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Variation in Properties of Sewage Sludge

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In recent years, the amount of sewage sludge in Japan has greatly increased every year as the sewerage system and area have increased. The disposal of sewage sludge produced in sewage treatment plants has become a serious problem. For proper operation and management of processes for sewage sludge disposal, both seasonal and long-term variations in the properties of sludge have to be made clear(Hanasaki and Kusaoka 1984). The authors made a time series analysis of the sludge properties seeking to clarify the annual and long-term changes in the properties.

MATERIAL AND METHOD

Outline of Sewage Treatment Plant Examined: For this study, a sewage treatment plant combined sewerage was used in which the activated sludge process (step aeration method). The capacity of its sewage treatment system was 171,000m^3 per day and its sludge treatment system was 14.1 ton per day in terms of its dry solid content. Figure 1 shows the system diagram of the plant.

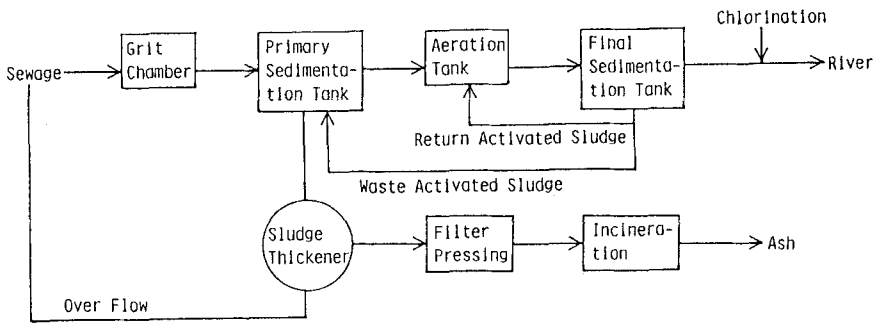

Figure 1. Flow Diagram of Sewage Treatment Plant.

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Present Condition of the Plant Examined: Figure 2 shows the year to year changes in the concentration of suspended solid contained in the waste water of the thickener. The values given in figure 2 represent the

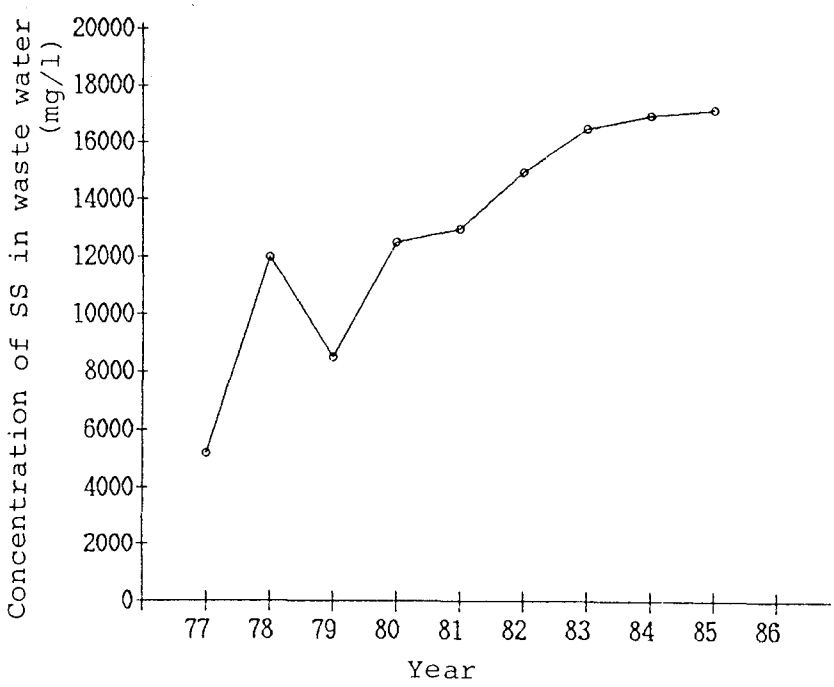

Figure 2. Relationship between Year and Suspended Solid Concentration.

annual average. It can be seen from the graph that the concentration of suspended solids has been gradually increased resulting in an increased load on the sewage treatment system. It is feared that this will have an adverse influence of the sewage treatment process. Figure 3 shows the yearly changes in the concentration of concentrated sludge. The sludge concentration has been decreasing every year and this may have a harmful influence on the dewatering process. The above results indicate a continuously worsening of the concentration of suspended solids in the waste water of thickener and the sludge concentration, i.e., data for material at the end of the concentration process, which will have adverse effects on the sewage and sludge treatment system.

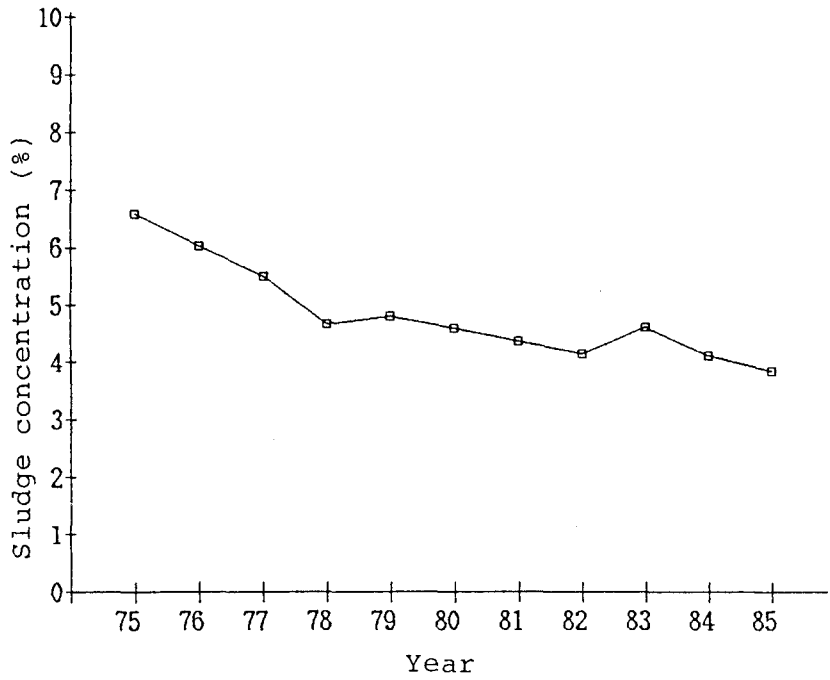

Figure 3. Relationship between Year and Sludge Concentration.

The variable names SCON, VTSN and VOLM for analysis of time series data denote sludge concentration of concentrated sludge(%), organic ratio of concentrated sludge(%) and quantity of effluent(m^3/day). Figure 4 shows the data analysis process and flow diagram of the study.

RESULTS AND DISCUSSION

Annual Variation in Properties of Concentrated Sludge: For a study of the variations in the properties of concentrated sludge, an analysis was made respect to two variables, i.e., sludge concentration and sludge organic ratio of the concentrated sludge. Figure 5(a)-(b) shows the yearly changes in sludge concentration and sludge organic ratio. It can be seen that these two variables indicate their own seasonal changes. The sludge concentration increases in summer and decreases in winter with a maximum-minimum difference of about 3%, while the sludge organic ratio has a tendency to

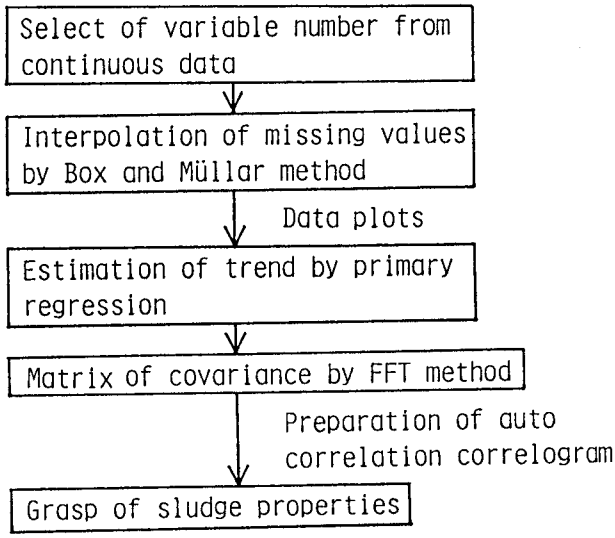

Figure 4. The Data Analysis Process and Flow Diagram of the Study.

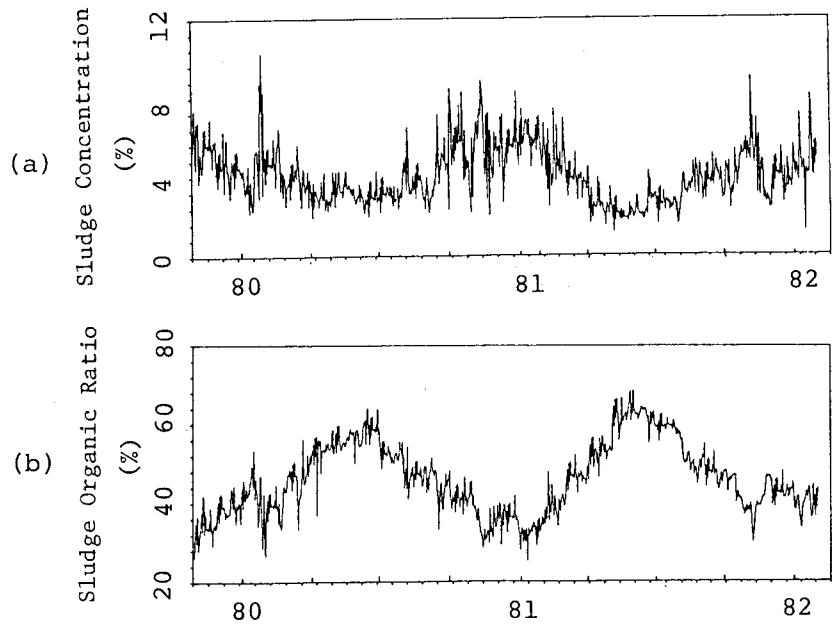

Figure 5 (a)-(b). Yearly Changes for Sludge Concentration and Sludge Organic Ratio.

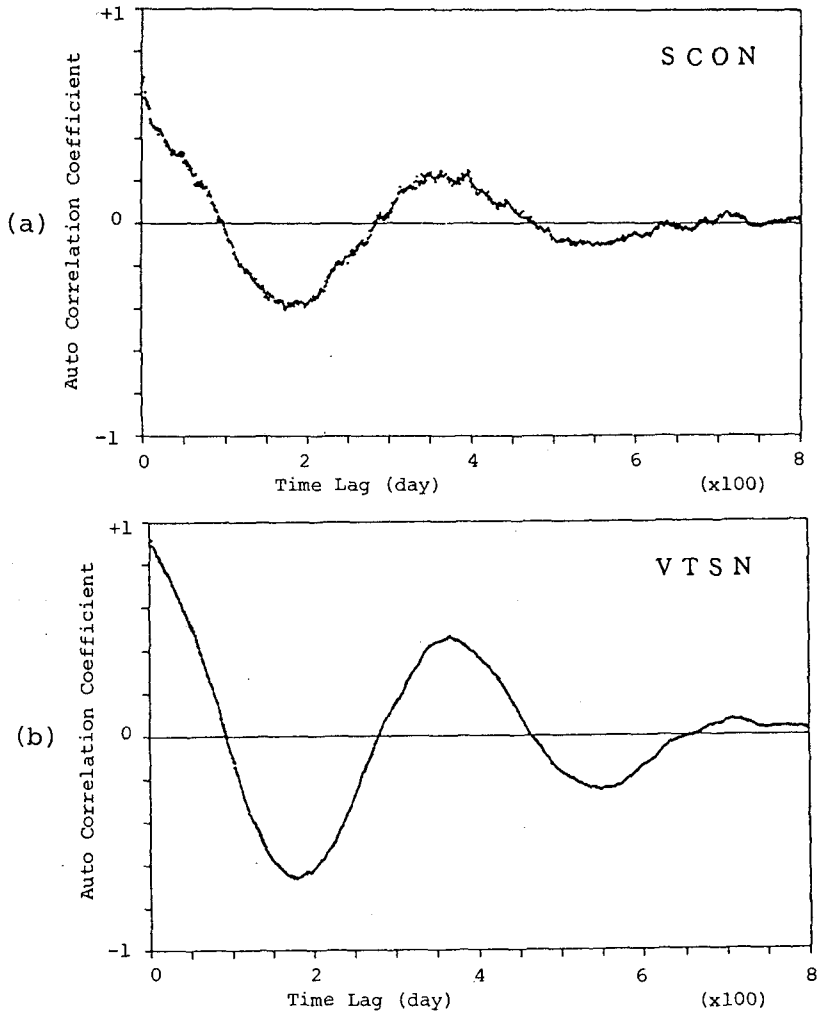

Figure 6 (a)-(b). Correlogram of Two Variables.

that of the sludge concentration with a maximum-minimum difference of about 30%. The periodicity of the variations was investigated on the basis of the correlogram illustrated in figure 6(a)-(b). As a result, it has found that each of the two variables change periodically with a period of 360-380 days. It has also seen that the periodicity of correlogram of these two variables gradually become less prominent. This may result from the fact that the variations become smaller with time.

Long-Term Changes in Properties of Sewage Sludge: To investigate the long-term variations in the properties of sludge, time series data were subjected to a linear regression analysis to estimate the trends. The trend equations for the variables were listed in Table 1. The trend equations of the sludge concentration is expressed as SCON = $-6.57 \times 10^{-4}T + 5.11$ (T:day), indicating an annual decrease of about 0.25%.

Table 1. Trend equation of variables.

Variables Name	Trend Equation
SCON	$Y=-6.57\times10^{-4}T+5.11$
VTSN	$Y= 4.87\times10^{-3}T+43.94$
VOLM	$Y= 1.52\times10\ \ T+129700$

Similarly, the sludge organic ratio increase of about 2.0%. Thus, a worsening tendency over a long period can not be denied. The trend regarding the amount of treated water was calculated by a similar procedure and it was inferred that the amount increased annualy 5500m^3 The increase in the amount of treated water has a close relation with the spread of the sewerage system. An increase in treated water will result in a rise in sludge organic ratio, leading to a decrease in the sludge concentration. And this will finally an effect on properties of sludge concentration capabillity.

REFERENCE

Hanasaki T, Kusaoka T (1984) Analysis of variable factors of adaptive control of gravity thickening process. Workshop on Instrumentation and Control of Water and Wastewater Treatment and Transport Systems 185-188

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