INDUSTRIAL WASTEWATER SYSTEMS

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Summary

Industrial water consumption is presumed to account for 20% of all water consumption in the world. Wastewater from industry contains many kinds of components, and advanced treatment is necessary to protect environment disruption.

When the treated wastewater is used as regenerated water in industrial factories, some portions need to be as pure as river water. To use limited water resources effectively, recycled water has to be used in industry, and the development of new water treatment technology is necessary.

1. Introduction

Total worldwide water consumption is 3,570 billion m^3/year, of which 20%, 715 billion m^3/year goes to industrial consumption[1)]. Of this 46% is consumed in Europe and 40% is consumed in the north America.

Japanese manufacturing industries draw approximately 13.7 billion m^3 of fresh water from water supplies every year, accounting for 15 percent of the overall water consumption in the country (88.7 billion m^3/year).

This level would be substantially higher if not for the water conservation efforts hitherto taken. In spite of a marked increase in industrial output, Japanese industries use little more water than they did in 1965, when industrial water consumption stood at 11.4 billion m^3.

As can be seen from the volumes of industrial water consumed (Table 1), industries use somewhat more recycled water than they do fresh water from sources such as reservoirs and wells. According to the latest statistics, the average consumption of recycled water across all industries is approximately 78 percent.

This marks a significant increase from the recycling ratio in 1965, which stood at just 36 percent. Above mentioned value 15% is smaller than the world average 20%. This demonstrates the positive results of the efforts in Japan toward recycling and minimization of industrial water.

Industry		Fresh Water				Recovery Ratio	Seawater
	Water Supply	Surface Water	Wells	Recycled Water	Total	[%]	
Foodstuffs/Beverages	1,159	537	1,636	1,616	4,965	32.5	1,162
Textiles/Clothing	344	116	1,072	309	1,854	16.7	1
Pulp and Paper	2,257	4,782	1,288	7,015	15,393	45.6	33
Chemical	4,743	2,041	1,550	43,081	51,633	83.4	15,140
Petroleum/Coal	838	2	15	8,126	8,995	90.3	7,354
Iron and Steel	2,981	454	184	34,566	38,226	90.4	15,427
Electrical Machinery	855	31	701	4,111	5,704	72.1	65
Transportation	452	20	327	9,458	10,262	92.2	54

Machinery							
Other	1,493	626	1,904	9,139	13,245	69.0	2,731
All Industries	15,122	8,609	8,677	117,421	150,277	78.1	41,967

Table 1: Industry Usage of Water by Source (Japan, 1999)[2)] (Unit: 1,000m^3/day)

Industry	No. of Factories	Boiler	Raw Materials	Product Treatment/ Washing	Cooling	Air Conditioning	Total
Foodstuffs/ Beverages	8,188	225	309	1,614	2,163	286	4,965
Textiles/Clothing	4,447	80	0	771	193	698	1,854
Pulp and Paper	1,780	315	1	12,199	2,286	137	15,393
Chemical	2,198	628	134	1,850	46,880	1,322	51,633
Petroleum/Coal	108	212	2	51	8,580	28	8,995
Iron and Steel	1,257	101	1	2,999	33,410	430	38,226
Electrical Machinery	7,704	50	0	917	2,162	2,194	5,704
Transportation Machinery	3,165	43	0	3,489	4,362	1,785	10,262
Other	23,622	206	95	1,425	8,942	1,759	13,245
All Industries	52,469	1,860	542	25,315	108,978	8,639	150,277

Table 2: Industry Usage of Water by Use (Japan, 1999) [2)] (Unit: 1,000m^3/day)

Table 2 gives a breakdown of the volumes of industrial water used by different industries. While there are no real differences among industries in the total volumes of water used for boilers and cooling, there are great differences in the volumes used for the treatment and washing of products, where water comes into direct contact with products and is used to remove contaminants. This chapter will examine characteristics of the various kinds of wastewater used.

2. Water Treatment Techniques

Figure 1 shows the various techniques used to treat water. These processes are used to purify water from rivers, wells, and other sources for use in factories, to remove organic matter and heavy metals from wastewater, and to carry out advanced wastewater treatments for the production of recycled water.

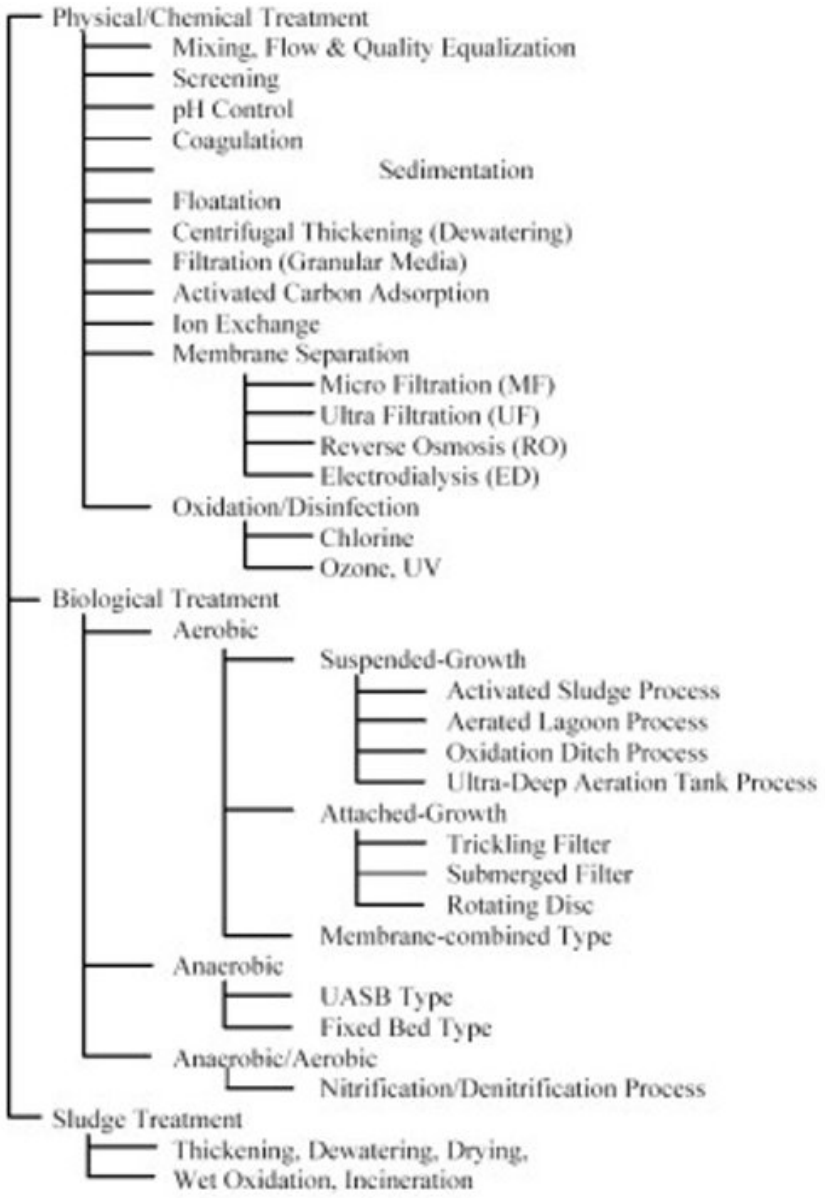

Figure 1: Water Treatment Techniques

3. Water Treatment for Use

When seeking to use ordinary river water or ground water for industrial applications, simple techniques such as sedimentation or sand filtration are normally used. However, there are times when higher quality water is required for certain industries or applications, in which case the water is treated by specific processes at the facilities where it is used.

In the many factories that use water for their boilers, hardening agents such as calcium have to be removed from this water to prevent the formation of scale in the heat exchanger.

In factories that manufacture foodstuffs, the concentrations of inorganic matter in water

used as a raw material have a great impact on product quality. In the interest of hygiene, microorganisms and toxic substances must be removed from this water.

In textile factories, inorganic ions can change the colors of dyes and affect the fastness of colors in textiles after they have been dyed. In these cases as well, the water used for dyeing must be treated beforehand.

With the exception of factories that require ultra-purified water for the production of pharmaceuticals, ICs, and so on, the purity requirements for water are less stringent. As a rule, water quality is acceptable in these facilities if the water has no detrimental effects on plant facilities through corrosion and scaling.

Table 3 shows quality standards for industrial water supplies in Japan. Today, these quality standards are relatively easy to achieve by treating water from rivers and other sources by simple filtration. In the future, as further consideration goes to the environment, it may become necessary to add new items to the list.

Item	(unit)	Standard Value
Turbidity	(-)	20
pH	(-)	6.5~8.0
Alkalinity	(mg/L)	75
Total Hardness	(mg/L)	120
Total Dissolved Solids	(mg/L)	250
Chloride Ions	(mg/L)	80
Iron	(mg/L)	0.3
Manganese	(mg/L)	0.2

Table 3: Standards of Quality for Industrial Water (Japan)

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Biographical Sketches

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