

Role of Research in Infrastructure Rehabilitation/Renewal Decision

Processes and Financing Option

社会基盤の改築更新についての意思決定過程および
財源負担方法に関する調査の果たす役割

Yuichi Suga, Japan Sewage Works Agency, Japan

日本下水道事業団 須賀雄一

Role of research in infrastructure rehabilitation/renewal decision processes and financing option

Yuichi SUGA

Research and Technology Development Division
Japan Sewage Works Agency
5141 Shimosasame, Toda, Saitama 335-0037 Japan

ABSTRACT

In Japan, the needs for the rehabilitation/renewal of wastewater treatment plants are increasing. When carrying out the rehabilitation/renewal, not the simple renewal but the functional improvement is called for in many cases.

In order to support municipal corporations which undertake sewage works, Japan Sewage Works Agency has prepared a manual for advancing the rehabilitation/renewal smoothly. Moreover, technology development required for the functional improvement is positively promoted.

KEYWORD

Rehabilitation/renewal manual, advanced treatment and high functional treatment, improved durability of facilities

INTRODUCTION

The percent of sewered population in Japan reached to about 65% in 2002, and 1,700 or more wastewater treatment plants are under operation. Among these, the percentage of aging treatment plants which have been operated for 15 years or more is over 35%. This number is increasing every year and the demand for facilities and the rehabilitation/renewal of apparatus is increasing. Furthermore, with the rise of the concern about environmental problems, water quality regulation is strengthened and the needs for the advanced treatment and multifunctionality are increasing. Consequently, also in the rehabilitation/renewal, renewal accompanied with functional improvement rather than simple renewal.

To cope with this problem, municipal corporations which undertake sewage works are asked for heavy financial burdens, and this causes the aggravation of their financial situation.

Japan Sewage Works Agency is an organization founded in order to support sewage works of municipal corporations which have less personnel with the special knowledge about sewer, and has so far participated in the plan, design, and construction of many sewage treatment

plants. With the rise of needs, the substantial support menu is also planned for the rehabilitation /renewal.

THE CONTENTS OF SUPPORT REQUIRED FOR THE REHABILITATION/RENEWAL

When municipal corporations undertake the rehabilitation/renewal of sewerage system, the contents of support expected to the Japan Sewage Works Agency are as follows.

- Support for the enforcement of the efficient rehabilitation/renewal
- Technical support for the advanced and efficient treatment function

In order to respond to these needs, the tasks which Japan Sewage Works Agency should carry out can be considered as follows.

- Accumulation of know-how and skills about the rehabilitation/renewal
- Preparation of full-scale estimation for design and construction
- Cooperation with municipal corporations for supporting work management and operation
- Technical proposals for the increase in efficiency and advancement of wastewater/sewage treatment, and the improvement in durability of facilities

In order to advance these works smoothly in response to the rise of needs for the rehabilitation/renewal by the municipal corporations, the new manual which systematized the rehabilitation/renewal was created in 2004. Moreover, various new technologies aiming at a treatment functions and the improvement in durability of facilities have been developed.

ACTIVITIES BY JAPAN SEWAGE WORKS AGENCY

Preparation of new manual about rehabilitation/renewal

Main works which municipal corporations need to do when undertaking the rehabilitation/renewal are as follows.

- Preparation of a financial plan
- Functional diagnosis of degradation, seismic capacity evaluation, treatment functional inspection, etc.
- Preparation of a rehabilitation master plan
- Rehabilitation design and construction

In order to perform such a series of works smoothly in response to municipal corporations' needs, Japan Sewage Works Agency revised the rehabilitation work manual. This manual covers the construction management of rehabilitation works from the formation of a medium-to-long term plan including the above-described financial plan, the various investigations and diagnostic works, the planning, design, and to construction management. As of these works, close cooperation should be established between the works led by the

municipal corporations, such as the preparation of a financial plan, the proper asset management of the facilities, and the daily operation and management of the facilities, and the works executed by Japan Sewage Works Agency based on the request of municipal corporations. The manual defines these works as a successive work steps. The flow diagram of the works is shown in Fig. 1.

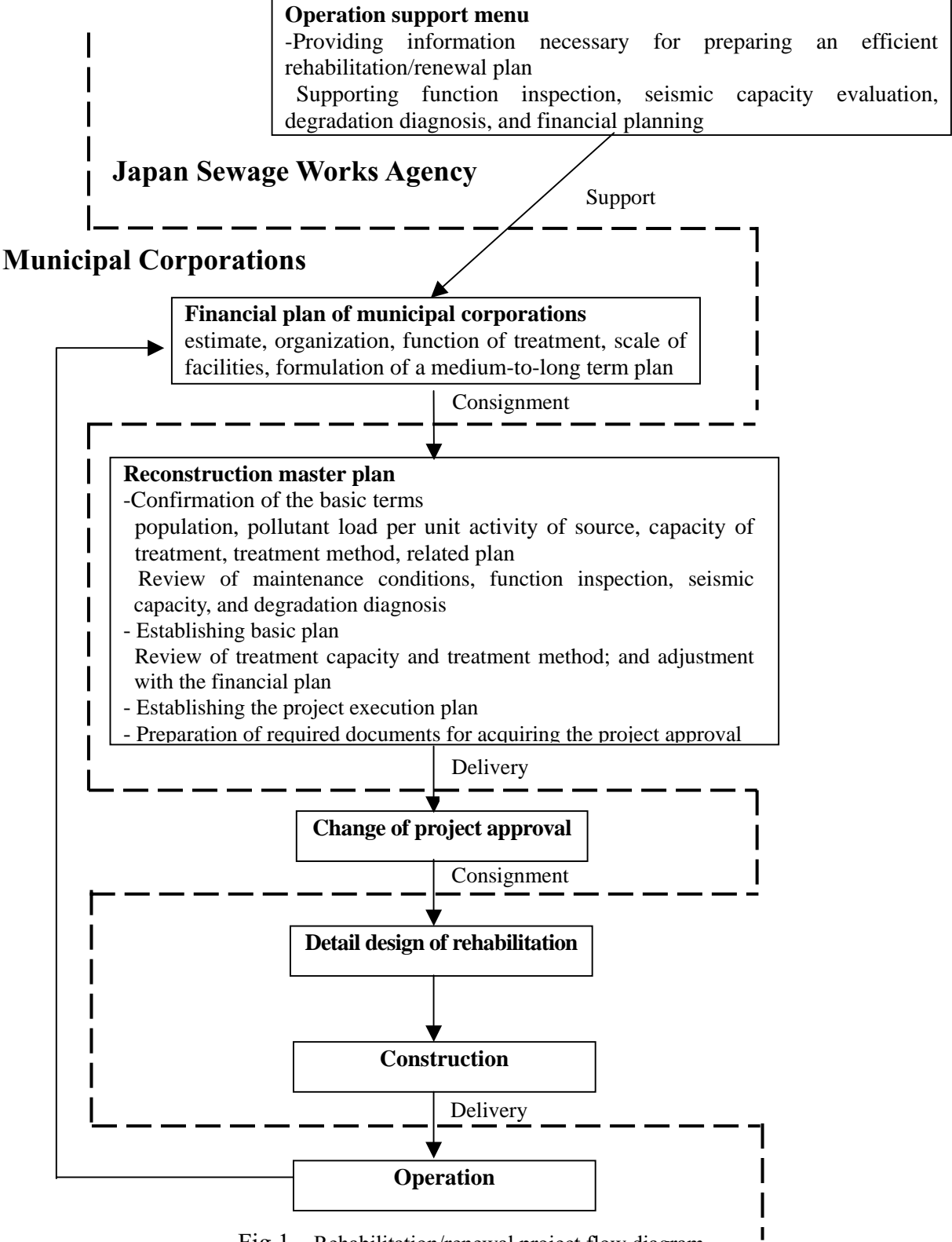


Fig.1 Rehabilitation/renewal project flow diagram

Development of New Technology

Technologies relating to the rehabilitation/renewal include the technology to increase in efficiency and to advance the water treatment and sludge treatment, and the technology to improve the durability of wastewater treatment facilities.

Water treatment, sludge treatment technology

The conventional wastewater treatment has been carried out focusing on the removal of organic materials and SS. However, the needs to nitrogen and phosphorus removal are also increasing by the strengthening of water quality regulation. Although it is necessary to add a new function to the present treatment system in order to raise the treatment functions with the rehabilitation/renewal, sewage treatment plants, especially in city areas of Japan, do not have enough space, and in many cases, they will need to raise the treatment function, maintaining present plant areas. For this reason, it is necessary to attain miniaturization of treatment facilities. The following measures have been carried out for the purpose.

- Development of the membrane bioreactor (MBR)
- Development of the step-feed multistage denitrification-nitrification process
- Development of the proper design method responding to discharge water quality



Fig.2 MBR experiment equipment

Moreover, responding to the rise of needs for recycling of sewer sludge, the following measures have been carried out as the new sludge treatment technology.

- Development of sludge volume reduction technology
- Development of an energy recovery type sludge treatment system
- Development of a sewage sludge carbonizing system

Technology for improving the durability of structures

On the other hand, since improving the durability of structures leads to prolonging the life of a treatment facility, and has the effect to lessen the frequency of rehabilitation/renewal, in

Japan Sewage Works Agency is tackle to improve the durability of concrete structures now. This is because concrete structures deteriorate at an early stage by sulfuric acid corrosion and pose a problem. At present, the surface covering method of construction by resin is adopted for concrete structures exposed under sulfuric acid corrosion environment. However, this method costs a lot and durability life is as short as ten years. In Japan the standard effective working life of a concrete structure is determined as 50 years, and it is necessary to repair repeatedly. The following measures are carried out in order to solve this problem.

- Development of concrete which is resistant to sulfuric acid corrosion and of repairing materials
- Development of a degradation prediction system for concrete material
- Development of a simple diagnostic technology for structures

Among these, concerning the development of sulfuric acid-proof concrete and mortar, we developed a concrete material which usually has about 5 times that of concrete. Development of the concrete which usually has 10 times as high sulfuric acid-proof nature as an ordinary concrete material has is due to be started from now on.



Before



After

Fig.3 Example of repair by sulfuric acid-proof mortar

CONCLUSION

- 1) For the smooth municipal corporations enforcement of the rehabilitation/renewal of a sewerage facility, the systematization of a project flow and the fulfillment of a support menu were conducted.
- 2) The new treatment technology and the durability improvement technology which lead to the successful rehabilitation/renewal have been developed, and the substantial technical support menu for municipal corporations is carried forward.

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Percent of sewerage population in Japan

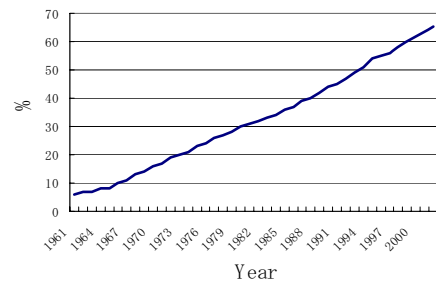
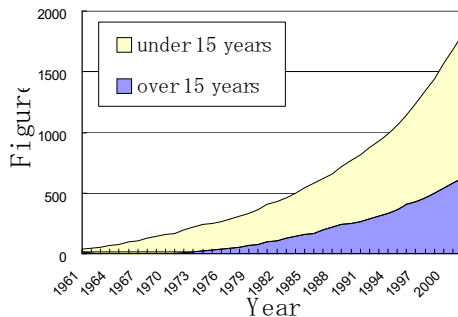


Figure of wastewater treatment plants in Japan



Problems of rehabilitation/renewal

- The percentage of aging sewage treatment plants which have been operated for 15 years or more is over 35%.
- Water quality regulation is strengthened.



The needs for the rehabilitation/renewal with the advanced treatment and multifunctionality are increasing.

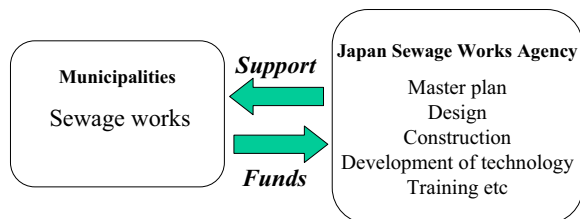


Municipalities which undertake sewage works are asked for heavy financial burdens.

Japan Sewage Works Agency



In order to support sewage works of municipalities which have less personnel with the special knowledge about sewerage, it was founded in 1972.



The contents of support required for the rehabilitation/renewal

- Accumulation of know-how and skills about the rehabilitation/renewal
- Preparation of full-scale estimation for design and construction
- Cooperation with municipalities for supporting work management and operation
- Technical proposals for the increase in efficiency and advancement of wastewater/sludge treatment, and the improvement in durability of facilities



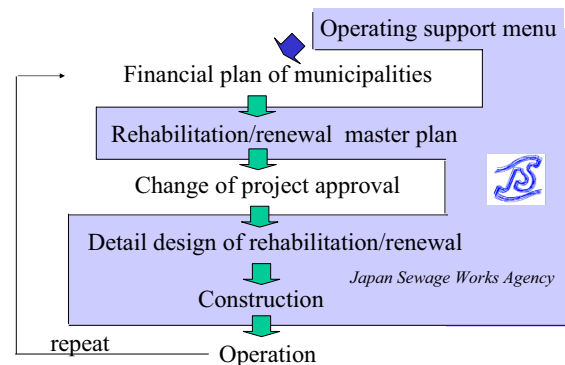
New manual and New technology

New manual about rehabilitation/renewal

In order to advance rehabilitation/renewal works smoothly, it was created in 2004.

- The formation of a medium-to-long term plan including the financial plan
- The various investigations and diagnostic works
- The management of planning, design, and construction

Rehabilitation/renewal flow diagram



Operation support menu

Providing information necessary for preparing an efficient rehabilitation/renewal plan.

- Supporting function inspection
- Seismic capacity evaluation
- Degradation diagnosis
- Financial planning

Rehabilitation/renewal master plan

- Confirmation of the basic terms
- Establishing basic plan
- Establishing the project execution plan
- Preparation of required documents for acquiring the project approval

Development of technology(1)

Wastewater treatment technology

- The membrane bioreactor (MBR)
- The step-feed multistage denitrification-nitrification process
- The proper design method responding to discharge of water quality

MBR experiment equipment

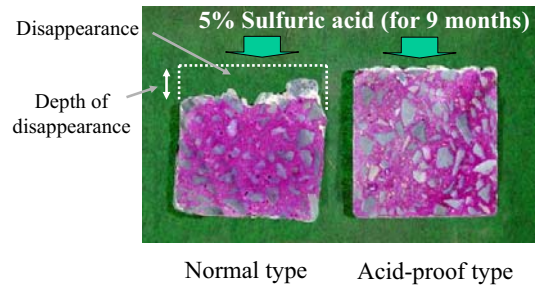


Development of technology(2)

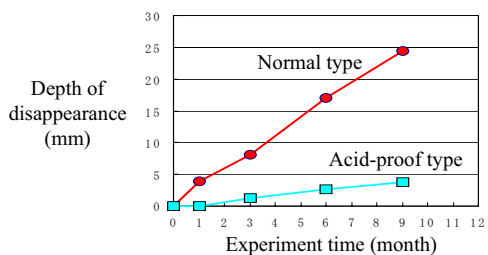
Improving the durability of structures

- Concrete and mortar which are resistant to sulfuric acid corrosion
- A degradation prediction system for concrete material
- A simple diagnostic technology for structures

Development of sulfuric acid-proof concrete



Depth of disappearance of the concrete soaked in 5% sulfuric acid



Repair by sulfuric acid-proof mortar



CONCLUSION

1)For the smooth municipalities enforcement of the rehabilitation/renewal of a sewerage facility, the systematization of a project flow and the fulfillment of a support menu were conducted by Japan Sewage Works Agency.

2)The new treatment technology and the durability improvement technology which lead to the successful rehabilitation/renewal have been developed.