

Reconstructing homes in disaster regions: challenges and support

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1. State of Japan when the giant earthquake occurred

As Japan's society ages and tax revenues fall amid continuing efforts to raise welfare budgets, the national debt is soaring. In the midst of global competition for survival, the Japanese economy has fallen behind those of China, Korea, and other nations, and deficits have appeared not only in its trade balance which has supported the importing of energy and food products, but also in its current account balance.

The Great East Japan Earthquake caused massive damage and casualties over a wide area. As Japan mourns the loss of many lives and works to restore the lives of those who survived, it faces a turning point and must decide how best to make the most of this opportunity to rebuild the nation.

2. Damage to sewage systems by the earthquake and countermeasures

The giant earthquake caused unprecedented damage to sewage systems. The Minami-Gamo Sewage Treatment Plant, which receives sewage from most of the 700,000 residents of Sendai City, and many other treatment plants at 120 locations along the coast were damaged by the tsunami. In the Kanto region too, liquefaction on reclaimed land around Tokyo Bay and near the mouth of the Tone River severely damaged buildings and other infrastructure, and also lifted up or pulled out manholes and sewer pipes, filling them with soil and making the systems unusable. In Urayasu City,

people were forced to live without sewage services even after the water supply was restored, and in Miyagi Prefecture, polluted water temporarily seeped out onto the surface of roads.

The Water Quality Control Department dispatched two-person teams to the site the morning after the earthquake to set up a field headquarters and investigate the damage. In total, more than 6,000 employees of regional government bodies and private-sector technologists from throughout Japan went to the disaster region and surveyed the damage in spite of fuel shortages. A committee set up jointly by the Ministry of Land, Infrastructure, Transport and Tourism and the Japan Sewage Works Association to study reconstruction technologies (chaired by Professor Hamada of Waseda University), which acted as our administration office (content-related), presented three proposals for emergency and temporary restoration and for final restoration, 1 month, 2 months, and 4 months after the disaster.

Table 1 shows the causes of sewage system damage and countermeasures taken. In the treatment plants on the Tohoku Coast, which had suffered almost no damage in the past, the tsunami caused unprecedented damage to their electrical and mechanical equipment. Under the impact of long-duration cyclic vibrations, pipes in reclaimed land in the Kanto region suffered severe damage caused by widespread liquefaction rather than by the conventional problem of backfill. Present earthquake resistance guidelines contain little

Table 1. Major damage to sewage systems and countermeasures

Cause	Treatment plant	Pipeline
Tsunami (Wave force, floating debris, inundation)	Destroyed structure or equipment → Load bearing structure* Damaged equipment → Elevating, adopting waterproof doors * Gas holder washed away → Countermeasures to prevent washing away *	Pipe bridge washed away → Inverted siphon* Blockage/manhole lid displaced → Anchored manhole cover Inundation → Flap gate, movable standby pump*
Earthquake motion Liquefaction Bank deformation	Equipment damaged or displaced Pipes damaged or displaced → Countermeasures under present guidelines Sloshing	Manhole uplifted or displaced → Completion of countermeasures under present guidelines* Lateral pipe uplifted or pulled out → Ditto, and flexible joints* (Blockage with sediment/road caved in)
Ground settlement	(Inundation, poor drainage)	(Inundation, poor drainage)
Power failure	Treatment stopped → In-house generator	Manhole pump stopped → Portable generator
Fuel or chemical shortage	Treatment stopped → Increase stock*	

*New countermeasure

Present guideline = Guideline to Sewage System Equipment Seismic Resistance Guideline

Table 2. Special features and major effects of the B-DASH revolutionary technology (2011)

Name (Location)	Corroboration Technology and Major Effects
Energy Management System Using Super High-efficiency Solid-liquid Separation Technology (Nakahama Treatment Plant, Osaka City)	<ul style="list-style-type: none"> • Super high-efficiency solid-liquid separation: compact, increases sludge recovery • High-temperature digestion of a carrier containing garbage: generates more gas and is extremely compact. • Smart hybrid electric power production: supply/demand control, full use of gas
Kobe City, Higashi-nada Treatment Plant, production of renewable energy (same treatment plant)	<ul style="list-style-type: none"> • Steel digestion tank containing biogas: increases gas production, lowers cost • High efficiency heating using sewage heat: saves energy, reduces CO₂ • Package biogas refining: lowers cost

detailed guidance concerning tsunami. With top priority on drainage and sterilization to protect residents from contact with polluted water overflowing sewage systems, and to prepare for cases where restoration takes a long time, the committee has proposed gradually improving treated water quality, as well as yardsticks for target water quality and restoration periods. The backfilling method of preventing liquefaction at pipelines, which was proposed and included in guidelines after the Chuetsu Earthquake, has only been implemented a few times, but field surveys confirmed that the method is effective. Regarding how to provide effective tsunami countermeasure nationwide, which is a major challenge, the committee issued its fourth proposal on March 8 and will complete a full report at the end of this year.

3. For new energy and city planning

The shortage of electric power will continue for a long time and increased imports of fossil fuels have pushed up electricity prices and CO₂ emissions. Meanwhile, electricity consumed to treat contaminated water accounts for almost 1% of domestic consumption, and sewage sludge, etc. constitutes a large source of potential energy. In addition to prior research, beginning in the latter half of 2010, new measures were prepared and revolutionary technologies such as for capturing energy from sewage sludge were verified and described in written guidelines. Research to verify these technologies in order to introduce them nationwide, and even worldwide, called B-DASH (Table 2, 2.4 billion yen), started in 2011. Facilities to verify methane gas recovery using local biomass were installed in treatment plants in the cities of Osaka and Kobe and data is now being gathered; in 2012, measurements will continue and preparation of a guideline will begin. Under B-DASH, beginning in 2012 (2.9 billion yen), four technologies—solid fuelization, nitrogen and phosphorus removal, and sewage heat use—were selected through a public request for proposals.

The Sewerage and Wastewater Management Department of the MLITT publicly invited proposals for new technologies to perform advance feasibility

studies. As a large earthquake restoration model, Kesennuma City started the “Local Production for Local Use Energy Supply Using Marine Biomass Project,” and Sendai City implemented the “Sewage Heat Recovery Pipeline Renewal Project.”

Regarding the temporary rise in the stored quantity of sludge containing radioactive substances, which was revealed in May, a survey showed that in sludge carried into combined sewage systems by rainfall, the concentration of radioactive substances increased 30-fold during rainfall. Therefore, tests were performed to verify various treatment methods proposed in response to the public request.

4. Management of a shrinking society

Torrential rainfall is occurring more frequently due to climate change, and the expert committee of the Central Environment Council has discussed the threat of new chemicals and is studying the impacts of changes in rainfall and sewage treatment.

On the other hand, the population of Japan has begun to shrink, about ten years after the working population started to decline, and a skillful response is needed. The results of past research on low-cost diagnosis methods, etc. for buried pipelines have been compiled in the Guideline to Stock Management Methods, but with severe restrictions on funds, personnel, and other resources, we must also improve efficiency through comprehensive stock management of sewage systems.

Worldwide, the international standard ISO55000 for improving various kinds of infrastructure management organizations is being drawn up with the participation of the Preparation Committee PC251. In May, various countries voted on the committee’s proposal, with the final voting proposal debated in the Czech Republic in June; this is scheduled to come into effect in the spring of 2014 after the final vote. Along with the domestic council, sewage treatment system operators have begun to take part in the debate. This deals with the entire infrastructure, and is likely to affect not only the international expansion of Japanese corporations, but also domestic organizations and corporations in various ways, and so an urgent response is needed.

5. Creating a Worldwide Marine Products

Industry

Today, it is difficult to survive using conventional approaches, so Japan's marine products industry must also "go global". In addition to aiming for international standardization under B-DASH, members of a sewage system global center are holding policy and technology seminars in China and Vietnam, responding to ISO-related trends, and participating in Japan-China-Korea cooperation.

As government systems continue to shrink, comprehensive management to maintain sewage treatment systems in line with trends in capital will be needed. We will continue to accelerate our global response.

References

Document from the Committee to Study Earthquake and Tsunami Technologies for Sewage Treatment Systems (Ministry of Land, Infrastructure, Transport and Tourism)