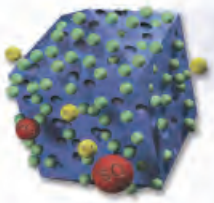

BICARB BULLETIN

Desulfurization of Power Station Flue Gases with Sodium Bicarbonate

SO_2 Removal with Dry Sodium Bicarbonate Injection at the City of Gardanne (Bouches du Rhône – France) Coal-Fired Power Station

The effectiveness of sodium bicarbonate for removing SO_2 from power station flue gases has already been proved for certain types of fuel:

- Fuel oil with a 1% sulfur content, in trials carried out at the SOLVAY factory at Heilbronn (West Germany).
- Coal at 1.4% sulfur content, during trials at the OMNICAL plant at Ewersbach (West Germany).

The tests carried out at the city of Gardanne power station have enabled the purification of flue gases given off by the combustion of high sulfur coal to be studied.

These tests were carried out from February 27 to March 3, 1989, by the SOLVAY Study and Research Centre at Dombasle (France), which also provided the mobile unit used for pulverizing and injecting the sodium bicarbonate into the gases to be purified, as well as measuring the SO_2 content of the flue gases.

Description of the Installation

The City of Gardanne power station is fitted with two boilers with the following characteristics:

- Thermal power (per unit): 2.5 MW
- Type: VATC
- Model: grid hearth with recirculation of primary air
- Manufacturer: Seccatier
- Fuel: Provence lignite – locally mined bright burning coal with high sulfur content (>5%)

This power station is also fitted with a smoke processing unit supplied by Syprim – Air Industrie Environment.

The bicarbonate is first pulverized in the Dombasle Research Centre's mobile installation (Alpine 315 UPZ pulverizer). It is then injected into a venturi, counter-current to the combustion gases coming from the boilers.

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At this location the turbulence assures thorough mixing of the bicarbonate into the gases.

The reaction between the bicarbonate and the sulfur dioxide takes place in a reactor consisting of two concentric tubes. The residence time of the gases between the bicarbonate injection point and the reactor is around 1.5 seconds. The gases are then filtered in a bag filter, which retains the purification reaction products.

For a given batch of coal, the level of SO_2 in the flue gas varies only slightly. For this reason it was simple to regulate optimally the amounts of sodium bicarbonate required. In order to study the influence of the stoichiometric ratio on the effectiveness of the purification, the feed rate of the bicarbonate was varied between 40 and 120 kg/h.

The SO_2 content was measured by bubbling part of the flue gases through H_2O_2 solutions. The analyses were carried out on a DIONEX QIC anion chromatograph.

Stoichiometric Ratio

In order to remove SO_2, the following global reaction applies:

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

(2 moles $NaHCO_3$ for 1 mole SO_2 correspond to a stoichiometric ratio of 1)

In other words,

$2 \times 84/64 = 2.625$ kg of $NaHCO_3$ are required in order to remove 1 kg of SO_2.

Testing

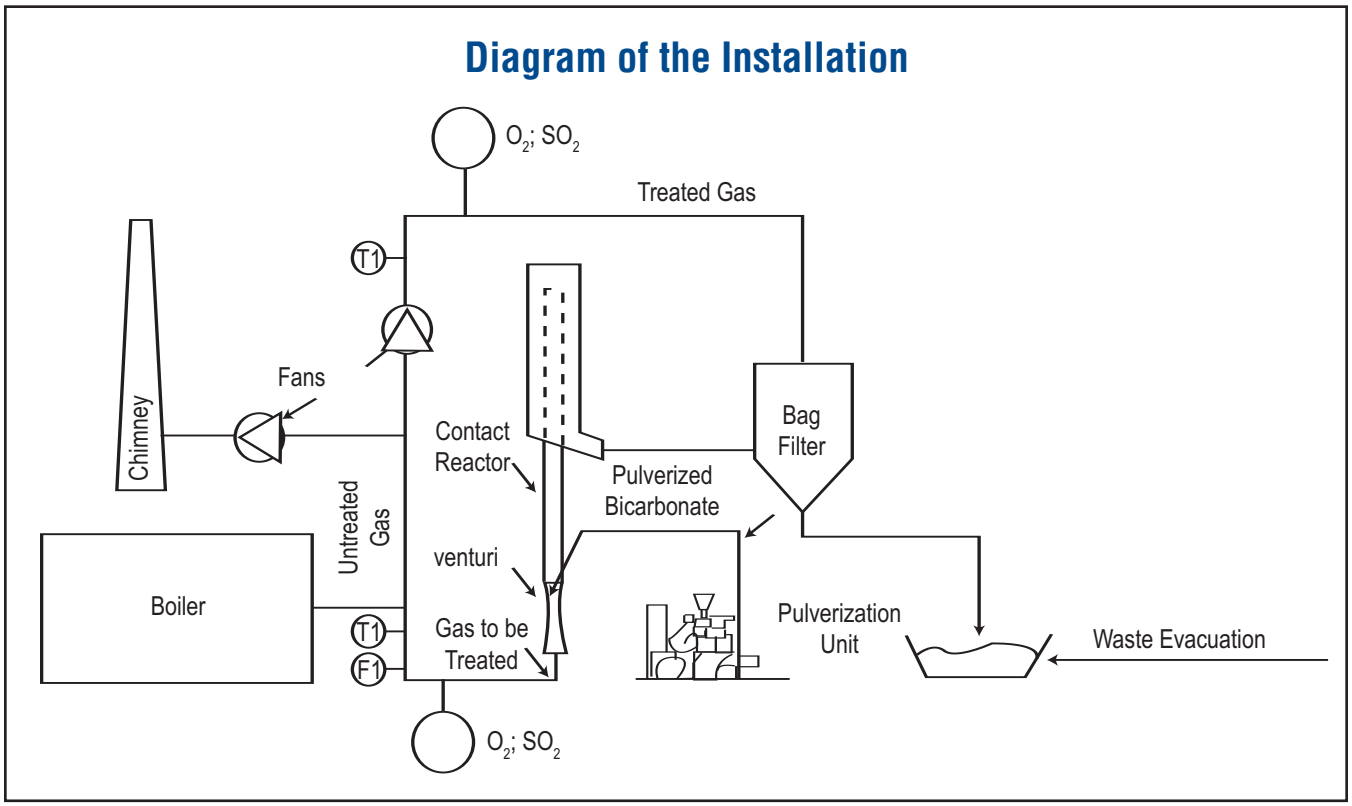
The following average values were measured at the bicarbonate injection point:

- Flue gas temperatures: 214°C
- SO_2 content: 9200 mg/Nm^3 ± 3%

A range of stoichiometric ratios between 0.5 and 1.6 was covered.

Diagram no. 1

Diagram of the Installation



Desulfurization of Power Station Flue Gases with Sodium Bicarbonate

Test Results

Table 1: Effectiveness of SO_2 removal

		Stoichiometric Ratio	
Pollutant	% Removal	Average	Maximum
SO_2	80	0.9	1.05
	90	1.05	1.2

Table 2: SO_2 content of the purified gases

		Stoichiometric Ratio	
Pollutant	Content mg/Nm³ dry gas at 7% O_2	Average	Maximum
SO_2	1000	1.05	1.2
	500	1.35	1.6

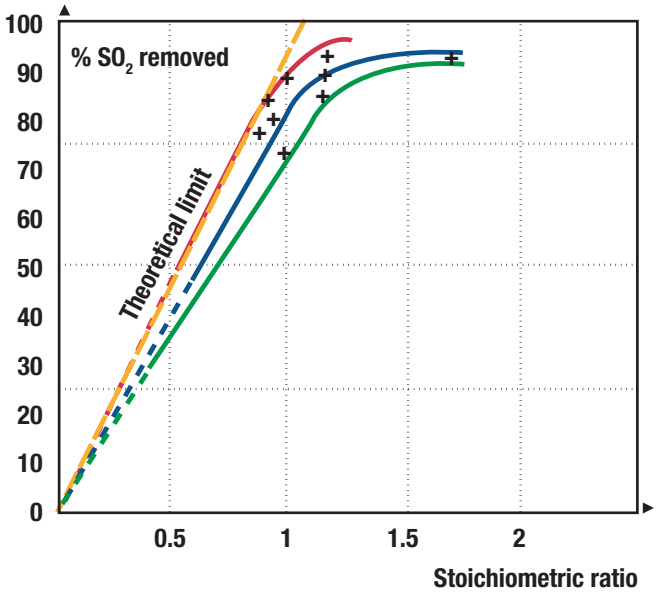
These results demonstrate the excellent effectiveness of sodium bicarbonate for desulfurizing flue gases. The low level of variation in the SO_2 content enabled almost the maximum possible effectiveness to be obtained.

The SO_2 content was reported at a 7% oxygen dilution, which corresponds to the normal operating level of a grid hearth boiler.

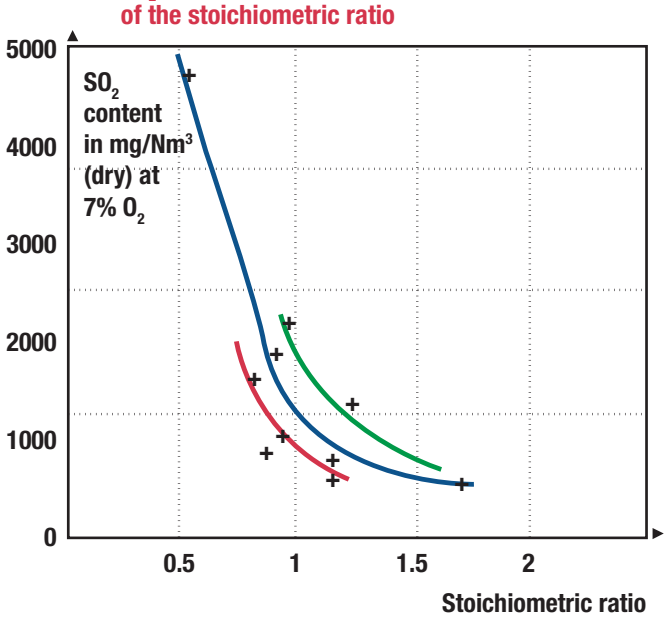
In calculating maximum values, an uncertainty margin of 15% has been added to average values, corresponding to the degree of error inherent in the measurement.

The SO_2 content of the purified gases may appear high, but this must be seen in relation to the very high SO_2 content of the untreated flue gas.

Graph 1: % SO_2 removed in relation to stoichiometric ratio



Graph 2: SO_2 content of purified flue gases as a function of the stoichiometric ratio



Conclusion

These results confirm the very high level of effectiveness of sodium bicarbonate for desulfurizing flue gases arising from the combustion of high sulfur coal.

90% of the SO_2 present in the gases was removed with a stoichiometric ratio between 1.05 and 1.2.

The low degree of variation in pollutant levels permitted optimal regulation of the amount of sodium bicarbonate required.