Integration of Social Science, Engineering and Environmental Management
-Case of a Sewerage for the Sustainable City-

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1. Evolution of Sewerage

Primal purpose of sewerage in early days was to remove both rain water and domestic wastewater from urban areas. The removed rain water was collected and used as water resource in urban areas. For the reuse purpose, human waste was not usually discharged into sewerage except in some areas like Rome. Therefore, sewerage played a role of critical facilities in terms of water circulation in urban areas. To respond to water demand of urban areas, huge water supply system like Pont du Gard was also installed. In the middle ages, urban areas were surrounded by ramparts and well water was mainly used for living, which meant that city water circulation system became useless although removal of rain water and domestic wastewater was functioned. In Modern Period, sewerage was restructured along with expansion of urban areas; however, human waste was not allowed yet to be discharged into sewerage so that hygienic status of urban areas was extremely miserable. In 18th century, flush toilets became popular among wealthy classes of urban areas. Since this social trend appeared, illegal discharge of human waste into sewerage increased. Finally, the city of London showed its understanding to the social trend and allowed wastewater from toilets to be discharged into sewerage in 1815. It was the dawn of modern sewerage, and also the beginning of water pollution by sewerage. Sewerage started to accept human waste besides rain water and domestic wastewater, which is called “combined sewer system.” Hygienic status of urban areas was improved but water bodies such as rivers and water channels in urban areas were getting polluted because the sewer system did not include facilities to treat collected sewage, but carried and directly discharged sewage into water bodies in urban areas. Pollution of water bodies linked to pollution of water resource, which threatened the people’s lives in urban areas.

2. Development of Sewage Treatment Technology

Construction of the new sewer system accelerated pollution of water bodies in urban areas, and resulted in malfunction of water circulation system of urban areas. Activated sludge process unveiled in 1914 was installed in sewage system to treat collected sewege and because of its cost effectiveness and efficiency of treatment this process was employed in all over the world. People regained water circulation system of urban areas by the process. After development of activated sludge process, sewage treatment technology was intensively studied and drastically improved. Sewage treatment technology was also applied to treatment of industrial wastewater, so quality of water bodies of urban areas became more improved. Purpose of wastewater treatment was gradually switched from just BOD reduction to additional reduction of COD, nitrogen and phosphorus. In Japan, tough water quality standard was made, especially, for closed water areas. To increase its efficiency, separate sewer system was proposed and installed.

3. Expansion of Urban Areas and Water Shortage

Because of population increase and enlargement of urban areas, consensus of reclaiming treated water of sewage grew in society. To meet the demand of reclamation, many advanced sewage treatment technologies were developed. Current sewage treatment technology makes even potable water from sewage. With those advanced technologies, citizen can enjoy biotope in urban areas and artificial streams with reclaimed water in urban parks. It can be said that new water circulation system was established.

4. Sewerage in Sustainable Society

Sewerage now has new mission; resource recycling under the situation that Japan directs to sustainable society. Sewerage in sustainable society should be restructured as an environmentally friendly system. Treated water and sludge from sewage treatment plants should be effectively used as one of resources and carbon dioxide emission should be minimized. Sewerage should also accept kitchen garbage and pursue more effective energy production through methane production. Besides, sewerage should be operated with intensive energy saving technologies and reduce greenhouse gases emission such as N_2O.