HERCCULES – DEMONSTRATION OF A NOVEL CO_2 CAPTURE TECHNOLOGY AT THE TITAN EFKARPIA PLANT

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ABSTRACT

The global cement production sector contributes approximately 8% of anthropogenic CO_2 emissions. A substantial portion of these emissions, around 1.5 $GtCO_2/y$, arises from the thermal decomposition of limestone (calcination), with approximately 4% occurring in Europe[1]. This calcination process is a major contributor, responsible for about two-thirds of the total CO_2 emissions from cement production[2]. Recognizing the urgency of mitigating carbon emissions, the cement industry has identified CO_2 capture and permanent storage as a pivotal decarbonization strategy, as outlined in established roadmaps toward achieving Net Zero. According to the Global Cement and Concrete Association (GCCA), Carbon Capture, Utilization, and Storage (CCUS) is projected to contribute about 36% of the reduction in CO_2 emissions by 2050[3-5].

In alignment with this global objective, the European Commission has consistently endorsed CCUS technologies, particularly in hard-to-abate industries. TITAN Cement Group, a key industrial partner in the Horizon Europe HERCCULES project (Heroes in Southern Europe to decarbonize industry with CCUS[6]), is part of a consortium comprising 23 partners that have secured approximately €29million in funding over a 5-year period. The HERCCULES initiative focuses on accelerating the deployment of CCUS technologies in Mediterranean Europe, emphasizing the entire CO_2 CCUS value chain. Its objectives encompass showcasing the feasibility of CCUS technologies, emphasizing energy-environmental performance, safety, CO_2 logistics optimization, and societal acceptance.

At the core of the project, TITAN leads the efforts in integrating the engineering design, construction, and demonstration of a novel high-purity CO_2 capture hybrid technology configuration, currently at Technology Readiness Level 7 (TRL7). The technology will be piloted at the TITAN Efkarpia Plant in Thessaloniki, incorporating two key components:

1. Oxyfuel combustion (both partial- and full- oxyfuel) combined with a Carbon Processing Unit (CPU) for efficient capture of calcination process emissions.
2. A new-generation solvent-based Post-Combustion Capture (PCC) system designed to efficiently capture emissions from the rotary kiln.

This integration culminates in the development of the HERCCULES hybrid CO_2 capture technology, seamlessly combining oxyfuel calcination, CPU for CO_2 purification from oxyfuel combustion, and advanced PCC for capturing CO_2 from both the rotary kiln flue gas and CPU vent gas. The project emphasizes not only technological advancements but also considers economic viability, safety, and societal acceptance in the pursuit of sustainable and effective carbon capture solutions for the cement industry.

KEYWORDS: CCUS, CO_2 capture, low carbon cement, industrial pilot

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