Scrubbing technology

When it comes to emission-reduction technology, how does a plant know it is selecting the right technology for the job? Redecam believes its $DeSO_x$ technology, known as RDS, provides the ideal solution for both the cement and the lime industry. Here it directly compares RDS with wet flue gas desulphurisation (FGD).

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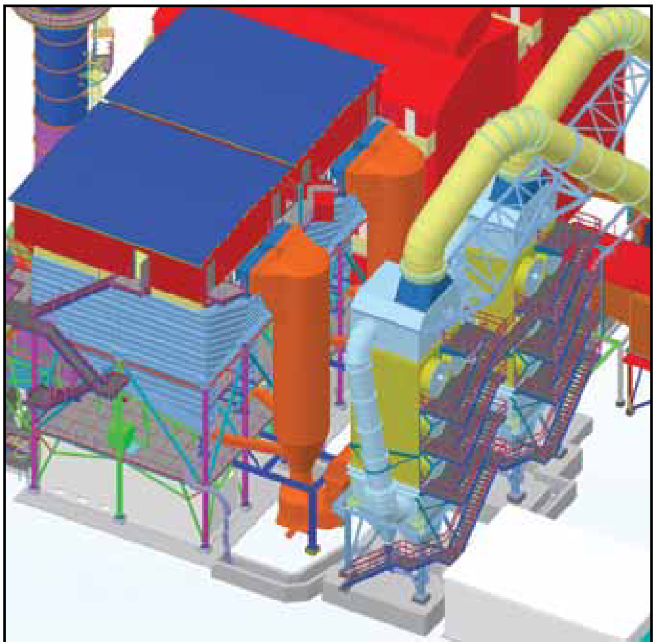
Environmental preservation is a global need, involving all countries in the world and all areas of human activity, from agriculture to industry. In terms of industry, there is a tendency to align emission requirements with the best performance achievable by technology. Therefore, it is vital that those companies operating in the industrial sector have as broad a spectrum of possibilities available to them when selecting the best emission-reduction technology for their plants.

Several factors have to be taken into account during this selection process, including the possibility of achieving the required emission targets, the technology reliability, the interaction with other gas treatment technologies, technology flexibility (turn-down), byproducts recovery, the specific skills required to operate and maintain the emission reduction plant, as well as the operating and investment cost.

Building on circulating fluidised bed technology

One technology that meets many of these factors is the circulating fluidised bed (CFB) semi-dry reactor from Redecam, known as RDS. CFB scrubbing technology is based on the fluidised bed principle. Hydrated lime and water are injected into a reactor where the powder is suspended and mixed using a high-velocity stream of flue gas entering from the bottom. The intense mixing between the acid gas, solid reagents and water, and the presence, for a given time, of a liquid phase over the reagent particles, enables SO_2 reduction efficiencies of over 95 per cent. The system is also active for the removal of hydrogen chloride (HCl), hydrogen fluoride (HF), mercury and other trace metals, without using reagents other than lime. Once mixed and reacted, the gas flow carries the solids out through the top of the reactor into a fabric filter, which separates the dust from the flue gas.

The dust is then recycled back into the reactor with a recirculation rate in the hundreds with respect to the fresh lime injected, after which the clean flue gas is conveyed to the stack. Since water is injected directly into the reactor, hydrated lime is fed in powder form and no slurry handling is necessary. Moreover, water is totally evaporated in the reactor, avoiding the need for wastewater treatment. As the final product evacuated from the filter is totally dry, drying equipment is also unnecessary.



Redecam's circulating fluidised bed semi-dry reactor, RDS, provides an alternative to wet flue gas desulphurisation technology to reduce SO_x emissions in the cement plant

The fabric filter is properly designed and sized for this application, due to the high dust load coming from recirculation and the relatively-low operating temperatures (usually 20˚C above the dew point). Thanks to the bed mixing, the lime conversion rate is high, even when elevated acid gas reductions are required, so allowing a Ca:S molar ratio of around 1.5 or less.

The final byproduct, even if not usable to replace gypsum as a cement regulator, has a wide range of applications, including as a fertiliser in agriculture, as a building material (additive for the production of screed and mortar, additive for production of building bricks and lime sand brick, fibreboards, etc), in the production of binders, in road construction, in the field of surface and underground mining, for the conditioning of sewage sludge.

Potential benefits to the cement industry

This technology is already widely used in the power and waste-to-energy (WTE) industry, while in other sectors, such as cement and lime, it is not yet present, mainly because the kilns does not usually require $DeSO_x$ installations due to their natural scrubbing effect. However, there are several cases where the characteristics of the process, whether for raw materials or fuels, do require $DeSO_x$ treatment. Here, RDS technology becomes a competitive option, particularly where high reduction is necessary or where the operating cost of a dry sorbent injection (DSI) technology is not sustainable.

Cost comparison

Tables 1 and 2 compare RDS and wet FGD for a 3000tpd cement kiln where SO_2 emissions need to be reduced by 95 per cent.

Table 1: RDS and wet FGD main technical features			
Parameter		**RDS**	**Wet FGD**
Reagent used		Medium-quality hydrated lime	Pulverised high-grade limestone (>95%)
Molar ratio		1.4	1.1
Reagent consumption	(Mta)	2.995	3.484
	kg/t clinker	3.1	3.6
Reactor Δp (mbar)		10	negligible
Power consumption (kWh/t clinker)		2.7	5.0
Water consumption (m3/d)		202	232
Byproducts – excl kiln dust (Mta)		5.226	5.325
Byproducts recovery		Recycled with other kiln dust	Gypsum into cement
Other issues			Visible plume at the stack

Table 2: RDS and wet FGD estimated operating costs			
Cost		**RDS**	**Wet FGD**
Reagent (€'000/year)		248.1	14.4
Energy (€'000/year)		106.3	198.6
Process water (€'000/year)		16.0	18.4
Maintenance (€'000/year)		166.8	314.1
Gypsum recovery saving ((€'000/year)		-	6.6
Total operating cost	(€'000/year)	537.2	538.9
	(€'000//t clinker)	0.58	0.58

The operating cost was evaluated starting from a hydrated lime cost of €83/t and a power cost of €41.40/MWh. A higher power cost would further penalise the wet FGD technology, which is the most energy-demanding in this comparison. From a technical point of view, it should be noted that while the byproduct coming from the wet FGD is recoverable in cement grinding in the place of gypsum (the replacement percentage is very low), the byproduct of the RDS can be mixed with the kiln dust and recovered into the raw meal.

The operating cost of the two options is very similar. The higher reagent cost of the RDS is balanced by the higher power and maintenance cost of the wet FGD. Of course, when the size of the plant decreases, the comparison goes in favour of the RDS, because maintenance cost is not linearly decreasing with plant capacity.

In terms of investment cost, RDS requires around half of the investment typically required for a wet FGD installation. Moreover, its footprint consumption is lower in comparison with a wet FGD as there are no sections for slurry treatment and byproduct drying. In addition, it does not require specific skills or additional personnel for operation and maintenance.

Finally, due to the necessity to have a specific filter design, RDS is a very interesting option when it is required to improve both SO_2 (or heavy metals, HCl, etc) and dust emissions. A typical application could be when the existing dedusting is carried out by an ESP or old baghouse that has to be revamped. In this situation, an RDS installed downstream, or in the place of the existing equipment, can solve both gaseous and powder emission issues without requiring heavy investment or big layout modifications. ■


RDS technology offers cost advantages, particularly in areas where power costs are high