Project No:
764697

Project acronym:
CHEERS

Project full title:
Chinese-European Emission-Reducing Solutions

Type of Action: **RIA**

Call/Topic:
European Horizon 2020 Work Programme 2016 – 2017, 10. 'Secure, Clean and Efficient Energy', under the low-carbon energy initiative LCE-29-2017: *CCS in Industry, including BioCCS*

Start-up: 2017-10-01
Duration: 60 months

Deliverable D3.1:
Description of all selected OC's properties and reactivity with pros and cons

Due submission date: 2021-02-28

Actual delivery date: 2021-01-24

Organisation name of lead beneficiary for this deliverable:
SINTEF AS
(short name: SINTEF MK)

Project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 764697, and co-funded by the Chinese Ministry of Science and Technology (MOST)		
Dissemination Level		
PU	Public	
CO	Confidential, only for members of the consortium (including the Commission Services and MOST)	X

Abstract for publication on the website of CHEERS

CHEERS conforms to the European Horizon 2020 Work Programme 2016 – 2017, 10. 'Secure, Clean and Efficient Energy', under the low-carbon energy initiative (LCE-29-2017: CCS in Industry, including BioCCS). The ambition is to improve the efficacy of CO_2 capture in industry, and help ensuring sustainable, secure, and affordable energy.

The action involves a 2nd generation chemical-looping technology. The 1st generation is tested and verified at laboratory scale (150 kWth). Within the framework of CHEERS, the core technology will be developed into a 3 MWth system prototype for demonstration in an operational environment. This constitutes a major step towards large-scale decarbonisation of industry, offering a considerable potential for retrofitting industrial combustion processes. The system prototype is based on a fundamentally new fuel-conversion process acquired from previous research and development actions over more than a decade. The system will include heat recovery steam generation with CO_2 separation and purification, and it will comply with industrial standards, specifications and safety regulations. Except for CO_2 compression work, the innovative concept is capable of removing 96% of the CO_2 while eliminating capture losses to almost zero.

The CHEERS project is financed by the European Union's Horizon 2020 research and innovation programme under grant agreement No 764697, and co-funded by the Chinese Ministry of Science and Technology (MOST). CHEERS started from 1 October 2017 and is scheduled to end by September 2022. The estimated budget is 16 mill. EUR.

WP3 of the CHEERS project is about oxygen carrying materials and fuel conversion. A main objective of this WP is to ensure that proper oxygen carriers will be available for demonstration of petcoke conversion by Chemical Looping Combustion in the demonstration unit to be developed within the project. There is a close coupling between the oxygen carrier properties and the design and sizing of the demonstration unit. Changes to one will cause changes to the other, and vice versa. Oxygen carrying materials need to be evaluated for the selected window of operation for the particular chemical looping configuration system to be designed. In this project, the aim is to have a high air utilization giving lean air with less than 2% O_2 out of the air reactor, to ensure high energetic efficiency. The fuel reactor will be a bubbling bed with high residence time due to the slow gasification of petcoke. To prevent the residence time from being exceedingly high, the average temperature in the fuel reactor will be at least around 950°C. If the selected oxygen carrying materials will cause an endothermic reaction in the fuel reactor, the oxygen carrier will also have to provide sufficient heat to ensure 950°C in the fuel reactor. Consequently, the outlet temperature of the air reactor might go up to 1050 - 1100°C. In case of oxygen carrier materials with exothermic reaction in the fuel reactor, the air reactor temperature can be reduced. Furthermore, the selection of oxygen carriers will also affect the nominal power of the pilot plant since this is related to the circulated amount of oxygen carrier material and its oxygen capacity. Deliverable 3.1 is the summary report from Task 3.1 on oxygen carrier development and selection. It describes the development and laboratory scale testing and evaluation of oxygen carrier materials that could be relevant for application in the CHEERS 3 MW demo unit. Special emphasis has been put on the three oxygen carriers that were selected as the most relevant candidates. These have been ilmenite chosen as the first candidate, a CMTF perovskite material chosen as a second candidate, and a manganese ore from China as a possible third candidate. The materials have been evaluated based on their suitability for the process, considering parameters such as oxygen capacity and oxygen release, temperature of operation, reaction kinetics, availability, sulphur tolerance, etc.