IFO380 recipes can meet 2020 reduced-sulfur bunker regs

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It is possible to make bunker fuel oil that meets all ISO 8217 specs for residual fuels, complying with the International Maritime Organization's (IMO) forthcoming 2020 regulations without using gas oils, enabling refiners to avoid thermal shocks and other fuel-switching headaches. Further, enough low-sulfur components exist in the US Gulf Coast (USGC) market to comfortably produce 0.5 wt % sulfur IFO380 without requiring refiners to reconfigure their plants or add expensive residue desulfurizers or hydrocrackers.

Assuming a global IFO380 consumption of about 300 million tonnes/year, neither budgets nor markets would be stressed to secure the lower-sulfur crudes or blendstocks required to produce these bunkers.

The IMO's upcoming 0.5 wt % specification for bunker fuel oil scheduled to take effect Jan. 1, 2020, has sparked a mild hysteria among the refining industry as to what course to take for compliance with the new regulation.[1]

Some refiners are wishing it away, while others are ignoring it for the moment in hopes of some miracle that will delay or eliminate the compliance deadline entirely.

We examined six options currently outlined for 2020 compliance: switching to marine gas oil (MGO), using IMO Emission Control Area (ECA)-compliant fuels, producing 0.5 sulfur wt % fuels, using scrubbers, switching to LNG, or doing nothing.[2]

This article discusses Refinery Automation Institute LLC's (RAI) research on the feasibility of making bunker fuels with today's widely available blend components as compared with research conducted by IMO CE Delft and IMO-unsolicited Ensys Energy & Systems Inc.-Navigistics Consulting.[3-5] Results indicate 2020-compliant bunker fuels can economically be produced using existing blend components.

RAI study

Released in August 2017, RAI's 2020-compliant bunker study examined in detail USGC availability of suitable blend components to make 2020-compliant bunker fuels.[3] We used these components and bunker-blend optimizer software to verify 2020-spec compliance and cost-effectiveness.[7-8]

The criteria used in selecting widely available blend components centered on low–sulfur crudes to avoid the need for more costly desulfurization via additional residue hydrocracking and hydroprocessing when using high-sulfur crude feedstock.

The blend components used for recipe testing included:

- Straight-run residue, < 1.0 wt % sulfur.
- Vacuum residue, < 1.0 wt % sulfur.
- No. 6 residual fuel oil, 0.3-1.0 wt % sulfur.
- Hydrotreated light-cycle oil.
- Slurry oil.
- Vacuum gas oil, < 0.5 wt % sulfur.

RAI 2020 IMO 0.5 WT % SULFUR IFO380 RECIPES AT USGC* Table 1

Blend component	Recipe 1, wt %	Recipe 2, wt %	Recipe 3, wt %	Recipe 4, wt %	Recipe 5, wt %
Atmospheric straight-run low-sulfur residue	73.95	71.43	31.82	72.95	0.00
Vacuum low-sulfur residue	0.00	0.00	31.82	0.00	47.25
Light-cycle oil, 0.5 wt % sulfur	2.14	9.93	29.15	3.33	18.54
No. 6 fuel oil, 1.0 wt %	6.81	0.00	7.20	0.00	4.77
No. 6 slurry oil	17.10	0.00	0.00	23.73	0.00
Low-sulfur vacuum gas oil	0.00	18.63	0.00	0.00	29.44
Blend results					
Sulfur, wt %	0.50	0.34	0.50	0.50	0.50
Vis. at 50° C., cst	380	80	101	337	120
Blend cost, $/tonne	307	379	335	308	389
Blend profit, $/tonne	78.0	5.8	50.0	77.0	-3.6

*Prices as of Aug. 4, 2017; IFO380 0.5 wt% sulfur is $385/tonne based on Platts methodology.

IMO CE DELFT 0.5 WT % SULFUR IFO380 RECIPES

Table 2

Component to blend	Volume, b/d	Volume, wt %	Sulfur, wt %	Viscosity at 50° C.
Europe				
Straight-run diesel	224,083	23.05	0.552	—
FCC light-cycle oil	113,224	11.65	0.587	—
Treated light distillate	27,316	2.81	0.044	—
Treated atmospheric gas oil, up to 85% desulfurization	351,048	36.12	0.148	—
Imported-purchased hydrotreated gas oil	5,404	0.56	0.015	—
H-Oil bottoms	152,943	15.73	1.000	—
Treated atmospheric residue	97,981	10.08	0.250	—
Total	**972,000**	**100.00**	**0.450**	**17.2**
US				
Visbreaker tar	9,071	2.88	3.494	—
Treated light-cycle oil	112,060	35.63	0.107	—
Light-cycle oil	11,703	3.72	0.714	—
Slurry oil	45,320	14.41	0.939	—
H-Oil bottoms	40,112	12.75	1.000	—
Treated light distillate, under medium-severity hydrodesulfurization conditions	76,694	24.39	0.019	—
Treated light distillate	18,770	5.97	0.000	—
Hydrotreated kerosine	649	0.21	0.065	—
Hydrotreated kerosine, desulfurized jet blend	111	0.04	0.326	—
Total	**314,490**	**100.00**	**0.444**	**14.7**
Asia Pacific				
Atmospheric residue	114,489	6.06	2.103	—
Treated light distillate	291,104	15.40	0.030	—
H-Oil bottoms	241,080	12.76	1.000	—
Treated atmospheric residue	1,243,327	65.78	0.263	—
Total	**1,890,000**	**100.00**	**0.450**	**110.7**

- Russian black gas oil.
- Marine gas oil.

Pricing of these blend components—which are all currently available in the USGC—was based on third-party independent price assessments from Platts, OPIS, and Argus. We estimated pricing for some components based on the Platts methodology of extrapolating between a pair of reference fuels that bracket the desired unknown component properties.

For residues, we explored a number of widely available low-sulfur crudes—including Cabinda, Minas, Girassol, Bonny Light, and some crude blends such as Saharan, BTC, and Palanca—to produce residues with a sulfur content in a range of 0.3-0.6 wt %.[6]

Table 1 shows recipes and projected costs for production of IMO 0.5 wt % sulfur IFO380 bunker fuel at the USGC.

IMO CE Delft study

A review of the IMO CE Delft study indicates a proposed compliance solution of gas oil with a viscosity of 14-17 cst at 50° C. using a recipe consisting of about 75% gas oils and 25% hydrotreated (desulfurized) atmospheric residue or H-Oil bottoms. The resulting product, however, could not be classified as bunker, in terms of either properties or price. The proposed recipe also calls for components that currently don't exist in certain geographic areas (e.g., the unavailability of visbreaker bottoms in the US and extreme rarity of H-Oil unit bottoms globally).

For Asia, IMO proposes a bunker fuel recipe with viscosity of 110 cst at 50° C., again using components that are hardly available because the process units either don't exist or are in limited use, such as those that produce hydrotreated atmospheric residue and H-Oil bottoms.

Tables 2 shows 0.5 wt % sulfur bunker recipes for Europe, the US, and Asia-Pacific as presented in the IMO CE Delft study.

IMO-unsolicited Ensys-Navigistics study

In October 2016, Ensys Energy and Navigistics Consulting released a joint parallel-availability study that concluded enough blend components won't exist to meet 2020 specs, nearly an opposite conclusion to that suggested by the IMO CE Delft study, despite more or less the same recipes using large volumes of treated residue (<1 wt % sulfur). OGJ

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