Promotion of Water Treatment Technology Considering Energy Optimization and Risk Control

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1. Introduction

Sewerage greatly contributes to maintenance of good water environment by processing / removing organic matter, nutrient salt, pathogenic microorganisms, etc. in sewage. Meanwhile, sewerage service by local governments generates greenhouse gas much more than other services and reduction of greenhouse gas emissions is therefore urgently required. Recycling of sewage treatment water has been proceeding at domestic and abroad, and it is required to study on the risk assessment of recycled water use since discussion on international standards for the same subject is already going on in ISO/TC282. This Division has been conducting researches and studies from various viewpoints in order to respond to such new social demand expected for sewage service.

2. Examination of energy optimization in air blowing system

Air blowing system accounts for the most amount of power consumption in sewage treatment facilities, and power saving is a major issue for them. However, specific effect of power saving is not clear since power consumption at a reduced air blow rate varies according to models of air blowers, etc. This study examined the relationship between air flow and power input in rated operation and air-flow-controlled operation for typical air blowers according to the types, capabilities, and other conditions of air blowers. Table 1 shows the relationship between air flow and power input. As a trend according to air blower types, the power input of turbo blowers per unit flow was higher when air flow ratio to the rating is low (40%). It is therefore conjectured that the energy saving effect of turbo blowers by air flow control becomes lower in the domain where air flow ratio is low. On the other hand, for roots blowers $50m^3/min$ and axis floating turbo blowers, their power input per unit flow rate is lower than turbo blowers in the domain where unit air flow ratio to the rating is low (40%). It is therefore conjectured that they are suitable for the control of air flow with a large fluctuation range.

We are going to organize the findings so far obtained as technical material so that they may be referenced in renewal, etc. of equipment in sewage treatment facilities.

Table 1: Relationship between air flow and power input in air blowers

Air blower type	No.	Relational expression	Efficiency	Air flow [m³/min]	Air flow ratio to the rated power input (kw/m³) per unit flow 100%	80%	60%	40%
Turbo blower	(1)	y = 0.6541x + 135.43	0.93	300	1.19	1.31	1.51	1.92
	(2)	y = 0.754x + 139.72	0.93	300	1.31	1.44	1.65	2.06
	(3)	y = 0.6632x + 158.27	0.93	300	1.28	1.42	1.66	2.13
	(4)	y = 0.914x + 34.448	0.93	107	1.32	1.40	1.54	1.82
	(5)	y = 0.9078x + 43.376	0.93	107	1.41	1.52	1.70	2.07
Roots blower	(6)	y = 1.1906x + 10.647	0.95	50	1.48	1.53	1.63	1.81
	(7)	y = 1.0665x + 9.4649	0.95	50	1.32	1.37	1.45	1.62
	(8)	y = 1.2257x + 10.779	0.95	20	1.86	2.00	2.24	2.71
Axis floating turbo blower	(9)	y = 0.9244x + 23.299	-	92	1.18	1.24	1.35	1.56
	(10)	y = 1.0032x + 27.123	-	92	1.30	1.37	1.49	1.74
	(11)	y = 0.8834x + 36.505	-	138	1.15	1.21	1.32	1.54
	(12)	y = 0.9648x + 40.798	-	138	1.26	1.33	1.46	1.70

3. Evaluation of hygienic risk control technology for treated / recycled water

Activity for recycling sewage treatment water has been proceeding in many countries. To use recycled water, assessment of safety and reliability according to each application is essential. In this study, hygienic risk values were set according to water use and the removal rates required to achieve those values were calculated.

Table 2 shows the results of calculation according to each application of recycled water concerning the removal rate of norovirus after secondary treatment, which is required to meet the hygienic risk values 10^{-3}, 10^{-4}, and 10^{-5}. For any risk value, the highest removal rate was required in recreational use, in which one-time water intake is large and exposure frequency is high, followed by use for flush toilet water and use for landscaping water. When using for flush toilet water and landscaping water, no recycling of sewage treatment water is required in the risk value 10^{-3}, and the removal rate of approx. 50% (removal rate of 0.3 log) is required in recreational use according to the calculation results.

We intend to continue the study more comprehensively including treatment/disinfection process that satisfies hygienic risk value, cost, and assessment of maintenanceability.

Table 2: Log removal rates of norovirus after secondary treatment required to meet the given hygienic risk values

Applications	Hygienic risk value 10^{-3}	10^{-4}	10^{-5}
Flush toilet water	0.0	0.7	1.7
Landscaping water	0.0	0.5	1.5
Water for recreational use	0.3	1.3	2.3