

Accumulation Mechanism and Effects of Naturally Occurring Radioactive Materials in the Filters of Bottled Mineral-Water Facilities

Woosik Shin¹, Jina Jeong², Jeong-Hee Han¹, Byung-Uck Chang³, and Sungwook Choung^{1,*}

¹Research Center for Geochronology and Isotope Analysis, Korea Basic Science Institute (KBSI), Cheongju 28119, Republic of Korea

²Department of Geology, Kyungpook National University, Daegu 41566, Republic of Korea

³Korea Institute of Nuclear Safety (KINS), Daejeon 34142, Republic of Korea

*Corresponding Author: E-mail: schoung@kbsi.re.kr; Phone: +82-43-240-5340; Fax: +82-43-240-5319

Number of pages: 5

Number of Figures: 2

Summary Information for individual bottled mineral-water facilities. Most of facilities are placed in granitic gneiss region of the Precambrian period, while facility B are located in the biotite gneiss region of the identical geology period. Each facility

has several wells to discharge groundwater, their well depths range from approximately 130 to 250m below the surface. The Facility A produces 810 tons of the bottled mineral water per day. The Facility B, C and D produce 304, 308, and 550 tons of the bottled water per day, respectively. In case of facility E, the mineral-water production capacity is approximately 1,300 tons a day that is the highest among the investigated facilities.

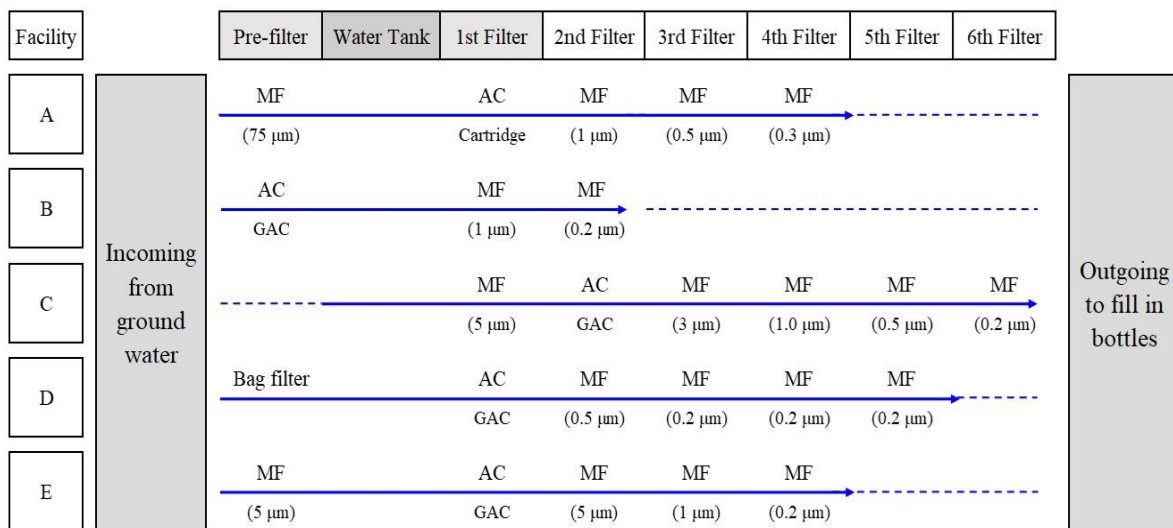
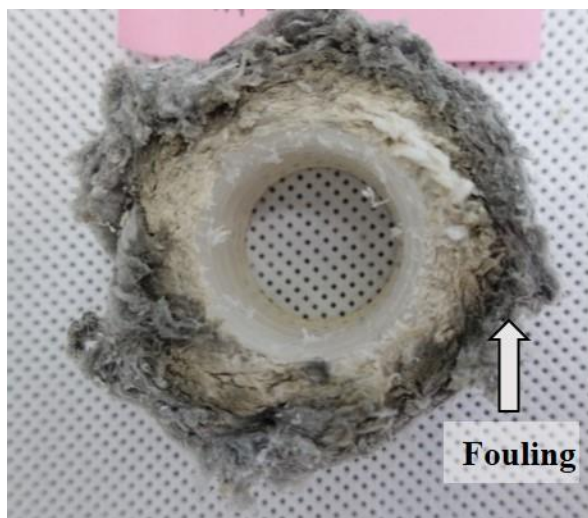
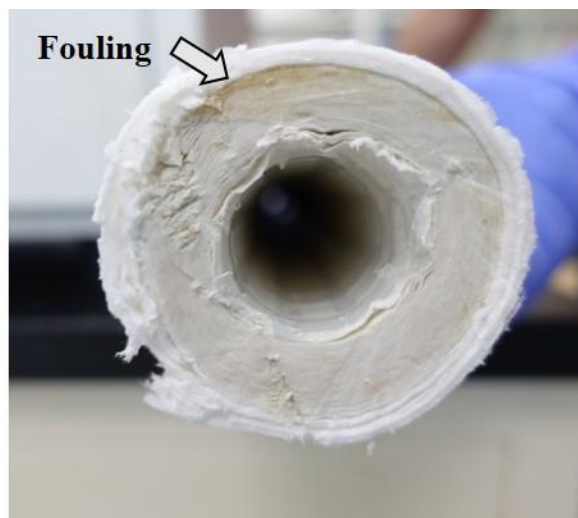


Figure S1. Mineral-water purifying processes at the individual bottled mineral water facilities. The dashed lines indicate that there is no filtration equipment in the relevant facilities. An activated carbon filter in facility B was used as a pre-filter to filtrate coarse materials in the water.



<1st Filter (5 μm MF)>



<3rd Filter (3 μm MF)>



<4th Filter (1 μm MF)>

Figure S2. Cross section of membrane filters along treatment processes at the C facility.

Table S1. Calculated effective dose at the bottled mineral-water facilities under estimated scenario (1 m distance) and extreme scenario (0.2 m distance)

	Calculated effective dose at 1 m distance (mSv yr ⁻¹)								Calculated dose at 0.2 m distance (mSv yr ⁻¹)						
	Bkgd.	Pre-filter	1st Filter	2nd Filter	3rd Filter	4th Filter	5th Filter	6th Filter	Pre-filter	1st Filter	2nd Filter	3rd Filter	4th Filter	5th Filter	6th Filter
A	0.001	n.a.*	0.020	0.001	0.001	0.005	-	-	n.a.*	0.500	0.025	0.025	0.125	-	-
B	0.002	0.008	0.019	0.003	-	-	-	-	0.200	0.475	0.075	-	-	-	-
C	0.001	-	0.047	0.008	0.002	0.005	0.003	0.002	-	1.175	0.200	0.050	0.125	0.075	0.050
D	0.003	0.012	0.034	0.003	0.002	0.002	0.002	-	0.300	0.850	0.075	0.050	0.050	0.050	-
E	0.002	0.015	0.053	0.002	0.004	0.002	-	-	0.375	1.325	0.050	0.100	0.050	-	-

*n.a. : not analyzed

Table S2. Calculated effective dose at the waste disposal site under estimated scenario (1 m distance) and extreme scenario (0.2 m distance)

	Calculated dose rates at 1 m distance ($\mu\text{Sv yr}^{-1}$)							Calculated dose rates at 0.2 m distance ($\mu\text{Sv yr}^{-1}$)						
	Pre-filter	1st Filter	2nd Filter	3rd Filter	4th Filter	5th Filter	6th Filter	Pre-filter	1st Filter	2nd Filter	3rd Filter	4th Filter	5th Filter	6th Filter
A	n.a.*	1.526	n.a.*	0.000	0.002	-	-	n.a.*	38.139	n.a.*	0.000	0.061	-	-
B	0.048	n.a.	n.a.*	-	-	-	-	1.188	n.a.*	n.a.*	-	-	-	-
C	-	0.127	0.569	0.001	0.001	n.a.*	n.a.*	-	3.166	14.217	0.019	0.031	n.a.*	n.a.*
D	n.a.*	n.a.*	0.009	0.006	0.000	n.a.*	-	n.a.*	n.a.*	0.22	0.138	0.000	n.a.*	-

*n.a. : not analyzed