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Comparison of $\text{Ca}(\text{OH})_2$ and NaHCO_3 as Sorbents Suitable for Dry Flue Gas Treatment at Temperatures Below 250 °C

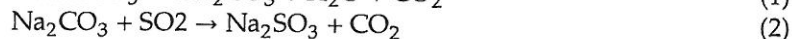
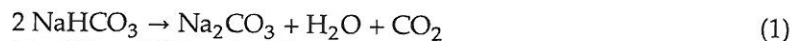
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Flue gas treatment is a very important part of every Waste-to-Energy (WtE) plant. Currently, dry flue gas treatment methods are very popular because they are not burdened by wastewater production. Frequently, there are attempts to simplify the process, lower the capital costs, operating costs, and the production of residues classified as hazardous waste.

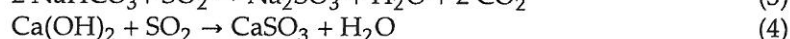
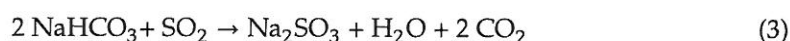
Simultaneous removal of multiple pollutants offers a big potential for simplifying of dry flue gas treatment. However, the individual processes have different optimal conditions. To operate dry flue gas treatment at compromise conditions, properties of sorbents have to be known.

$\text{Ca}(\text{OH})_2$ and NaHCO_3 are the most common sorbents for dry removal of acidic gases from flue gas at low temperature and were, therefore, chosen for comparison. The most important factors are temperature and flue gas humidity.

The properties of NaHCO_3 are great for sorption of SO_2 and HCl and the sorption process works sufficiently regardless of the process temperature and flue gas humidity. Firstly, NaHCO_3 in flue gas decomposes to Na_2CO_3 , which then reacts with the acidic gases. Equations (1) and (2) describe the decomposition reaction of NaHCO_3 and its reaction with SO_2 respectively. During this decomposition, H_2O and CO_2 leave the sorbent and cause the formation of surface structures suitable for sorption of acidic gases. Although this surface is smaller than surfaces of some calcium based sorbents, high reactivity of Na_2CO_3 formed *in situ* in flue gas enables its use with low stoichiometric excess ratio (1.1–1.4). The disadvantages of NaHCO_3 are its relatively low reactivity towards HF , water solubility of air pollution control residues, and price.



Ca(OH)₂ is commonly used with higher stoichiometric excess ratio (usually 2.0–2.5). On the other hand, calcium is bivalent. Therefore, in comparison with NaHCO₃, theoretically only the half of the amount of substance is necessary for removal of the same amount of SO₂, HCl, or HF, as can be seen from equations (3) and (4). The mass of used NaHCO₃ and Ca(OH)₂ is, therefore, similar despite of the big difference in stoichiometric excess ratios.



The sorption rate of HCl on Ca(OH)₂ is, in comparison with NaHCO₃ (Na₂CO₃), an order of magnitude lower and to reach the emission limits, the flue gas treatment has to be conducted under suitable conditions. A suitable temperature for removal of acidic gases by calcium based sorbents is connected to the content of H₂O in flue gas. The reaction rate is very good in the vicinity of dew point but the process conditions shouldn't be too close to the dew point to avoid condensation. The advantages of Ca(OH)₂ are better reactivity towards HF, very low water solubility of air pollution residues, and low price in comparison with NaHCO₃.

Acknowledgements

This research was conducted within Waste to Energy Competence Centre funded by the Technology Agency of the Czech Republic (project TE02000236) and was co-financed from specific university research (MSMT No 20-SVV/2016).