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CTCN UN Climate Technology Centre & Network

Online Workshop

Pre-feasibility study for groundwater desalination and resource recovery in Uzbekistan

Ryu, YoungBok (KITECH)

14 May 2026

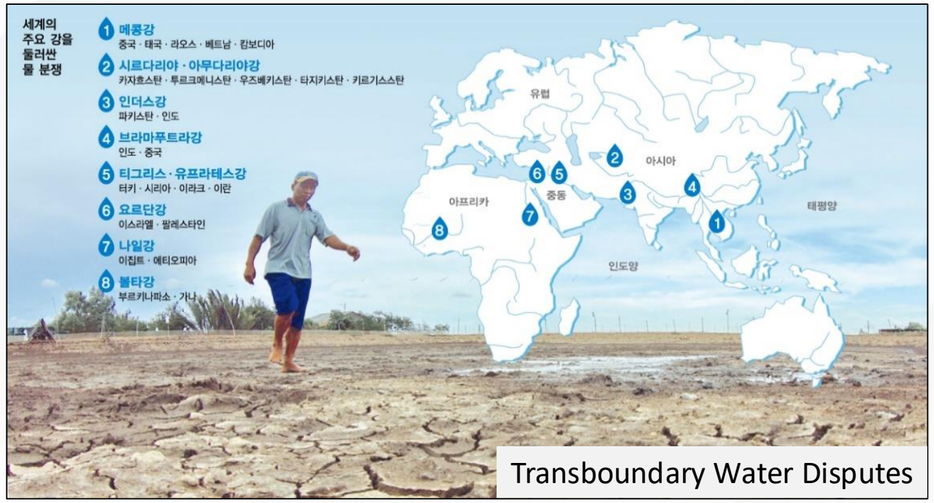
14:30 - 18:00 Seoul, GMT+9
12:30 - 16:00 Bangkok, GMT+7
01:30 - 05:00 New York , GMT-5

Photo from : The Malaysian Reserve

Joint Certificate Programme

Background / Regional Context & Water Challenges

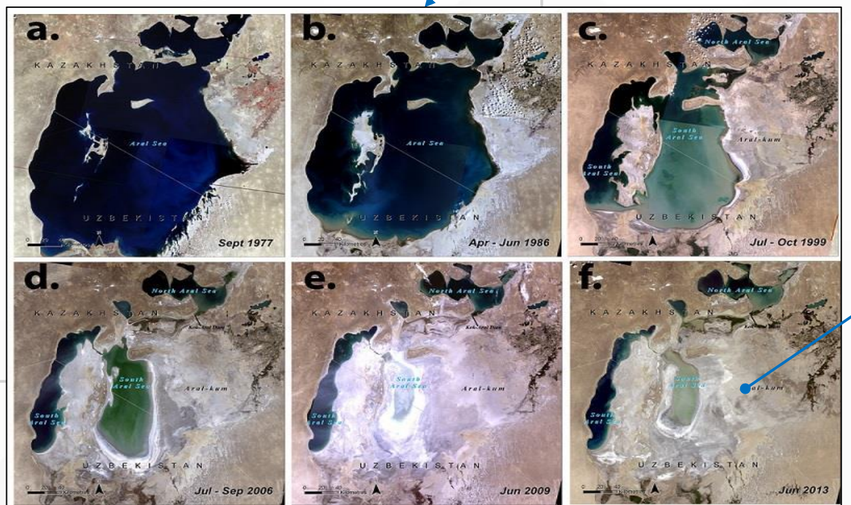
- **Arid Climate Characteristics**
  - Uzbekistan is a **doubly landlocked country** in Central Asia.
  - Average annual precipitation is approx. 150 mm, exhibiting **arid desert climate** features.
- **Water Source Limitations**
  - Major Freshwater Sources: Amu Darya and Syr Darya rivers.
  - Shared with neighboring countries (**ongoing water disputes**) → Difficult to secure independent water resources.
- **Groundwater Dependency**
  - **80% of total national water demand** is dependent on groundwater.



Transboundary Water Disputes

Background / Groundwater Utilization Policy & Future Strategies

- **Government Initiatives**
  - The government is actively promoting **groundwater utilization** to meet rising demand.
- **Challenges in Water Quality**
  - High mineral content due to geological factors.
  - **Approx. 40% of groundwater has high salinity**, making it unsuitable for direct use.
- **Strategic Requirements**
  - Securing water resources via groundwater requires **professional talent training** and **technology transfer**.
- **Agricultural Impact**
  - Irrigation with saline water has led to **soil salinization** → Reduced farmland and productivity (Soil restoration is a priority task).
- **Circular Economy Opportunities**
  - Potential for **recovering dissolved resources** (Alkali / Alkaline Earth Metals) from concentrated wastewater.
  - Action Plan: Training of resource recovery experts and introduction of advanced technologies.



Background / Groundwater Utilization Policy & Future Strategies

- **Established Policy Framework (2017-2030)**
  - **Systematic Roadmaps**: Implementation of Presidential Decrees (PP-3437, PP-6024) to secure and manage water resources.
  - **Legal Foundations**: Emergency measures and 2023 legislation focused on groundwater protection and rational use.
  - **Strategic Goals**: Reduction of soil salinity and transition to resource-recovery models.

- **The Critical Challenge: Technical & Institutional Gaps**
  - **Need for Advanced Technology**: Despite established policy goals, there is a requirement for specialized desalination and resource-recovery technologies tailored to local conditions.
  - **Capacity Enhancement**: Importance of strengthening technical expertise and institutional frameworks to implement sustainable systems.
  - **International Cooperation**: Identifying, piloting, and scaling appropriate technologies through global partnerships.

- **Strategic Conclusion**
  - **From Policy to Action**: Transitioning from a theoretical roadmap to practical implementation through immediate technical intervention and expert training.

Project Overview

- **Title :** Pre-feasibility study for groundwater desalination and resource recovery in Uzbekistan
- **Period :** 07/11/2025 ~ 06/09/2026 **/ Budget :** 249,914 USD
- **Proponent :** HYDROENGEO (Uzbekistan) **/ Implementor :** KITECH (KOREA)
- **Location :** Tashkent (Targeting high-salinity wells)
- **Project Objectives**
  - **Tech Assessment**: Identify feasible desalination and resource-recovery technologies.
  - **Pilot Design**: Design an optimized pilot system for producing potable and industrial water.
  - **Capacity Building**: Strengthen national expertise through technology transfer and professional training.
  - **Strategic Roadmap**: Establish the technical and economic groundwork for future scale-up.

Project Scope & Outputs

Output 1 / Technical Review

- **Technology status and capacity assessment in Uzbekistan**
  → Summary of global technology review and best practices
- **Local survey in Uzbekistan (Groundwater characteristics)**
  → Site visit and raw water sampling report including test results
- **Desalination and resource recovery testing**
  → Technology screening matrix with environmental and economic evaluation
- **Assessment of local applicability based on test results**
  → Final assessment report with technology recommendations and site selection rationals

Output 2 / Pilot System Design

- **System design review based on sample and test results**
  → Pilot process flow configuration summary based on test results
- **Conceptual design of process flow and site-specific layout**
  → Conceptual process flow diagram (PFD) and site-specific layout
- **Pilot scale optimization based on CAPEX and OPEX analysis**
  → Technical memo on CAPEX/OPEX and sizing analysis
- **Preparation of basic engineering documents for pilot construction**
  → Basic engineering design package including specifications and drawings

Output 3 / Feasibility Assessment

- **Technical evaluation**
  → Technical Evaluation Materials
- **Socioeconomic & gender analysis**
  → Socioeconomic Evaluation Materials, Gender analysis report
- **Environmental impact assessment**
  → Environmental Evaluation Materials
- **Scale-up project concept note**

Output 4 / Training & Engagement

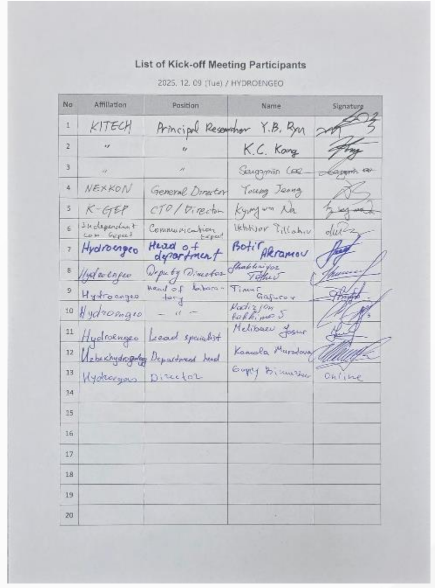
- **Steering committee formation and meetings**
  → List of committee members, Minutes of the steering committee meeting
- **Stakeholder training and technical workshops**
  → Updated stakeholders list, introductory training materials(Gas hydrate, Mineral carbonation), Technical Training Materials (Practice-Oriented, Based on Pilot Design)
- **Final report and result dissemination**
  → Final Report and Presentation materials

Project Timeline

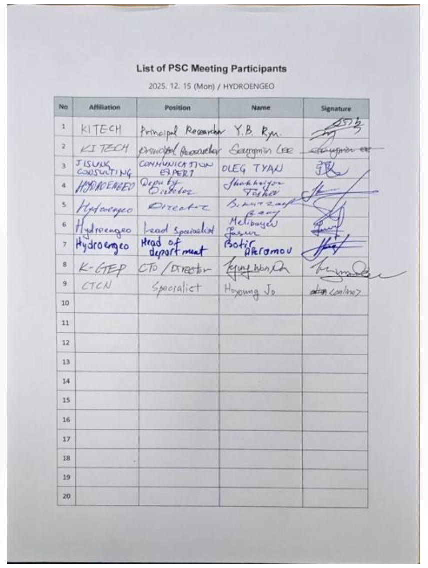
STEP	Title	Month									
		1	2	3	4	5	6	7	8	9	10
Mandatory Output	Project management										
Activity A	Pre-implementation										
Activity B	Implementation										
Activity C	Post-implementation										
Output 1	Review of applicable desalination and resource recovery technologies in Uzbekistan										
Activity 1.1	Technology status and capacity assessment in Uzbekistan										
Activity 1.2	Local survey in Uzbekistan (Groundwater characteristics)										
Activity 1.3	Desalination and resource recovery testing										
Activity 1.4	Assessment of local applicability based on test results										
Output 2	Design of pilot system for groundwater desalination and resource recovery										
Activity 2.1	System design review based on sample and test results										
Activity 2.2	Conceptual design of process flow and site-specific layout										
Activity 2.3	Pilot scale optimization based on CAPEX and OPEX analysis										
Activity 2.4	Preparation of basic engineering documents for pilot construction										
Output 3	Feasibility assessment of the pilot system and Scale-up project concept note										
Activity 3.1	Technical evaluation										
Activity 3.2	Socioeconomic evaluation (Including gender considerations)										
Activity 3.3	Environmental evaluation										
Activity 3.4	Scale-up project concept note										
Output 4	Technical training and stakeholder exchange on groundwater treatment and resource recovery										
Activity 4.1	Steering committee formation and meetings (Twice)										
Activity 4.2	Stakeholder training and technical workshops										
Activity 4.3	Final report and result dissemination										

Major Activities / Kick-off Meeting

- **Overview**
  - **Date :** December 9, 2025
  - **Venue/Mode :** HYDROENGEO Meeting Room (Hybrid: In-person & Online)
  - **Organizer** : KITECH (Korea Institute of Industrial Technology)
  - **Participants**: Key stakeholders from HYDROENGEO, KITECH, and National experts
- **Main Objectives & Achievements**
  - **Official Launch**: Formally initiated the **UNFCCC CTCN Technical Assistance** project.
  - **Scope Alignment**: Finalized and introduced the project scope, objectives, and expected outputs.
  - **R&M Definition**: Clarified the specific roles and responsibilities of each stakeholder.
  - **Action Plan**: Confirmed the immediate implementation schedule and set priorities for the next steps.



Major Activities / PSC Meeting



List of PSC Meeting Participants

2025. 12. 15 (Mon) / HYDROENGEO

No	Affiliation	Position	Name	Signature
1	KITECH	Principal Researcher	Y.B. Ryu	[illegible]
2	KITECH	Principal Researcher	Seungmin Lee	[illegible]
3	JISUNG CONSULTING	COMMUNICATION EXPERT	OLEG TYAN	[illegible]
4	HYDROENGEO	Deputy Director	[illegible]	[illegible]
5	Hydroengeo	Director	[illegible]	[illegible]
6	Hydroengeo	Lead specialist	Melibayev Jasur	[illegible]
7	Hydroengeo	Head of department	Botir Akramov	[illegible]
8	K-GTEP	CTO / Director	[illegible]	[illegible]
9	CTCN	Specialist	Hoyoung Jo	(online)
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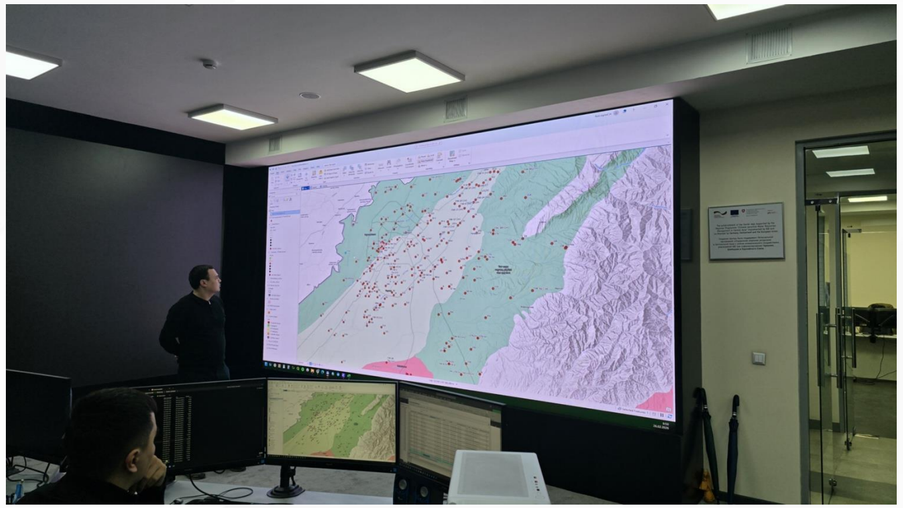
- **Overview**
  - **Date :** December 15, 2025
  - **Venue/Mode :** HYDROENGEO Meeting Room (Hybrid: In-person & Online)
  - **Organizer** : CTCN & KITECH
  - **Participants**: Steering committee members, including representatives from CTCN, KITECH, and HYDROENGEO

- **Main Objectives & Achievements**
  - **Governance Establishment**: Formally established the PSC and confirmed its roles and responsibilities to ensure stable project oversight.
  - **Strategy Review**: Conducted a comprehensive review of the project scope, implementation approach, and overall governance structure.
  - **Strategic Guidance**: Provided initial strategic direction to align the project with local and international climate technology goals.
  - **Consensus Building**: Reached an agreement on the decision-making process for key project milestones.

Major Activities / Local survey

Monitoring System (HYDROENGEO)

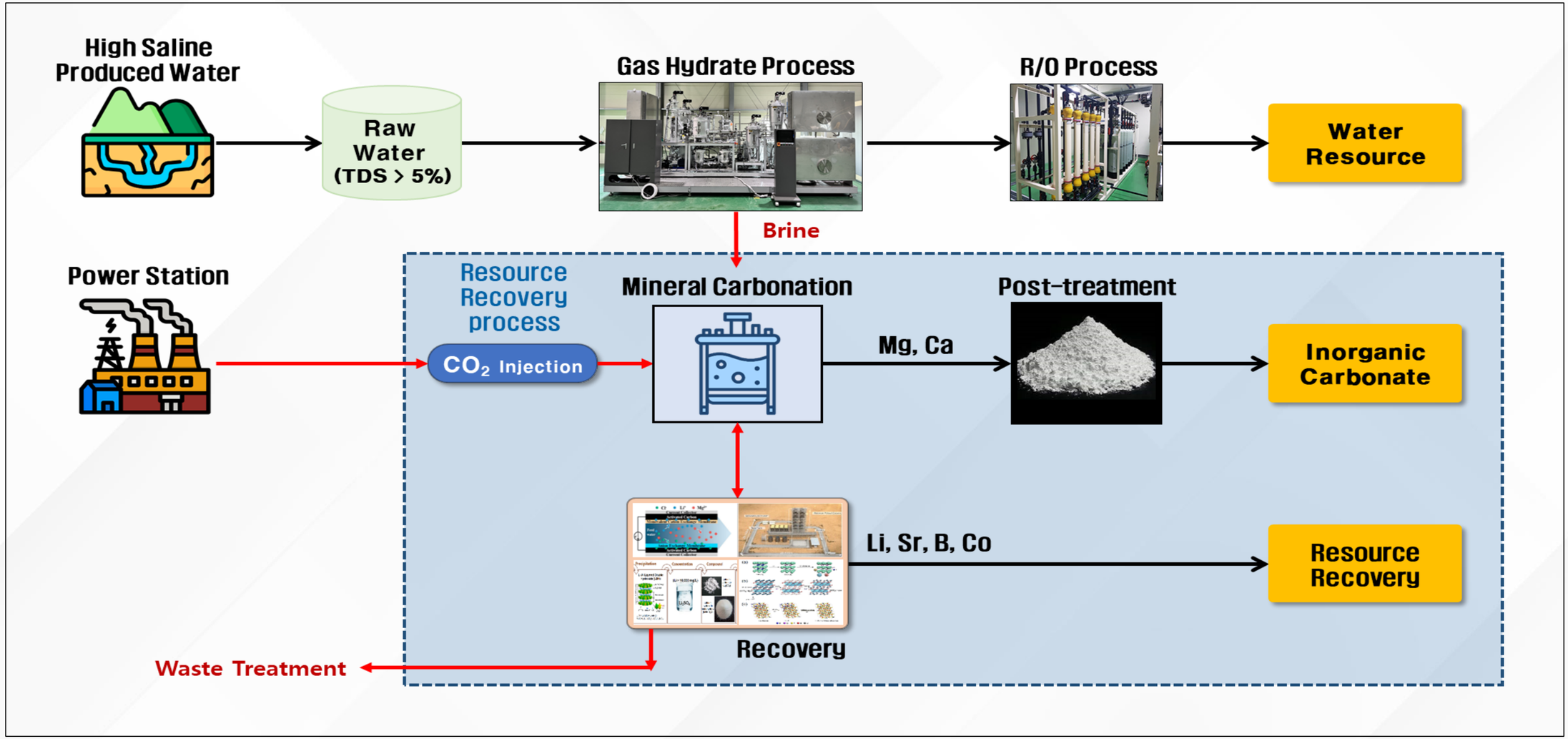


- Utilized the **Centralized Monitoring Room** to identify well locations and real-time water quality data.
- Uzbekistan manages approximately **3,000 wells** nationwide, with over **200 wells** located in the Tashkent region.

Field Survey: Chirchik-Keles Aquifer

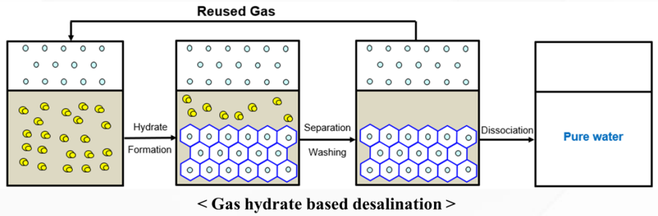
- Selected and inspected high-hardness wells based on monitoring data.
- **Location / Infrastructure**: Evaluated surrounding infrastructure and potential CO_2 sources for resource recovery.
- **On-site Testing & Sampling**: Collected raw water samples for precise lab analysis and desalination testing.

Technology Concept

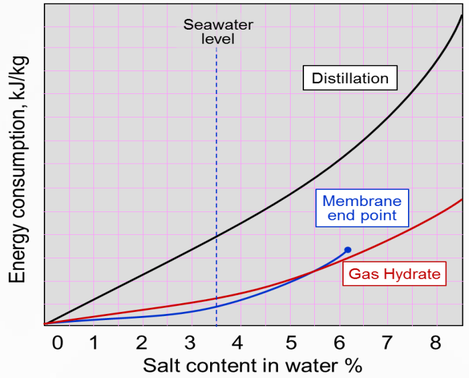


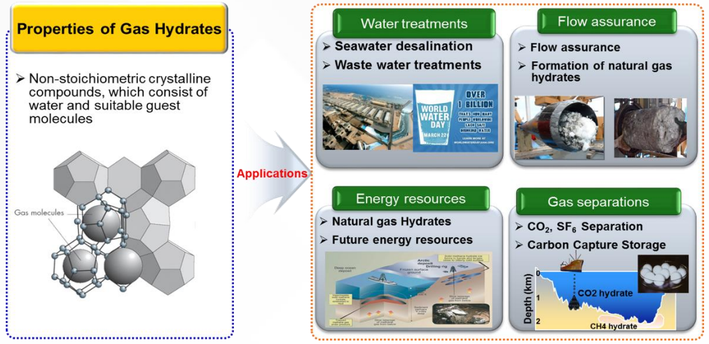
Technology / Gas Hydrate

- Produced water(wastewater) in Oil and gas field contains a large amount of TDS.
- Secure TDS and water resources with low-energy, eco-friendly technology.
- Concentration technology is needed to increase the content of useful resources.



< Gas hydrate based desalination >





Gas hydrate Technology

- No fouling
- Operating over high TDS (salts, over 5%)
- Recovery rate is lower than that of the membrane method(50%), but the energy is reduced by about 4 times compared to the evaporation method.

Technology / Mineral Carbonation

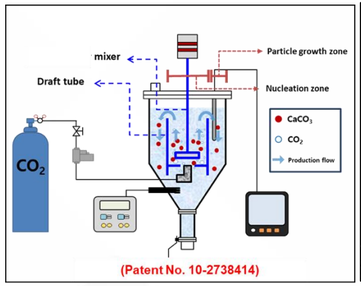
- What is Carbonation Technology?
  - Carbonation technology is a process in which ionic metals (M^+, M^{2+}) react with carbon dioxide (CO_2) to form stable carbonates (MCO_3, M_2CO_3).
  - This technology leverages the principles of **low Gibbs free energy (ΔG) and exothermic reactions**, enabling energy-efficient and eco-friendly recovery of valuable metals.
- Key Advantages of Carbonation Technology

  ① **Low Gibbs Free Energy** (ΔG) and **Exothermic Reaction**
  - The formation of carbonates (MCO_3) occurs spontaneously due to low ΔG and is an exothermic reaction, allowing the process to continue without additional energy input.
  - This characteristic facilitates carbon-neutral resource recovery, reducing carbon emissions while extracting valuable metals.

  ② **CO_2 Utilization Potential**
  - CO_2 can be obtained from filtered exhaust gases generated from surrounding production processes or obtained through Direct Air Capture (DAC) technology.

Reactor Design & Development

High-Efficiency Mineral Carbonation Reactor



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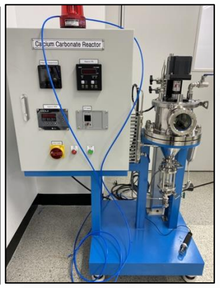
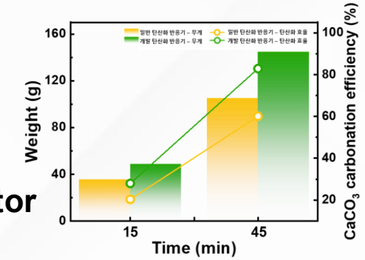
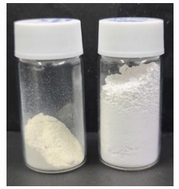
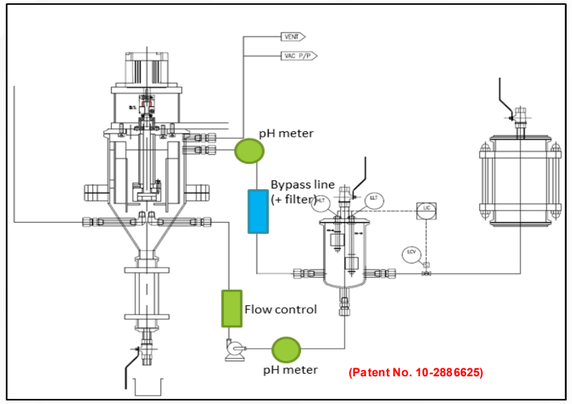





Calcite ($CaCO_3$)


Hydromagnesite ($Mg_5(CO_3)_4(OH)_2(H_2O)_4$)

Internal circulation Continuous mineral carbonation reactor



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Thank You !!