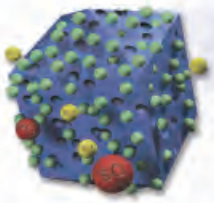

BICARB BULLETIN

Deacidification of Refuse Incinerator Flue Gases with Sodium Bicarbonate

SO_2 and HCl Removal with Dry Sodium Bicarbonate Injection at the Edegem (Antwerp, Belgium) Refuse Incineration Plant

The effectiveness of sodium bicarbonate for removing SO_2 in the flue gases of a coal-fired power station has already been proved during testing at the OMNICAL factory at Ewersbach (West Germany). However, no data were available on the behavior of bicarbonate during the purification of gases emitted by refuse incineration plants, gases which contain both HCl and SO_2, as well as traces of hydrofluoric acid (HF).

Tests were carried out at the Edegem (Antwerp, Belgium) refuse incineration plant from May 30 to June 3, 1988 in collaboration with the firm SYPRIM AIR INDUSTRIE, (manufacturer of gas treatment installations). These tests were monitored by the SOLVAY Research Centre in Dombasle (France), which installed the system for pulverizing the sodium bicarbonate and injecting it into the gases to be purified.

Measurement of the level of pollutants in the gases was carried out by Mol (Belgium) Nuclear Energy Research Centre.

The following points were studied:

- The effectiveness of bicarbonate for purifying gases containing HCl, SO_2 and HF.
- The progress of gas purification before and after the electrostatic precipitator or electro-filter.
- The effectiveness of the electro-filter trapping the purification residues.

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Description of the Unit

The refuse incineration unit consists of two identical lines working in parallel, which merge before the common electro-filter. Each line consists of an incinerator, a tubular reactor (residence time 5 seconds), and a cyclone. The bicarbonate is pulverized in the Dombasle Research Centre's mobile pulverization unit (Alpine 315 UPZ pulverizer), and then distributed equally into the two lines. The bicarbonate is injected into the exit of a venturi tube placed at the entrance to the reactor. The solid residues are trapped by the electro-filter.

The incineration plant treats 5 t/h of refuse and produces 85 m^3/h water at 180°C under a 15 bar pressure, corresponding to a power of 8.6 MW. Flue gas flow is 28,000 Nm^3/h.

The heterogeneous nature of the fuel prevented determining in advance the exact bicarbonate requirements. The injection rate varied between 50 and 150 kg/h. The gaseous components were measured by bubbling part of the flue gases through H_2O_2 and NaOH solutions. The analyses were carried out on a DIONEX QIC anion chromatograph. The amount of flue gases given off, the O_2 levels in the chimney and the dust content of the discharge into the atmosphere were also measured.

Stoichiometric Ratios

For removal of SO_2 and HCl, the following global reactions apply:

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

$2\ NaHCO_3 + SO_2 + 1/2\ O_2 \rightarrow Na_2SO_4 + H_2O + 2\ CO_2$

In other words,

84/36.5 = 2.301 kg of $NaHCO_3$ are required in order to remove 1 kg of HCl and 2 x 84/64 = 2.625 kg of $NaHCO_3$ are required in order to remove 1 kg of SO_2.

Testing

The following average values for the two lines together were measured at the bicarbonate injection points:

- Flue gas temperature: 225°C
- HCl content: 880 mg/Nm^3 (dry) ± 28%
- SO_2 content: 143 mg/Nm^3 (dry) ± 34%
- HF content: 6 mg/Nm^3 (dry) ± 36%

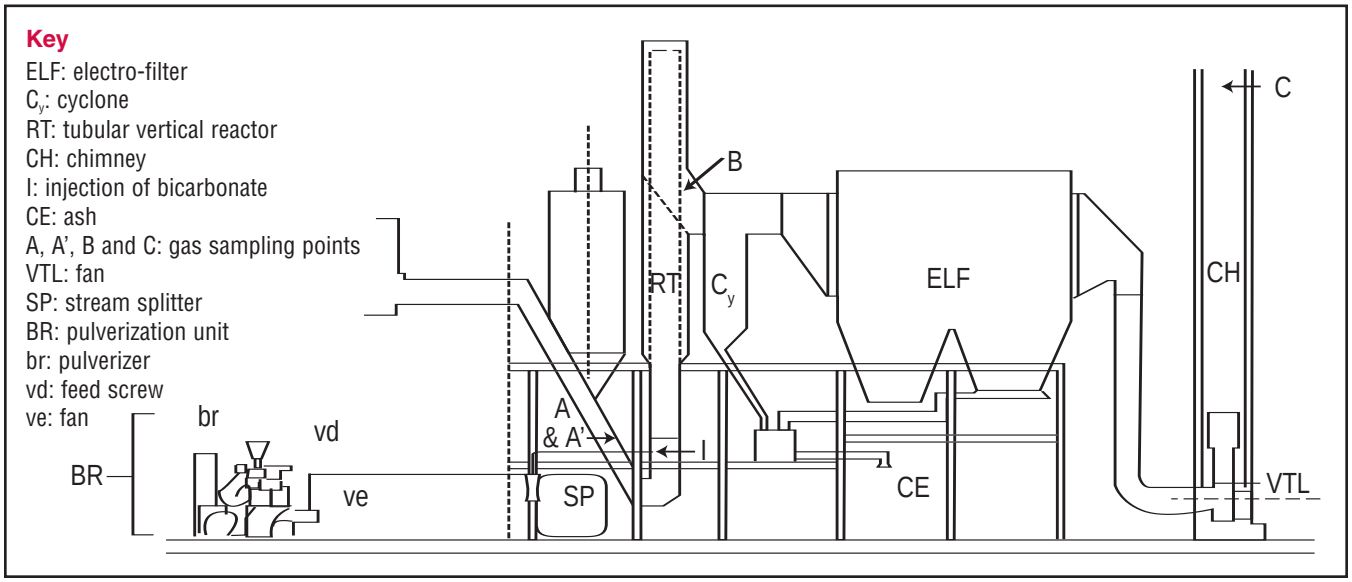
During testing the composition of the flue gases to be purified fluctuated widely.

A range of stoichiometric ratios between 0.9 and 2.03 was covered.

On leaving the reactors and cyclones, the gases were already 75% purified compared with levels at the electro-filter outlet.

Diagram of the Unit

Diagram no. 1



Deacidification of Refuse Incinerator Flue Gases with Sodium Bicarbonate

Test Results

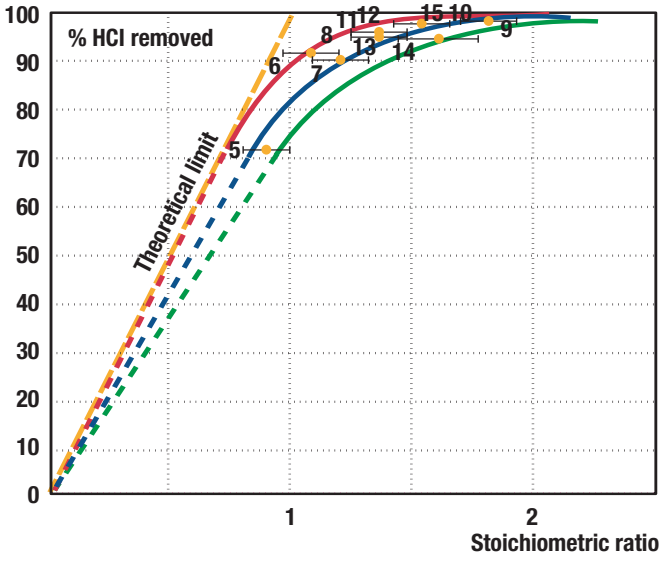
A stoichiometric ratio of 1 corresponds to 2 moles of $NaHCO_3$ for 1 mole of SO_2.

The less effective removal of SO_2 can be explained in part by the low initial levels of SO_2 in the flue gases.

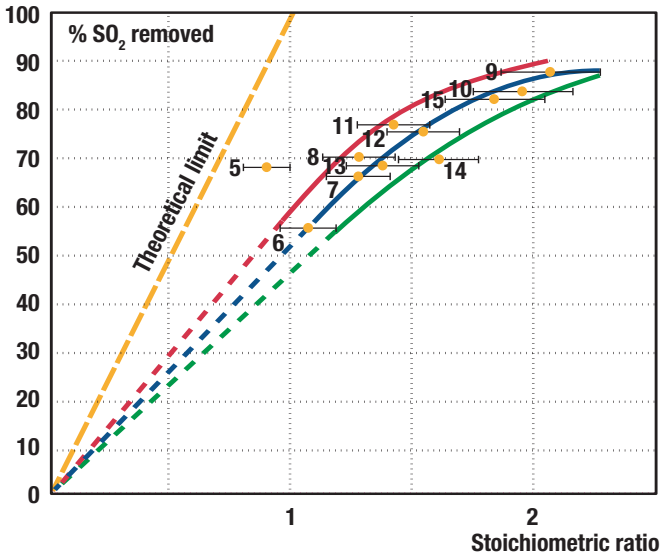
Table 1: Effectiveness of removal of pollutants

		Stoichiometric Ratio	
Pollutant	**% Removal**	**Average**	**Maximum**
HCl	90	1.2	1.4
	95	1.45	1.7
SO_2	75	1.55	1.75
HF	The initial levels were too low to permit significant calculations		
Total Acidity	90	1.3	1.5

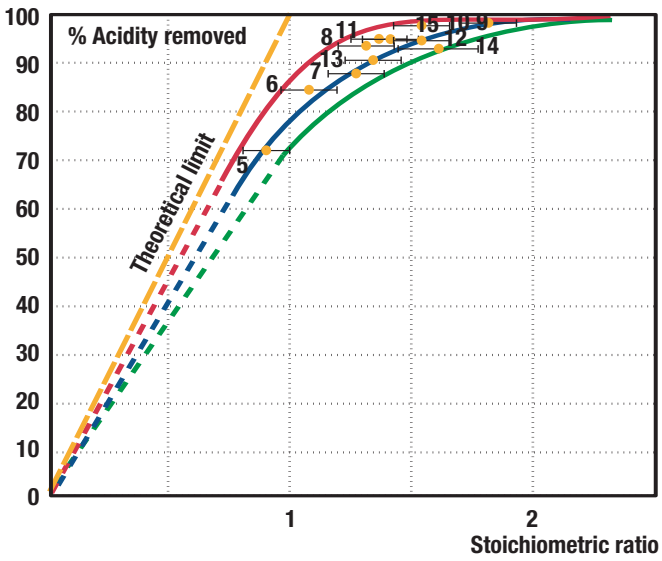
Graph 1: % HCl removed as a function of the stoichiometric ratio



Graph 2: % SO_2 removed as a function of the stoichiometric ratio



Graph 3: % Acidity removed as a function of the stoichiometric ratio



Deacidification of Refuse Incinerator Flue Gases with Sodium Bicarbonate

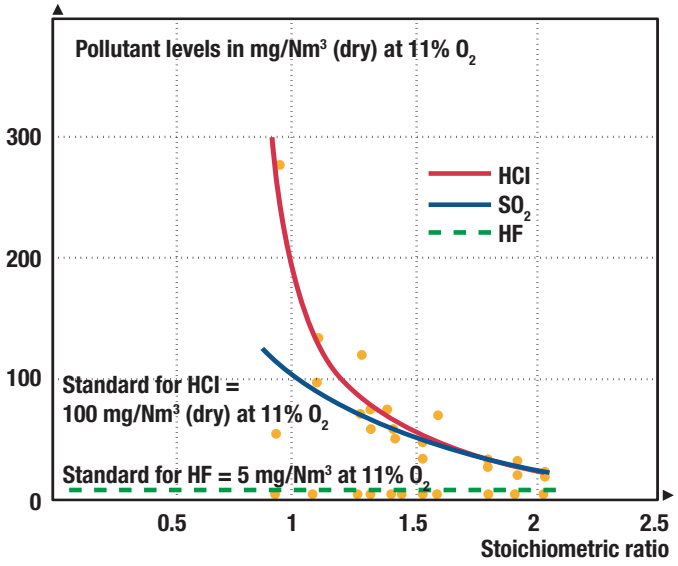
The HCl and HF levels reported meet the Belgian standards. There is as yet no Belgian standard for SO_2.

The Belgian standard also limits the admissible level of dust in discharges into the atmosphere to 100 mg/Nm³ (dry) at 11% O_2. This value was achieved in every case except two: this would appear to show that the electro-filter traps the solid residues in a satisfactory manner.

Table 2: Levels of pollutants in the purified gases

Pollutant	Content mg/Nm³ dry gas at 11% O_2%	Stoichiometric Ratio	
		Average	Maximum
HCl	100	1.2	1.4
SO_2	50	1.4	1.5
HF	5	Independent of ratio between 0.9 and 2.0	

Graph 4: HCl, SO_2 and HF levels in flue gases after purification as a function of the stoichiometric ratio



Conclusion

These results confirm the very high effectiveness of sodium bicarbonate for purifying flue gases from refuse incineration plants. Ninety percent of the acidity could be removed with an excess bicarbonate level of between 20 and 40%.

The presence of an electro-filter is not prejudicial to the purification process.