How big is the impact on Russian oil refining industry when receiving the global change in 2020 of fuel quality consumed for ships?

-Consideration concerning both counter measures in Russian oil refining industry and the better economic oil specification in East Asia when setting new global quality on oil for ships -

M. Soga

***Abstract* - The logistics is most important in the world economy. Now the cheaper and high sulfur fuel, which is about three million barrel/day (BD) in the world, can be used for ships with big diesel engines. This product quality will be changed lower sulfur until 2020. Now this matter has been considering by International Maritime Organization (IMO). If the changing of the specification in 2020 would be, for example sulfur content would be reduced from 3.5% to 0.5%, Russian refining industry would have big influence in oil balance. Now the biggest supplier of high sulfur fuel in the world is Russia and the biggest buyer is Asia. So this matter is very sensitive for Russia and Asia. On this chance both counter measures in Russian refining industry and the better economic change of oil quality will be studied, when receiving this dramatic quality change. On this study Russian refining model 2016 will be used to simulate the condition 2020 in Russian oil balance with new oil specification.**

I.PETROLEUM PRODUCT BALANCE

The oil balance in the world, the lack tendency will be strengthened on middle distillate in the future, and will be surplus after 2020 on fuel petroleum as shown at Fig-1.

So the oil refining industry in the world will have to invest a lot of secondary units. If the specification of fuel for ships would have the global change in 2020, because the fuel of three million BD in the world may be changed to gas oil. This matter is not assumed in this figure yet.

II. INVESTMENT OF SECONDARY UNITS IN RUSSIAN REFINERIES

Trying to produce more middle distillate and less fuel at the same time, in future secondary units for cracking of residue would be planned to be constructed aggressively in the world and Russia as shown at TABLE-1.

M Soga is with Nippon Mining Research & Technology Co., Ltd., Japan (e-mail: soga@shinnikko-tr.co.jp).

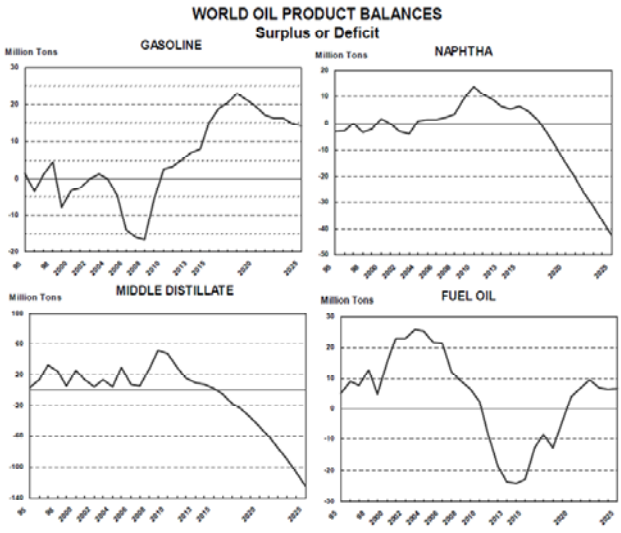

Fig-1 Petroleum products balance in the world

Source) Parpinelli TECNON 2009

TABLE 1 REFINING CONDITION ON 2008 AND 2016 IN THE WORLD AND RUSSIA

Kinds of refining facilities 2008 Capacity (Million BD)		Central	North West	South	Volga	Ural	Siberia	Far East	Russia Total	World Total
Crude Distillation (Atmospheric)	A	0.98	0.48	0.48	2.34	0.19	0.75	0.20	5.42	90.57
Residue Distillation (Vacuum)		0.42	0.10	0.09	0.93	0.00	0.36	0.08	1.99	35.03
Naphtha Hydrodesulphurization		0.12	0.08	0.05	0.36	0.02	0.12	0.02	0.76	20.16
Middle Distillate Hydrodesulphurization		0.16	0.10	0.08	0.67	0.02	0.11	0.02	1.16	22.60
Diesel Gas Oil Hydrodesulphurization		-	-	-	-	-	0.03	-	0.03	1.70
Heavy Naphtha Reforming		0.11	0.06	0.06	0.32	0.01	0.10	0.02	0.68	13.20
Alkylation & Isomerization		0.03	0.01	0.01	0.06	-	0.01	0.01	0.14	4.55
FCC	B	0.11	-	-	0.12	-	0.12	-	0.35	17.29
VGO Hydrodesulphurization	B	0.09	-	-	0.10	-	0.08	-	0.27	5.70
Atmospheric Residue Hydrodesulphur	B	-	-	-	-	-	-	-	-	1.80
Hydro Cracking	B	0.05	-	-	0.07	-	-	-	0.12	6.38
Delayed Coker	B	-	-	0.01	0.05	-	0.02	-	0.08	5.47
Visbraker	B	0.07	0.01	-	0.17	-	0.03	-	0.28	3.84
Residue Upgrading Fasilities Ratio	∑B/A %	32	3	3	22	0	33	0	20	45
Kinds of refining facilities 2016 Capacity (Million BD)		Central	North West	South	Volga	Ural	Siberia	Far East	Russia Total	World Total
Crude Distillation (Atmospheric)	A	0.91	0.52	0.81	2.65	0.19	0.75	0.60	6.43	100.68
Residue Distillation (Vacuum)		0.42	0.19	0.25	1.07	0.03	0.41	0.27	2.64	40.34
Naphtha Hydrodesulphurization		0.15	0.08	0.12	0.45	0.02	0.13	0.10	1.05	24.20
Middle Distillate Hydrodesulphurization		0.14	0.10	0.12	0.70	0.02	0.13	0.11	1.33	26.78
Diesel Gas Oil Hydrodesulphurization		-	-	0.07	0.03	-	0.03	0.10	0.23	3.21
Heavy Naphtha Reforming		0.14	0.06	0.09	0.35	0.01	0.10	0.10	0.85	14.99
Alkylation & Isomerization		0.04	0.01	0.03	0.09	-	0.03	0.03	0.24	5.44
FCC	B	0.11	0.04	0.03	0.25	-	0.14	0.08	0.64	19.44
VGO Hydrodesulphurization	B	0.11	0.06	0.04	0.20	-	0.09	0.14	0.63	6.75
Atmospheric Residue Hydrodesulphur	B	-	-	-	-	-	-	-	-	2.49
Hydro Cracking	B	0.10	0.00	0.11	0.16	-	0.03	0.05	0.44	9.37
Delayed Coker	B	0.02	0.00	0.06	0.12	-	0.03	0.04	0.28	7.98
Visbraker	B	0.07	0.05	-	0.21	-	0.03	0.01	0.36	4.12
Residue Upgrading Fasilities Ratio	∑B/A %	44	27	30	35	0	41	53	36	50

Source) Prepared by considering the information in Parpinelli TECNON 2009 and PETRO MARKET RESEARCH GROUP (PMRG)

III. OIL PRODUCT QUALITY RESTRICTION FOR SHIP SCHEDULED IN 2020

In the world, the new quality regulation of the petroleum product for the ship is considered by IMO as shown at Fig-2. Until 2020 there would be decision to set the severe specification with 0.5% sulfur max for petroleum product using the ship. The specification would have two cases. One case is only gas oil without residue and the other case is the mixture including gas oil and residue.

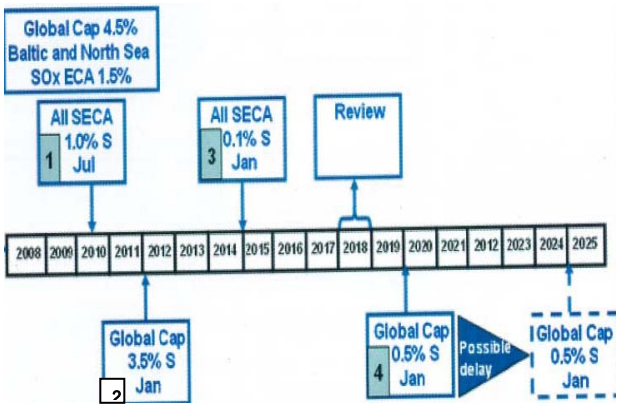

Fig-2 Study plan of the specification in IMO

Source) Energy Market consultants (London) 2009

Ⅳ. POSSIBILITY OF COUNTER MEASURES IN RUSSIAN OIL REFINING INDUSTRY WHEN SETTING FUEL QUALITY WITH LOWER SULFUR (0.5%) FOR THE SHIP

A. Russian oil balance as one country

Russia produces naphtha, gasoline, middle distillates and residue more than the amount of domestic demand. The surplus products are forecasted to be exported as shown at Fig-3.

B. Russian oil balance at each seven area (a calculation in 2008 with a lot of data.)

(A) Demand of petroleum products 2008

At the first the demand quantity of petroleum products is shown at Table-2.

(B) Specification of petroleum products 2008

The main specifications of petroleum products in Russia 2008 are shown at Table-3.

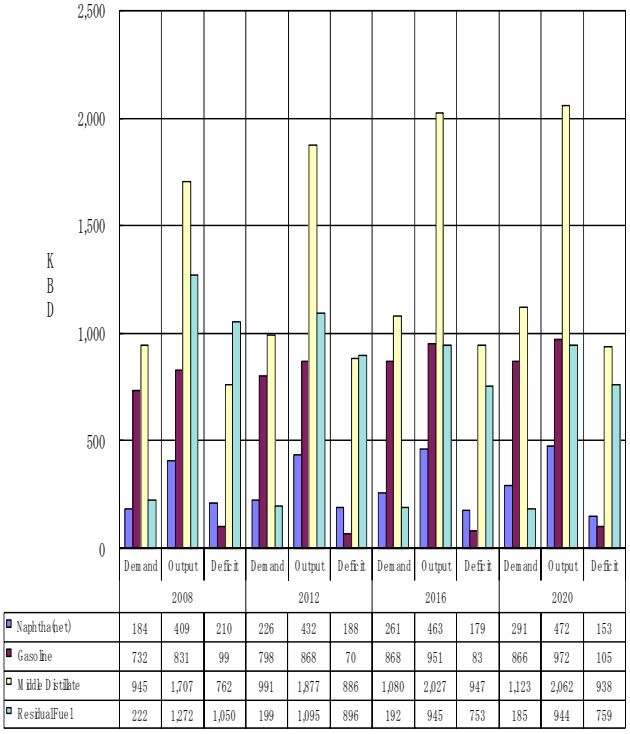

Fig-3 Russian oil balance

Source) Parpinelli TECNON 2009

TABLE 2 DEMAND OF PETROLEUM PRODUCTS ON EACH RUSSIAN DISTRICT IN 2008

2008 KBD	Administration for Defense Districts	Central	North West	South	Volga	Ural	Siberia	Far East	Cent West	East	Russia
		A	B	C	D	E	F	G	ABCDE	FG	Total
Demand (Analyzed) A	LPG	37	9	8	68	2	37	2	124	39	163
	Naphtha	44	19	105	37	33	100	38	238	138	376
	Material for BTX	15	10	9	19	17	15	11	70	26	96
	Gasoline	230	75	68	166	92	82	21	629	103	732
	Jet	94	30	28	68	38	33	9	257	42	299
	Diesel gas oil for Cars	44	29	28	57	52	44	32	210	76	286
	Gas oil for Industry & Ships	56	36	36	71	65	56	40	264	96	360
	Lubricant	9	6	6	12	11	9	7	44	16	60
	Fuel	25	52	7	79	7	26	25	170	51	222
	Asphalt	12	8	8	16	14	12	9	58	21	79
	Total	566	274	302	591	331	414	195	2,064	609	2,673

Source) This table is prepared by considering the information in Parpinelli TECNON 2009 and PMRG. Each demand quantity is set as each calculated production amount only for both LPG and naphtha.

TABLE 3 SPECIFICATION OF PETROLEUM PRODUCTS IN RUSSIA 2008

2008	Material for BTX	Gasoline	Jet	Diesel gas oil for Cars	Gas oil for Industry & Ships	Fuel
Octane NO Min (RON)	98	92				
Sulphur Max (PPM)	1	500	3000	500	1000	20000

(C) Material selection on refineries

The material selection on refineries in each Russian district would be able to be done with both min 90% crude and max 10% condensate. The nature of Russian crude is assumed as Arabian Light crude in Saudi Arabia to calculate the refining oil balance.

(D) The result of calculation on oil balance in each district 2008

The method of calculation on oil balance in each district is as follows;

① Each district has both one refinery and one oil products market supported by Table-1, 2 and 3.

② By try and error method using general each refining model seven districts, the calculation of oil balance in Russia will be done as considering max profitability on international oil price in Asia 2008.

③ The result is shown at Table-4.

TABLE 4 THE RESULT OF CALCULATION ON OIL BALANCE 2008

2008 KBD	Administration for Defense Districts	Central	North West	South	Volga	Ural	Siberia	Far East	Cent West	East	Russia
		A	B	C	D	E	F	G	ABCDE	FG	Total
Production (Calculated with refining model) B	LPG	37	9	8	68	2	37	2	124	39	163
	Naphtha	44	19	52	59	64	100	38	238	138	376
	Material for BTX	0	0	0	54	0	31	11	54	42	96
	Gasoline	181	67	56	394	10	105	20	708	124	832
	Jet	97	30	28	68	33	44	0	255	44	299
	Diesel gas oil for Cars	74	29	28	82	26	44	3	239	47	286
	Gas oil for Industry & Ships	131	105	100	631	7	168	40	975	208	1,183
	Lubricant	22	0	0	18	0	19	0	40	19	60
	Fuel	110	180	166	591	30	127	36	1,077	163	1,240
	Asphalt	22	8	8	16	0	25	1	53	26	79
	Total	718	446	446	1,981	173	698	152	3,764	850	4,614
Balance (Calculated) B-A (A is in Table-2.)	LPG	0	0	0	0	0	0	0	0	0	0
	Naphtha	0	0	-53	23	31	0	0	0	0	0
	Material for BTX	-15	-10	-9	35	-17	16	0	-16	16	0
	Gasoline	-49	-8	-11	228	-82	23	-1	78	22	100
	Jet	3	0	0	0	-4	10	-9	-2	2	0
	Diesel gas oil for Cars	30	0	0	26	-26	0	-30	30	-30	0
	Gas oil for Industry & Ships	75	69	65	560	-57	112	0	711	112	823
	Lubricant	13	-6	-6	7	-11	10	-7	-4	4	0
	Fuel	85	128	159	512	23	101	11	906	112	1,018
	Asphalt	10	0	0	0	-14	12	-8	-5	5	0
	Total	151	173	144	1,390	-158	284	-43	1,700	241	1,941

(E) The result of calculation on facilities 2008

The result for capacity and utilized condition on facilities in each district is shown at Table-5.

(F) The harmonization between calculation result and actual data 2008 in Petro Market Research Group

The calculation result agrees with the report of the actual numbers in PMRG well. The report value of processed crude including condensate is 4.78 million BD in 2008 of PMRG report. The calculated quantity on processed crude oil including condensate is 4.82 million BD in the whole Russia and the utilization ratio on crude distillation unit is 89%.

TABLE 5 THE CAPACITY AND UTILIZATION OF FACILITIES ON AN EACH DISTRICT IN RUSSIA 2008

Kinds of refining facilities B Processed Feed Quantity (Million BD)	Central	North West	South	Volga	Ural	Siberia	Far East	Russia Total
Crude Distillation (Atmospheric)	0.76	0.46	0.46	2.08	0.18	0.72	0.15	4.82
Residue Distillation (Vacuum)	0.23	0.06	0.02	0.23	0.00	0.18	0.00	0.73
Naphtha Hydrodesulphurization	0.10	0.07	0.05	0.32	0.01	0.08	0.02	0.65
Middle Distillate Hydrodesulphurization	0.12	0.09	0.08	0.53	0.02	0.10	0.02	0.96
Diesel Gas Oil Hydrodesulphurization	-	-	-	-	-	0.03	-	0.03
Heavy Naphtha Reforming	0.11	0.05	0.05	0.30	0.01	0.07	0.01	0.60
Alkylation & Isomerization	0.00	0.00	0.00	0.05	-	0.01	0.01	0.07
FCC	0.10	-	-	0.12	-	0.11	-	0.33
VGO Hydrodesulphurization	0.08	-	-	0.10	-	0.08	-	0.26
Atmospheric Residue Hydrodesulphurization	-	-	-	-	-	-	-	-
Hydro cracking	0.05	-	-	0.07	-	-	-	0.11
Delayed Coker	-	-	-	0.05	-	0.02	-	0.07
Visbraker	0.06	0.01	-	0.03	-	0.03	-	0.13
Kinds of refining facilities C=B/A Utilization Ratio (A is in table-1)	**Central**	**North West**	**South**	**Volga**	**Ural**	**Siberia**	**Far East**	**Russia Total**
Crude Distillation (Atmospheric)	0.78	0.96	0.96	0.89	0.96	0.96	0.73	0.89
Residue Distillation (Vacuum)	0.56	0.54	0.23	0.25	0.00	0.52	0.04	0.37
Naphtha Hydrodesulphurization	0.86	0.94	0.96	0.91	0.74	0.63	0.96	0.86
Middle Distillate Hydrodesulphurization	0.73	0.96	0.96	0.79	0.96	0.96	0.96	0.83
Diesel Gas Oil Hydrodesulphurization	-	-	-	-	-	0.96	-	0.96
Heavy Naphtha Reforming	0.96	0.88	0.74	0.94	0.96	0.73	0.81	0.89
Alkylation & Isomerization	0.00	-	-	0.88	-	0.51	0.96	0.48
FCC	0.96	-	-	0.10	-	0.96	-	0.96
VGO Hydrodesulphurization	0.96	-	-	0.96	-	0.96	-	0.96
Atmospheric Residue Hydrodesulphurization	-	-	-	-	-	-	-	-
Hydro cracking	0.96	-	-	0.96	-	-	-	0.96
Delayed Coker	-	-	-	0.96	-	0.96	-	0.79
Visbraker	0.96	0.96	-	0.17	-	0.96	-	0.48

C. Russian oil balance at each seven area (a calculation in 2016 with a lot of data.)

(A) Demand of petroleum products 2016

The demand of petroleum products in Russia 2016 is shown at Table-6.

TABLE 6 MAND OF PETROLEUM PRODUCTS ON EACH RUSSIAN DISTRICT IN 2016

2016 KBD	Administration for Defense Districts	Central	North West	South	Volga	Ural	Siberia	Far East	Cent West	East	Russia
		A	B	C	D	E	F	G	ABCDE	FG	Total
Demand (Analyzed) A	LPG	28	14	12	74	2	34	19	130	53	183
	Naphtha	40	26	26	52	47	40	29	191	70	261
	Material for BTX	15	10	9	19	17	15	11	70	26	96
	Gasoline	272	88	80	196	109	97	25	746	122	868
	Jet	125	41	37	90	50	44	12	342	56	398
	Diesel gas oil for Cars	56	37	36	72	66	56	41	267	97	365
	Gas oil for Industry & Ships	49	32	31	63	57	49	36	232	85	317
	Lubricant	9	6	6	12	11	9	7	45	16	61
	Fuel	22	45	6	68	6	23	22	147	44	192
	Asphalt	13	8	8	17	15	13	9	61	22	83
	Total	630	308	252	663	380	381	210	2,233	591	2,824

Source) The same source on Table-2

(B) Specification of petroleum products 2016

The main specifications of petroleum products in Russia 2016 are shown at Table-7.

TABLE 7 SPECIFICATION OF PETROLEUM PRODUCTS IN RUSSIA 2016

2016	Material for BTX	Gasoline	Jet	Diesel gas oil for Cars	Gas oil for Industry & Ships	Fuel
Octane NO Min (RON)	98	92				
Sulphur Max (PPM)	1	50	1500	50	1000	20000

(C) Material selection on refineries

The same assumption is set for material selection on refineries in each Russian district 2016 as shown at the same item 2008.

(D) The result of calculation on oil balance in each district 2016

The method of calculation on oil balance in each district is as follows;

① Each district has both one refinery and one oil products market supported by Table-1,6 and 7.

② The same calculation method is used as shown at the same item 2008.

③ The result is shown at Table-8.

TABLE 8 THE RESULT OF CALCULATION ON OIL BALANCE 2016

2016 KBD	Administration for Defense Districts	Central	North West	South	Volga	Ural	Siberia	Far East	Cent West	East	Russia
		A	B	C	D	E	F	G	ABCDE	FG	Total
Production (Calculated with refining model) B	LPG	28	14	12	74	2	34	19	130	53	183
	Naphtha	3	26	49	52	64	40	27	193	68	261
	Material for BTX	15	0	9	57	0	0	0	81	0	81
	Gasoline	164	79	107	496	0	110	100	846	210	1,056
	Jet	128	55	32	0	32	151	0	247	151	398
	Diesel gas oil for Cars	13	15	111	131	7	25	41	278	66	343
	Gas oil for Industry & Ships	148	71	170	657	0	90	260	1,046	350	1,396
	Lubricant	0	6	20	28	0	0	0	54	0	54
	Fuel	43	63	1	237	28	77	39	370	116	487
	Asphalt	32	8	8	12	0	0	18	61	18	79
	Total	573	338	520	1,743	133	527	504	3,307	1,031	4,338
Balance (Calculated) B-A (A is in Table-6.)	LPG	0	0	0	0	0	0	0	0	0	0
	Naphtha	-38	0	23	0	17	0	-2	2	-2	0
	Material for BTX	0	-10	0	38	-17	-15	-11	11	-26	-15
	Gasoline	-109	-10	27	300	-109	13	75	100	88	188
	Jet	3	15	-5	-90	-18	107	-12	-95	95	0
	Diesel gas oil for Cars	-43	-21	75	58	-58	-32	0	10	-32	-21
	Gas oil for Industry & Ships	99	39	138	595	-57	41	224	813	265	1079
	Lubricant	-9	0	14	16	-11	-9	-7	9	-16	-7
	Fuel	21	17	-5	168	21	55	17	223	72	295
	Asphalt	19	0	0	-4	-15	-13	9	0	-4	-4
	Total	-57	31	268	1080	-248	146	294	1074	440	1514

(E) The result of calculation on facilities 2016

The result for capacity and utilized condition on facilities in each district is shown at Table-9.

(F) The difference between two cases of Russian oil balance in 2008 and 2016

① The quantity is almost the same, but the quantity of exporting fuel is very smaller in 2016 than 2008. The quantity of exporting gasoline and gas oil is larger in 2016 than 2008.

TABLE 9 THE CAPACITY AND UTILIZATION OF FACILITIES ON AN EACH DISTRICT IN RUSSIA 2016

Kinds of refining facilities B Processed Feed Quantity (Million BD)	Central	North West	South	Volga	Ural	Siberia	Far East	Russia Total
Crude Distillation (Atmospheric)	0.64	0.35	0.54	1.86	0.16	0.63	0.56	4.74
Residue Distillation (Vacuum)	0.25	0.12	0.19	0.70	0.00	0.23	0.23	1.72
Naphtha Hydrodesulphurization	0.11	0.06	0.06	0.26	0.00	0.09	0.07	0.66
Middle Distillate Hydrodesulphurization	0.14	0.09	0.12	0.60	0.02	0.13	0.10	1.20
Diesel Gas Oil Hydrodesulphurization	-	-	0.06	0.00	-	0.03	0.09	0.19
Heavy Naphtha Reforming	0.11	0.04	0.09	0.28	0.00	0.09	0.08	0.69
Alkylation & Isomerization	0.04	0.01	0.01	0.06	-	0.03	0.02	0.17
FCC	0.10	0.04	0.03	0.24	-	0.12	0.08	0.61
VGO Hydrodesulphurization	0.10	0.05	0.04	0.19	-	0.08	0.12	0.59
Atmospheric Residue Hydrodesulphurization	-	-	-	-	-	-	-	-
Hydro cracking	0.09	-	0.11	0.15	-	0.03	0.05	0.43
Delayed Coker	0.02	-	0.06	0.12	-	0.03	0.04	0.26
Visbraker	0.04	0.04	-	0.14	-	0.03	0.01	0.25
Kinds of refining facilities C=B/A Utilization Ratio (A is in table-1)	Central	North West	South	Volga	Ural	Siberia	Far East	Russia Total
Crude Distillation (Atmospheric)	0.70	0.67	0.67	0.70	0.83	0.83	0.93	0.74
Residue Distillation (Vacuum)	0.59	0.64	0.76	0.65	0.07	0.56	0.87	0.65
Naphtha Hydrodesulphurization	0.72	0.76	0.50	0.57	0.16	0.72	0.77	0.63
Middle Distillate Hydrodesulphurization	0.96	0.96	0.96	0.85	0.96	0.96	0.96	0.90
Diesel Gas Oil Hydrodesulphurization	-	-	0.96	-	-	0.96	0.96	0.82
Heavy Naphtha Reforming	0.84	0.64	0.96	0.80	0.28	0.88	0.81	0.82
Alkylation & Isomerization	0.96	0.38	0.41	0.66	-	0.92	0.69	0.70
FCC	0.96	0.96	0.96	0.96	-	0.88	-	0.94
VGO Hydrodesulphurization	0.96	0.96	0.96	0.96	-	0.96	-	0.94
Atmospheric Residue Hydrodesulphurization	-	-	-	-	-	-	-	-
Hydro cracking	0.96	-	0.96	0.96	-	0.96	0.96	0.96
Delayed Coker	0.96	-	0.96	0.96	-	0.96	0.96	0.96
Visbraker	0.63	0.84	-	0.66	-	0.96	0.96	0.71

② This result is come from trying to get the better economics in Russian refining industry because of hesitating to produce fuel with lower price.

③ The background of this result is investment of secondary units including cracking facilities in 2016 more than 2008.

D. Case study concerning the secondary unit reinforcement of the refining industry in Russia according to fuel quality change for ship (a calculation with the changed specification of product for ships in 2020.)

(A) Setting of case study

① Original case is Russian oil balance 2016 which was already calculated as shown as Case A.

② The new changed specification of low sulfur gas oil instead of high sulfur fuel would be introduced to Case A. The result of this calculation will be shown as Case B, which will have no exporting of high sulfur fuel.

③ The next case is added secondary units (Hydrocracker and coker) on Case B as shown as Case C. At the same time it would be set that some asphalt will be exported.

④ The new changed specification of low sulfur fuel instead of low sulfur gas oil would be introduced to Case C. The result of this calculation will be shown as Case D, which will have HDS units instead of the hydrocracker and coker. At the same time it would be set that some straight residue (treated by HDS) and asphalt will be exported.

⑤ The next case is added secondary units (Hydrocracker and coker) on Case D as shown as Case E. This case will have most various secondary units.

(B) The result of calculation on oil balance in each district 20016 when introducing the new specification

The same calculation method as used at III. *C.* (D) is used, too. The result is shown at Table-10. On this study Russian refining model 2016 will be used to simulate the condition 2020 in Russian oil balance with new oil specification. Because it is very difficult for us to have the most right model 2020 in Russian refining with additional secondary units.

In Case B, fuel cannot be exported. So the amount of the processed crude oil will become 4042 thousand barrel/day (KBD) with the reduction of 695 KBD. The marginal profit in the Russian refining industry will be decreased greatly as the quantity (155KBD) of exported gas oil will be decreased.
Case C can increase a great amount of processed crude oil by the introduction of the cracking facilities and exporting asphalt. The reinforcement ability of the cracking facilities is 686KBD. The amount of exported gas oil would become 2193KBD by increasing of gas oil for the ship mainly. The marginal profit in Russian refining industry will recover greatly.

TABLE 10 THE OIL BALANCE AND SECONDARY UNITS NEEDED IN RUSSIA 2016 WITH THE NEW SPECIFICATION

Items/Cases	E	D	C	B	A
Spec of product for ships(sulphur PPM)	Fuel $000)		Gas Oil $000)		Fuel $5000)
Quantity of export KBD					
Gasoline & BTX	589	532	414	172	172
Heating Gas Oil for Europe	1,068	1,068	370	191	1,068
Gas Oil for ships (5000)	0	0	1,823	723	0
Fuel for ships (5000)	987	1,067	0	0	0
Fuel(Straight Desulpfurized Fuel or Fuel)	86	86	0	0	293
Asphalt	86	86	86	0	0
Total	2,817	2,839	2,692	1,086	1,534
Crude (including condensate) KBD	5,868	5,868	5,797	4,042	4,737
Utilization Ratio on fasilities ％)					
CDU	91	91	90	63	74
Reformer for heavy naphtha	100	100	99	65	79
FCC	100	100	62	88	93
HDS (Middle Distillate)	82	83	80	81	96
HDS (Vacuum Gas Oil)	99	96	98	97	96
Hydro Cracker (Vacuum Gas Oil)	100	100	100	100	95
Coker (Vacuum Residue)	100	100	100	100	82
HDS (Atmospheric Residue)	100	100	–	–	–
New Additional Capacity KBD					
HDS (Middle Distillate)	311	393			
HDS (Vacuum Gas Oil)	233	388			
Hydro Cracker (Vacuum Gas Oil)	243		474		
Coker (Vacuum Residue)	109		212		
HDS (Atmospheric Residue)	182	385			
Total	1,078	1,166	686		
Remarks	This case would have not only HDS (Middle Distillate, Vacuum Gas Oil and Atmospheric Residue) but also Hydro Cracker etc.	1. Straight Desulpfurized Fuel and Asphalt will be exported. 2. Fuel can be used for ships. 3. This case would have HDS (Middle Distillate, Vacuum Gas Oil and Atmospheric Residue)	1. New additional fasility would be introduced. 2. This case would have Hydro Cracker and Coker.	1. Only gas oil would be used by ships 2. No exporting of fuel	Oil balance in 2016 when continueing to be able to use high sulphur fuel for ships

Case D will have the additional HDS units. At the same time this case will export asphalt and the straight run residue processed by desulfurization. A great amount of processed crude can be increased. The reinforcement ability of the desulfurization units is 1166KBD. The amount of exported gas oil for Europe will be increased to become 1068KBD. The export of gasoline increases, too. The marginal profit on the refining industry in Russia will have the maximum level.

Case E will have the introduction of various devices. The reinforcement ability of various devices would be 1078KBD. The refining industry in each district should have the possibility of selecting various combinations in the secondary units according to the each characteristic.

V. CONCLUSIONS

The quality change of the fuel (about 3 million BD) for ships in the world is scheduled in 2020. This change is extremely important for both the refining industry and the logistic industry in Russia and Asia.
It greatly influences not only for the marginal profit decrease (some billion dollars a year) of the refining industry in Russia but also for the global cost increase (about twenty billion dollars a year) of the marine transportation that supports the world economy.
Russia and Asia will be able to cooperate, and it is necessary to make all efforts as promptly as possible for the minimization of this marine transportation cost. The cooperation is effective for the setting of a more appropriate newer petroleum product quality.
By sharing the knowledge of both shipping business and the refining technology on the desulfurization on residue with higher sulfur etc, this cooperation will be able to have the better specification of product for ships in the world.

VI. REFERENCES

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VII. BIOGRAPHIES

Masayoshi. Soga is Principal Researcher for Petroleum Refining & Market, Nippon Mining Research & Technology Co., Ltd., Japan.
He graduated Hokkaido State University in 1972 and now he is Doctor of Engineering (given by Tokyo maritime university at 2003).
Major interests include following research fields: A. Numerical methods for modeling with optimization on the complex refining plants B. The analysis of method on the solution of crude Asian premium