Curriculum Vitae, Anders Lyngfelt

Data

PhD in Energy Conversion 1988, Docent in Energy Technology 1992, Professor 1999

Research overview.

Before 1998 Lyngfelt's his main field of research was related to fluidized bed combustion with focus on sulphur capture process

Lyngfelt has made Chalmers world-leading in chemical-looping combustion (CLC), initiating this research in 1998. CLC is a novel combustion technology where fuel and combustion air are not direct incontact, instead the oxygen needed for combustion is transferred from air to fuel by means of an oxygen carrier. Thus, the combustion products, i.e. carbon dioxide (CO_2) and water vapour, are not diluted with the nitrogen in the air, and therefore an essentially pure CO_2 is obtained after condensing the water vapour. This means that CO_2 capture is accomplished without the expensive and energy demanding separation normally needed. It is expected that CLC could lower the cost of CO_2 capture with a factor two to four. Chalmers was first to successfully demonstrate this novel combustion principle in 100 h operation of a 10 kW pilot.

The research focus is now negative CO_2 emissions and, in addition to bio-CLC, Lyngfelt has studied the consequences of leakage of stored CO_2. IJGGC-19

Lyngfelt has proposed a policy instrument aimed at fulfilling the target of maximum 1.5 degree warming, which imposes a CO_2 emitter liability. Thus, the emitter is obliged to remove his emissions from the atmosphere and to accomplish this, the emitter is enforced to pay for deposit deeds corresponding to his emissions. The deposit deeds, including returns, are redeemed upon certified proof of removals. ACORDs

Publications and recognition

Lyngfelt is the author/co-author of 248 scientific publications, with 21,515 citations, and an H index of 76 (Scopus, May 2024) and Lyngfelt is in the list 2019 Highly cited researcher, Web of Science, as one of "3,000 highly cited researchers in 21 fields of the sciences and social sciences", "In recognition of ranking among the top 1% researchers for most cited documents, in their specific field".

Lyngfelt has been ranked as the 2nd most productive and cited researcher in Sweden in the area of physics and technology (Fokus, Sveriges Nyhetsmagasin, October 3, 2019).

Lyngfelt was ranked as the 2nd Best Engineering and Technology Scientists in Sweden and No. 149 world-wide: *https://research.com/scientists-rankings/engineering-and-technology/se*

Worldwide ScholarGPS ranked Lyngfelt as No. 1 on Solid fuel, No. 9 on Greenhouse gas and No. 11 on Combustion.

The journal Energy & Fuels has honoured the work by Lyngfelt with a Special Issue: *"Pioneers in Energy Research: Anders Lyngfelt"* including 29 articles on chemical-looping combustion, [1].

For Chalmers' CLC publications: *www.entek.chalmers.se/lyngfelt/co2/co2publ.htm*
List of Lyngfelt's publications: *https://research.chalmers.se/person/anly*

Conferences

Lyngfelt brought the *3rd International Conference on Chemical-Looping*, Chalmers, Gothenburg 2014, with 180 participants to Sweden.

Lyngfelt further initiated the start of a new conference series:

1st *International Conference on Negative CO_2 Emissions*, http://negativeco2emissions2018.com Chalmers, Gothenburg, Sweden, May 22-24, 2018.

The conference had 300 participants, 11 plenaries, 150 orals/papers. Further, Chalmers was entrusted with holding the 2nd conference, [2]:

2nd *International Conference on Negative CO_2 Emissions*, http://negativeco2emissions2020.com, Chalmers, Gothenburg, Sweden, June 14-17, 2022, [3].

The 2nd conference had 315 participants, 12 keynotes and 140 orals/papers.

All the three conferences were organized by Carl Linderholm.

Chemical-looping combustion

The work on chemical-looping combustion (CLC), began in 1998 with the development of oxygen-carrier material for the process and Chalmers was first to successfully demonstrate this fundamentally new fuel conversion process in 100 h sustained operation in a 10 kW prototype unit for gaseous fuel in 2003. Moreover Chalmers was first to operate a 10 kW CLC unit designed for solid fuels (2006) and was also first to operate CLC with liquid fuels (2011). Chalmers now has more than 4000 h of operational experience of chemical-looping combustion in four units, the largest being a 100 kW dual CFB for solid fuels. This involves the first successful demonstration of chemical-looping combustion with oxygen carriers based on nickel, iron and manganese oxides, combined oxides like $CaMnO_3$ and $FeTiO_3$, as well as natural minerals (ilmenite and manganese ore), using natural gas, syn-gas, bituminous coal, pet coke, kerosene, wood char and wood pellets as fuels. Under his leadership, Chalmers has investigated more than 500 different oxygen carrier materials in laboratory and more than 70 in actual operation.

In addition to first demonstration of CLC with gaseous, solid and liquid fuels, as well as the first demonstration of the use of a number of monometallic or combined oxygen carriers, the work involves a number of breakthroughs in different aspects of chemical-looping technology, e.g. *i)* Proposal of: chemical-looping steam reforming for hydrogen production with simultaneous CO_2 capture, *ii)* Proposal of Chemical-Looping with Oxygen Uncoupling (CLOU), *iii)* Finding the potential for CLOU using oxygen releasing capabilities of a number of combined manganese oxides, i.e. Mn combined with Fe, Ni, Si, Mg and Cu, and iv) proposal of novel system for circulation in 200 MW design of combined CFB-CLC.

Research projects

Through a number of international research projects, see below, Lyngfelt has been in close collaboration with appr. 25 companies, universities and research institutes. The major part of the funding of Lyngfelt's CLC research has come from EU, with a total budget for his research of 10 M€. Thus, he has been deeply involved in the conception of ten EU/ EU-RFCS projects on CLC and coordinated several:

- GRACE 2002-2003, coordinated by BP. CLC part proposed and led by Lyngfelt.
- CCCC 2001-2004, EU-RFCS project coordinated by Lyngfelt.
- ENCAP IP-project 2004-2007, CLC part for solid fuels proposed by Lyngfelt with support of Alstom.

- CLC Gas Power, 2006-2008, EU-project coordinated by Lyngfelt.
- Cachet, IP-project, 2006-2008, coordinated by BP, CLC part led by Lyngfelt.
- ECLAIR, 2008-2012, EU-RFCS project coordinated by Alstom. Project based on experimental work by Chalmers in ENCAP and initiated by Lyngfelt.
- INNOCUOUS, 2010-2013, EU-project coordinated by Lyngfelt
- $NoCO_2$, 2012-2017, ERC Advanced Grant, Principal Investigator Anders Lyngfelt
- ACCLAIM, 2012-2013, EU-RFCS project coordinated by Lyngfelt
- SUCCESS, 2014-2018, EU-project co-ordinated by Techn. Univ. of Vienna, based on proposal by Lyngfelt

Moreover Lyngfelt coordinated the Nordic CO_2 Sequestration Programme ($NoCO_2$), 2003-2006, funded by Nordic Energy Research. He also coordinated the Nordic Project "Negative CO_2", 2015-2020, one of three flagship projects selected for funding out of >100 applications.

Lyngfelt has also received an ERC Advanced Grant ($NoCO_2$ above) as well as a prestigious "Forskningsmiljö" from Swedish Research Council, *i.e.* appr. 2.5 M€ during 6 years (2017-2022).

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1) Haibo Zhao, 2022 Pioneers in Energy Research: Anders Lyngfelt, *Energy Fuels* 36:17 (2022) 9365–9370

2) The series is now well established and the 3rd conference will be hosted by CO2RE, Oxford, UK, June 18-21, 2024.

3) The conference was delayed two years because of the pandemia.