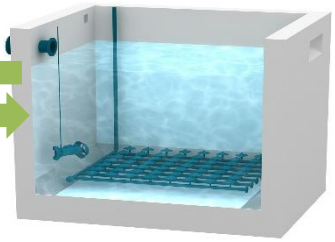
# | Anaerobic Digestion Process



(Pre-treatment)

Anaerobic Digester

Biogas holder



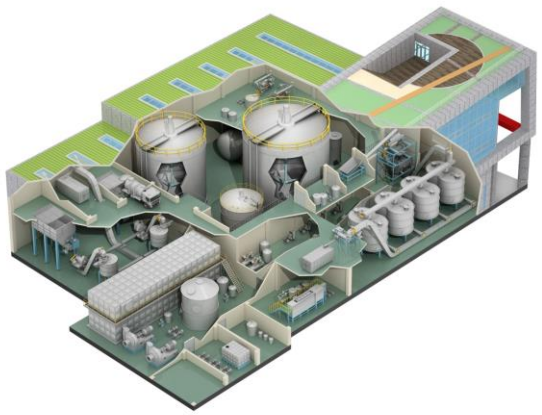
NCR
(Nitrogen Control Reactor)

## Features

- Anaerobic digestion process consists of anaerobic digester (AD), nitrogen control reactor (NCR), and biogas holder. In case of higher digestibility is required, pre-treatment equipment such as cavitation generation device is added prior to AD.
- Stable and steady anaerobic digestion performance is possible by controlling influent organic loading which can prevent AD failure due to shock organic loading.
- Installation of NCR is helpful in preventing ammonia inhibition in AD and reducing nitrogen loading in post-treatment.
- Biogas from AD can be used for electricity generation and/or AD heating.

## Applications

- Organic wastes such as sewage sludge, food waste, animal manure etc.
- Agro-wastes such as bagasse, molasses, palm oil mill effluent (POME) etc.



## Advantages

- Maintains balanced and constant operation by managing influent flow rate
- Minimizes the ammonia inhibition by NCR
- Creates biogas, a renewable source of energy that can be used to natural gas
- Prevents methane emission into atmosphere, a greenhouse gas with a global warming potential
- Reduces post-treatment loads by high digestion efficiency and low nitrogen content
- Produces much less biomass than aerobic processes
- Sludge is more easily dewatered

# | Pre-treatment types

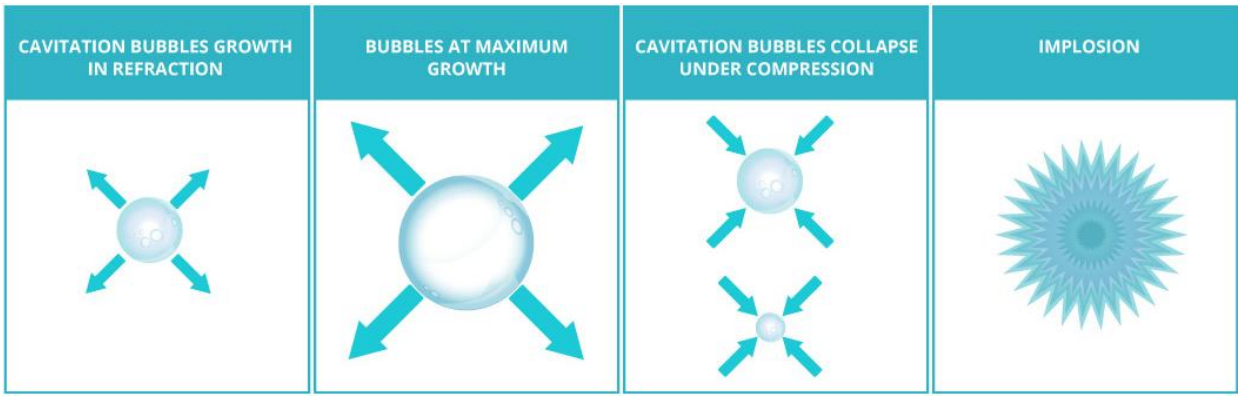
## Option I. Cavitation

- This method is to utilize cavitation generated by ultrasonic or hydro-dynamically, which disrupts microbial cells.
- Cavitation enhances anaerobic biodegradability of various organic materials in AD.
- Easy to install and maintain equipments
- Easy to construct, expand, and replace
- Effective auto operation by flow-rate control

## Option II. Cyclone

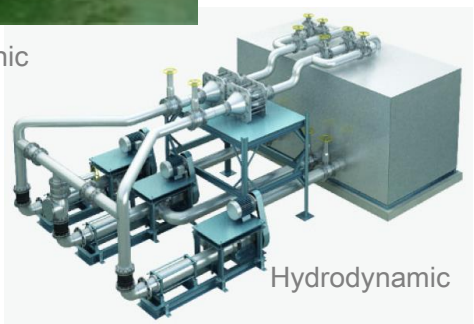
- This method is to separate organic matters and inorganic matters using difference of specific gravity.
- It is suitable for pre-treatment of sludge generated from combined sewerage and drainage system having low VS/TS ratio.
- Low energy consumption
- Low operating and maintenance costs
- No chemical requirements

### CAVITATION BUBBLE GENERATION AND IMPLOSION



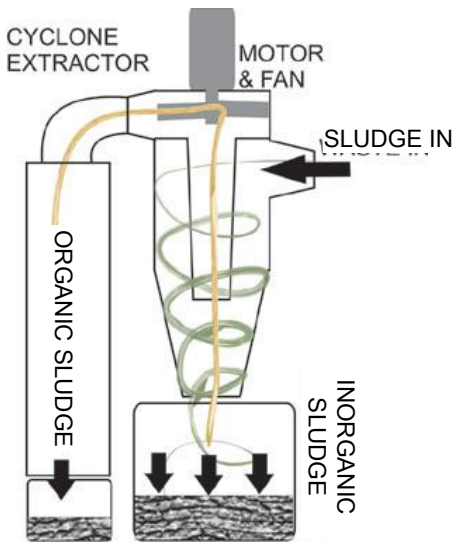

### CAVITATION GENERATION DEVICE

Ultrasonic



Hydrodynamic

### CYCLONE SCHEMATICS

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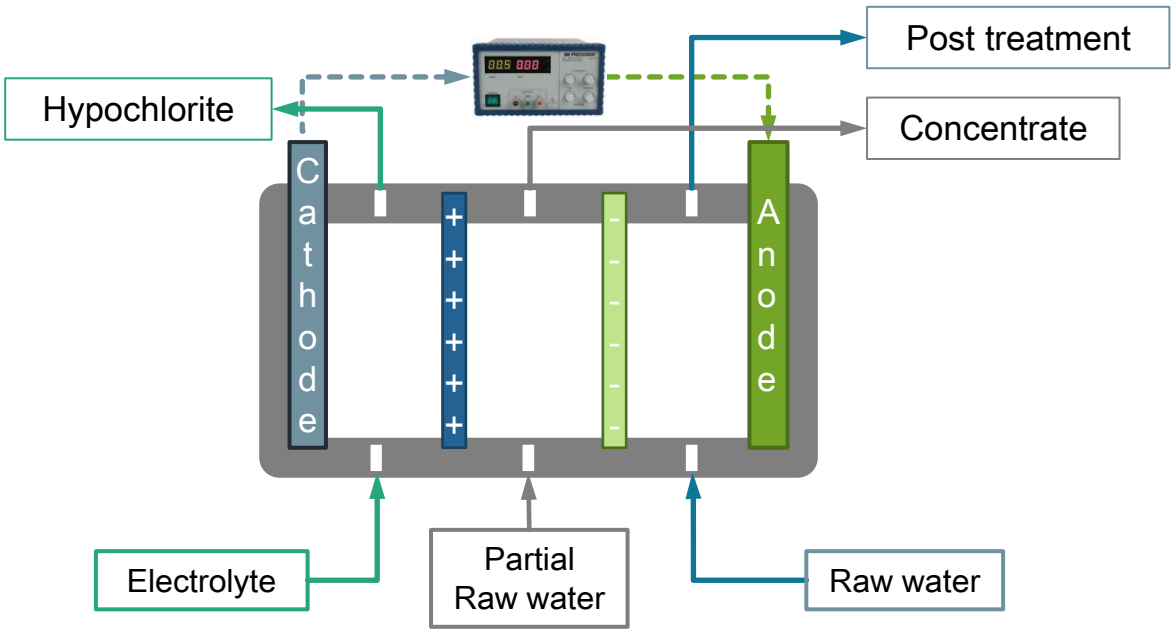
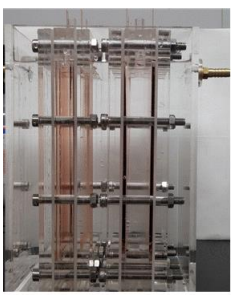
# | Water Treatment System – Electro-Chemical Separator




Electro-Chemical Separator (ECS)

## Features

- This technology is able to provide stable and sustainable water. It is possible to respond with various water quality requirements and water amount demands.
- The ECS system consists of a cation exchange membrane (CEM) and an anion exchange membrane (AEM) between an anode and a cathode
- The ECS system can be able to remove of various pollutants in water and wastewater including ionic pollutants, biological pollutants, and heavy metals.



## Advantages

- The ECS advantages are as follows.
  - can be applied to water, wastewater, and groundwater treatment
  - maintenance friendly
  - small footprint
  - low energy consumption
  - low capital and operating costs
  - no disinfection system requirements
  - low wastewater production compared to ion exchange resins

## Applications

- Water treatment for drinking water production
- Production of ultra pure water
- Groundwater treatment : Nitrate, arsenic, fluoride, heavy metals removal, Hardness & salts reduction, Pathogenic bacteria disinfection
- Wastewater treatment/reuse
- Desalination of sludge
- Demineralization of food products
- Recovering valuable materials such as heavy metals

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# | Water Treatment System – Adsorption/Oxidation Filter

## Ammonium Adsorption Filter + Iron/Manganese Contact Oxidation Filter

## Features

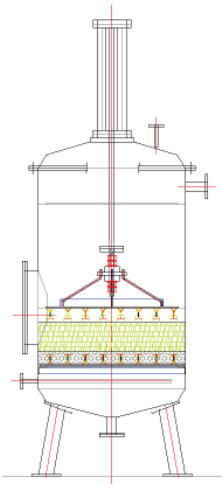
- This technology is able to provide stable and sustainable water by conducting simultaneously physical adsorption and filtration.
- Zeolite with selective ion exchange ability can remove ammonium ion in the water, and insoluble oxidized metals are filtered by special packing materials.
- Can be applied to various ionized pollutants removal such as ammonium, iron, and manganese in water and groundwater.
- High water quality effluent
  - ammonium < 0.5 mg/L
  - iron / manganese < 0.3 mg/L

## Advantages

- Cost-effective system
  - low energy consumption
  - low capital and operating costs
  - semi-permanent filter media
- Small footprint through compact design
- Easy to install and respond
- Maintenance friendly
- No additional chemical requirements

## Applications

- Water and groundwater treatment for drinking water production
- Wastewater reuse
- Industry wastewater treatment such as cooling water, dying wastewater

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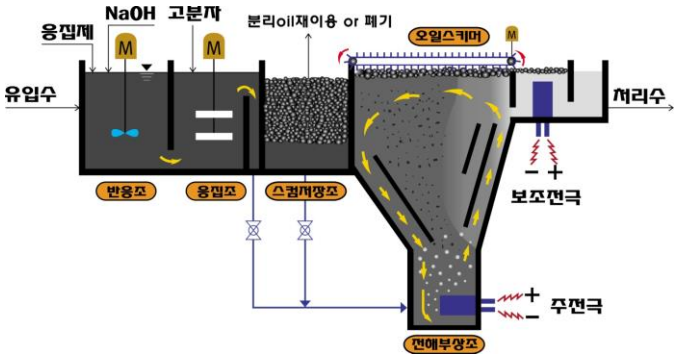
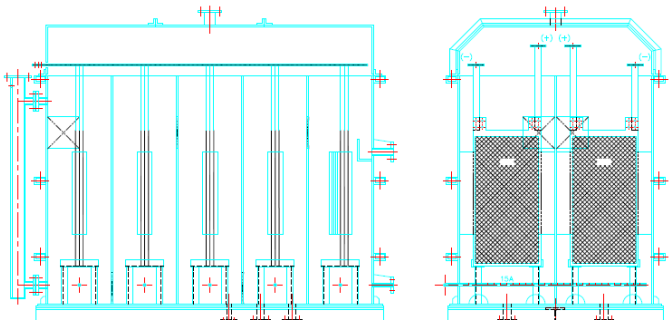
# | Recalcitrant Wastewater Treatment

## Electro-Flotation (ECOLYZER®-EF)



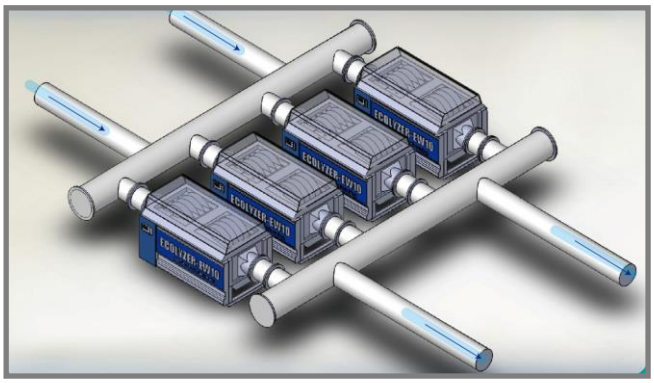

- Oil and suspended solids removal by 10㎛ micro-bubbles
- Excellent water quality
- Low power and chemical costs
- Low scum production, low scum water content
- Additional effects; decoloration, COD & BOD removal

## Electrochemical Oxidation (ECOLYZER®-ED)



- Effective treatment for non-biodegradable / high toxic wastewater
- Effective treatment for sea water / wastewater with high chlorine content
- No effects on high (>40°C) and low (<15°C) temperature
- Energy saving by using selective electrodes depending on target substances

## Electro-Winning (ECOLYZER®-EW)



- Wiper skims metals extracted on rotating cathode
- Effective treatment for wastewater with heavy metals (iron, cupper, lead etc.)
- Effective treatment for wastewater with high hardness (calcium, magnesium etc.)
- Recovery and Reuse of extracted metals

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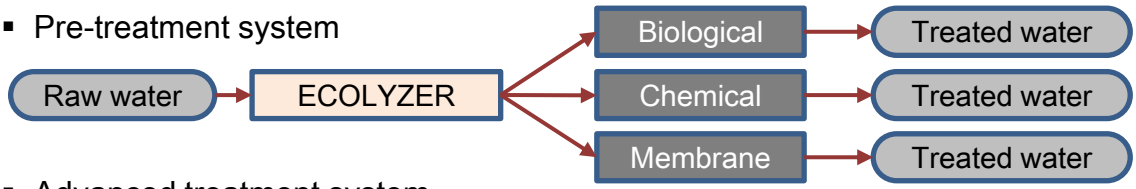
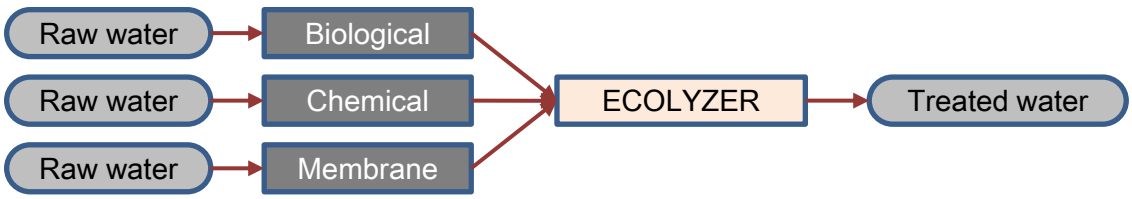
## Process Utilities

- Main treatment system


- Pre-treatment system




- Advanced treatment system




## Applications











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# | Electrokinetic Sludge Dewatering Technology


## Features

- This technology offers separation, dewatering and drying solution and equipment in sludge treatment process.
- It is helpful to reduce the production of the sludge, reduce the environmental impacts and substantially improve drying efficiency for recycling of the sludge or producing bio-energy from municipal and industrial sludge.

## Advantages

- Long and reliable working life demanding minimal operational and maintenance costs
- Easy to integrate with existing dewatering systems or operated as an independent dewatering system
- Not only save the operation and disposal cost but also offer the most effective way of sludge into energy

## Principle of the Electrokinetic Dewatering

- This distribution takes the following forms;
  (a) free water that is not attached to the sludge particles and can be removed by gravitational settling.
  (b) interstitial water that is trapped within the flocs of solids or exists in the capillaries of the dewatered cake and can be removed by strong mechanical forces
  (c) surface water that is held on the surface of the solid particles by adsorption and adhesion and
  (d) intracellular and chemically bound water
- The electrokinetic dewatering can achieve 35-40% of dry solid by taking out the free water, interstitial water, surface water and part of intracellular and chemically bound water, whereas the conventional dewatering can achieve only 20-25% dry solid by taking out only free water.

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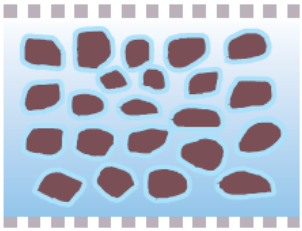
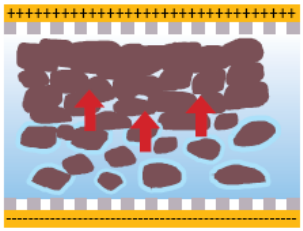
## Mechanism and Process of the Electrokinetic Movement

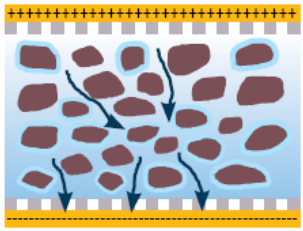
Preliminary mechanical pressure



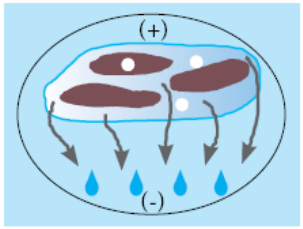
1. Electrophoresis



2 & 3 Electro-osmosis and capillary pressure



4. Rupture of cell membrane




- Preliminary Mechanical Pressure
- 1st phase. Electrophoresis
  Negative-charged sludge particles are forced to move toward positive-charged anode by the difference of the electric potentials
- 2nd phase. Electro-Osmosis
  The positive-charged free water particles are forced to move toward the negative-charged cathode by the difference of electric-potentials.
- 3rd phase. Electro-Osmosis, Capillary Pressure
  Adsorbed water particles percolate through sludge particles and move toward the cathode
- 4th phase. Rupture of cell membrane
  By the rupture of the cell membranes in the sludge, the absorbed water becomes free.

## Standard Specification

| Model | E700 | E1000 | E1500 | E2000 |
|---|---|---|---|---|
| Throughput (MT/H) | 0.5 – 0.7 | 0.8 – 1.0 | 1.0 – 1.4 | 1.6 – 2.0 |
| Inlet sludge DS | 15 – 20 % | | | |
| Discharged sludge DS | 35 ± 3 % | | | |
| Energy consumption | 140 kw per 1 Mt of sludge | | | |
| Dimension (M) | 2.5(W)*3.5(L)*1.5(H) | 3.2(W)*3.5(L)*1.5(H) | 2.5(W)*3.5(L)*2.2(H) | 3.2(W)*3.5(L)*2.2(H) |

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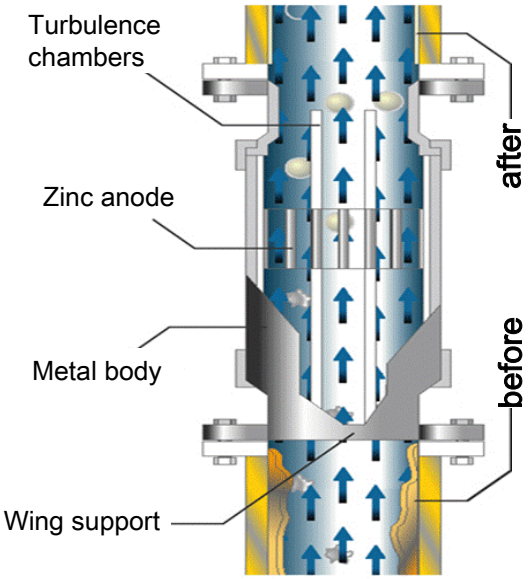
# | Scale-Buster




Scale-Buster Schematic Diagram

Zn Ion ($Zn^{2+}$)

- Prevent creation of slime, scale, rust
- Remove slime and scale
- Soften water

Anion ($2e^-$)

- Prevent rust
- Convert rust into magnetite
- Prevent water leakage
- Prolong pipe lifetime

## Features

- Scale Buster is a water treatment device/system to prevent and remove slime, rust and scale in the water pipe without additional chemicals or external electricity.

  - External : Brass

  - Internal : Special Zinc, PTFE

## Advantages

- Prolongs the lifetime of water pipe by removing the scale and converting the structure of rust to magnetite.
- Saves the cost by over 85% compared to replacement of water pipe.
- No inconvenience occurs to resident's life because it is installed on existing water pipe.
- Minimized inconvenience for residents due to short installation time (can be finished in 4-5 hours).
- Lifetime of Scale Buster lasts out 20 years, and 20 years later you only need to replace Zinc in the Scale Buster to extend the lifespan.
- Accordingly, it can prolong the lifetime of water pipe and buildings.
- Makes more softened water and good for skin trouble treatment.

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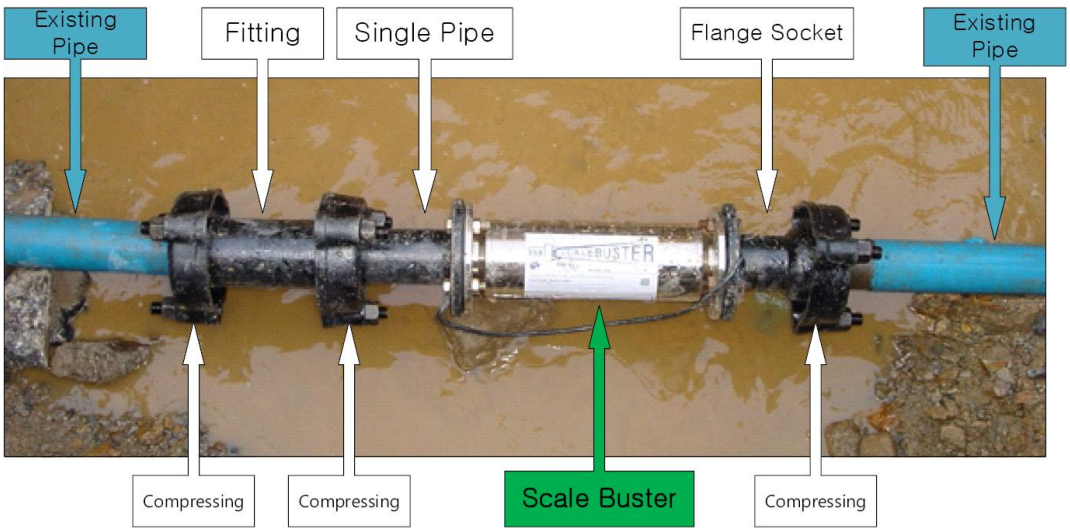
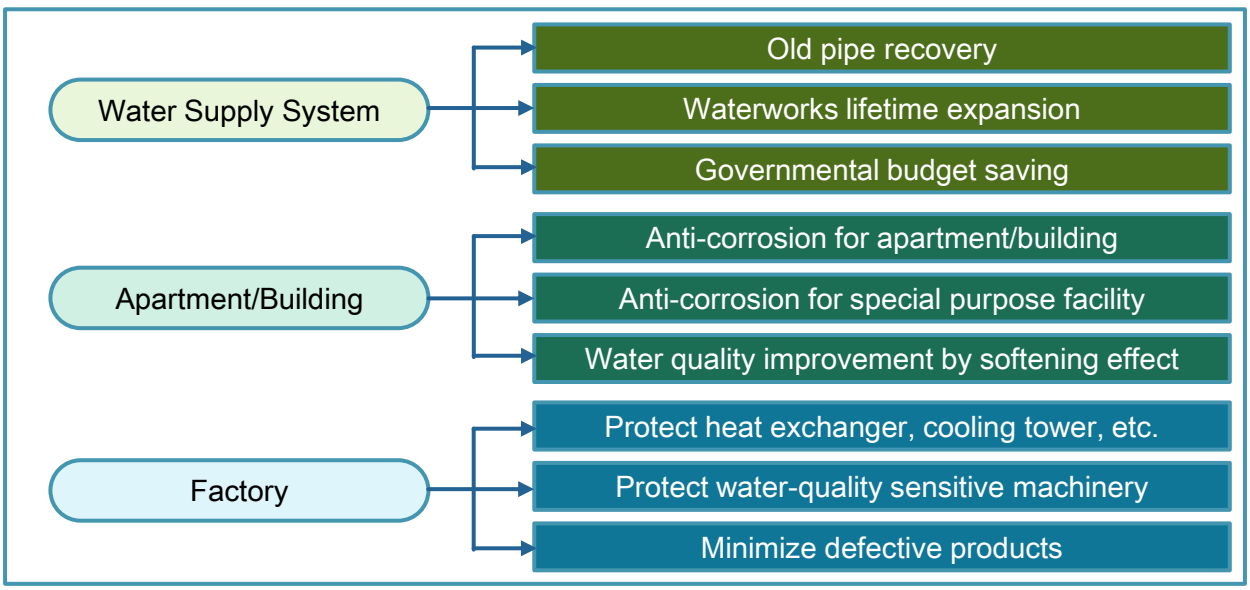
## Scale-Buster Installation Effects




Before (Oct. 2011)
40% of pipe was clogged by scale and rust

After 17 month (Mar. 2013)
90% of scale was removed

## Applications

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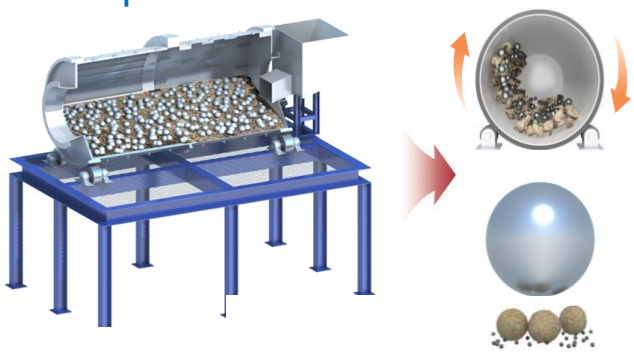
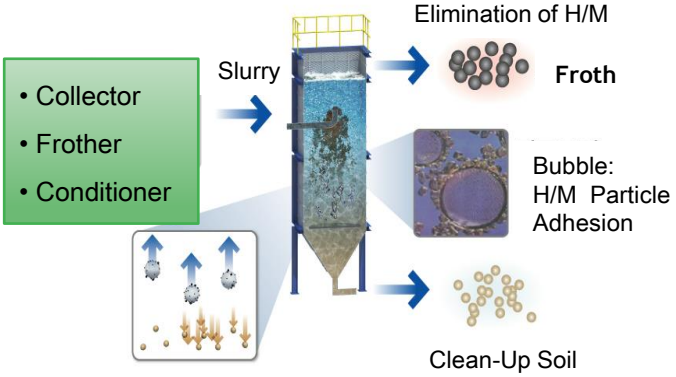
# | Remediation Technology for Contaminated Soil

Ball-Mill and Bubble Size Adjustable Flotation for Remediation of Heavy Metal Contaminated Soil

## Principle



- Attrition(Surface Grinding)
  - Technology for heavy metal contaminated soil, which has developed from traditional mineral dressing technology
  - Easy separation of heavy metal from contaminated soil without using chemical agents (no acids/bases are needed)




- BSA(Bubble Size Adjustable) Flotation
  - Contaminant (Heavy Metal) selective separation technology using bubble size adjustable flotation
  - Reduce by-products and wastes

## Process


## Applications

Janghang Refinery Site

(Seocheon, South Korea)

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