BURNERS, COMBUSTION AND HEAT TRANSFER

(629) - (*) - EXPERIMENTAL EVALUATION OF 100 % OXYFUEL COMBUSTION CHARACTERISTICS FOR CEMENT PRODUCTION

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Cement production is one of the most CO_2 (carbon dioxide) intensive industries, where CO_2 is not only produced due to the combustion in the kiln and calciner burners but also as a side product of the calcination process. To reach the CO_2 reduction goal set by the Paris agreement, the cement industry will need to commit to additional CO_2 mitigation measures. The IEA (International Energy Agency) has confirmed that CCUS (Carbon Capture Usage and Storage) is an important measure to apply in the cement sector to achieve the 2°C scenario goal by 2050.

In frame of the AC^{2}OCem project, oxyfuel technology for cement production is being evaluated through experimental and analytical studies to potentially find a cost efficient method of applying CCUS in the cement industry and reduce the time to market of the technology. At the University of Stuttgart, combustion tests have been performed in the 20 kW el technical-scale, down fired, combustion facility. The purpose of the experiments are to advance the know-how of oxyfuel combustion, specifically in new-build cement plants, where no flue gas recirculation is planned. The combustion experiments are performed with coal and up to 100 % oxygen in the primary and secondary gas inlets to evaluate the combustion process.

During the oxyfuel combustion tests, the atmosphere in the combustion chamber is kept similar to that of a new-build cement kiln, where no flue gas recirculation is foreseen. Three experimental cases at near stoichiometric conditions are tested, a reference case with air and two oxyfuel cases with 30 and 58 vol.- % total oxygen in the inlet gases (OXY30 and OXY58). In OXY58, the inlet gases consisted of 100 % oxygen and the coal carrier gas was CO_2. Furthermore, the combustion of coal with excess oxygen is studied, where the oxygen to fuel equivalence ratio was 3.4 and the total inlet oxygen was 67 vol.- % (OXY67). The excess oxygen has a cooling purpose at the burner tip, and in new-build cement plants will also serve as the oxidizer in the calciner combustion process.

Axial measurements are taken along the centerline of the furnace at 0.25, 0.5, 0.75, 1, 2 and 2.5 m from the burner. At these positions, the flame temperature and concentration of the combustion gases such as oxygen, CO_2 and nitrogen oxides are measured and evaluated.

The temperature profile between 1 m and 2.5 m behave similar for all four cases, the striking difference is observed at the near burner region between 0.25 m and 0.75 m (attachement). The temperature profile of OXY30 case behaves most similar to the air case, yet at the burner the OXY30 exhibits around 60°C higher temperature. The positive effect of the excess oxygen is demonstrated by comparing the OXY58 and OXY67 temperature profiles to air. At 0.25 m from the burner, the OXY58 exhibits 1510°C, the OXY67 1410°C and the air case 1270°C. To conclude, the increase of the oxygen to fuel ratios shows promise to help preserve a desirable temperature atmosphere in the cement kiln.

Palavras-chave : Oxyfuel, CCUS, coal, cement

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