IFO380 Bunker Recipes for IMO 2020 Sulfur Specs

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No day passes without publications, the blogosphere, and pundits wringing their hands over the upcoming IMO 2020 0.5%S bunker specs.

Some are simply giving up, with headlines crying "Industry…Just Sleepwalking into Gasoil" [1], others wishing it away by….ignoring it for the moment, and hoping for some miracle... But is it justified?

We looked at the six choices for 2020 documented elsewhere [2], including switching to MGO, using ECA fuels, using 0.5%S fuels (still to be made), using scrubbers, switching to LNG, or doing nothing.

This paper discusses our own research on the feasibility of making bunkers with today's widely-available blend components [3], the IMO CE Delft study [4], and the IMO-unsolicited Ensys/Navigistics study [5]. We are happy to confirm that we can successfully and economically make 2020-compliant bunkers TODAY!

1. RAI US Gulf Coast 0.5% S Bunker Feasibility Study (August 2017)

RAI 2020-compliant Bunker Study [3] examined in detail Gulf Coast (USA) availability of suitable blend components today to make 2020-compliant bunkers. We used these components and bunker blend optimizer software [8] to verify 2020 spec compliance and cost-effectiveness.

The criteria used in selecting widely-available blend components were based on low – Sulfur crudes, thus avoiding costly desulfurization via residue hydrocrackers or residue HDS processing.

The blend components used for recipe testing were:

- Straight Run Residue – LS (< 1%)
- Vacuum Residue – LS (< 1%)
- No. 6 residual fuel oil (0.3%S to 1%S)
- HT LCO
- Slurry Oil
- VGO-LS (< 0.5% S)
- Russian Black Gasoil
- Marine Gasoil

The components are currently available in the US Gulf Coast. The prices of these blend components were from Argus, Platts, and OPIS. For some components, we estimated their prices based on the Platts methodology of extrapolating between a pair of reference fuels that "bracket" the desired "unknown" component properties.

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For residues, we explored a number of “low Sulfur” crudes, producing residues with a sulfur content between 0.3 and 0.6 Wt% S. The crudes we tried are widely available crudes such as Cabinda, Minas, Girassol, Bonny Light, and some crude blends such as Saharan, BTC, and Palanca [6]. The criteria is for these crudes to produce residues that do not exceed approximately 0.6 to 0.7 Wt% S.

Fig, 1 Example of 2020 Optimized Bunker Recipes

Optimum Blend

Objective Function: 407.98 | Std LP | Details | ☐ Blend Biases Active | 2 Limits Hit (***)

Last Run at: 08/08/17 10:24 AM | Feasible: Yes, OK

Blend Stock	Amount, Tons	Wt% in Blend	% of Option	Imputed Value	Blend Property	Result at Optimum	Spec Range
Atmosph SR Resid-Lo S	3,697.4	73.95	7.4	49.48	Density, kg/CuM	979.2	<991
Vac Resid-Lo Sulf	.	0.00	0.0	30.26	Sulfur Content, wt%	0.50	*** 0><0.5
No6 Fuel Oil-2%S	.	0.00	0.0	47.18	Flash Point, deg. C	97.1	>60
LCO-LS 0.5%	107.1	2.14	0.2	91.22	Pour Pt, deg C	30.0	*** <30
No6 Fuel Oil-1%S	340.6	6.81	0.7	55.47	Vis at 50 deg C	380.0	300><380
No.6 SLURRY	855.	17.10	1.7	49.55	Ash, Wt Pct	0.030	<0.1
LS MGO	.	0.00	0.0	146.71	Con Carbon, Wt Pct	4.1	<18
LS VGO	.	0.00	0.0	125.59	Water & sediment, Vol Pct	0.16	<0.5
SR LAGO	.	0.00	0.0	153.15	Total Sediment Potential, Wt %	0.003	<0.10
IFO380 - 3.5%S	.	0.00	0.0	47.70	Vanadium, ppm W	28.6	<350
			% Min/Max Blend		Aluminum+Silicon, ppm W	16.9	<60
Total	**5,000.** Tons		100.0		ULO-Zinc, ppm W	0	<15 (Not A
Minimum	1,000 Tons				ULO-Phosphorus, ppm W	0	<15 (Not A
Maximum	5,000 Tons				ULO-Calcium, ppm W	0	<30 (Not A
			Cost, $/Ton	307.31			
			Sales Price, $/Ton	385.40	Specific Energy , MJ/kg	41.00	>30
			Profit, $/Ton	**78.09**	Acid Number, mg KOH/g	0.00	<2.5 (Not A
			Total Profit, $000	**390.5**	Sodium, mg/kg	0.00	<100 (Not
					Asphaltenes, Wt %	0.00	0<>10 (Not
					H2S, mg/kg	0.0	0<>2 (Not
					CCAI	841	<870
					BMCI	71	<71 (Not A
					Stability K=BMCI/TE	12.9	>1.15 (Not

Imputed Value is the effective value of the component in the blend. It can be low because of poor quality or high cost. Slack values have imputed value=component cost.

Note: *** shows a Limiting Specification

The recipes use low Sulfur atmospheric crude residues with “cracked” blendstocks, like FCC LCO and Slurry. This pretty much guarantees blend stability and compatibility because of the aromaticity of these components keeps the asphaltenes in solution.

We also compared the costs of making these blends vs. cost of other fuels, ECA-hybrids, LS (1%) IFO380 (Genoa), and 0.1%S MGO’s. In all cases, the US GC blends were significantly cheaper (Fig. 2).

We purposely used low Sulfur crude residues to avoid costly hydrodesulfurization to keep the costs manageable. Expecting refiners to build new desulfurization units is wishful thinking in the current low crude oil price environment, which is not showing any signs of abating soon.

Is the use of low Sulfur crude residues realistic? We think so. There are over 100 different crudes meeting the criteria (see reference 6 for specific lists), and available both in Asia-Pacific, Africa, and US. Of course, it’s going to take a little bit of extra work to line up contracts at the right price, and insuring un its can run on the alternate crude diets.

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Fig. 2 Examples of RAI Recipes and their Costs (August 2017)

RAI 2017 Study of IMO 0.5% S IFO380 Recipes (for 2020) in USA Gulf Coast					
Blend Component	Recipe 1 [wt%]	Recipe 2 [wt%]	Recipe 3 [wt%]	Recipe 4 [wt%]	Recipe 5 [wt%]
Atm Straight Run-LS	73.95	71.43	31.82	72.95	0
Vac Resid-LS	0	0	31.82	0	47.25
LCO-LS 0.5%S	2.14	9.93	29.15	3.33	18.54
No6 Fuel Oil 1%S	6.81	0	7.2	0	4.77
No6 Slurry	17.1	0	0	23.73	0
VGO LS	0	18.63	0	0	29.44
Blend Results					
Sulfur m/m %	0.5	0.34	0.5	0.5	0.5
Visco, cSt (50C)	380	80	101	337	120
Blend Cost ($/MT)	307	379	335	308	389
Blend Profit ($/MT)	78	5.8	50	77	-3.6
Notes:					
1. Prices as of August 4, 2017					
2. IFO380 0.5%S is $385/MT based on Platts methodology					

2. Review of IMO study undertaken by CE Delft

Our basic critique is that for Europe and the US, their “solution” is a 14 to 17 cSt viscosity gasoil, the IMO recipe being ~75% gasoils and 25% hydrotreated (desulfurized) atmospheric residue or H-Oil bottoms, which cannot be called bunker, either property-wise, or price-wise. In addition we believe to be misleading to claim the use of components that currently don’t exist in certain geographical areas, e.g. visbreaker bottoms which don’t exist in the US, or the very rare H-Oil unit bottoms.

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Fig. 3 IMO's European 0.5% S Bunker Recipe

Europe HFO blending (2020)				
Component to Blend	Volume (barrels/day)	Vol%	SUL % (m/m)	Viscosity cSt@50°C
SR DIESEL	224,083	23.05	0.552	-
FCC LCO	113,224	11.65	0.587	-
TR LT DIST	27,316	2.81	0.044	-
TRT AGO 85%	351,048	36.12	0.148	-
TRT PURCH GASOIL	5,404	0.56	0.015	-
H-OIL BTMS	152,943	15.73	1.000	-
TRT ATRES	97,981	10.08	0.250	-
Total	972,000	100.00	0.450	17.2

Credit: IMO-CE Delft

Fig. 4 IMO's USA 0.5% S Bunker Recipe

North America HFO blending (2020)				
Component to Blend	Volume (barrels/day)	Vol%	SUL % (m/m)	Viscosity cSt@50°C
VISBR TAR	9,071	2.88	3.494	-
TRT LCO	112,060	35.63	0.107	-
LCO	11,703	3.72	0.714	-
SLURRY	45,320	14.41	0.939	-
H-OIL BTMS	40,112	12.75	1.000	-
TRT LT DIST - MED HDS	76,694	24.39	0.019	-
TR LT DIST	18,770	5.97	0.000	-
TRT KERO	649	0.21	0.065	-
TRT KERO (DSL TR)	111	0.04	0.326	-
Total	314,490	100	0.444	14.7

Credit: IMO-CE Delft

For Asia, IMO claims a 110 cSt bunker, the recipe again uses components that are hardly available because the process units don't exist or there are just a handful, e.g. using about 65% hydrotreated atmospheric residue (even if there aren't meaningful number of facilities available), and about 13% H-Oil bottoms, again, with very few units available.

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Fig. 5 IMO's Asia 0.5% S Bunker Recipe

Asia HFO blending (2020)				
Component to Blend	Volume (barrels/day)	Vol%	SUL % (m/m)	Viscosity cSt@50°C
ATRES	114,489	6.06	2.103	-
TR LT DIST	291,104	15.4	0.030	-
H-OIL BTMS	241,080	12.76	1.000	-
TRT ATRES	1,243,327	65.78	0.263	-
Total	1,890,000	100	0.450	110.7

Credit: IMO-CE Delft

3. IMO unsolicited competitive study by Ensys/Navigistics

A parallel availability study was undertaken by Ensys/Navigistics that drew completely opposite conclusion to that of IMO/CE Delft: that there won't be enough blend components to meet 2020 specs. However their recipes were more or less paralleling CE Delft recipes using a lot of treated residue (<1%S).

4. Conclusion

The RAI study confirmed that

- We can make 2020 specs bunkers at about the same cost as making today's IFO380
- The bunkers meet all the ISO8217 specs for residual fuels, and are not "gasoils", avoiding thermal shocks and other fuel switching headaches
- There are enough low Sulfur components on the US GC market today to comfortably make 0.5%S IFO380
- Importantly, it does not require refiners to re-configure their plants or add expensive residue desulfurizers or residue hydrocrackers (which won't be available anyway for Jan 1, 2020)
- Assuming 300 million tons/year of IFO380 consumption (about 6million BPD), it does not stretch budgets or markets to get the lower Sulfur crudes or blendstocks.

References

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