K-eco’s role for water quality conservation in Korea

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“Water quality accidents during Industrialization”

'89 : Heavy Metal Contamination
'91 : Phenol released in Nak-dong river
'94 : Organic solvent released in Nak-dong river

1980, Environment Agency (EA)

Korea Resources Recovery & Reutilization Corporation

1987, Environment Management Corporation

1994, EA was changed to the MOE. MOE was given bigger authorities with its functions and budget.

K-eco, 2010
Introduction

Sewerage status in Korea (2019)

Sewage (municipal & households wastewater) Treatment Plants

Sewer (pipeline) Networks

Treatment efficiencies
### Case: Brief History about Sewerage Management in Korea

K-eco has been providing policy supporting and implementing policies for the Ministry of Environment.

<table>
<thead>
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</thead>
<tbody>
<tr>
<td><strong>1st Generation</strong></td>
<td><strong>2nd Generation</strong></td>
<td><strong>3rd Generation</strong></td>
<td><strong>4th Generation</strong></td>
<td><strong>5th Generation</strong></td>
</tr>
</tbody>
</table>

- **Initial focus on sewage treatment**: Fast conveyance of raw sewage to water body
- **Industrialization & Development & Urbanization caused water pollution**.
  → Need to treat sewage before discharging → Need to remove organic matters
- Need to improve river water quality → Reinforcing effluent standard (Nutrients: N, P)
- **Needs for better living**: Need to introduce separate sewer system
- **Needs to control Hazardous substances in Wastewater**: Introducing TU(toxic unit) standard
  : Target – 82 facilities receiving hazardous matters such as metal mining, dyeing facility
Overview: MoE declared a revising effluent standard in advance in order to give enough time for developing relating technology and installing facilities.

<table>
<thead>
<tr>
<th>Act</th>
<th>Year</th>
<th>BOD (mg/L)</th>
<th>COD (mg/L)</th>
<th>SS (mg/L)</th>
<th>T-N (mg/L)</th>
<th>T-P (mg/L)</th>
<th>Number of Coliform(/ml)</th>
<th>Toxicity (TU)</th>
<th>Applied from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Pollution Act</td>
<td>1964</td>
<td>20-150</td>
<td>-</td>
<td>70-200</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Water Quality Conservation Act</td>
<td>1978</td>
<td>30</td>
<td></td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Quality Conservation Act</td>
<td>1991</td>
<td>20</td>
<td>50</td>
<td>20</td>
<td>120</td>
<td>8</td>
<td></td>
<td>1996.1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1993</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td>60</td>
<td>8</td>
<td></td>
<td>1996.1.1</td>
<td></td>
</tr>
<tr>
<td>Sewerage Act</td>
<td>2001</td>
<td>10-20</td>
<td>40</td>
<td>10-20</td>
<td>20-60</td>
<td>2-8</td>
<td>3,000</td>
<td>2008.1.1</td>
<td></td>
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<tr>
<td></td>
<td>2008</td>
<td>10</td>
<td>40</td>
<td>10</td>
<td>20-40</td>
<td>2-4</td>
<td>3,000</td>
<td>2012.1.1</td>
<td></td>
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<td></td>
<td>2010</td>
<td>10</td>
<td>40</td>
<td>10</td>
<td>20-40</td>
<td>2-4</td>
<td>3,000</td>
<td>2011.1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>5-10</td>
<td>20-40</td>
<td>10</td>
<td>20-40</td>
<td>0.2-4</td>
<td>1,000-3,000</td>
<td>1</td>
<td>2012.1.1</td>
</tr>
<tr>
<td></td>
<td>2020</td>
<td>5-10</td>
<td>15-25</td>
<td>10</td>
<td>20</td>
<td>0.2-4</td>
<td>1,000-3,000</td>
<td>1</td>
<td>2021.1.1</td>
</tr>
</tbody>
</table>

Effect

- Localization of STP's Process & Create Large Scale Environment Market
- Enhance independence rate on machinery => O&M can be done by domestic companies
Role of K-eco for Water Quality Management in Korea

A Policy Supporting and Implementing Organization under the Ministry of Environment

**Policy support**
- Analysis of current status of Environmental Facilities
- Review the Master Plan
- Technical support to MoE especially subsidy for new or renovation

**R&D/Capacity Building**
- Trying to improve water quality and construct efficient facilities

**Expert Dispatch**
- On-site investigation
- Technical Assistance for local governments

**Installation / O&M of Facilities**
- On behalf of MoE and local Govt., K-eco installs the Environmental Facilities. After installation, K-eco hands over the facilities to Local Govt.
Good Practice 1 – Policy supporting by providing technical review on
A Policy Supporting and Implementing Organization under the Ministry of Environment

When local govt. establishes a Master Plan for Sewerage system, each local governments shall be approved it from the Ministry of Environment according to Sewerage Act- Article 3, 5 and 6

**Enforcement Decree of the Sewerage Act Article 3 –(2)**
Where the MoE intends to approve a master plan for sewerage maintenance or any amendment thereto pursuant to Article 6 of the Act, if deemed necessary for reviewing related technical matters, the MoE can hear opinions of the Korea Environment Corporation established under the Korea Environment Corporation Act

**Establishing Sewerage M/P** → **Design for Sewerage facility** → **Negotiation with the MOE for Subsidy amount** → **Approval for installation** → **Construction**

Goal: trying to achieve planned water quality of rivers or watershed
→ Trying to establish an efficient and systematical Master plan on sewerage facility
→ Trying to use a confined budget efficiently

(6) When a Mayor/ Province Governor intends to issue a public notice pursuant to paragraph (2) or grant authorization pursuant to paragraphs (3) and (4) concerning the public sewerage system that he or she plans to install with a subsidy from the State, he or she shall consult in advance with the Minister of Environment about the raising and spending of funds necessary for the installation thereof, as prescribed by Presidential Decree.
Good Practice 2 – Project Management for Large scale Sewerage Expansion Project

**Project Summary**

- **Introduce River Basin Management & Expand Sewerage Facilities**
- **Project** was planned out by MOE and carried out by K-eco and 37 local governments for improving and conserving water quality in 4 major river basins.

**Structure of Project and Roles of stakeholders**

<table>
<thead>
<tr>
<th>Role</th>
<th>MOE</th>
<th>K-eco</th>
<th>Local government</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plan and Subsidy</td>
<td>Project Management</td>
<td>Administrative support</td>
</tr>
<tr>
<td></td>
<td>Support for budget</td>
<td>Input K-eco’s experts for</td>
<td>Budget – 20-30% of Cost</td>
</tr>
<tr>
<td></td>
<td>(70-80% of Cost)</td>
<td>Design &amp; Construction</td>
<td>O&amp;M after Construction</td>
</tr>
</tbody>
</table>

**Pilot Project** for Rehabilitation of existing Sewer line around Paldang Dam (2001-2015)
- 9 cities, 1,714 km, House-connections 80,197 ea, 1.19 Billion USD (≒ 1.334 Billion KRW, $1-1,120 KRW)

**Sewerage Expansion Project** in upstream area of dams (2005 - 2011)
- **Target**: 7 dams - 28 municipals [located in upstream area of Dam]
- **Cost**: 1.21 Billion USD (≒ USD1,350 Billion KRW)
- **Quantity**: 526 STPs, Sewer 1,747 km, House-connections 68,858 ea
- **Effect**: Coverage of sewerage from 32% to 75%
Effect of pilot project in Han river Basin and Sewerage Expanding below Dams

Efficient collecting and transporting polluted water to STPs by introducing separate

Installation of house connection and **Closure of septic tank**

Change to separate sewer system

- Improvement of the water quality of stream
- Restoration of river and Creating riverside park

**<Before>** | **<After>** | **<Before>** | **<After>**
Good Practice 3 – PPP Projects for expanding Sewerage Facilities

Based on the experience of conducting large scale sewerage projects, K-eco has been carrying out sewerage PPP projects since 1998.

### BTO cases – STPs, WWTPs and Water Reuse projects

<table>
<thead>
<tr>
<th></th>
<th>Sum</th>
<th>Road</th>
<th>Seaport</th>
<th>Railway</th>
<th>Environment</th>
<th>Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (%)</td>
<td>216</td>
<td>83</td>
<td>18</td>
<td>9</td>
<td>77</td>
<td>29</td>
</tr>
<tr>
<td>Total cost (Trillion KRW)</td>
<td>70.1</td>
<td>41.5</td>
<td>6.9</td>
<td>13.3</td>
<td>5.7 (= 5.1 billion USD)</td>
<td>2.7</td>
</tr>
</tbody>
</table>

### BTL cases – Sewer projects

<table>
<thead>
<tr>
<th></th>
<th>Sum</th>
<th>School</th>
<th>Sewer line</th>
<th>Military House</th>
<th>Railway</th>
<th>Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (%)</td>
<td>435</td>
<td>220</td>
<td>94</td>
<td>71</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>Total cost (Trillion KRW)</td>
<td>27.2</td>
<td>9.4</td>
<td>6.9 (= 6.2 Billion USD)</td>
<td>5.6</td>
<td>4.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### BTO cases(STPs)

<table>
<thead>
<tr>
<th>STPs (m3/d)</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 STPs (77,000)</td>
<td>88.2</td>
<td>236.2</td>
<td>140.2</td>
<td>507.3</td>
<td>971.9 (= $ 868 M)</td>
</tr>
<tr>
<td>5 STPs (239,000)</td>
<td>1,205</td>
<td>3,511</td>
<td>1,539</td>
<td>1,539</td>
<td>730</td>
</tr>
<tr>
<td>9 STPs (356,000)</td>
<td>1,000</td>
<td>2,307</td>
<td>1,307</td>
<td>1,151</td>
<td>638</td>
</tr>
<tr>
<td>6 STPs (286,200)</td>
<td>1,000</td>
<td>2,307</td>
<td>1,307</td>
<td>1,151</td>
<td>638</td>
</tr>
<tr>
<td>22 STPs (737,800)</td>
<td>1,205</td>
<td>3,511</td>
<td>1,539</td>
<td>1,539</td>
<td>730</td>
</tr>
</tbody>
</table>

### BTL cases(sewer line)

<table>
<thead>
<tr>
<th>Length (Km)</th>
<th>05</th>
<th>06</th>
<th>07</th>
<th>08</th>
<th>09</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,205</td>
<td>1,359</td>
<td>1,539</td>
<td>730</td>
<td>200</td>
<td>187</td>
<td>129</td>
<td>9,040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,307</td>
<td>1,307</td>
<td>1,151</td>
<td>638</td>
<td>222</td>
<td>173</td>
<td>129</td>
<td>6,927 (= $ 6.2 B)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Project Cases | 17 | 29 | 15 | 15 | 10 | 4 | 2 | 2 | 94 |

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Statistics Graph of PPP
Good Practice 4 – Real Time Water Quality Monitoring System on STPs and WWTPs

Around-the-clock real-time, remote monitoring system for monitoring the effluent water quality from Sewage and Wastewater Treatment Plants of the capacity over 500 m³/day

Sewage and Wastewater Treatment Plants in Public Sector

Wastewater Treatment Plants in Private Sector

Control Center

Ministry of Environment
River Basin (Regional) Environmental Offices & local governments
Sewage and wastewater treatment plants

Final discharge outlet
TMS station
Final discharge outlet
TMS station

Measured data
National total discharge quantity
Quantity monitored by TMS

23.33 million m³/d
22.14 million m³/d 94.9%

Real-time monitoring of 94.9% of treated water nationwide
Water TMS Installation Status in Korea

Amendments to the Water Quality and Ecosystem Conservation Act (Act, Enforcement Decree, and Enforcement Rule)
- Public sewage: applied to over 700 m³/d
- Foundation for administrative fine for exceeding the effluent standard

Establishment of Integrated Water Control Center
- Attaching CCTV to all Water TMS stations
- Introduction of TOC Water Quality Standard
- Disclosure of pollutant emission status

Measurement Items
- pH, TOC/COD, SS, T-N, T-P

Nationwide
- Public sewage treatment facilities: 622
- Public wastewater treatment facilities: 146
- Wastewater Discharging facilities: 288 (including 1 prevention facility)

Metropolitan Area
- Public sewage: 243
- Public wastewater: 33
- Discharging facilities: 99
- Total: 375

Chungcheong Area
- Public sewage: 104
- Public wastewater: 57
- Discharging facilities: 79
- Total: 240

Gwangju-Jeonnam-Jeju Area
- Public sewage: 116
- Public wastewater: 18
- Discharging facilities: 45
- Total: 179

Daegu-Gyeongbuk Regional Office
- Public sewage: 77
- Public wastewater: 19
- Discharging facilities: 24
- Total: 120

Busan-Ulsan-Gyeongnam Area
- Public sewage: 82
- Public wastewater: 19
- Discharging facilities (including 1 prevention facility): 41
- Total: 142

Auxiliary Facilities
- Flow meter, power meter, automatic sampler, data logger

As of 2021
Effects of Water TMS on Lowering Pollutant Concentrations

Reduction of water pollutant concentrations by approximately **58%** compared to the pre-installation concentrations in 2008

- **COD**: 8.3 → 2.1 (71% reduction)
- **SS**: 12.7 → 7.3 (35% reduction)
- **T-N**: 9.700 → 6.618 (32% reduction)
- **T-P**: 2.270 → 0.176 (92% reduction)

Administrative Agencies
- To provide feedback data to environmental policies
- To eliminate irrationality by scientific based monitoring methodology

Discharging facilities
- To try meet the effluent standard by alarm service
- Easy to operate the facility by monitoring the water quality in real-time

Environment
- To prevent water pollution accidents
- To improve river water quality by managing discharged water quality
Experience and Lessons

Harmony
- Consensus among Stakeholders
  - Central & Local Gov & Residents
- Upstream & Downstream Area
- Protection vs. Development

Localization
- Water Treatment Process
- Material & Machinery
- Pursuing Stable O&M

Quality Control & Assurance
- Importance of QC in Piping Work
  - Reducing Leakage in Water Supply and Infiltration/Inflow in Sewerage
- Introduction QA system in STP
  - Set Target before Bidding
  - 3~6 months for test-run & final Q/A

Experts and Financial Sources
- Establishment of Experts Institution
  - R&D, National Project Implementation
  - Dispersing Relating Technology, QA/QC
  - Monitoring Water Quality and Analysis
- Securing Financial sources
  - Sewerage expanding projects are needed a huge amount of budget compared to water supply projects
Future Collaboration

Collaboration with WB and Clients countries with K-eco for using KGGTF
- K-eco’s good practices such as Tele-Monitoring System for monitoring water or air quality can be applied to partner countries.
- K-eco has been collaborating with WB team to improve the environment in Jordan. (waiting the selection result)

Using Korea’s Green ODA fund or Knowledge Sharing Program
- Korean Government has been trying to share Korea’s experience and good practices with partner countries since 2004.
- One of KSP programs is to collaborate with MDBs including WB.
- WB & K-eco collaborated to carry out the feasibility study for constructing a sanitary landfill at Atyrau in Kazakhstan in 2016.
- Based on the KSP-WB collaboration result, we can develop a Green ODA project in environment area.

Sharing K-eco’s experience with Partner countries
- Many partner countries have visited K-eco tory to improve and conserve the environment during last 30 years.
- K-eco has been sharing with WB teams and partner countries K-eco’s experiences and practices.
- K-eco is always welcome to visit K-eco to learn Korea’s good practices.!!!
Thank You for Attention

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