

## Study on the concept of urban development fostering energy generation and recycling

Whole term

1995.4 ~1997.3

### (Purpose)

Recently environmental problems like 'heat island' phenomenon, shortage of water and energy resources, problems of waste treatment etc. are becoming worse day by day. This situation necessitates all social activities to be aimed at conservation of the environment.

The above recognition prompted investigations about technologies to achieve urban development fostering energy generation and recycling in the light of an explicit understanding of the material flow within 'towns and cities'. The target technologies include those enabling utilization of potential energy-sources existing within the city-boundary, rainwater harvesting, wastewater treatment, reclamation and reuse, and so on. Regulations related with the technologies as well as the available methods to apply and evaluate those were summarized in this study.

The Urban Development Cooperation entrusted Japan Institute of Wastewater Engineering and Technology with this research during the period FY 1995 and FY1996. The findings from this study were summarized as a guideline for subsequent application of these technologies during the implementation of development plan.

### (Results)

1. Issues and problems, as prevailing in the urban areas, regarding solid waste, water environment (rain water, municipal supply water, reclaimed water etc.) and energy sources were considered. Following four standard types of 'cities' were taken into account;

Architectural city center residential type (area K in district T)

Redeveloped type (new city center S)

Middle-scale residential type (Western part of O)

Large-scale newly developed residential type (New town T)

Main issues and problems are outlined below.

The issues considered in relation to waste generation and collection from middle to high storied residences were odor, usage of elevator and promotion of waste-segregation at source. Issues like difficulty in securing land for construction, NIMBY syndrome, construction cost, and so on were considered in case of intermediate treatment plants and dump yards.

Diverse water usage modes were considered. For example, the importance of conservation of water environment and formation of waterfronts were underscored.

2. In accordance with the above issues, three specific technologies; (1) utilization of heat evolving from sewage system, (2) rain water harvesting and use of reclaimed water, (3) utilization of raw garbage, were considered as potential technologies.

#### (1) Utilization of heat evolving from sewage system

Mainly application of geothermal air conditioning (geothermal heat pump technology) was focused upon. Different aspects were explored in the following order of sequence; (a) estimation of the status of the target area, type of heat usage, amount of potential reusable heat from sewage system, and heat demand, (b) calculation of the treated volume of wastewater, coverage of area by such heat-supply system, and associated cost, (c) overall evaluation.

Under the assumption of constant wastewater quantity and quality, the scope for utilizing reclaimed heat for heating is the largest in the commercial areas followed by the residential areas and the office areas. In case of utilizing heat for cooling, the scope is the largest in the residential area followed by the commercial area and the office area.

Overall evaluation was performed based on the impact on energy conservation (estimated by reduction of annual energy consumption) and the effect on environmental conservation (estimated by the reduction of annual gas emission (CO<sub>2</sub>/NO<sub>2</sub>)).

#### (2) Rain water harvesting and reuse of reclaimed water

Harvested rainwater and reclaimed water were designated to be used for toilet flushing, landscaping and waterfront recreation, gardening and car washing. The proposed design of the whole system included water catchment system, water storage system, and water supply system.

Water catchment system was designed following proper consideration of the facts like whether water is originating from isolated or collective housing, whether the catchment system is individual or collective, and whether water is collected only from roof or from both roof and the surrounding ground.

Construction of large storage system would facilitate retention of large volume of water, but the system may not be economically viable. Therefore, the volume of storage tank was determined after simulating the utilization volumes and ratio of rainwater.

#### (3) Effective utilization of raw garbage

The appropriate way of introducing 'disposer (kitchen waste disintegrator)' to the waste collection system was explored. Also demands for compost and recovered methane gas were assessed.

Research funded by Husing and Urban Development Corporation

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Keywords

Energy generation, recycling, unused energy, rainwater harvesting, reclamation of treated wastewater, effective utilization of raw garbage