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Determination of Geosmin and 2-Methylisoborneol Removal at Water Treatment Processes

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Abstract

Geosmin and 2-methylisorboneol (2-MIB) are major organic pollutants responsible for undesirable taste and odour in drinking water. Geosmin produces earthy (muddy) taste and 2-MIB produces musty (mouldy) taste. These compounds impact greatly on the aesthetic quality and general consumer acceptability of drinking water. Hence identification, quantification and removal of these compounds from water is essential. There are no direct guidelines been established for drinking water taste and odour causing compounds. But according to SLSI standards and other international standards (WHO and USA EPA), taste and odour causing compounds in the drinking water should be below the human sensory threshold level (5 ng/L). Hence, water treatment technologies that can remove Geosmin and 2-MIB from water below human detection threshold (<5 ngl^{-1}) are highly sought by drinking water suppliers worldwide. Geosmin and 2-MIB contamination levels in 16 treated final water samples from National Water Supply and Drainage Board water treatment plants covering 5 districts (Anuradhapura, Pollonnaruwa, Ampara, Batticcaloe and Trincomalee) in Sri Lanka at dry season were analyzed using solid phase micro-extraction (SPME) and gas chromatography-mass spectrometry (GC-MS). The level of Geosmin in treated water was ranged between 8.4 to 38.9 ng/L whereas 2-MIB level ranged from 4.5 to 98.5 ng/L. Neither Geosmin nor 2-MIB were recorded at Wavantiv and Kondawatuwana WTP treated water at detectable levels (Geosmin minimum detectable level-1.5 ng/L, 2-MIB-1.3 ng/L). Various conventional and modern treatment processes such as granular activated carbon beds, usage of powder activated carbon, membrane filtration system, Dissolved Air Flotation (DAF) system, coagulation, flocculation, sedimentation, filtration (Sand filter system) and disinfection facilities are being operated in the Wavnativ and Konadawatuwana WTP where both Geosmin and 2-MIB were not detected. It was found that the treatment processes include granular and powder activated carbon. However, All the other treated water collected from Jayanthi tank, Minneriya tank and Parakkrama Samudra reservoir showed taste and odour issue with having greater concentration of Geosmin (18.6 ng/L, 38.9 ng/L, 10.3 ng/L) and 2-MIB (22.7 ng/L, 10.3 ng/L, 34.1 ng/L) in treated water and the concentrations were greater that the raw water. The reason for elevating the levels of Geosmin and 2 MIB in raw water might be due to stress effect on algae and cyanobacteria during the treatment processing steps such as pre-chlorination, flocculation, coagulation, which may enhance algae and cyanobacteria cell lysis. It was noticed that the Jayanthi tank, Minneriya tank and Parakkrama Samudra follow conventional water treatment processes with some modifications and activated carbon is not used for the treatment. A questionnaire analysis found that most of the consumers rejected those treated water with geosmin and 2-MIB due to the bad taste and odour for drinking purposes. As a summary, 84% and 63% collected treated water exceeded human sensory threshold level of Geosmin and 2-MIB compounds. The study showed that activated carbon either granular or powder form, regular usage at the treatment processes was highly effective in removing Geosmin and 2-MIB. Compared to activated carbon, it was also found that both sand filtration and membrane filtration fail in removing these two odorants.

Keywords: Geosmin, 2-MIB, Water treatment, Raw water, Activated carbon, SPME, GC-MS