

Tab. 3 Difference of running cost between 100% and 10% ozone-treatment systems<sup>a</sup>

	100% ozone-treatment system	10% ozone-treatment system
Cost of water	Substitution of water: 4 times a year 20 t x 4 times x 130 yen/t = 10,400 yen Cleaning of bath: once a week 2 t x 52 times x 130 yen/t = 13,520 yen <b>23,920 yen</b>	Substitution of water: everyday 20 t x 365 times x 130 yen/t = <b>949,000 yen</b>
Fuel expense	Non-substitution of water (from 36 to 42 degree C) (20,000 x 6 x 62.5 x 361) / 10,300 = 262,864 yen Substitution of water (from 15 to 42 degree C) (20,000 x 27 x 62.5 x 4) / 10,300 = 13,107 yen Cleaning of filter (from 15 to 42 degree C, once a week) (20,000 x 27 x 62.5 x 52) / 10,300 = 17,039 yen <b>293,010 yen</b>	Warming water from 15 to 42 degree C, everyday calorific value per 1 dm <sup>3</sup> of kerosene: 10,300 cal kerosene: 62.5 yen dm <sup>-3</sup> (20,000 x 27 x 62.5 x 365) / 10,300 = <b>1,195,995 yen</b>
Personnel expenses for cleaning	2 persons, 4 days, 2 h, 800 yen/h 2 persons x 4 days x 2 h x 800 yen/h = <b>12,800 yen</b>	2 persons, 365 days, 2 h, 800 yen/h 2 persons x 365 days x 2 h x 800 yen/h = <b>1,168,000 yen</b>
Total cost	<b>329,730 yen</b>	<b>3,312,995 yen</b>

<sup>a</sup>Calculated for 20 t of bath water per year.

ozone-treatment has been reported to be effective for the disinfecting [1], decomposition of organic compounds [2], decolorization [3], and deodorization [1]. The results of the analysis of water after the 100% ozone-treatment system are shown in Tab. 2. As expected, all the data were within permitted limits. Thus, 100% ozone-treatment system was very effective not only for the disinfecting of water but also for the decomposition and removal of organic and inorganic compounds.

The ozonized water is good to drink by passing through a filter as shown in Fig. 1. Thus, 100% ozone-treatment system is also good for countermeasures against calamities.

### 2.3 Running cost of 100% ozone-treatment system

The difference in running cost between 100% and 10% ozone treatment systems are summarized in Tab. 3. Since water is hardly substituted in the 100% ozone-treatment system, the cost of water is about one-fortieth compared with the 10% ozone-treatment system. Fuel expense in the 100% ozone-treatment system is about one-fourth compared with the 10% ozone-treatment system. The personnel expenses for cleaning the bath in the 100% ozone-treatment system is also extremely low, being one-ninetieth compared with the 10% ozone-

treatment system. Therefore, the total running cost in the 100% ozone-treatment system was calculated to be about one-tenth compared with that in the 10% ozone-treatment system.

CERAZONE can purify 10 t of water per hour. The consumed energy and total amount of evacuated carbon dioxide through the whole life cycle are calculated to be 950,000 MJ and 38 t, respectively. Consumed electricity was calculated to be 80 MWh. The total amount of substituted water is 1,050 t, being 9 t per month. CERAZONE has been selected as one of the best ecodesign model [4].

### 3. Conclusion

100% ozone-treatment system was very effective to purify bath and swimming pool water. This system was also very excellent ecodesign model. Water charges and fuel expenses were calculated to be one-thirtieth and one-fourth, respectively, compared with those of a usual 10% ozone-treatment system.

### References

- [1] T. Ishibashi, *Recent Development in Ozone Technology*, Sanshyu Co., Ltd., Tokyo, 1986. (in Japanese) and literatures cited therein.
- [2] P. S. Bailey, "Ozonation in Organic Chemistry Volumes. 1 and 2", Academic Press, New York, 1978 and 1982.