

TECHNICAL BRIEF • GAS TREATMENT & ODOR CONTROL

Hydroxyl Radical Eliminates H₂S in Wet Scrubbers & Flue Gases

In a Houston study, DZ 9966 ROS took a natural-gas stream from 2,000 mg/L H₂S to complete elimination — shifting ORP from -150 mV to +100 mV, leaving only inert sulfate compounds.

2,000 mg/LH₂S ELIMINATED
FROM THE STREAM**-150→+100 mV**ORP SHIFT THAT
REMOVED H₂S**\$0.0040 /lb**COST PER LB OF
H₂S REMOVED

In a recent Houston, TX study, H₂S was removed from a natural-gas stream containing 2,000 mg/L H₂S and 5% CO₂ using DZ 9966 ROS — a new mineral oxychloride compound that generates reactive oxygen species (ROS) such as hydroxyl radical ions in a highly soluble, easy-to-use form. Simulating wet-scrubber operating conditions, the study found that the high concentration of soluble hydroxyl radical ions rapidly took the ORP from -150 mV to +100 mV, completely eliminating the H₂S. The only residual materials left in solution were inert sulfate compounds.

“Sour” gas and water contain significant amounts of hydrogen sulfide (H₂S), and are common at oil refineries and natural-gas plants. Removing sulfides matters because burning sulfur-bearing fuels releases sulfur dioxide (SO₂) — a pollutant the U.S. EPA has regulated for decades. Fossil-fuel combustion at power plants (73%) and industrial facilities (20%) are the largest SO₂ sources; short-term exposure is linked to bronchial constriction and increased asthma symptoms, especially in children, the elderly, and asthmatics.

— Wet scrubbing — and the challenge

Wet scrubbing removes nitrogen (NO_x) and sulfur (SO_x) compounds by contacting a gas stream with a recirculating water-based scrubbing liquid in a countercurrent tower. Alkaline solutions (caustic soda, sodium hypochlorite, lime slurry) absorb acidic gases like SO₂, CO₂, and H₂S, with the goal of keeping H₂S below 4 mg/L. An effective scavenger must meet four criteria: a rapid reaction rate, a non-reversible path (no reversion to H₂S), cost efficiency per mole of H₂S removed, and no problematic solids formation (e.g., dithiazine).

— The solution — hydroxyl radical ions

How quickly and efficiently H₂S is oxidized is directly proportional to the oxidant's oxidation potential — the higher the potential, the faster the reaction. DZ 9966 ROS generates hydroxyl radical ions, which sit near the top of the scale and meet all four scavenger criteria.

It is a new, low-cost technology that oxidizes sulfur compounds to sulfur oxide or elemental sulfur. Using a simple ORP meter and controlling dosage between +100 mV and +300 mV eliminates H₂S; the reaction is fast and does not revert to H₂S or form precipitates. (Above +700 mV, DZ 9966 generates elemental sulfur, S⁰.)

Capital cost is low: the feed system is simply a metering pump and a storage tank, with an optional ORP controller on the return line or sump for full automation.

OXIDATION POTENTIAL OF OXIDIZERS		
OXIDIZER	FORMULA	E ^v
Fluorine	F ₂	3.0
Hydroxyl Radical	OH•	2.8
Ozone	O ₃	2.1
Hydrogen Peroxide	H ₂ O ₂	1.8
Potassium Permanganate	KMnO ₄	1.7
Chlorine Dioxide	ClO ₂	1.5
Chlorine	Cl ₂	1.4
Oxygen	O ₂	1.2
Hypochlorite	OCl ⁻	0.9

— Odor-control technologies — cost comparison

TECHNOLOGY (MAX H ₂ S)	CAPITAL COST	ANNUAL O&M	COST / LB H ₂ S
Chemical Scrubber (100 ppm)	\$206,000	\$148,000	\$3.50
Bio-Scrubber (100 ppm)	\$383,000	\$10,200	\$0.24
Bio-Filter (5 ppm)	\$355,000	\$65,000	\$30.62
Std. Carbon Scrubber (5 ppm)	\$100,000	\$315,000	\$148.41
Catalytic Carbon Scrubber (5 ppm)	\$140,000	\$30,100	\$14.18
DZ 9966 ROS (2,000 ppm)	\$10,000	\$4,700	\$0.0040
Triazine (2,000 ppm)	\$300,000	\$30,000	\$0.0132

Rated at 10,000 cfm (75,000 lbs air/day) with 200 ppm H₂S; 2009 costs. DZ 9966 ROS has no upper limit on H₂S removal; ~1 mg/L DZ 9966 removes 2.0 mg/L H₂S by weight.

CONCLUSION

For non-regenerative wet scrubbing, DZ 9966 is a low-tech, easy-to-feed, ORP-monitored primary oxidant for H₂S and CO₂ — safe (non-flammable, non-combustible) and effective on natural gas, crude oil, refined products, digester gas, and flue gas.



For more about DZ 9966 and related technology, contact D&Z Worldwide at deepak@dz-worldwide.com.