AMK KRAKÓW S.A.
Grupa Mostostal Warszawa

WET LIMESTONE GAS DESULPHURISATION SYSTEM

TÜV NORD
ISO 9001/ISO 14001

Introduction

Wet limestone FGD is unquestionably the most frequently used technology used for removal of sulphur dioxide in power generation and metallurgy.
AMK Krakow S.A. offers plants based on two-stage absorption technology developed and patented by the Non-Ferrous Metals Institute and the Institute of Chemical Engineering in Gliwice.

Process chemistry

Chemistry of the wet limestone FGD process , based on calcium carbonate as absorption agent, is shortly summarized in the following reactions :

Absorption of SO_2 in water to form sulphurous acid
$SO_2\ (g) + H_2O\ (l) \rightarrow H_2SO_3$

Sulphurous acid dissociation
$H_2SO_3 \rightarrow H^+ + HSO_3^-$

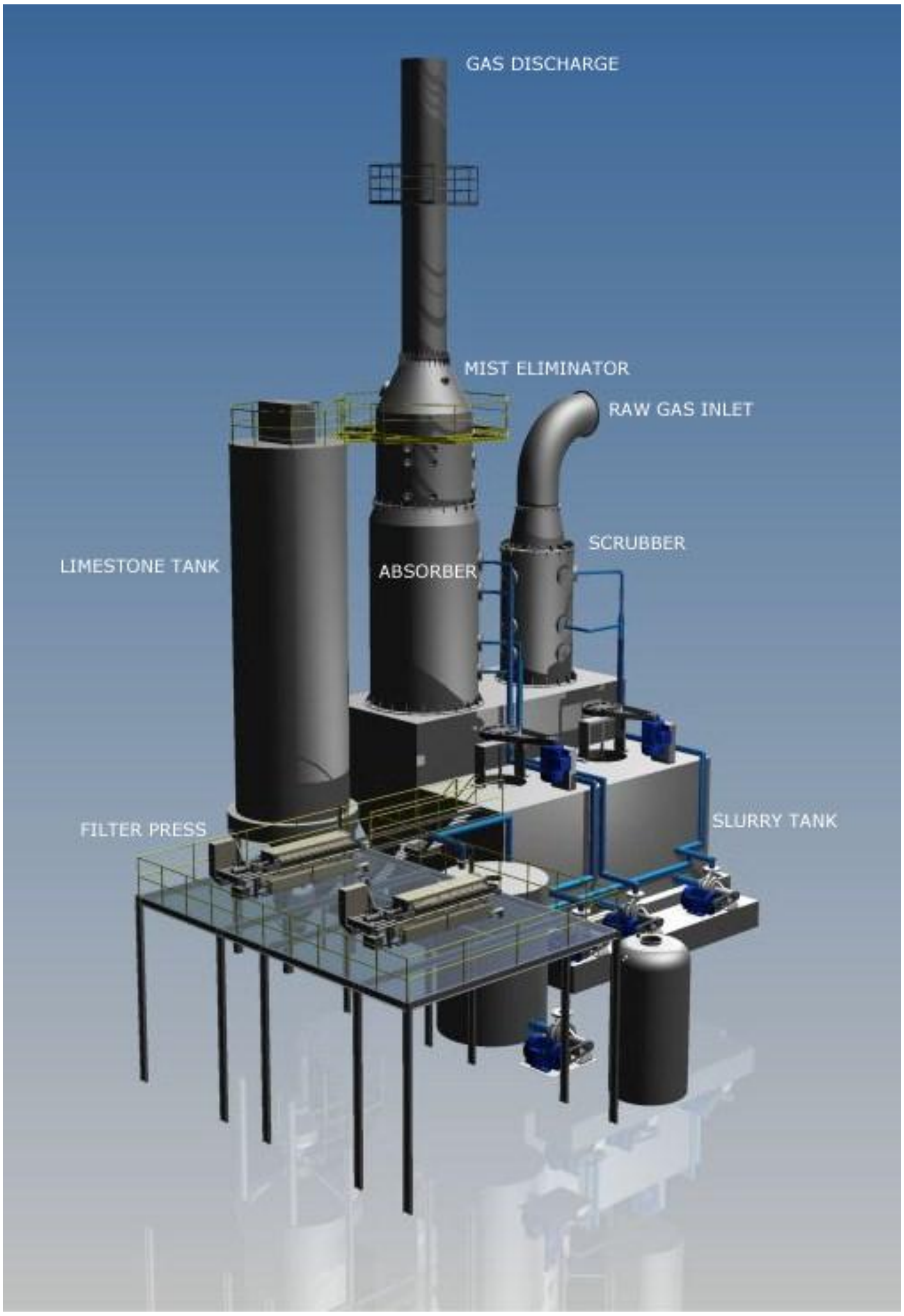
HSO_3^- ion oxidation to SO_4^{2-}
$H^+ + HSO_3^- + \frac{1}{2}O_2 \rightarrow 2H^+ + SO_4^{2-}$

Sulphuric acid neutralization with limestone
$CaCO_3 + 2H^+ + SO_4^{2-} \rightarrow CaSO_4 \times H_2O + CO_2$

PROCESS CHEMISTRY

Process description

The physical principle of wet limestone technology consists in contact of flue gas with gypsum and finely ground limestone suspension which results in formation of calcium sulphite, subsequently oxidised to gypsum. The effectiveness of the process is determined by the duration of contact of gaseous and liquid phase, the interfacial surface area and the ratio of flow rates of both phases. In the technology offered by AMK Krakow S.A., absorption takes place in two spray columns connected in series with separated sorbent suspension circulation loops.



This arrangement allows to split the process functions. The first stage of absorption, at relatively low pH , ensures excellent sorbent utilization and high quality of the end product (gypsum), while the second stage run at slightly higher pH offers high desulfurization efficiency. High sorptive capacity of periodically exchanged limestone suspension and the option to cut off selected spaying levels, gives the system ability to adjust to variable input conditions and maintain good overall process economy. The flow of gas and liquid phases in the first column (scrubber) is concurrent, while in the second (absorber) it is countercurrent. The source of oxygen necessary to oxidize the calcium sulfite and bisulfate to gypsum is air dispersed in scrubber tank.

Meeting by the process end product the gypsum market specifications requires that dust and heavy metals vapours are removed from the gas stream before it enters the scrubber.

Desulphurized, fully saturated with water vapour gases after passing through two-stage demister are discharged to the atmosphere. The gypsum suspension from the scrubber bottom tank is removed for dewatering and replaced with absorber suspension while fresh limestone suspension is added to the absorber bottom tank. If necessary, water added to the scrubber to make up for the evaporation and carry-off losses is used for washing of the scrubber inlet.

The auxiliary system components:

- limestone storage tank
- fresh limestone suspension preparation and feeding system
- discharge and storage of gypsum slurry
- dewatering of gypsum slurry (filter presses, centrifuges ore belt filters)
- gypsum storage

Process control

Installation is fully automatic, without the need for operator intervention in the process operation. Process control is based on automated measurements of pH, slurry density and suspension levels in absorber and scrubber bottom tanks.
The suspension exchange cycle may be triggered either by the pH or density of the scrubber slurry. Frequency of the suspension exchange depends on SO_2 concentration in the raw gas introduced to the system. Suspension level in the scrubber bottom tank is controlled by a water control valve.
Mist eliminator is automatically washed with process water from the spaying nozzles at specific intervals.
The system is also equipped with advanced supervision and diagnostics system .

Wet lime FGD system benefits:

- high desulphurisation efficiency with excellent sorbent utilization
- high quality end product (gypsum)
- flexibility of operation
- fully automatic operation

Process parameters

Gas flow rate	20 000 – 500 000 Nm^3/hr
SO_2 removal efficiency	90 - 99 %
End-product	marketable gypsum
$CaSO_4 \times 2H_2O$ contents	> 95 %
depending on the sorbent quality and efficiency of primary dust removal	< 10 %

application : production of gypsum wallboards, raw material for cement production

Examples of completed projects

Zinc Smelter “Bolesław Recycling”
Emission source: gases from the Waelz process

Flue gas plant was built as a part of a comprehensive modernization of Zinc Smelter. Wet limestone FGD treats gases generated in processing of the electrowinning residues. Before the upgrade the gas was directed directly to atmosphere.

Zinc Smelter and Refinery “Miasteczko Śląskie”
Emission source: flue gas from sinter plant at the Imperial Smelting Process zinc plant

The change of batch composition for ISF process, (increase of oxides material share) caused a decrease in SO_2 concentration below the suitable for Sulphuric Acid Plant but still very high level of approx. 1 %. The FGD plant was necessary to maintain the SO_2 emission at an acceptable level.

Basic process parameters:

	Bolesław Recycling	Z S&R Miasteczko Śląskie
Gas flow rate [Nm^3/h]	80 000	100 000
Gas temperature [^oC]	<200	35-40
SO_2 concentration [mg /Nm^3]	5-10	10-30
Efficiency [%]	>90	>98
Gypsum moisture content [%]	<10	<10
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