Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Highlights of Bioenergy Research 2020
January 24th, 2020, Messe Congress Graz, Austria

Abstract

The OxyCar-FBC project: Improving biomass combustion in fluidized beds for higher efficiency and lower emissions

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Within the ERA-NET Bioenergy project Oxygen Carriers in Fluidized Bed Combustion of Biomass for Higher Efficiency, Reduced Emissions and (or) Negative CO2 (OxyCar-FBC), two processes for the efficient use of biomass for energy production are investigated. One will be available with little de-velopment time and the other one will be a long-term option in the fight against climate change.

The fluidized bed technology is widely used when it comes to thermal use of biomass (combustion or gasification) because of its flexibility, robustness and low emissions. Usually silica sand is used as bed material in such facilities. The OxyCar-FBC project investigates how the use of metal oxides – so-called oxygen carriers - as bed material can improve those processes. These oxygen carriers are oxidized in contact with air and reduced trough contact with fuel. They are thus able, to selectively transport oxygen.

The first process, Oxygen Carrier Aided Combustion (OCAC), directly improves the efficiency and performance of fluidized bed combustors through replacing the bed material with oxygen carriers. Conventional fluidized bed combustors for biomass and waste, proper mixing of fuel and combus-tion air is usually a problem. Here, fuel rich zones suffer from a lack of oxygen, whereas fuel lean zones see too much oxygen excess. Additionally, the fuel characteristics or fuel mass flow change over time. This requires excess air of 20% or more. In OCAC, the bed material is fully or partially replaced by an oxygen carrier, which is able to transport oxygen within the fluidized bed from fuel lean zones to fuel rich zones. This can significantly reduce mixing problems and improve combus-tion. First tests show that the excess air ratio can be reduced and peaks of CO in the exhaust gas can be avoided. Further, NOx emissions were reduced by up to 30%. Within the project, suitable materials were identified and will be tested in large scale biomass plants in the range of 100 MW fuel power input.

The second process, Chemical Looping Combustion, is a completely new combustion process with inherent CO2 capture. Here, the combustion divided into two steps, using two fluidized beds, which are called air reactor and fuel reactor. Thus, air and fuel are never mixed and the energy intensive gas separation is avoided. The oxygen carrier, which acts as bed material, circulates between the two reactors and transports oxygen from air to fuel. It is oxidized in the air reactor by the air and reduced in the fuel reactor by the fuel. This yields two exhaust gas streams: oxygen depleted air from the air

reactor and CO_2 and steam from the fuel reactor. After condensation of steam, a highly concentrated CO_2 stream is available. Thus, CO_2 is separated with nearly no energy penalty. The CO_2 can then be stored underground (Bioenergy Carbon Capture and Storage – BECCS) or used for synthesis processes (Carbon Capture and Utilization – CCU). The process is coupled with a heat recovery steam generator producing high pressure steam which can be used for production of power and heat.

More information about the event, photos and presentation slides are available for download: https://nachhaltigwirtschaften.at/en/iea/events/2020/20200124-highlights-bioenergy-research.php