The 7th International Symposium on Southeast Asian Water Environment

Proceedings of Special Session on “Water Reuse Technology in Tropical Regions”

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WateR-InTro (JST-JICA Project on “Research and Development for Water Reuse Technology in Tropical Regions”)

Department of Environmental Quality Promotion
Ministry of Natural Resources and Environment
Thailand

Japan Science and Technology Agency (JST)

Japan International Cooperation Agency (JICA)

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Chair: Dr. Ryo Honda (University of Tokyo)

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Effective management and monitoring system for community-based water reuse

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Abstract

The increasing demand for high quality of water resource and conservation of aquatic environment has led communities to reduce their water consumption as well as decreasing their pollutant loads into environment. For example, unimproved environmental quality situation has forced industry sector in Thailand to adopt zero discharge policy in some areas like in Chaopraya River Basin which causes industry prompt considering water reuse concept. In the part of urban communities, although water shortage situation is not so serious, the concern on environmental quality deterioration particularly in canals, rivers, water reservoirs, lakes and coastal areas are the main criticism in communities. According to the report of Pollution Control Department, in 2008 there are 86 wastewater treatment plants operating to treat wastewater of municipalities throughout the country, which generate about 2 millions m^3 per day. This amount of water even treated until its discharge quality meets effluent standard, enable to deteriorate quality of aquatic environment at some extents which is a big concern on the society presently. Water reuse methodology is trying to treat wastewater until it has quality suitable for various types of use and bring back to communities to use. Adoption of water reuse concept in societies of Thailand is not well acceptable particularly in urban societies. On the other hand, industrial society tends to easily adopt the concept because of social and economic pressure. This report will show examples and propose the methodology for successful implementation for water reuse project in Thailand according to the Thailand and Japanese Technical Cooperation Project for Research and Development for Water Reuse Technology in Tropical Regions.

Key components of successful implementation for water reuse programs in any societies should be composed of 2 factors: public acceptance and effective monitoring of reused water quality.

In term of the public acceptance, community should have public learning and awareness on the value of water and water crisis in their community, risk of health as well as ecology regarding the community discharging all or some of treated wastewater to their environment. In case of adoption of water reuse program, what benefits the community will gain. This will include economic benefit of the project and reduction of risks of human health as well as ecology. On the other hand water reuse community needs to be able to respond to the questions and

concerns raised by public by conducting research relating to health and ecological risk assessment on micro-constituents in reuse water such as pathogenic bacteria and viruses, endocrine disrupting compounds and pharmaceutically active residues. This information is necessary for communicating to public in initiating water reuse program for communities.

Effective monitoring facilities and analytical capability should be established to guarantee 100 % safety of community participating in the water reuse program in order to obtain public confidence and trust of the water reuse program. Necessary parameters for routine monitoring of reuse or reclaimed water quality is shown in the Table 1.

Table 1. Parameters needed to be monitored in water reuse program

Types of constituents	examples
Heavy metals	As, Cd, Cr etc.
Bacteria	Shigella, salmonella, Vibrio cholerae etc.
Viruses	Enteriviruses, Hepatitis A, Adenovirus etc.
Endocrine disruptor Pharmaceutical residues	Sex hormones, Synthetic steroids etc.

Minimizing or absent of these compounds in reuse water will be an effective tool for raising confidence and trust of the soceity using reuse or reclaimed water. Limits of the constituents allowed to be in the reuse water will be set up and agreed between water reuse suppliers and water users by the basis of risk that will be accepted by the users. Although Thailand is in the first stage of water reuse implementation, it must be note that a failure at even one case may do much to damage the implementation nationally. For this reason it is proposed a national water reuse program should be strongly supported by public participation and research programs. This is expected to focus on non-potable reuse initially, and subject to demand to consider potable reuse later.

In the case of implementation of water reuse programs in Thailand, Huahin Municipality will be used as a case study of water reuse program of community. The study will include public learning, public acceptance, health risk assessment in the case of having or not having water reuse program, ecological risk assessment and economic suitability analysis for evaluating benefits the Huahin community will obtain in adopting water reuse project. For industrial community, Laemchabang industrial estate and 7 types of factories will be used as case studies of potential and successful implementation of water reuse programs.

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Water quality assessment of water resources in community for development of water quality information platform

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Abstract

Apart from the typical water resources (surface water or groundwater), new water sources such as rain water and reclaimed water, have been receiving growing interest. Identifying new water sources is an economical way to meet increased water demand for a community. However, general public often does not understand the quality difference among different type of possible water resources and hence many communities do not have a positive image on reclaimed water or rainwater. Therefore, it is important to develop a simple way to represent the difference of water quality (WQ) among various water resources, including reclaimed water or rainwater, available in a community. The main purpose of this study is to develop a WQ information platform by assessing the WQ of community based water resources. Water quality information platform, which provides the WQ criteria reference to be compared among different waters, is a better tool to evaluate WQ level of possible water resources available in a community. Thus, this kind of information platform will useful for general public to change their attitude and behavior toward the quality of reclaimed water or rainwater.

Developing of WQ information platform will require several WQ data from various possible water sources such as surface waters (river waters, pond waters), ground water, typical WWTP effluents, advance treated WW (MBR, RO), rainwater and reclaimed wastewater. Besides the conventional parameters (BOD, COD, TN, TP, etc), micro pollutants such as heavy metals and pharmaceuticals will also be included in the WQ information database. The WQ evaluation approach for developing WQ information platform has five steps: (1) Gathering data: Measuring or collecting WQ parameters and collection of WQ standard, (2) Scoring: Determining 3-level sores based on scientific evidences or WQ standard, (3) Labeling: Characterizations of WQ using scores, (4) Ranking: Ranking by water availability and WQ labeling information, (5) Judgment of water use: Judging the type of water usage such as, gardening, toilet flushing, car washing, landscape, etc.

The outcome of this WQ assessement will also provide easy expression to simply compare the WQ of reclaimed water or rain water directly with surface water or ground water. This will lead to overcome public uncertainty about a reuse system, particularly fears that relate to public health and WQ. Ultimately, developed WQ information platform, combined with effective management and monitoring system, will lead to sustainable use of community-based water reuse system.

Acknowledgement: The authors acknowledge the CREST project of ‘Risk-based Management of Self-regulated Urban Water Recycle and Reuse System’ (granted by JST) for the concept of WQ ranking and labeling.

The Combined Membrane Bioreactor with Iron-oxide Coated Sand System for Biological Nutrient Removal

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Abstract

This research aims to study the efficiency of Submerged Membrane Bioreactor (SMBR) combined with Iron-Oxide Coated Sand system for treatment and reuse of Department store wastewater. The experiment investigated the stability of the membrane process, treatment efficiency and the quality of treated water in terms of COD, nitrogen and phosphorus. The SMBR system could remove both organic and nitrogen in a single reactor. The intermittent aeration was applied to make possible switching between the aerobic and anoxic condition. The efficiency of nitrification when sludge age was infinite was 94-98% and denitrification efficiency was 80-93%. COD/TKN ratio varied from 7.5-25.2. The accumulated differential of TKN and NO3 in anoxic and aerobic period resulted from nitrification and denitrification reaction-limited would slightly affect the efficiency of the system, depending on the aeration period. Intermittent aeration period 150 minute gave slightly better result of nitrogen removal than 120 minute. When operate with sludge age 50 days the nitrogen removal efficiency had not been affected and could maintain as high as 92%.

The system could remove higher than 99% of turbidity and SS, 80-93% of nitrogen and 97% of COD through the experiment. Treated water had average color intensity of 0.99 SU and fecal coliform bacteria was not detectable. The quality of treated water reached the standard quality of reclaimed water for nonportable uses of guideline for standard of water quality of Japan.

The SMBR system could remove phosphorus only 30% when sludge age was infinite and could remove up to 53% when sludge age was kept at 50 days. Iron-Oxide coated sand 2 columns in series were used for removal phosphorus that remained in treated water from the SMBR system. The efficiency of the iron-oxide coated sand in series was averagely 80%, having sorption capacity 0.72 mg.P/g.coated sand.

Treatment performance and microbial characteristics in two-stage membrane bioreactor applied to partially stabilized leachate

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Abstract

Two-stage membrane bioreactor system was applied to the treatment of partially stabilized leachate from solid waste landfill in Thailand. In the system, anoxic tank with inclined-plate for biomass separation from re-circulated sludge is followed by second-stage aerobic tank in which direct submerged hollow-fiber membrane module is used for solid-liquid separation.

During steady operation of 200 days, BOD, COD, NH3 and TKN removals were found to be 99.6, 68%, 89% and 86% respectively. Determination of nitrogen transforming bacteria by fluorescent in-situ hybridization (FISH) technique revealed slightly higher percentage of nitrifying bacteria in the aerobic tank and higher percentage of denitrifying bacteria in anoxic tank respectively.

Anammox-like bacteria were also detected at relatively high percentage.

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