THE PROCESS OF MINERAL CARBONATION OF FLY ASH WITH A HIGH CONTENT OF CALCIUM OXIDE FROM THE GROUP HCFA

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INTRODUCTION

Currently, it is estimated that about 50% world emission of carbon dioxide comes from coal burning in the power stations [1]. One of the most hazardous substance which is produced by the energy sector is fly ash with a high content of calcium oxide, included to the group HCFA- High Calcium Fly Ash. It is estimated that annual production of fly ash is around 750 mln. tonnes, of which only use 16% in the industry [2]. In Europe, more than 50% of the total production of fly ash is HCFA [3]. Fly ash is mostly used for production of cement, building materials and as the component in road construction. If calcium oxide content in fly ash is more than 10% it is included to the group HCFA. Mineral carbonation is one of the safest and environmentally benign technologies for Carbon Capture and Storage. This mechanism consists of the fixation of carbon dioxide into calcium and/or magnesium bearing minerals to form stable carbonates. Due to the method of mineral carbonation process it is possible to reduce carbon dioxide emissions and in the same time neutralize fly ash, which is used as one of the substrates in this reaction. This process has two steps. First, the hydration of CaO is taking place and next, it is followed by carbonation of calcium hydroxide [4].

EXPERIMENTS

The aim of our research was to examine the mineral carbonation process of calcium fly ash. The experiments were conducted at three different temperatures: 298, 323 and 343 K and a pressure range of CO_2 from 0.4 to 1.5 MPa.

RESULTS AND DISCUSSION

One of the examined materials was biomass fly ash. The main components are: silicon dioxide (51,33%), calcium oxide (12,01%) and aluminium oxide (10,42%). The maximum sequestration capacity was achieved for biomass fly ash at 343 K and 0.711 MPa, and it was 29,382 dm^3 CO_2/kg of fly ash, it has been observed that the biggest values were obtained at the highest selected experimental parameters. The second material was fly ash from power station, the main are: silicon dioxide (37,12%), calcium oxide (15,34%) and aluminium oxide (13,14%). The maximum sequestration capacity was achieved at 298 K and 0,527 MPa, and it was 25,937 dm^3 CO_2/kg fly ash. In contrary to biomass fly ash, the biggest value was obtained at the lowest temperature, however at the highest pressure.

CONCLUSION

The experiment shown that increasing the pressure and temperature enhances the process of carbonation in case of biomass fly ash. However, it has been concluded that for fly ash from power plant increasing the temperature does not influence the effectiveness of carbonation process. It has been proven that HCFA has a big potential in the carbonation process. Thanks to carbonation process, the reduction CO_2 emission is possible, whats more it may allow to find a new way of fly ash utilization.

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