

CO₂ Fixation Technology in Controlled Coastal Landfill Sites During the Post-Closure Maintenance Period

CO₂ Fixation Technology at Coastal Landfill Sites

The water content of highly alkaline waste transported to a controlled sea-level landfill site is adjusted by sprinkling water, and CO₂ is recovered from the atmosphere and fixed in waste particles by exposing the waste to the atmosphere. This treatment suppresses the leaching of alkaline components from the waste at the time of underwater landfill and in the landfill site. The landfill method using this technology is an effort to achieve carbon neutrality of the landfill site and early abolition.

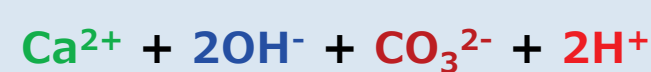
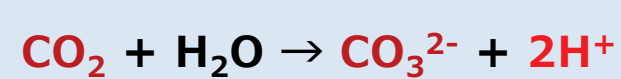
CO₂ Fixation by Sprinkler Curing on Incoming Waste

CO₂ fixation method by sprinkler curing.

CaO contained in waste is leached by sprinkling water.

On the other hand, CO₂ in the atmosphere dissolves in the water containing Ca and forms carbonate, which adheres to the particle surface. When the surface of waste particles is covered with carbonate, CaO is difficult to leach, and alkali formation is suppressed when waste is buried in water.

Suppressed.



Previous research

In the FY 2023 field experiment, it was found that a large amount of CO₂ was fixed in the surface layer thickness of about 2 cm of the waste embankment. In the case of municipal solid waste (fly ash) with a large CaO content, about 50 ~ 100 kg-CO₂/t was fixed in 7 days after spraying water and curing.

Amount of CO₂ fixed by waste type

In the FY 2024 laboratory experiment, 4 types of waste with a large pH value, which were tested in the Kankyo No. 13 test, were used. The results showed that fly ash fixed the largest amount of CO₂. This made it possible to select an efficient waste for actual use.

Verification of the Effectiveness of Thin-Layer Landfill

We confirmed that it is possible to fix a large amount of CO₂ by using thin-layer and multi-layer landfill.

Study on Optimization of Water Content

Although the moisture content suitable for CO₂ fixation differs depending on the type of waste, it was found that management at 20 ~ 50% is desirable.

[Analysis Method] The amount of CO₂ fixed in the waste is analyzed using the hydrochloric acid gas pressure method.

This method quantifies CO₂ by measuring the pressure increase of the generated CO₂ and using a calibration curve.



[Challenges] Examining practical daily operation by establishing methods for selecting waste capable of fixing large amounts of CO₂, supplying CO₂ to deep landfill layers and managing moisture content.

[Initiative] Selected for the "Aichi Environmental Innovation Project" organized by Aichi Prefectural Government, aiming to commercialize CO₂ sequestration in waste through demonstration experiments at the Kinuura Port No. 3 Waste Disposal Site. This initiative seeks to achieve carbon neutrality at controlled marine landfill sites.

※<https://www.toyo-const.co.jp/topics/technicalnews-20793>

Sprinkling Curing Conditions (2023 Field Experiments)



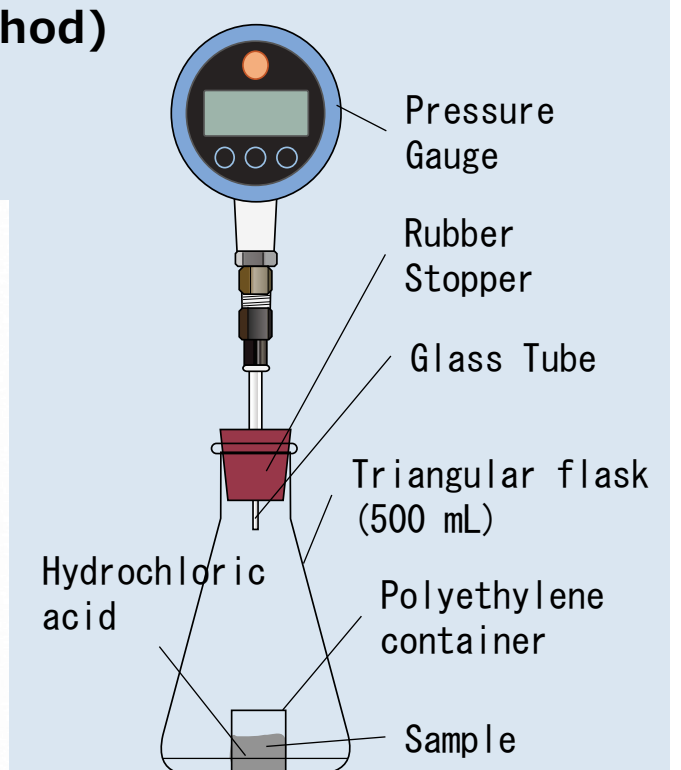
Waste Properties (2024 Test Samples)

Waste	Fly ash	Bottom ash	Dust	Slag	
Particle density (g/cm ³)	2.93	3.04	2.53	2.67	
Particle size	Coarse sand (%)	0.1	13.6	0.02	13.2
	Medium sand (%)	20.9	37.4	5.5	29.3
	Fine sand (%)	16.1	20.5	43.3	29.1
	Silt (%)	26.2	14.1	41.6	19.6
	Clay (%)	36.6	14.5	9.6	8.8
Moisture content (%)	37.5	29.5	27.1	10.2	
COD(mg/L)	25	3.3	3.4	8.8	
TN(mg/L)	3.2	0.12	0.09	0.12	
X-ray fluorescence analysis	Na ₂ O	4.0	2.7	0.77	<0.007
	Al ₂ O ₃	1.1	16	12	14
	SiO ₂	3.5	19	39	17
	SO ₃	4.1	1.8	5.0	1.4
	Cl	39	12	15	7.2
	K ₂ O	5.7	1.8	4.5	0.03
	CaO	39	39	15	51
	Fe ₂ O ₃	1.0	2.6	5.3	2.9
Initial CO ₂ content (kg-CO ₂ /t)	50	32	10	25	

Curing Conditions (2024 Laboratory Experiments)



Analytical Method (Hydrochloric Acid Gas Pressure Method)



Experimental Results (Depth Profiles of CO₂ Fixation and Moisture Content)

