

The quality of groundwater in central Tokyo and its potential for beneficial use

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Recently, the situation surrounding groundwater in urban area has been changing. For example, in central Tokyo, groundwater abstraction has been banned since the 1970s. As a result, the groundwater table has been rising, which is posing various negative impacts upon underground infrastructures including railway stations and subway stations. Accordingly, an idea has been arising to mitigate such problems by controlled abstraction of groundwater, which would provide a new water resource for various uses in urban areas. On the other hand, a growing number of large water consumers such as hospitals and department stores have recently started to switch the water supplier from public water supply systems to private water supply systems using groundwater, in order to save the cost of water and to prepare for emergency. Besides, rainwater infiltration facilities, such as permeable pavements and rainwater infiltration trenches, have been gradually installed, which resulted in the increased recharge of unconfined groundwater.

Because of the considerable change in groundwater environment as mentioned above, an up-to-date management of urban groundwater is needed with the aim of securing safety of urban infrastructures as well as assuring environmental soundness. In order to support such a policy change, not only data on groundwater quantity but also data on quality are needed.

Groundwater in urban area can be contaminated but still used for portable water. Therefore, the current status of groundwater quality should be evaluated not only based on the current environmental standards, but also based on the possible uses at present and in the future.

For this purpose, groundwater samples were collected in central Tokyo at public boreholes such as emergency wells, and private boreholes such as boreholes for public bath between October 2005 and December 2007. In total 174 groundwater samples were collected from 121 boreholes. pH, dissolved oxygen, electric conductivity, ammonia nitrogen, dissolved organic carbon, major anions, major cations, turbidity, E. coli and total coliforms were measured. Borehole information such as depth was obtained from hearing from local caretakers.

Nitrogen concentration, which is the summation of ammonia nitrogen and nitrate nitrogen, exceeded the national nitrogen standard of 10mgN/L at 10% (6/51) of unconfined groundwater and 8% (5/60) of confined groundwater. As for unconfined aquifer, geological conditions determined the predominant nitrogen species found in groundwaters. In confined groundwater, ammonia nitrogen was mainly detected and nitrate nitrogen was hardly detected.

The obtained water quality data were evaluated in comparison with several existing water quality standards to estimate the availability and potential use of groundwater in central Tokyo.

Without purification, approximately 80% of boreholes satisfied the standards for flushing toilet and watering roads, which include pH, E coli (total coliforms), and COD. Approximately 30% of boreholes were applicable to water parks and water sceneries without purification.

Only a small number of sampled groundwaters met the standards for other uses. For portable use, only 15% of sampled groundwaters satisfied current drinking water standards. However, it was considered that by chlorination, boiling, or removal of iron and manganese by filtration, as many as 55% of sampled groundwaters will be applicable for portable use.

In conclusion, it was suggested that groundwater quality monitoring should be carried out to fulfill the requirements of possible application of groundwater in urban area. It was revealed that groundwater quality in Tokyo is contaminated by various contaminants. The countermeasures toward protection of groundwater quality should be implemented based on more accurate data on groundwater quality and contaminant sources.