

IMO 2020 0.5% sulfur regulation: The debate over scrubbers

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The new IMO 2020 sulfur (0.5 wt%) regulation is creating concern and uncertainty worldwide. Everyone is afraid of the impossibility of making new bunker blend recipes that satisfy the regulation, and are “sleepwalking into gasoil.” Of course, this fear is unfounded, as Refinery Automation Institute (RAI) showed in its internal research on making IMO 2020 compliant fuels in the US GulfCoast.

What about alternatives, such as using scrubbers? Is it really cheaper than buying ultra-low sulfur fuel oil (ULSFO) or marine gasoil (MGO)? The answer is, “Yes.” Scrubbers allow vessels to continue burning cheap IFO 3.5 wt% S, and they pay for themselves in a year or less.

The results of two calculations to determine scrubber payback are discussed here: simple return on investment (ROI) and discounted cash flow (DCF) return. The payback varies with ship size (different fuel consumption rates), from a couple of months for

Container Post Panamax-es to more than a year for smaller ferries and small Panamax Bulkers. Individual parameters can be used for calculations depending on the specific case situation. The difference between the two calculators is that the first (ROI) is a quick ballpark estimator, while the second (DCF) calculates the internal rate of return and net present value using CAPEX, OPEX, life of equipment, interest rates and depreciation.

What is a scrubber? A scrubber is a fairly large electromechanical-chemical device that is attached to the vessel’s exhaust chimney to clean the bunker-burning engine exhaust gas sulfur to a globally acceptable level, i.e., below 0.5 wt% S.

The scrubber chemically converts the sulfur dioxide (SO₂) and sulfur trioxide (SO₃) in the exhaust gas into rather benign calcium sulfate (CaSO₄).

The most frequently used scrubbers are either an open-loop or closed-loop type (FIG. 1). In an open-loop scrubber, the water with CaSO₄ is simply placed into the ocean; obviously, this is a cheap solution, but it does affect the alkalinity of the seawater. In a closed-loop scrubber, the CaSO₄ is filtered out as “sludge” and disposed of properly in a port equipped for sludge disposal. Consequently, this option is more expensive.

Other considerations impact scrubber costs:

- They consume a lot of space and weigh many tons, so there must be space to install them and support their weight.
- They must be equipped with performance-monitoring electronics (sensors and computers) to prove that the cleaned exhaust meets the IMO 2020 specs.
- They create “back-pressure” on the engine, which affects energy efficiency.
- The engine exhaust and sludge are highly corrosive, which limits the life of the scrubber, even with the use of corrosion-resistant materials.
- The cost of sludge disposal is not negligible, as is the scrubber’s periodic maintenance cost.

(H₂), catalyst and energy to “bind” sulfur species to H₂ in the form of hydrogen sulfide (H₂S). This costs a significant amount of money.

To estimate payback time, two cases were analyzed spanning min/max vessel fuel consumption ranges, from 40 tpd–300 tpd. The payback varied between 0.3 years and 1 year.

The main assumptions used were:

- Life of scrubber: 10 years
- Price of scrubber, installed: \$5 MM
- Annual maintenance cost: \$1 MM/year in sludge disposal, scrubber inspections and minor repairs, and checking performance monitoring instrumentation
- Prices of fuels and maintenance costs are in 2017 USD using Singapore prices, and were assumed constant over the next 10 years.

Exceptions do exist: for smaller vessels like those in a fishing fleet, the payback is still favorable. The big problem is the lack of space, the ability to carry the extra weight on a smaller vessel, and the impact of back pressure on engine efficiency and fuel consumption.

For all cases where daily fuel consumptions are greater than 40 tpd, scrubbers will pay for themselves in significantly less than one year, providing a real alternative to “sleepwalking into gasoil.” ●

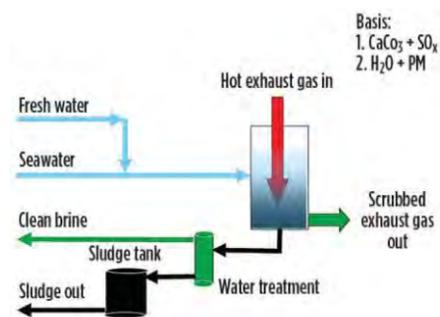


FIG. 1. Exhaust gas SO_x scrubber principle.

DISCOUNTED CASH FLOW CALCULATION SPREADSHEET														DATE: 3/23/2018	
PROJECT: Bunker Scrubber Initiative Project CAPEX: Base; commercial scrubber (2017) price 5,000,000 USD															
SHIP Consumption= 400 MT/Day 146,000 MT/Year Fuel Prices, US\$/MT Houston, March 23, 2018 IFO380 3.5%S 363 MGO 0.1%S 596 Price Differential 233 \$34,018,000 per Year															
1) Scrubber Project Savings (=Consumption(MT/yr)X (IFO380-GO price differential)) \$34,018,000 2) TOTAL YEARLY SAVINGS \$34,018,000				SAVINGS				YEARLY OPERATING COSTS (OPEX)				OP COST			
				1) Sludge Disposal Yearly Maintenance Costs \$500,000 2) Scrubber Electronics Instrumentation Verification and Calibration Checks and Adjustments \$250,000 3) Scrubber Computer Software Performance Monitoring and Validation Check Verification and Adjustment \$150,000 4) Miscellaneous government authorities inspection and registration update fees \$100,000 TOTAL YEARLY OPERATING COSTS \$1,000,000											
INITIAL INVEST. LF DB A 22 100% B \$6,000,000 10 100% C \$0 16 100% D				ADVALOREM= 5.00% YEAR 0 WC= \$0 PROJ LIFE= 10 TAX RATE = 35.00% PROJ REC = 0 % DEPLTN = 0.00% TOLERANCE= 0.1				%DCF= DCF > 100% NPV= \$126,142,297 PAYBACK= 0.3 YEARS IRR= 360.5% STATUS= FALSE				NOTES: PROJ LIFE: 6 YEARS COMPUTERS / IT EQUIPMENT 10 YEARS SCRUBBERS AND BLEND EQUIP. 16 YEARS PROCESS PRODUCTION UNITS 20 YEARS LAND IMPROVEMENTS 22 YEARS TANKAGE AND PIPELINES			
YR	ANN INV	LF	DB	REVENUES	OP COST	OTHR CST	WC CHANGE	INCOME	DEPR	TAX	DISCOUNTED CASH FLOW	UNIFORM CASH FLOW	TOTAL CASH FLOW	NPV	CUMULATIVE CASH FLOW
0	6,000,000		ABOVE	0	0	0	0	0	0	0	-6,000,000	0	-6,000,000	-6,000,000	-6,000,000
1	0	10	200%	34,018,000	1,000,000	0	0	33,018,000	600,000	11,346,300	0	21,671,700	21,671,700	19,701,545	15,671,700
2	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	17,749,339	37,148,400
3	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	16,135,763	58,625,100
4	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	14,668,875	80,101,800
5	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	13,335,341	101,578,500
6	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	12,123,037	123,055,200
7	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	11,020,943	144,531,900
8	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	10,019,039	166,008,600
9	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	9,108,217	187,485,300
10	0	10	200%	34,018,000	1,000,000	0	0	32,718,000	600,000	11,241,300	0	21,476,700	21,476,700	8,280,198	208,962,000
	6,000,000			340,180,000	10,000,000	0	0	327,480,000	6,000,000	#####	-6,000,000	214,962,000	208,962,000	126,142,297	1,117,168,500