TECHNOLOGIES FOR FLUE-GAS TREATMENT

Research group: Carlo Stramigioli, Giacomo Antonioni, Valerio Cozzani, Daniele Guglielmi
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Power generation from municipal solid waste incineration is widespread used as a technology for solid waste treatment and energy recovery.
However one of the main sources of environmental impact for these plants is the continuous emission of pollutants into the atmosphere (emissions of airborne pollutants are regulated by European Union Directive 2008/1/EC on IPPC). Another issue to be addressed is the generation of solid or liquid residues from flue-gas cleaning, depending on the flue-gas treatment process.
For these reasons two-stage processes are becoming more and more popular for the treatment of the flue-gas from Municipal Solid Waste Incinerators (MSWI). Even if there are some plants that are already running this process, showing high levels of effectiveness in terms of exhaust gas concentrations, there is still lack of knowledge about reaction efficiency and reactant consumption. Thus a great amount of solid products are produced by and should be disposed of, usually by landfilling.
Among the substances produced during waste combustion, acid gases are of particular interest because of their environmental impact (long term exposure, acid rains, etc.), and a feasible solution is to remove them by means of dry processes. The two-stage dry treatment of flue gas with solid reactants is one of the Best Available Technologies for acid gas cleaning. Each stage is composed of a reactor (where the solid reactants are mixed with the flue gas) followed by a filter (where the solid products are separated).
An operational model based on literature data was proposed to describe the removal efficiency of acid gases (HCl, HF and SO2) in an incineration power plant. The model was developed considering the ratio of solid reactants (calcium hydroxide and sodium bicarbonate) to stoichiometric values, initially on the basis of plant design data. Then model parameters have been calibrated using the design data of an existing MSWI. The implementation within Aspen Hysys® allowed an economic optimization of the treatment process taking into account both reactant and disposal costs (Fig. 2).

Fig.1 The emission stack of the MSWI running the two-stage process.

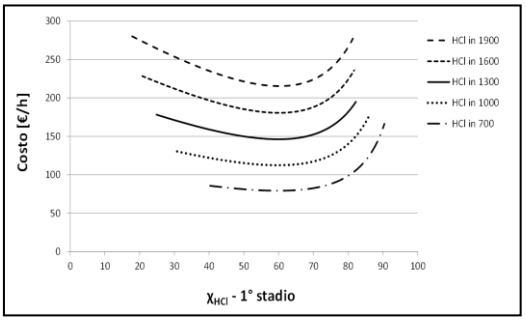

Fig. 2 Economic process optimization of the flue-gas treatment section of a MSWI.

MAIN PUBLICATIONS

Antonioni, G., Modeling and simulation of an existing MSWI flue gas two-stage dry treatment (2013) Process Safety and Environmental Protection, ISSN 0957-5820.

Guglielmi, D., Antonioni, G., Stramigioli, C. Cozzani V. Ottimizzazione di un processo di abbattimento a secco per l'abbattimento dei gas acidi prodotti nella termovalorizzazione di RSU. Atti Convegno GRICU 2012

Antonioni, G., Guglielmi, D., Stramigioli, C., Cozzani, V MSWI flue gas two-stage dry treatment: Modeling and simulation (2012) Chemical Engineering Transactions, 26, pp. 213-218.

Antonioni, G., Sarno, F., Guglielmi, D., Morra, P., Cozzani, V. Simulation of a two-stage dry process for the removal of acid gases in a MSWI (2011) Chemical Engineering Transactions, 24, pp. 1063-1068.

RESEARCH PROJECT

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CONTACTS

valerio.cozzani@unibo.it
giacomo.antonioni3@unibo.it