

Development of cement free binders: activation of circulating fluidized bed combustion boilers fly ash

P. PAAVER¹ AND K. KIRSIMÄE¹

¹Department of Geology, Tartu University, 50411 Tartu, Estonia (*correspondence: peeter.paaver@ut.ee)

Increasing pressure on the reducing cement clinker production, the second largest industrial CO₂ emitter, drives the research and innovation in finding alternative binders.

There are different ways to reduce classical cement clinker uses including its partial to full replacement by supplementary cementitious materials and/or development of alternative binders with smaller CO₂ footprint than of cement clinker production. Fly ash along with granulated blast-furnace slag has been widely used supplements of cement clinker but utilization rate for fly ash is only 30%, mainly because of its largely variable properties resulting from use of different fuels and firing technologies. The worst case are the fly ashes from energy efficient and low SO₂ and NO_x emission fluidized bed (FB) combustion with limited usability in cement and concrete composition, mainly because of their variable composition and low reactivity.

In this contribution we show that CaO free and sulphate rich FB combustion fly ashes can be successfully upgraded both in terms of final compressive strength as well as the strength development by only a short mechanical activation without any chemical activation or blending, and further enhanced by moderate alkali activation achieving compressive strengths comparable to ordinary portland cement.

The strength development in activated FB fly ash is provided by rapid formation of ettringite similar to calcium sulfoaluminate cements, and proceeded with hydration of silicate phases and formation of C-S-H gel providing further compressive strength increase up to 60 MPa.