Decontamination of the contaminated water by the Fukushima nuclear accident.

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Abstract

A lot of radioisotope was emitted by the accident of the first nuclear power plant in Fukushima in an East Japan great earthquake, and high-concentration contaminated water flowed into the sea. It aims at decontaminating the water polluted with radioisotope. Furthermore, it aims at securing safe drinking water and life city water, and preventing contamination.

The swim pool contaminated water of the junior high school and park of Koriyama-city, Fukushima was extracted. Four kinds of water purification systems of the OSMO Company were used as a decontamination system. One is an activated carbon filter and removal of radioactive iodine has an effect. Others are an ion-exchange membrane and a filton stone, and the ion-exchange membrane used two kinds, the object for pure water, and the object for soft water. It compared with what measured the activity concentration of raw water 500 ml by Becquerel-Monitor. The water which the sediment is also contained in the extracted water and is processed is 50. It is a liter. The sediment was also contained in the water which processed 50 litters.

As a result, the raw water of the junior high school was 287.7 Bq/l. It decreased 13.3% using the activated carbon filter. In each the object for the pure water of an ion-exchange membrane, and for soft water, they were 72.2% and 79.1% reduction. However, it increased 3.8% with the filton stone. The raw water of a park is 71.7 Bq/l and this is low concentration. It decreased 41.1% using the activated carbon filter. The object for pure water and the object for soft water of the ion-exchange membrane decreased 100%. The filton stones decreased in number 45.6%. It suggested that it could decontaminate efficiently by an ion-exchange membrane. There was a decontamination system chosen by activity concentration.

Key Words: Decontamination, Fukushima nuclear power plant, water-purifying filter, Dosimetry

Purpose

It aims at purifying the water polluted with the radioisotope emitted in the accident of the first nuclear power plant of Fukushima. And it aims at securing safe drinking water and life city water, and preventing contamination.

Method

Water was extracted from the 25m swim pool of the first junior high school of Koriyama in Koriyama city, Fukushima Prefecture. The depth of a swim pool is 1.3 m at the maximum. The swim pool for comparison is a 50m swim pool of the Kaisei mountain park, and the depth is a maximum of 1.6 m. The activated carbon filter (stem 2 type) by Chisso Filter Co., Ltd., the ion-exchange resin (Amberlite MB-2) by ORGANO CORPORATION, RO (Reverse Osmosis) reverse osmosis membrane (ESPA-1812, ESPA-4021) made from Hydranautics Corporate was used as a water-purifying filter which verifies water disposal technology. The activated carbon filter was shown in Fig.1. It has three-layer structure and the polyolefin system composite fiber (ES fiber) is used as primary filtration. The second layer is adsorption layers and is manufacturing the coconut husks activated carbon of materials by Activation by Steam.

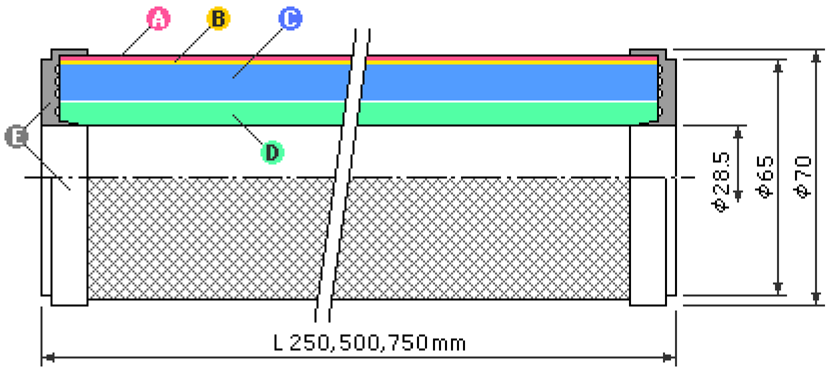

Fig.1 The activated carbon filter (http://www.jnc-corp.co.jp/filter/product/stem/index.html#shiyo)

(A) Outer layer protection net (B) Primary filter

(C) Adsorption layer (activated carbon particle size) (D) Secondary filter (E) Gasket

The third layer is secondary filtration and collects detailed particles with CP filter. The ion-exchange resin for tap water was shown in Photo.1. Basic structure is a styrene system and is the reproduced type mono-bed resin which set the rate of positive ion exchange resin and anion exchange resin to 2 to 1. Density is 705 g/liter.

Photo.1 The ion-exchange resin (ORGANO CORPORATION)

RO reverse osmosis membrane used the home small RO film and industrial RO film, as shown in Fig.2, 3. Configuration is Spiral Wound and Membrane Polymer is Composite Polyamide. Maximum Feed Flow is 11litter per minute. In order to compare with what measured the activity concentration of raw water 500 ml by Becquerel-Monitor, measurement also with same water that let each filter pass was performed. The sediment is also contained in the extracted water and quantity of treated water was set to 50 liter.

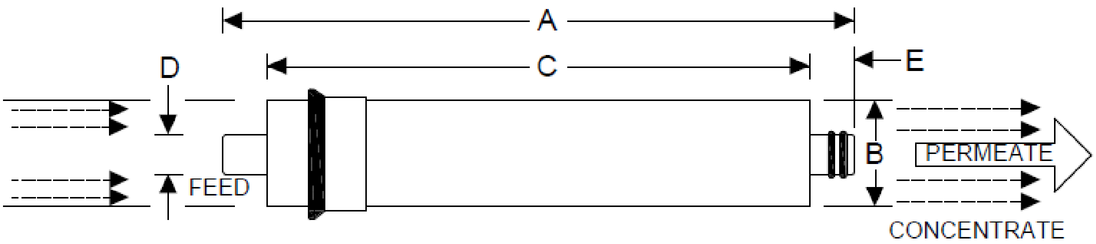

Fig.2 The home small RO reverse osmosis membrane（http://www.membranes.com/index.php）

A, inches (mm) 11.74 (298)　　B, inches (mm) * 1.78 (45.2)

C, inches (mm) 10.0 (254)　　D, inches (mm) 0.68 (17.3)

Dry Weight, lbs. (kg) 0.5 (0.23)

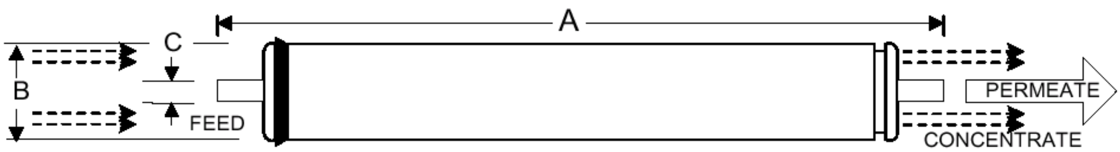

Fig.3 The industrial RO reverse osmosis membrane（http://www.membranes.com/index.php）

A, inches (mm) 21.0 (533.4)　　B, inches (mm) 3.95 (100.3)　　C, inches (mm) 0.75 (19.1)

Weight, Ibs. (Kg) 4 (1.8)

Results and Discussion

The ratio in comparison with the radioactivity per water 1 liter and raw water which were purified by the all directions method is described in Table 1. Table 1 shows the purification result of the swim pool of the first junior high school of Koriyama, and Table 2 shows the purification result of the Kaisei mountain park swim pool.

The raw water of the first junior high school of Koriyama is 287.7 Bq/liter, and the activity concentration using an activated carbon filter decreased 13.3%.

Table1 The purification result of the swim pool of the first junior high school of Koriyama

	Raw water	The activated carbon filter	The industrial RO reverse osmosis membrane	The home small RO reverse osmosis membrane	The filton stones
Activity concentration	287.7 Bq/l	249.3 Bq/l	80.0 Bq/l	60.0 Bq/l	298.7 Bq/l
Ratio	100%	86.7%	27.8%	20.9%	103.8%

Table2 The purification result of the Kaisei mountain park swim pool

	Raw water	The activated carbon filter	The industrial RO reverse osmosis membrane	The home small RO reverse osmosis membrane	The filton stones
Activity concentration	71.7 Bq/l	42.3 Bq/l	0.0 Bq/l	0.0 Bq/l	39.0 Bq/l
Ratio	100%	41.0%	0%	0%	54.4%

The activity concentration using an ion-exchange membrane was 79.1% reduction in the object for soft water 72.2% at the object for pure. However, with the Phil Tong stone, it became 3.8% of increase. The raw water of the Kaisei mountain park is 71.7 Bq/l and low concentration, and the activity concentration using an activated carbon filter decreased 41.1%.
As for the activity concentration using an ion-exchange membrane, the object for pure and the object for soft water decreased 100%. The Phil Tong stone was 45.6% of reduction.
The removal effect of radioisotope had the high ion-exchange membrane, and it became clear that it is dependent on activity concentration. Although it was shown that contaminated water can be purified by this, for a certain reason, the jam of a filter etc. also needed to take into consideration the sediment with various contaminated water, such as a pool and a pond.

Conclusion

Although it aimed at purifying radioactive contamination water using a purification filter, it suggested that it could purify efficiently by an ion-exchange membrane. It became clear that there is a purification system chosen by activity concentration.