ON-SITE DOMESTIC WASTEWATER TREATMENT IN THAILAND

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Workshop on On-site Domestic Wastewater Treatment in Asia
November 20-21, 2013, Tokyo, Japan
Population

- 64,623,000 million
- City = 29,662,000 million
- Local area = 34,961,000 million
Surface Water Resources in Thailand

Surface Water Resources: divided into 25 River Basins

1. Salaween
2. Khong
3. Kok
4. Chi
5. Mun
6. Ping
7. Wang
8. Yom
9. Nan
10. Chao Phraya
11. Sakae Krang
12. Pasak
13. Tha Chin
14. Mae Klong
15. Prachinburi
16. Bang Pakong
17. Tonele Sap
18. Eastern Coast
19. Phetchaburi
20. Western Coast
21. South-East Coast
22. Tapi
23. Songkhla Lake
24. Pattani
25. South-West Coast
Overall water quality of water resources during 2007-2011, tended to improve. The number of water resources at a deteriorated level was decreased and no water resource at a highly deteriorated level had been found since 2008. One of the important factors of water quality was rainfall, such as 2008 and 2011. However, the water quality had decreased in some areas (Figure 17 and Table 12).

**Figure 17**: Percentage of Water Resources at Good, Fair, Deteriorated and Highly Deteriorated and Rainfalls during 2007 – 2011

**Source**: Thai Meteorological Department
The main causes of deteriorated water quality were municipal wastewater that was not sufficiently treated because there were only 101 wastewater treatment plants around the country, which treated only 10% of all wastewater, and industrial and agricultural untreated wastewater drainage into water resources. Steps taken to decrease water pollution were measures determining to control water drainage from different sources, water use reduction promotion, waste and wastewater reduction and legal waste disposal and water treatment. In addition, local administrative organizations created efficient municipal wastewater treatment systems so that water quality met the standard and collected wastewater treatment fees. Communities were also encouraged to take part in water protection campaigns. However, many businesses did not have a clear pollution control measures such as cultivation, water use in irrigable areas, livestock farming, municipal industry, etc. Water protection or wastewater drainage standards were not consistent with wastewater treatment capacity of water resources, considering from current water quality problems in each region.
The main reason causing water quality deterioration, considering from the parameters, was due to the wastewater from communities. This also included wastewater from other activities, such as industrial activities and agricultures which discharged wastewater to water sources without prior water treatment. As a solution to these causes, there should be campaign encouraging the public to reduce water usage in order to reduce wastewater and to manage wastewater at the point source by treating the wastewater from household and recycling the wastewater.
The main reason causing water quality deterioration, considering from the parameters, was due to the *wastewater from communities*.

As a solution to these causes, there should be campaign encouraging the public to **reduce water usage** in order to reduce wastewater and to manage wastewater at the source by **treating the wastewater from household and recycling the wastewater**. The local government should construct community wastewater treatment system.

**Following by**

- charge a fee for wastewater treatment
- encourage the business owners to apply clean technologies
- enforce wastewater treatment before draining to the environment
- control low quality water drainage through irrigation or agricultural areas to reduce
- enforce the law on the drainage water standard
MUNICIPAL WASTEWATER MANAGEMENT IN THAILAND
Status of Municipal Wastewater Treatment Facilities in Thailand

Location of 101 Municipal Wastewater Treatment Facilities in Thailand

- Constructed 92 Plants
- Under Construction 8 Plants
- Delayed (Samutprakan Province) 1 Plant
Technology for Wastewater Treatment Facilities in Thailand

Municipal Wastewater Treatment Systems defined by System:

- SP system: 46 plants
- AL system: 16 plants
- AS system: 36 plants
- CW system: 2 plants
- RBC system: 1 plant
### Types of Collection Systems

#### Central Wastewater Treatment

#### Combined Sewer System
- Drains both runoff and sewerage within one system

#### Separate Sewer System
- Sewerage and runoff are collected in separate piping systems

### Design Criteria for Central Wastewater Treatment

<table>
<thead>
<tr>
<th>The type of collection systems</th>
<th>BOD (mg/l)</th>
<th>SS (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Sewer System</td>
<td>65 - 110 (80)</td>
<td>40 - 110 (80)</td>
</tr>
<tr>
<td>Separate Sewer System</td>
<td>(160)</td>
<td>(160)</td>
</tr>
</tbody>
</table>
## Number and Capacity of Municipal Wastewater Treatment System

<table>
<thead>
<tr>
<th>Organization</th>
<th>Completed construction (plants)</th>
<th>Under construction (plants)</th>
<th>Delayed Project (plant)</th>
<th>Total (plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Running operation (plants)</td>
<td>Testing operation (plants)</td>
<td>Not deliver (plants)</td>
<td>Under maintenance (plants)</td>
</tr>
<tr>
<td>1. Municipality</td>
<td>62 (1,057,475)</td>
<td>1 (36,000)</td>
<td>2 (66,000)</td>
<td>13 (137,400)</td>
</tr>
<tr>
<td>2. Provincial Administrative Organization</td>
<td>1 (22,500)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. Subdistrict Administrative Organization</td>
<td>2 (600)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4. Pattaya City</td>
<td>2 (85,000)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5. Samut Prakan</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6. Bangkok Metropolitan Administration</td>
<td>7 (992,000)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>74 (2,157,575)</td>
<td>1 (36,000)</td>
<td>2 (66,000)</td>
<td>13 (137,400)</td>
</tr>
<tr>
<td>Total</td>
<td>90 (2,396,975)</td>
<td>10 (291,420)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note:** (...) Means the capacity in accepting wastewater in cubic meter per day.

**Source:** Department of Public Works and Town & Country Planning, Bangkok Metropolitan Administration, Office of Natural Resources and Environmental Policy and Planning and Pollution Control Department.
The collection of wastewater treatment fee

The implementation of municipal wastewater treatment requires the budget for operation and maintenance which include the compensation to personnel. Currently, there were only 7 Local Administration Offices that issued the regulation to set and collect the wastewater treatment fee. They were Hat Yai City Municipality, Songkhla province, Mueang Pattaya Municipality, Chon Buri province, Karon Subdistrict Municipality, Phuket province, Pa Tong District Municipality, Phuket province, Si Racha Town Municipality, Chon Buri province, Saensuk Town Municipality, Chon Buri province, and Banpae Subdistrict Municipality, Rayong province.

During 2008 - 2009, the National Environmental Board set the wastewater treatment fee and published in the Royal Government Gazette an increase of another 6 areas that will utilize the Environmental Fund (under Section 88 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992). They were Tha Rae Subdistrict Municipality, Sakon Nakhon province, Mae Sod Town Municipality, Tak province, Huakwang Subdistrict Municipality, Maha Sarakham province, Mukdaham Town Municipality, Mukdaham province, Hua Hin Town Municipality, Prachuap Khiri Khan province and Pa Tong Town Municipality, Phuket province.

Bangkok Metropolitan Administration (BMA) had not yet collected the wastewater treatment fee but had issued a BMA regulation entitled The Collection of Wastewater Treatment Fee 2003 and published in the Royal Government Gazette, Volume 121, Special section 61 D, dated 31st May, 2003 (B.E. 2548). The BMA had coordinated with Metropolitan Waterworks Authority (Thailand) to prepare an agreement to assign the Metropolitan Waterworks Authority (Thailand) to collect the wastewater treatment fee for the BMA.
Sources of Water Pollution

**Domestic:**
- 1,687 Municipalities,
- 6,089 LAOs,
- BMA, Pattaya City
- Approximately 9.8 M m³/d

**Industry:**
- >120,000 factories
- Approximately 2.8 M m³/d

**Agriculture:**
- Pig farm+ Aquaculture (Point source) 0.1 M m³/d
- Paddyfield (Non Point source) 150 M m³/d
Municipal Wastewater Management in Thailand

(1,687) Municipalities
MWW~2.5 M m³/d

BMA, Pattaya City
MWW~9.0 M m³/d

(6,089) LAOs

Total MWW~14M m³/day

Treatment capacity ~ 3.2 M m³/d
(≈ 22.9% of total MWW)

Total BOD Loading
~ 2,600 Ton BOD/day

Total Budget 83,152 M Baht
The Main Problem
Municipal Wastewater Management in Thailand

**Municipal Wastewater:**
- is one of the most serious environmental problems in Thailand.
- Approximately 14 M m³/day of municipal wastewater generated by the population around the country in year 2008, including:
  - 1,687 Municipalities ~ 2.5 M m³/d
  - 6,089 LAOs ~ 9.0 M m³/d
  - BMA, Pattaya City ~ 2.5 M m³/d
- 101 Municipal Wastewater Treatment Facilities in the country have been constructed (approximately 3.2 millions m³/day or app 22.9 % of total wastewater treated)
## Constraints:

- Many urban communities lack appropriate municipal wastewater management.
- The communities and people still lack understanding in wastewater problem and awareness to protect the environment.
- The local administration organizations are still unable to manage municipal wastewater.
- Lack of budget for construction of the new wastewater collection system and wastewater facilities.
Operational Problems of Municipal Wastewater Treatment System

1. Operation and Maintenance.

2. Management of Central System and Wastewater Treatment.

3. Promotional Campaign and Communities’ Involvement in the Central Wastewater Treatment System Management.

4. Law Enforcement, Regulating Mechanism, and Driving Local Administration to Act Progressively.

5. TARGET
The Main Problem in Wastewater Facilities Management

Weak Wastewater: the systems are sized to treat highly diluted wastewater

Sewerage leakage: pumped mains experience substantial leakage with potential contamination of groundwater

Sewer sedimentation: high levels of intrusion and low hydraulic profiles in gravity sewers.
The Main Problem in Wastewater Facilities Management

Staff skills: the treatment technologies require a high level of skilled operator more difficult to resource up-country.

Operational cost: Electrical costs are particularly high.

Tariff charges: as a result of the low perceived benefit and local political considerations, progress in levying tariffs has been limited to 3 municipalities to date.
Solution Problem on Domestic Wastewater Management
Term of MSMS 2008
Bring Back Better
Natural Water resources

- Reduce waste at pollution sources by the simple technologies (Ex. Grease Trap and On-site treatment)
- Rehabilitate the existing municipal wastewater facilities
- Construct new wastewater treatment system using appropriate technology
- Polluter Pay Principal (PPP)
Alternatives for Municipal Wastewater Management in Thailand

- On-site, (individual house)
- Cluster Wastewater Treatment (Group of House)
- Centralized Wastewater Treatment (High density)
On-site
Household Wastewater Treatment

Cluster Wastewater Treatment
Household Wastewater Treatment

Old House
- Washer
- Kitchen
- Toilet
  - Oil Trap
  - Septic Tank

New House
- Washer
- Kitchen
- Toilet
  - Oil Trap
- Wastewater Treatment Unit

Paths:
- Old House Washer → Kitchen → Toilet → Oil Trap → Public Drainage → Land Filtration
- New House Washer → Kitchen → Toilet → Oil Trap → Public Drainage → Land Filtration
Household
Ko Chang (Trat Province)

Ko Chang: Anaerobic Filter (AF)

Flow 1-3 m³/d
BOD 200 mg/L

Septic

AF 1
AF 2
AF 3

BOD <30 mg/L

Media

Construction Cost 32,200 - 61,600 Baht
Cost comparison between centralized and onsite systems

Cost

Centralized type cost curve

Household type cost curve

Density of house

Cost per house
Water Pollution Control Policy

- Reduce wastewater at pollution sources by simple technologies (Ex. Grease Trap and On-site treatment)
- Rehabilitate the existing municipal wastewater facilities
- Construct new wastewater treatment system using appropriate technologies
- Polluter Pay Principal (PPP)
Wastewater Management

- Law Regulation and Enforcement Measures:
  - Water Quality Standards: Ambient Water Quality Standards
  - Effluent Standards
  - Other Laws

- Management Measures:
  - Monitor and Evaluate Water Quality
  - Pollution Control Zone

- Investment Measures:
  - Establish Wastewater Treatment Facilities
**Challenges in Municipal Wastewater Management in Thailand**

**Challenges:**

- Review current status and update the data of existing wastewater collection network and the drainage system.
- Propose and assess technically and economically feasible options for Centralized, Cluster and Onsite of wastewater treatment system, including identifying types, separate sewage system, or combined sewer system which are appropriate for LAOs.
Removal of pharmaceutical residuals and endocrine disrupting compounds by constructed wetlands
The current study of fenton ball research in the constructed wetland of ERTC
Testing of Onsite Commercial Wastewater Treatment Units

Various types of commercial wastewater treatment tanks are sold in markets.

No procedure of testing and none government authority to guarantee the efficiency of tank.

Because of the lack of technical data to support a verification system.
### Experimental Set up and operation

<table>
<thead>
<tr>
<th>Experiment conditions</th>
<th>duration</th>
<th>Operation condition</th>
<th>No. of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start up</strong></td>
<td>3 months</td>
<td>Influent flow rate 1,000 L/d (± 10%)</td>
<td>≥ 5 times</td>
</tr>
<tr>
<td><strong>Normal situation</strong></td>
<td>≤ 3 months</td>
<td>Influent flow rate 1,000 L/d (± 10%)</td>
<td>≥ 5 times</td>
</tr>
</tbody>
</table>

**Stress situation**

- **- 2 times of normal**
  | ≤ 2 months | Influent flow rate 2,000 L/d (± 10%), 5 consecutive days and run in normal situation | ≥ 5 times |

- **- A half of normal**
  | ≤ 2 months | Influent flow rate 500 L/d (± 10%), 5 consecutive days and run in normal situation | ≥ 5 times |

- **- No influent**
  | ≤ 2 months | stop flow 5 consecutive days and run in normal situation | ≥ 5 times |
Results

- Stress tests do not have effects on removal efficiencies of BOD of the tested tanks.
- Removal efficiencies of BOD are in the range of 61-77 % and the average is 68 %.
- BOD in effluents are in the range of 42-74 mg/L.
- For TKN, Phosphorus, sulfide and TDS removal efficiency couldn’t well so should add secondary treatment to increase removal efficiency.
Support system by government

- Design by PCD
- Consulting
- Reduce pollutant from wastewater on-site
- Polluter Pay Principal: PPP
- Discharge standard
Popular on-site treatment technology

- Treatment tank
- Septic tank
- Grease tab tank
Challenges to promote on-site wastewater treatment in Thailand

- Low cost
- Maintenance system
- 30 Baht/month
We acknowledge the valuable assistance of PCD and ERTC staffs for results and recommendations.