中欧污染物减排技术研究

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: 72 months

Deliverable
D6.5: Oxygen Carrier Purchasing

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Organisation name of lead beneficiary for this deliverable:
SINTEF MK

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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 (delete this table when deliverable is PUBLIC)
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 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 synthesised from prior 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 1 October 2017 and is scheduled to end by September 2022. The estimated budget is 16 mill. EUR. The Chemical Looping Combustion (CLC) is based on an inherent separation of CO2, by avoiding the mixing of air into the fuel stream. This is performed by having oxygen carrier materials (OCM) delivering oxygen into the fuel chamber to make a clean combustion. The Chemical Looping Technology consist of two reactors; the air reactor where the OCM take up oxygen from the air and heat is extract from this very exothermic oxidation of OCM, in the fuel reactor the OCM will give oxygen to the combustion. The reactions in the fuel reactor are a combination of two reactions: one exothermic oxidation of the fuel and one endothermic reduction of the OCM (for the most active OCM's this reaction is weakly exothermic). The oxygen carrier material (OCM) needed for transfer of oxygen from the air to the fuel reactor in order to assist clean combustion of the fuel with delivered oxygen from the OCM have several demands to fulfil. In general, OCM can be any oxides, but considering the demand on cost and performance, it should be abundant, redox active, sulfur tolerant, give high degree of combustion, be none toxic, environmentally friendly etc. The obvious metal oxides are often oxides containing iron or manganese or mixtures of both. The main aims • To ensure proper oxygen carriers for petcoke conversion by CLC technology • To characterise oxygen carriers optimised for solid fuels with exceedingly high content of sulphur and metals • To specify recipes for semi-industrial production of bespoke oxygen carriers Another aim for the project was also to develop a OCM that possesses a long lifetime in the range of 10 000 h. Several good synthetic candidates have been developed and one was scaled up to 1 tonne in China for testing at Tsinghua university in their 100 kW CLC rigg for combustion of coal. The material has a lot of good properties but failed unfortunately on tolerance towards sulfur, which is critical in combustion of pet-coke. An alternative to synthetic materials is natural minerals with much shorter lifetime. The mineral ilmenite has good performance and a relatively long lifetime (ca 500-1000 h) compared to other natural minerals and was therefore selected for the demo tests. The ilmenite from Norway was then selected among the ilmenite sources considering its low cost and good performance,

even though the lifetime is shorter compared to developed synthetic materials. Since the lifetime is shorter, more backup mass is needed and the project consist of two campaigns with different designs, requiring more mass delivered to the demo rigg. In the proposal stage, ca. 10 tonnes were planned based on artificial material with long lifetime but given the much shorter lifetime of ilmenite the required amount will be close to 250 tonnes - estimated from design, life-time, and OCMs fraction size needed for the designs. In order to manage such deliverable, the interplay between the design and their flexibility in size range of particles, we need to find a manageable solution. The OCM cost for the EU part could not be realised within the EU budget if China could not use and pay for some of the fractions sieved off from the batch EU need in their design. The cost sharing and belonging argument, as well as the procurement, are covered in this deliverable.