



Figure 1. Flowchart of 100% ozone treatment system

Table I shows the differences between the 100 and 10 % systems. In the case of the 100 % system, ozone is a main reactant to purify water. In a medium size (20 m^3) bath, ozonized water is circulated in *ca.* 30 min in the 100 % system, indicating whole water is ozonized every 30 min. Therefore, the addition of chemicals such as sodium hypochlorite into water is not necessary. In the 10 % system, chlorine is usually added to maintain the quality of ozonized water. The ozone concentration in the 100 % system is higher (0.3 - 0.4 ppm) than the 10 % system (0.15 ppm). However, no smell of ozone is detected in the bath water. Crushed ceramics are used as filtering materials at filtering apparatus 2 in the 100 % system. Therefore, the suspensions larger than $10 \mu\text{m}$ could be removed

from water. Since the size of crushed ceramics becomes smaller after 3 years use, addition of a small amount of new ones is necessary. In the 10 % system, sand which can filter the suspensions larger than $30 \mu\text{m}$ is used as a filtering material. Sand is substituted every 3 years. The waste ozone is decomposed by heating at $360 \text{ }^\circ\text{C}$ for 2 sec in the 100 % system. Ozone is completely decomposed into oxygen under the conditions. Furthermore, no consumed products are required in the ozone decomposition apparatus, while, in the 10 % system, waste ozone is decomposed by adsorbing on active carbon. Therefore, the substitution of active carbon is required. From the viewpoint of recently required zero-emission systems, the 100 % system is better than the 10 % system.

Table I. Differences between 100 and 10% ozone-treatment systems

	100% system	10% system
Main Reactant	ozone	ozone, chlorine, UV
Ozonation time (sec)	<i>ca.</i> 120	20-120
Ozone concentration (ppm)	0.3-0.4	0.15
Filtering material	crushed ceramics	sand
Decomposition method for waste ozone	heating	adsorbing

Quality of Ozonized Water

It is very important to check the quality of ozonized water. The results are shown in Table II. Since ozone is a powerful oxidizing reagent, ozone-treatment is very effective to disinfect water (1) and decompose organic compounds such

as amines (2), thiols (2), phenol (3), and dyes (4). As expected, all data of bath water treated with 100 % system were within permitted limits. Thus, the 100 % system was very effective not only for disinfecting of water but also for removal of organic and inorganic materials.