Sample received: 11.04.2013

Lab. ID number: 1130001148

Fuel sample F-RME180

Date: 7.5.2013

Analysis ordered by: BIMONT d.o.o.
Senčna ulica 19, 6310 Izola, Slovenia
For: Mr. Trošt, Mr. Štok

Property	Unit	Test method	Date	Measur. uncertainty	0	1	2	3	4	5
Density at 15 °C	**kg/m3**	EN ISO 12185:98	17.4.13	1,2	**942,2**	**939,7**	**939,7**	**939,7**	**939,2**	941,0
Density at 50 °C	**kg/m3**	EN ISO 12185:98	17.4.13	1,2	**919,2**	**916,6**	**916,6**	**916,7**	**916,1**	918,0
Viscosity at 50°C	**mm/s2**	EN ISO 3104:98	19.4.13	5,2%	**144,7**	**133,9**	**139,6**	**122,8**	**121,3**	126,5
Carbon residue	**%(m/m)**	EN ISO 10370:98	17.4.13	0,59	**7,29**	**7,52**	**6,80**	**7,16**	**7,14**	6,79
Ash content	**%(m/m)**	EN ISO 6245:03	23.4.13	0,003	**0,029**	**0,026**	**0,027**	0,036	0,037	0,036
Water content (by distillation)	**%(m/m)**	ISO 3733:99	18.4.13	0,1	0,60	**<0,05**	**<0,05**	**<0,05**	**<0,05**	**3,20**
Pour point	**°C**	ISO 3016:96	16.4.13	3	**15**	**9**	**6**	**9**	**21**	**15**
Heat of combustion - net	**MJ/kg**	ASTM D 4868:10	7.5.13	0,07	**40,70**	**41,10**	**41,40**	**41,09**	**41,41**	**41,41 !**
Water and sediments (centrifuge)	**%(V/V)**	ISO 3734:97	19.4.13	0,10	**0,50**	**0,50**	**0,10**	**0,10**	**0,10**	**4,00**
Vanadium content	**mg/kg**	PML.I.14597:97	7.5.13	9	87	86	86	86	86	79
Nickel content	**mg/kg**	PML.I.14597:97	7.5.13	6	30	29	29	29	29	26
					stand	**no add**	**no add**	**+1 add**	**+2 add**	**+2 add + water**
	Not accredited									
Flash point, PM - info	°C	EN ISO 2719			**128,5**	**118,5**	**116,5**	**160,5**	**124,5**	178.5
Elements, WD-XRF										
Sulphur	%(m/m)	PML.0716.+18.			1,553	1,528	1,521	1,540	1,515	1.439
Aluminium	mg/kg	PML.0716.+18.			**5**	**<1**	**2**	3	3	**<1**
Silicium	mg/kg	PML.0716.+18.			**10**	**4**	**6**	7	8	6
Iron	mg/kg	PML.0716.+18.			23	22	24	24	24	22
	mg/kg									

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Legend :

0. **Original** fuel F-RME180.
1. **Homogenized 2 times**, the analysis is made 6 days after treatment.
2. **Homogenized 4 times**, the analysis is made 6 days after treatment.
3. Homogen. 4 times F-RME180 + **additive to improve combustion**.
4. Homogen. 4 times F-RME180 + **add. to imp. comb.** + **add. to reduce freezing point**.
5. Homogen. 4 times F-RME180 + **add. to imp. comb.** + **add. to reduce freezing point** + **4% of water.**

The analysis is done 6 – 12 – 25 days after the fuel treatment.
All comments below

comparable with the analysis of exactly the same fuel that has been made in Rijeka Refinery

Analysis of the documents - modify the properties of heavy hydrocarbon fuels

shipboard fuel IFO-180 (INA HR)	N		formal standart	original sample	1	2	3	4	comment
density at 15 °C	1	kg/m3	<= 991	947.6	945.7	945.7	948.1	949.6	agree
kinematic viscosity at 50 °C	2	mm2/s	<= 180	138.5	117.8	117.6	129.1	136	super
aromaticity index	3	(CCAI)	<= 860	820	820	820	821	822	agree
total sulfur content	4	% m/m	<= 4.5	1.59	1.56	1.57	1.54	1.49	agree
flash-point	5	°C	>= 60	92.0	94	94	> 100	> 100	*
amount of sediment	6	% m/m	<= 0.10	0.02	0.05	0.04	0.03	0.04	**
amount of coke residue	7	% m/m	<= 15.0	14.06	8.53	8.18	8.19	7.63	super
flow point	8	°C	<= 30	+30	+24	+24	+21	+24	super
amount of water	9	% v/v	<= 0.50	0.1	0.05	0.05	3	5.6	agree
amount of ash	10	% m/m	<= 0.07	0.04	0.04	0.03	0.04	0.04	agree
amount of vanadium	11	mg/kg	<= 200	125	122	120	115	112	super
amount of sodium	12	mg/kg	<= 50	4.93	7.25	7.85	5.72	5.34	***
amount of Al + Si	13	mg/kg	<= 50	5	5	5	5	5	agree
energy value	14	MJ/kg	-	-	41.02	41.02	39.7	38.88	agree
			standart	no add	no add	no add	+3% w	+6% w	

Legend for understanding

0. A sample of the initial fuel.
1 - Fuel after the first stage of processing on the device TRGA - without any additives.
2. Fuel after the second stage of processing on the device TRGA - without any additives.
3. Fuel processed with the addition of 3% water.

Some comments below

1. **Fuel density** decreased after treatment in all samples, from **942,2 to 939,7**(**919,2 - 916,7**) and increased by the addition of water - everything is right and logical.
   The greatest density decrease at low temperatures.

2. **Viscosity generally tends to decrease**. An abnormal increase in the viscosity of the sample number 2 is due to resinification fuel during storage. This means that after processing the viscosity of this sample was minimal **144,7 (0) 133,9 (1) 139,6 (2) 122,8 (3) 121,3 (4)** 126,5 **(5)**

   We ordered the analysis of fuel immediately after the processing with a minimum interval between

treatment and analysis. Since our apparatus directly mounted to the engine.
Instead we were given tests of fuel that had lain in the laboratory 6 days. Rancid oil.

You can conditionally accept that the viscosity of the sample No. 2 at the time of treatment was 130 **mm/s2. This way, after 6 days of storage viscosity less fuel by 9.8%.**
We have had different results from different laboratories, that understands how important it is to fulfill the requirements of customers - the viscosity immediately after treatment was reduced by 15%.
http://www.afuelsystems.com/ru/trga/s135.html

Adding additives for improve combustion + homogenization of the mixture - additionaly reduced viscosity of the fuel **to 122,8 (3)** and wherein the fuel gumming process was stopped. Interesting fact.
This way, the overall reduction in viscosity was 15.2%, while the additive ensured conservation of fuel from gumming process.

Error of the method is very high - I recommend to use a more precise instrument and method.

3. **Carbon residue** - figures are roughly the same. values in the sample 1 - error but within the error of measurement. tendency to decrease. Error of the method is very high - I recommend to use a more precise instrument and method.

   Blending additives - slightly increases carbon residue.

4. **Ash content** - Ash tsontent - almost the same.
   Blending additives - slightly increases Ash content.

5. **Water content (by distillation) - 0,60 <0,05 <0,05 <0,05 <0,05 3,20**
   Water-oil emulsion with small amounts of water will not shared by distillation, at large - only partially. This will increase engine life and reduce the cost of disposal of this water.

6. **Water and sediments (centrifuge) - 0,50 0,50 0,10 0,10 0,10 4,00**
   Increasing homogenization cycles (low water content) forms an emulsion which is not divided in the centrifuge.

7. **Pour point – 15 9 6 9 21** 15 Increasing homogenization cycles significantly reduces **Pour point**. not understand why this rate increased by the addition of additives.

8. **Heat of combustion – net - 40,70 41,10 41,40 41,09 41,41 41,41 !**
   Increasing homogenization cycles **increases caloric consumption by 1.7%** more cycles - the more complete combustion - **40,70 41,10 41,40**
   The caloric value - 41.09 - measurement error, as the previous and the next numbers are the same.
   The result, when the fuel which has 4% of water shows a high calorific value than the original fuel without water - contrary to the theory of combustion (part analysis method), since this means that 4% of the fuel may be replaced by water without loss of calories.

You have to be careful in the production of analyzes.

9. **Vanadium and Nickel content – the same.**

10. **Sulphur content -** slightly decreases with increasing homogenization cycles and decreases proportionally to homogenize the water consumption (this fact we also observed earlier). Figures with the presence of additives exclude. **1,553** **1,528** **1,521** 1,540 1,515 **1.439**

11. **Aluminium content – 5** **<1** **2** 3 3 **<1** Figures with the presence of additives exclude too. There is a significant reduction of these particles especially with the addition of water.

12. **Silicium content – 10** **4** **6** 7 8 **6** The trend is the same

13. **Flash point, PM – info - 128,5** **118,5** **116,5** **160,5** **124,5** **178.5**

Increasing homogenization cycles leads to a decrease in the **Flash point. (- 9/3%).** This leads to acceleration of combustion and fuel economy.

Additive to improve combustion - this greatly increases this option - properties of the additive?
Additive to reduce the pour point - significantly reduces this option - properties of the additive?
The addition of water - this greatly increases this option - it is logical.

We know that the increase in flash lengthens combustion increases the fuel losses during combustion. **Which way to evaluate the result that the addition of 4% of the water increases the calorie consumption? See Item 8.**

Summary

1. Provided the test results are of value only in comparison with other analyzes made earlier.
2. A complete picture from a combination of two test results - partly confirm each other, in spite of the some error results of tests.
3. Despite the unnecessarily long pause between making samples and production analyzes, confirmed the main points - **reducing the viscosity reduction of coke particles, reducing the amount of aluminum and silicon, as well as a reduction in the pour point of the fuel.**

Andrii Ruban. 09.03.2013
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