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## Extended Abstracts

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**General hydrogeological problems**

**6.4**  
**Cost-effective measures to control and contain groundwater contamination**

title: **Cost-effective remediation of high fluoride rich groundwater in parts of India**

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Fluoride problems are wide spread in India especially in nine States covering almost the entire country. In order to assess the water quality and the related health problems due to high fluoride content, water samples from nine States across India have been collected and analyzed. Analyses from surface, subsurface and thermal water samples had fluoride concentration that range from < 0.2 to 13.2 ppm. The probable source of high fluoride relates to the water-rock interaction within the sedimentary basins. During rock weathering and subsequent circulation of pore water through the soil and rock matrix, fluorine is leached out, mainly from the mineral fluorite ( $\text{CaF}_2$ ) and calcium difluoride, and dissolved in the ground water. Human health affects of high fluoride content in water are manifested in the form of 'endemic fluorosis' causing tooth mottling and inducing the prevalence of osteoporosis and collapsed vertebrae. Fluorosis has no known treatment other than early detection and limiting the amount of fluoride ingested. The concentration of fluoride below 1.5 ppm according to World Health Organization (WHO) is helpful in the prevention of tooth decay, and such level of fluoride also assists in the development of perfect bone structure in human and animals but long term ingestion of drinking water having fluoride concentration above 1.5 ppm leads to dental and skeletal fluorosis as well as non skeletal manifestations. High fluoride consumption leads to the fluorosis of the bones which is generally found in Asian region but it is particularly acute in India. Reducing the high fluorine content of groundwater is done by dilution or by defluorination process. Dilution with the surface water is one very simple technique but not very practical in water scarce India. In-situ treatment is now receiving more attention. Alkaline soils can be remedied through the application of gypsum, pyrite and sulfuric acid. Gypsum treatment is the classical method of alleviating the soil alkalinity but makes the water harder. However, this may be an advantage of getting a higher intake of  $\text{Ca}^{2+}$  which can mitigate the effect of  $\text{F}^-$ . Encouraging results have been obtained for lowering fluoride content in water using turmeric and planting the popular trees (*populus deltoids*) trees in affected to alleviate sodicity in soils. But the addition of  $\text{Ca}^{2+}$  ions to the fluoride rich groundwater causes an appreciable decrease in fluoride concentration which appears to be the potential cost effective solution to high fluoride problem in an otherwise water scarce India.



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