ULTIMATE

WATER SMART INDUSTRIAL SYMBIOSIS

Factsheet:

Sulphur Recovery

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Sulphur Recovery

Unique selling points:

- ✓ Allowing for treatment of high sulphur waste
- ✓ Removal of SO_2 from fumes reaching legislative requirements
- ✓ Recovery of Sodium Bisulphite
- ✓ Circular economy system

Description of the technology

The exhaust gases from waste incineration facilities may contain many potentially harmful substances. Particularly, sulphur will produce sulphur oxides (SO_x) in the flue gases (National Research Council, 2000). Acid gases cause widespread damage when they precipitate as acid rain or when they form weak acidic solutions with moisture at ground level. Consequently, SO_2 emission standards have been introduced in many countries on a national and regional basis (Falcone Miller & Miller 2010) and are decreasing all over the world (Lestinsky et al. 2017).

The reduction of SO_2 emissions is achieved by installing a flue gas desulfurization system. There are two categories of recovery processes which varies as a function of generated by-products. First, processes called “regenerative”, which allow to generate elementary sulphur or sulphuric acid by absorption of sulphur dioxide (Jacubowiez et al. 2000). Then, processes called “non-regenerative”, involve the formation of different by-products, generally associated to oxidated components like sulphate or gypsum (Lunt et al. 2000, Jacubowiez et al. 2000).

In the Roches-Roussillon chemical platform, SUEZ IWS Chemicals has developed the range of waste received, with the treatment of high-sulphur waste. They now want to upgrade the current (non-regenerative) process to a recovery solution. The chosen recovery process must adapt to constraints imposed by the composition and characteristics of effluents. Generally, scientific works published past few years discuss more simple systems or only mention desulfurization without talking about recovery (Wang et al. 2015, Chang et al. 1985, Zeicht et al. 2020).

The process developed is based on a patent (Hustache et al. 2001). It has the objective of removing the SO_2 from the fumes producing Sodium Bisulphite. Sulphur dioxide is a strong acid gas (Vanderschuren et al. 2010) which forms bisulfite ion (HSO_3^-) in aqueous solutions at a pKa level of 1.9, and sulfite ion (SO_3^{2-}) at a pKa level of 7.2. The pH level will therefore be an essential parameter to obtain the target product. Sodium bisulphite has many commercial uses including as disinfectant, bleaching agent and as mild reducing agent for removal of small

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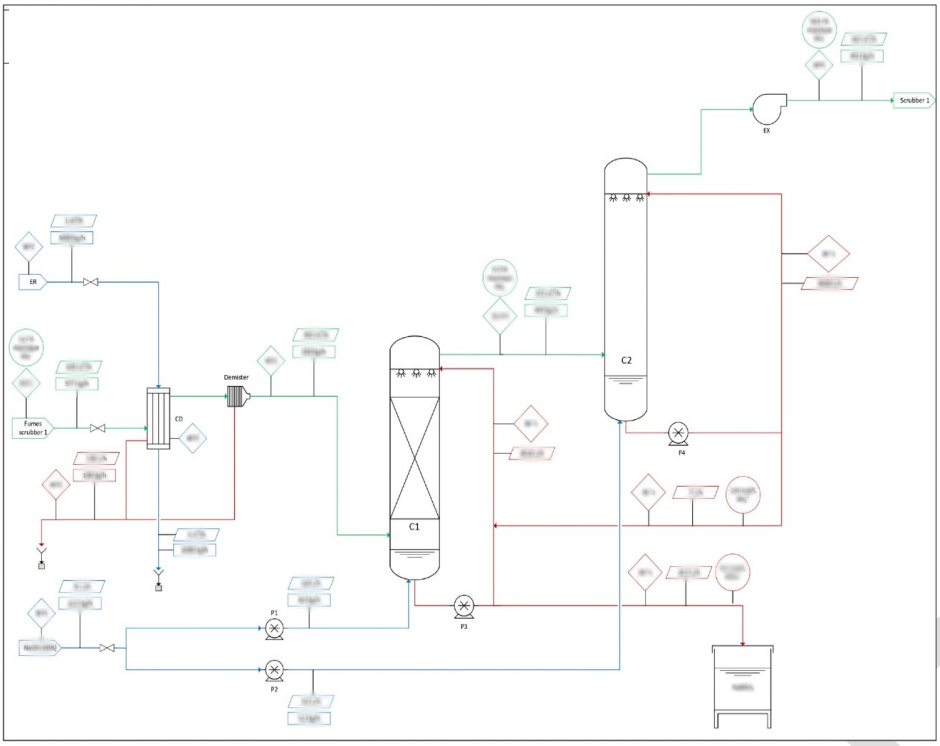
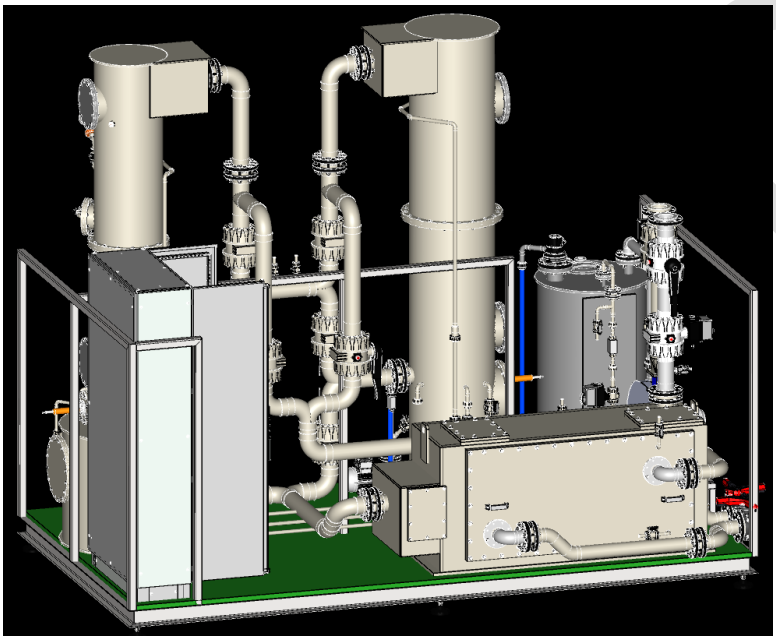
amounts of chlorine, bromine, iodine, hypochlorite salts and oxygen (i.e. an oxygen scavenger agent) (Kisielewski et al. 2011).

The industrial pilot was designed from this process. It is composed of a heat exchanger allowing to condense fumes, of two absorption columns regulated at different pH level by soda addition for SO_2 absorption and of a storage tank for the target product (cf. **Flow Scheme of the technology**).

Flow scheme of the technology



Pictures of the technology and product



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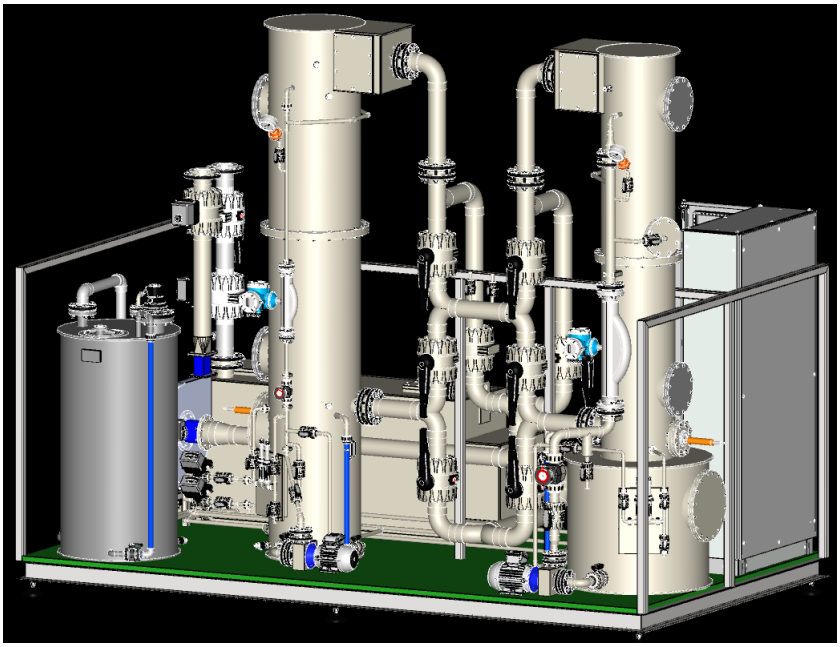

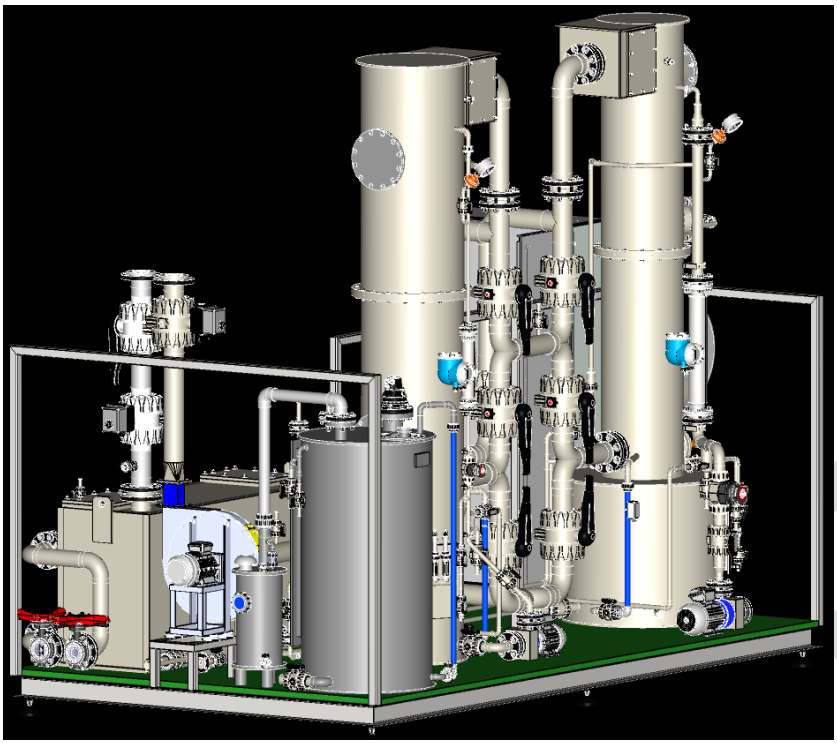

Synergetic effects and motivation for the implementation of the technology

- ✓ High removal efficiencies for a wide range of inlet SO_2 levels;
- ✓ Tolerant of wide fluctuations in inlet SO_2;
- ✓ Generation of an interesting by-product;
- ✓ Material recovery;
- ✓ Establishment of a system promoting a circular economy.

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Requirements of the technology and operating conditions

Tab. 1 Typical ranges for operating parameters

Parameter	Units	Min	Max	Reference
% SO_2 in flue gas	%	0,1	2	ULTIMATE
pH	-	3	8.5	ULTIMATE
Temperature	°C	ambient	80	ULTIMATE
Oxygen content in flue gas	%	2.0	10.0	ULTIMATE

Key performance indicators

Tab. 3 Key performance indicators

Parameter	Units	Min	Max	References
SO_2 removal from flue gas	%			
Recovery rate of sulphur from organic waste	%			
Purity of the sulphur product formed	%			

Links to related topics and similar reference projects

Process/technologies	Reference

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