

The Study on Functional Diagnosis of Major Sewage Treatment Equipment

Whole term

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(Purpose)

In Japan, there are 1,924 sewage treatment plants installed by the end of the fiscal year of 2003 and the coverage of sewage treatment amounts to 66.7 %. To maintain such a large number of sewage treatment plants appropriately and renovate them simultaneously, a well-planned approach to reconstruction is required based on assessment of physical and functional degradation of equipment and by considering required function, operation and maintenance, energy saving and contribution to reduction of environmental impact.

The objective of this study is to prepare technical guidelines that include required items to be considered in assessing major sewage treatment equipment and methodology of formation of a reconstruction plan of sewage treatment plant to achieve adequate and effective reconstruction.

(Outline)

In the study, the following three steps are proposed to prepare an effective reconstruction plan based on the results of functional diagnosis:

1. Formulation of Long-Term Plan

The following are described in this study:

- (1) Method and guidelines to decide target service life of equipment considering experience of local governments
- (2) Methodology to formulate a long-term plan based on target service life

2. Formulation of Immediate Plan

Based on the results of functional diagnosis of treatment process and equipment (unit process), methodology of formulating an immediate plan considering the priority of equipment to be rehabilitated is proposed as follows:

(1) Functional Diagnosis of Treatment Process

This diagnosis is a method to understand the degree of degradation of unit process using the present treatment conditions. The following is the method to analyze and evaluate the factors that cause degradation of equipment.

1) Diagnosis based on input parameters:

- ① Identification of irregularity in the trend of input parameters on operation and maintenance costs, consumption of electricity, chemicals etc.
- ② Analysis of factors that generate irregularity

2) Diagnosis based on output parameters:

- ① Comparison of actual outputs and design values of treatment process in operation and maintenance parameters

(2) Functional Diagnosis of Treatment Equipment

This diagnosis is a method to evaluate condition of functional degradation of treatment equipment quantitatively from following viewpoints:

- 1) Physical diagnosis, service life and function diagnosis
- 2) Weighted factors by diagnosis items and contents, type of equipment etc.

3. Formulation of Reconstruction Plan

Study and evaluation methods to formulate an effective reconstruction plan of treatment equipment considering the results of functional diagnosis of major treatment equipment have been proposed including the following contents:

- (1) Evaluation method of economical efficiency and social impacts that are useful for prioritization of rehabilitation
- (2) Equalizing method of reconstruction cost over several years to reduce local government's budgetary burden
- (3) Method of formulation and revision of reconstruction plans (long-term and immediate plans)

(Results of Case Study)

Case studies to verify validity of the proposed methodology have been conducted by selecting three sewage treatment plants. The outline of the results is described as follows:

1. Sewage Treatment Plant (A)

There is no significant difference confirmed in the results of physical diagnosis in case of this sewage treatment plant, because well-planned repairs have been done aiming at preventive maintenance. However, it has been found out that proposed evaluation items in the functional diagnosis table are to be modified depending on conditions of sewage treatment plant. In this case study, the proposed methodology can be adopted by adding following five aspects to define priority of reconstruction. ① Prevention of scattering of sewage and sludge and spread of odor; ② Operation ; ③ Energy efficiency ; ④ Emergency measures ; ⑤ Frequency of failures ; Therefore, high applicability of the proposed methodology has been confirmed.

2. Sewage Treatment Plant (B)

In recent years, electricity consumption of sewage treatment plants is increasing year by year. In this case study, functional degradation of blower and air diffuser, which consumes about 70 % of the total electricity consumption in a sewage treatment plant, has been identified. Putting high priority on the identified equipment in reconstruction plan enable definite equalization of cost over years. In addition, it is realized that long-term equalization of reconstruction cost is brought with short term one in the treatment plant in which the number of equipment is small.

3. Sewage Treatment Plant (C)

The selections of the type of sludge dehydrator is made based on evaluation of CO₂ generation and Life Cycle Cost (LCC) including initial, repair and sludge disposal costs. As a result of the case study, it has been recognized that replacement by dewatering centrifuge machine is more economical. However, if appeal of use of composting of dehydrated sludge cake to citizens is considered in evaluation it has been found out that filter press dehydrator is more advantageous depending on weight of the policy. Therefore, it has been realized that future policies should be considered when weighting factors for evaluation items are decided.

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