16th International Conference on Greenhouse Gas Control Technologies **GHGT-16**

23-27th October 2022, Lyon, France

Demonstration of solvent performance at an industrial WtE facility

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Abstract

The use of CCUS technologies in Waste to Energy (WtE) conversion facilities can greatly reduce CO_2 emissions from waste incineration to the atmosphere. Due to the fact that the biogenic proportion of the feedstock (municipal waste) incinerated ranges from 50 to 60%, there is a great potential for negative emissions [1,2]. In this scenario, NEWEST-CCUS (Negative Emissions in the Waste-to-Energy Sector: Technologies for CCUS, Project number 299683) project will help to accelerate the development and deployment of CO_2 capture technology and de-risk promising technologies for CO_2 capture in the WtE sector. As part of the project, TNO in collaboration with Carbon Clean will demonstrate the performance of CDRMax (a proprietary solvent developed by Carbon Clean) in a two month campaign at Twence, a WtE company in The Netherlands.

Twence is equipped with a CO_2 capture plant and treats a slip stream from one of the waste incinerator furnaces with a capacity to produce 12 ton CO_2/day. The produced CO_2 is partly utilized for bicarbonate production, which is used locally for removing SO_x from the flue gas, with the remaining CO_2 being liquified and used externally in the horticulture sector. In previous Dutch national projects, Twence and TNO collaborated in equipping the plant so that it became a multi-solvent test facility, with the capacity to work with a variety of drop-in amine-based solvents. The plant currently operates with 30 wt.% monoethanolamine (MEA).

CDRMax is an advanced proprietary CO_2 capture solvent from the company Carbon Clean and has been tested extensively during the development, scale-up and commercialisation of the technology. Field demonstration carried out by Carbon Clean has confirmed the excellent performance of CDRMax. In comparison to the benchmark solvent MEA, CDRMax has shown lower emissions and more resistance to oxidative degradation [3], leading to 86% less solvent makeup during operation [4]. In NEWEST-CCUS, CDRMax will be tested at a Waste to Energy facility for the first time, and the influence of the WtE flue gas composition on the solvent performance will be evaluated.

The campaigns at Twence will focus on validating the energy requirements and investigating the operational performance of the solvent. Additionally, the impacts that WtE flue gas impurities may have on key performance indicators, including solvent degradation and reboiler duty, will be assessed. Prior to the campaign, the amount of particles will be measured by TNO using an ELPI (Electrical Low Pressure Impactor). TNO will also support the operation by providing an FT-IR (Fourier-Transform Infrared spectroscopy) for online gas composition and emissions

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monitoring and a mini-ATR (Attenuated Total Reflection spectroscopy) for on-line liquid composition monitoring, to be installed and commissioned in the capture plant. The active components and CO_2 in the solvent will be measured to monitor the solvent quality during operation. Frequent samples will be taken to monitor solvent degradation by means of quantifying the accumulation of degradation products, such as formic acid and acetic acid and, also, metal ion content.

The demonstration will consist of two campaigns, one short campaign for parametric optimization and one long campaign, in which the optimal setting from the short campaign will be used. During the short campaign different L/G ratios will be evaluated and, during these runs, the amine concentration and CO_2 loading will be followed via the mini-ATR, while emission levels will be constantly monitored by the FT-IR. The long campaign will follow directly after the short campaign, and it will last until the end of the two-month testing period.

This work will present the results of the demonstration of the CDRMax operation at Twence, scheduled to occur in the first half of 2022, and provide data on solvent degradation and solvent management options in connection with waste-derived flue gases.

Keywords: Waste-to-Energy, CDRMax, PCCC, demonstration, solvent degradation

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Acknowledgements

NEWEST-CCUS project (Project No. 299683) is funded through the ACT programme (Accelerating CCS Technologies) with financial contributions from: Gassnova of Norway through the CLIMIT program, Norway; The Federal Ministry for Economic Affairs and Energy (BMWi), Germany; Netherlands Ministry of Economic Affairs and Climate Policy, the Netherlands; and the UK Department for Business, Energy & Industrial Strategy (BEIS)