[Poster presentation]

Feasibility Assessment of Carbon Mineralization and Potassium Recovery Using Cement Kiln Bypass Dust (CBPD)

D.W Kim*, I. G. Hong, J. S. Lee*, C. G. Phae****

* Institute of Environmental Technology, Seoul National University of Science and Technology
** Dept. of Environmental Engineering, Seoul National University of Science and Technology

*Corresponding author: Prof. Chae-gun Phae

Tel&Fax: +82-02-970-6617
(E-mail: *phae@seoultech.ac.kr*)

Acknowledgement : This research was supported by Development of stable utilization technology for cement kiln chlorine bypass dust Fund (RS-2023-00265662 / 2410000433) by MOT, Korea.

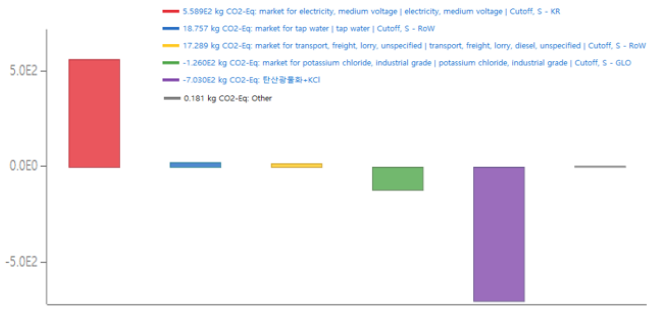
ABSTRACT

The cement industry accounts for a significant share of global greenhouse gas (GHG) emissions due to the calcination of limestone and fossil fuel combustion during clinker production. To mitigate these emissions, carbon mineralization using Cement Kiln Bypass Dust (CBPD) offers a promising solution, as capturing CO_2 while enabling potassium chloride (KCl) recovery. This study aims to assess the environmental and economic feasibility of a CBPD-based carbon mineralization and KCl recovery process as an alternative to landfilling. A Life Cycle Assessment (LCA) following the IPCC (2021) GWP 100 method was conducted to estimate CO_2 reduction, and a Benefit–Cost (B/C) analysis was performed using process data derived from pilot-scale operation and mass balance modeling. The results indicate that the developed process achieves a net GHG reduction of –0.156 kg CO_2-eq per kg of CBPD, confirming its carbon-negative performance. In addition, the process was found to be economically viable, yielding a net profit of 315,041 KRW per ton of CBPD and a B/C ratio exceeding 3.0, primarily due to revenue from $CaCO_3$ and KCl recovery and carbon credit trading. Overall, the proposed technology demonstrates strong potential for industrial-scale decarbonization in the cement sector by transforming a landfill-bound by-product into valuable mineral and chemical resources. Future research should focus on scaling up, LCA–TEA integration, and policy linkage to promote commercialization and inclusion within circular economy and carbon neutrality frameworks.

Contents

Global warming

GHG emission	Landfill	T 1	T 2	T 3
$kgCO_2eq/kgCBPD$	0.012	0.968	0.242	–0.156



B/C

Category		Conventional Technology	T3
Overview		Landfilling	Carbon mineralization + KCl recovery
Installation Cost		–	19,660,000 KRW per unit
Treatment (Operation) Cost		152,000 KRW/ton	695,025,000 KRW/year
Treatment Capacity (ton/year)		–	10,000
Service Life (years)		–	20
Unit Installation Cost (KRW/ton–CBPD)		–	9,830
Unit Treatment Cost (KRW/ton–CBPD)		152,000	97,345
Total Unit Cost (KRW/ton–CBPD)		152,000	107,175
Benefit (KRW/ton–CBPD)	$CaCO_3$ 1)	–	179,643
	KCl 2)	–	202,263
	CO_2 emisson 3)	–	40,310
Total Cost (KRW/ton–CBPD)		152,000	–315,041

Notice

1) Replacement of CBPD : 0.252 kg $CaCO_3$eq/kg Desalted cake, $CaCO_3$ as limestone 6500 KRW/25 kg–$CaCO_3$
2) Replacement of KCl : 0.170 kg KCl/kg–CBPD, KCl as Fertilzer 26,400 KRW/25 kg–KCl
3) Carbon Credit Trading Revenue : 0.4687 kg CO_2/kg–CBPD, CO_2 86,000 KRW/Ton–CO_2eq