II-515 Load reduction ratio in two solid-liquid separators

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1. Introduction The process of solid-liquid separator comprises of stormwater sedimentation, concentration of sediments toward the center of separator, and sediments withdrawal. Concentration of sediments, most characteristic and important function in separator, is caused by centrifugal force with the secondary flow in the separator due to the rotating moment transferred from inflow momentum.

In this paper, the reduction ratio, defined as r=QoutCout/QinCin, selected as a factor which indicates the magnitude of concentration force, were calculated with the surveyed data in Tengen, Germany, and in Matsuyama, Japan. The aim of the study is to compare the efficiency of two separators with the reduction ratio.

2. Description of separators and surveys Table 1 shows the general aspect of two separators. In Tengen, five surveys were carried out during summer season in 1990. Elapsed time until the beginning of overflow were 5 to 45 minutes.Considering this time, maximum flow rate, and the profile of flow rate, Rain1, Rain2, and Rain3 were selected for further analysis. In Matsuyama, four surveys were carried out during the period from June, 1989 to October, 1990. Elapsed time until the beginning of overflow were 30 to 40 minutes in Rain2 and Rain4, whereas over 3 hours in Rain1 and Rain3. Considering this point, Rain2 and Rain4 were selected for further analysis.

Table 1 General Aspect of Separator in Tengen and Matsuyama

	Tengen	Matsuyama
Draiage area(ha)	11	609
Separator		
Diameter(m)	2	29.6
Height(m)	3	7.4
Volume(m^3)	4.2	5,200
Average Detention time(min)	6	22
Started in	1987	1988

3. Results and considerations

Excess load accumulation In Tengen, the bottom of the separator is inclined, thus no excess sediments accumulation or residual load is expected. The outflow load increases corresponds to inflow load, but the difference between rains were not large. In Matsuyama, the bottom flow is guided by the ditch excavated as the shape of eddy, but the bottom is not inclined. This fact suggests the possibility of the sediments accumulation.

Fig.1 shows the residual load in the separator in Matsuyama, defined as Σ(Inflow load - Outflow load - Overflow load). In Rain1 and Rain3, even load withdrawal was continuing, the amount of residual load was increasing. In Rain2 and Rain4, after the rapid increase, there occurred the decrease at the beginning of outflow and overflow. After that there resumed the increase.

These facts indicates that concentration force is insufficient to gather all the sediment to the center.

Reduction ratio r Fig.2 shows the relationship between detention time(T) and reduction ratio(r) during the overflow period in Tengen. Here shows good linear correlation between two factors. The reduction ratio is described as follows.

r=T(minutes)*0.03+0.1......(1)

On the contrary, Fig.3, data in Matsuyama, shows not good relation between two factors. The reason ascribed the high value of r in the period of short detention time.

For getting improved correlation, data adjustment was attempted. Fig.4 shows the relationship between inflow rate(Q) and outflow concentration(Cout). In this figure, some data locate far from the regression line. These data , due to the flush of excess accumulated sediments at the beginning of outflow, were adjusted on the regression line, described as follows.

$$Cout(mg/l)=Q(m^3/s)*40+70......(2)$$

After this adjustment of Cout , the high value of r decreased to near the regression line. The reduction ratio is described as follows.

$$r=T(minutes)*0.005+0.1......(3)$$

The slope of equation(3) is smaller than that of equation(1), showing the inferior efficiency of separator. This result also indicates the insufficient concentration force.

4. Conclusions The efficiency of two solid-liquid separators in Tengen and Matsuyama were compared with load reduction ratio, r=QoutCout/QinCin, which was calculated using detention time(T) as $r=\alpha*T+\beta(\alpha,\beta:constant)$. The slope($\alpha$) for Matsuyama is smaller than that of Tengen, showing the inferior efficiency of separator. Data in Matsuyama also showed excess load accumulation. These results indicates the insufficient concentration force.

Reference H. Brombach et al, "Experience with Vortex separators for Combined Sewer Overflow Control", Water Science Technology, Vol.27, No.5-6, pp93-104, 1993

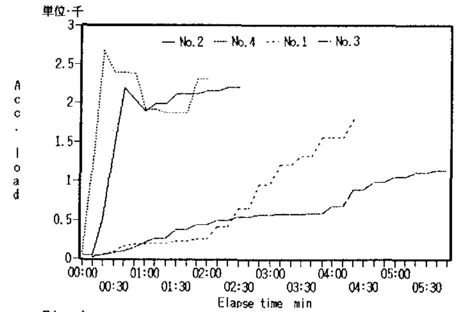

Fig.1 Residual load in Matsuyama

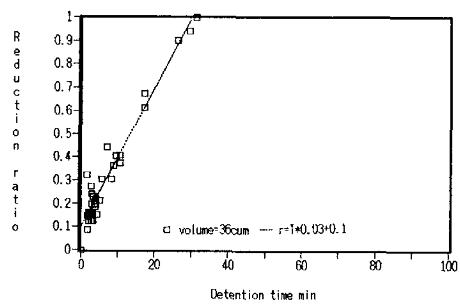

Fig.2 Detention time and removal ratio in Tengen

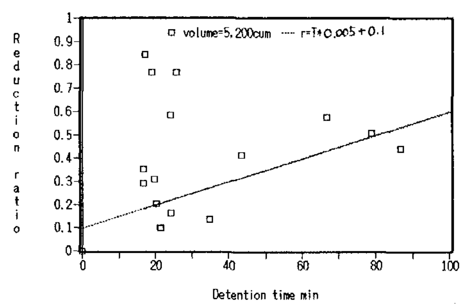

Fig.3 Detention time and removal ratio in Matsuyama

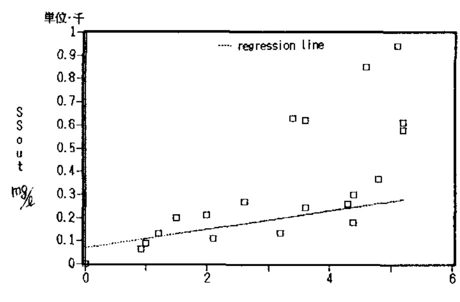

Fig.4 Inflow rate and outflow water quality in Matsuyama