of the country. Over few centuries bricks cut from laterite rock has been extensively used for building construction. Water Treatment has been found to be effective when laterite rock was crushed to particle sizes of 8 - 16 mm and is used in up flow arrangement of water with low velocities and increased retention time.

Application of laterite in iron and manganese removal

Removal efficiency of Iron and Manganese with laterite is tested on pilot level over last-five years at village level in two locations, in Kandy.

The laterite media was placed in the hopper chamber (upward flow) of the Finnidia square type Iron removal plant, a low cost treatment plant which is being designed to be fitted to a hand pump well, to cater a population of 15-20 families. The cost of a Laterite pack is 20 US$ (100 Kg.) The monitoring of the performance was carried out in two levels. During the level I of the monitoring process the removal efficiency was tested frequently with the each step of the cleaning operation for a period of 3 months. The level II of the monitoring consisted intermittent testing carried out in predetermined intervals. The level I of the monitoring was carried out only for the first hand pump well with excessive Manganese (well No. 4020- Uda Uludeniya) during the first 4 months after installation of a treatment unit. Based on the successes of the results during the period the same treatment technology was used for treating excessive manganese at well 4088 at Meegastenne. The monitoring programme at level II was carried out for both locations to check the applicability of the technology for effective Iron and Manganese removal in small scale at the village level.

The laterite media was replaced thrice during the 5 years period for the case of well No. 4020. In the case of well No. 4088 the laterite media was replaced only twice during the period. In both cases the water sources are still continued to be used by the beneficiaries.

The level I monitoring carried out for Well No. 4020 shows that the iron removal efficiency of the filter was over 95% during the cycle.

In the case of Manganese the efficiency of removal was not uniform through out the cycle.

The status of Iron and Manganese concentration at different stages of the filter unit is illustrated in Table I. Generally 50% of the removal was found to be reduced during the flow through laterite and rest was removed by the sand layer in the filter. Subsequently the samples were taken randomly and allowed to operate by the beneficiaries without support from the project, with level II monitoring (Table 2).

Similar level of incidence of Iron and Manganese was observed in the case of well No. 4088, and the experiment with the successful application of the same treatment method.

However the study could not be continued since the Manganese concentrations of the Particular well reduced to the acceptable level with the ageing of the well.

Fluoride removal

While techniques for the defluoridation of fluoride-rich water are indeed available, the application of such techniques in remote parts of the developing countries where dental fluorosis is most common has inherent problems. The defluoridator developed is a simple and inexpensive method of a household filter.

A filter media used for fluoride removal is low temperature burnt clay known as bricks. The burnt clay has silicates, aluminates and hematites. When this is soaked in water for several hours those oxides get converted to oxyhydroxides of iron, aluminium and silica. The Si-O, Al-O bounds are much stronger than Fe-O bonds. The geochemistry of the fluoride ion (ionic radius 1.40 A) and the hydroxyl ion (ionic radius 1.36 A) are similar and the these could be easily exchangeable between them. Laterite also has been used as an alternative filter media, for Fluoride removal. The laterite has properties as mentioned earlier with iron oxyhydroxide in the material in addition to silicon and aluminium oxyhydroxides .

Conclusion

Laterite is a low cost natural filter medium for Iron, Manganese & fluoride removal, at small scale water treatment. However it is worthwhile investigating the application of this technology at medium scale.

References

Attanayake MASL and Padmasiri J.P (1994). An appro priate iron removal technology. 20th WEDC conference, Loughborough University of Technology, U.K. P 269-271.

Padmasiri J.P. and Attanayake MASL (1991). Reduction of iron in ground water using a low cost filter unit. Journal of the Geological Society of Sri Lanka Vol. 3, page 68-77.

Padmasiri J.P. and Fonseka WSCA (1994). Low cost fluoride removal, Discussion paper 20'h WEDC conference, Loughborough University of Technology, U.K. P 295-296.

Padmasiri J.P and Dissanayake C.B. (1995). A simple defluoridator for removing excess fluorides rom fluoride-rich drinking water. International Jourllal of Environmental Health Research 5, Jourllal Oxford Ltd., U.K.

Table 1. Fate of Fe and Mn at different stages in the filter

Table 2. Iron and manganese removal using laterite