

The Chemistry of Free Lime in CFBC Ashes

E.M. Bulewicz¹, D. Gora¹ and E.J. Anthony²

1. Institute of Inorganic Chemistry and Technology, Cracow University of Technology, Poland

2. CETC, NRCAN, Ottawa, Ontario, Canada

"Anthony, Ben" banthony@NRCan.gc.ca

Abstract

Utility-scale CFBC boilers firing high sulfur fuels use an excess of limestone to capture SO_2 , and in the process produce a residue, which consists of a mixture of $\text{CaSO}_4/\text{CaO}/\text{CaCO}_3$ and fuel derived ash. The chemistry of the CaO is of critical importance for both the utilization and disposal of those ashes. For reutilization approaches, hydration is the suggested method for reactivating the spent sorbent for reuse in the combustor for sulfur capture, while many other utilization strategies also depend on the total CaO content of the ash. For ash disposal strategies, hydration is likewise a critical step for reducing the chemical activity of the ash and ensuring the safe deposition and long term stability of the ash disposal site. Unfortunately, in all of the previous work done on these topics, a primary hypothesis has been that the sum of the number of moles of CaO and $\text{Ca}(\text{OH})_2$ in the ash system is constant and independent of the hydration method. This tenet underpins attempts to study the hydration reaction using calorimetry for instance, and is key to the assessment of water needs for disposal in landfill. Unfortunately, for ashes from full-scale boilers, this hypothesis is not at all well founded. In fact, it has been shown that up to 40% or so of the CaO oxide expected, based on simple stoichiometry, is actually present in the ash as "other calcium compounds" (OCC). Moreover, the type of hydration method and the conditions under which it is used contribute to determining the final free lime content of the ashes. This study endeavours to explore these phenomena using ashes from two CFBC boilers. These are the 165 MWe Point Aconi CFBC boiler owned and operated by Nova Scotia Power Inc, burning high sulfur coal and the two 100 MWe CFBC boilers owned and operated by the Nelson Industrial Steam Company in Louisiana burning petroleum coke.