

# HERCULES A-B-C, A 10-Year, EC funded, Major R&D Effort Towards the Next Generation Large Marine Diesel Engines

*Presented by*  
**Prof. Nikolaos P. Kyrtatos**  
*HERCULES Coordinator*



NATIONAL TECHNICAL UNIVERSITY OF ATHENS

LABORATORY OF MARINE ENGINEERING  
[www.lme.ntua.gr](http://www.lme.ntua.gr)

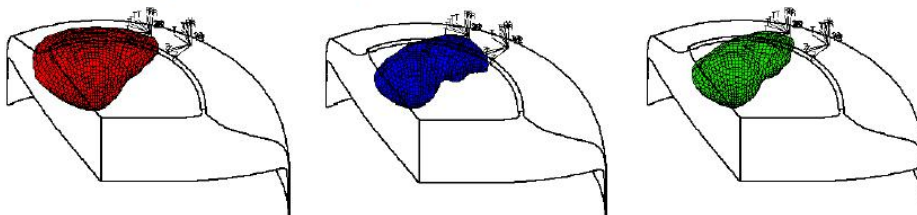


**... under the HERCULES program is considered an “ original technology “  
of adding water to the combustion chamber ...**

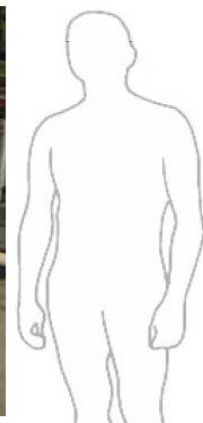
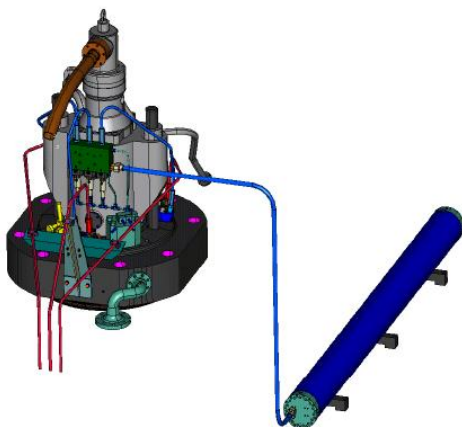


## H - A: Water injection techniques

Direct Water Injection (DWI) system

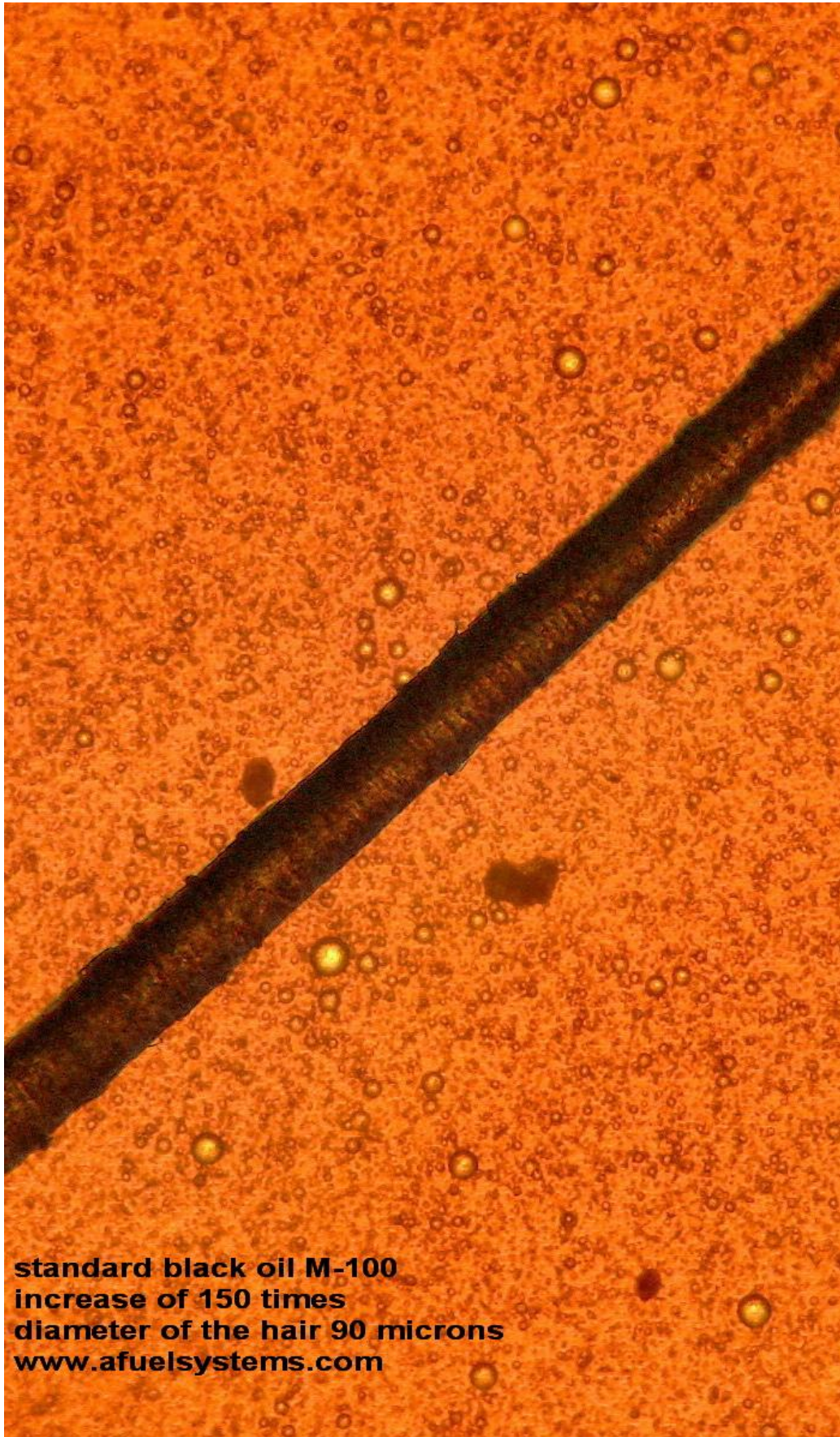


Comprehensive simulation studies for DWI system optimisation



**but my god ... this solution cumbersome and expensive**

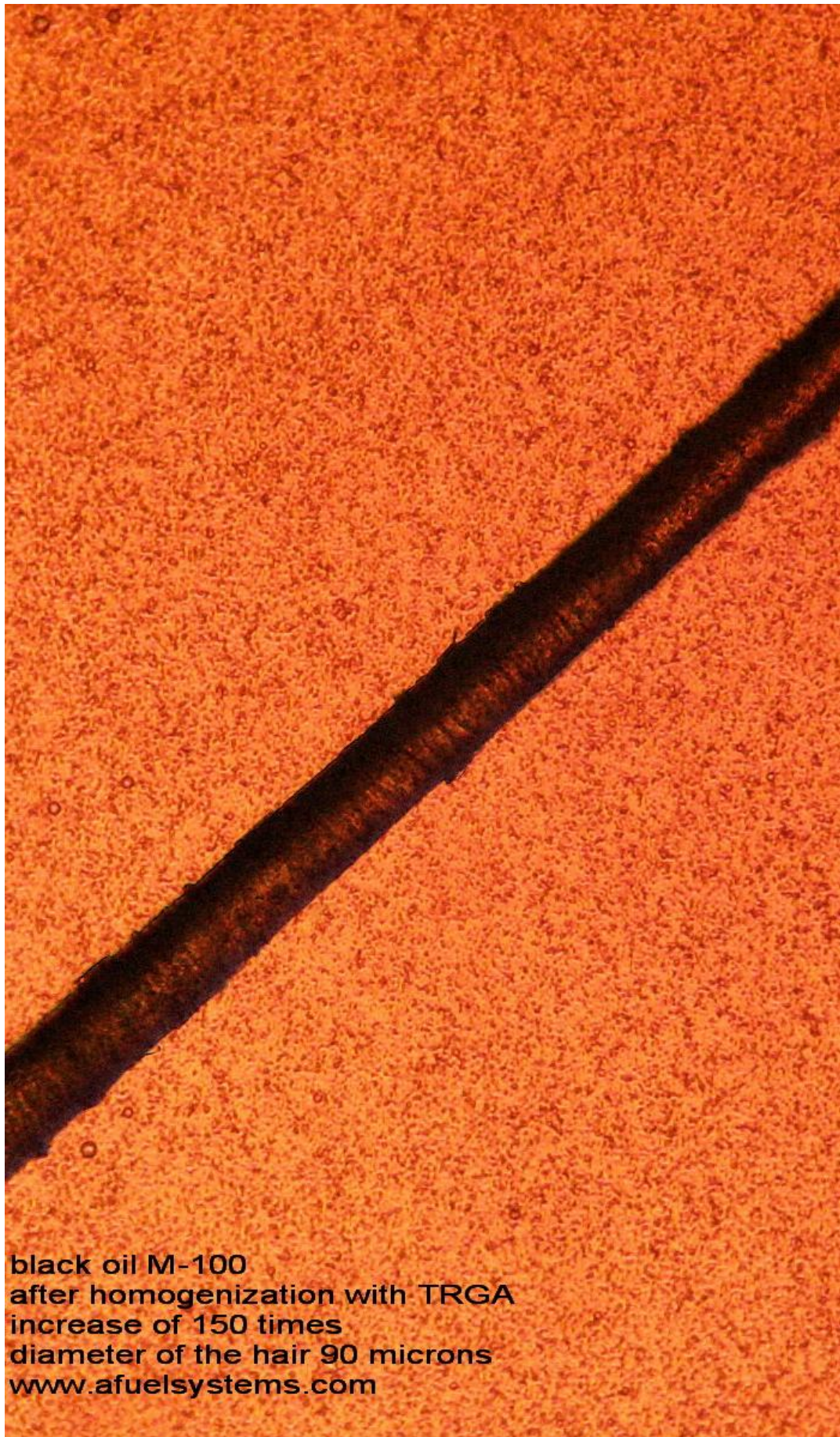
But our [system of pretreatment ship's fuel](#) (save ship's fuel) - PSSF - making it parallel with other factors that improve the quality of fuel. **Photo below** M100 fuel oil with 4% water - normal water content in fuel oil which has long stored and transported away



standard black oil M-100  
increase of 150 times  
diameter of the hair 90 microns  
[www.afuelsystems.com](http://www.afuelsystems.com)



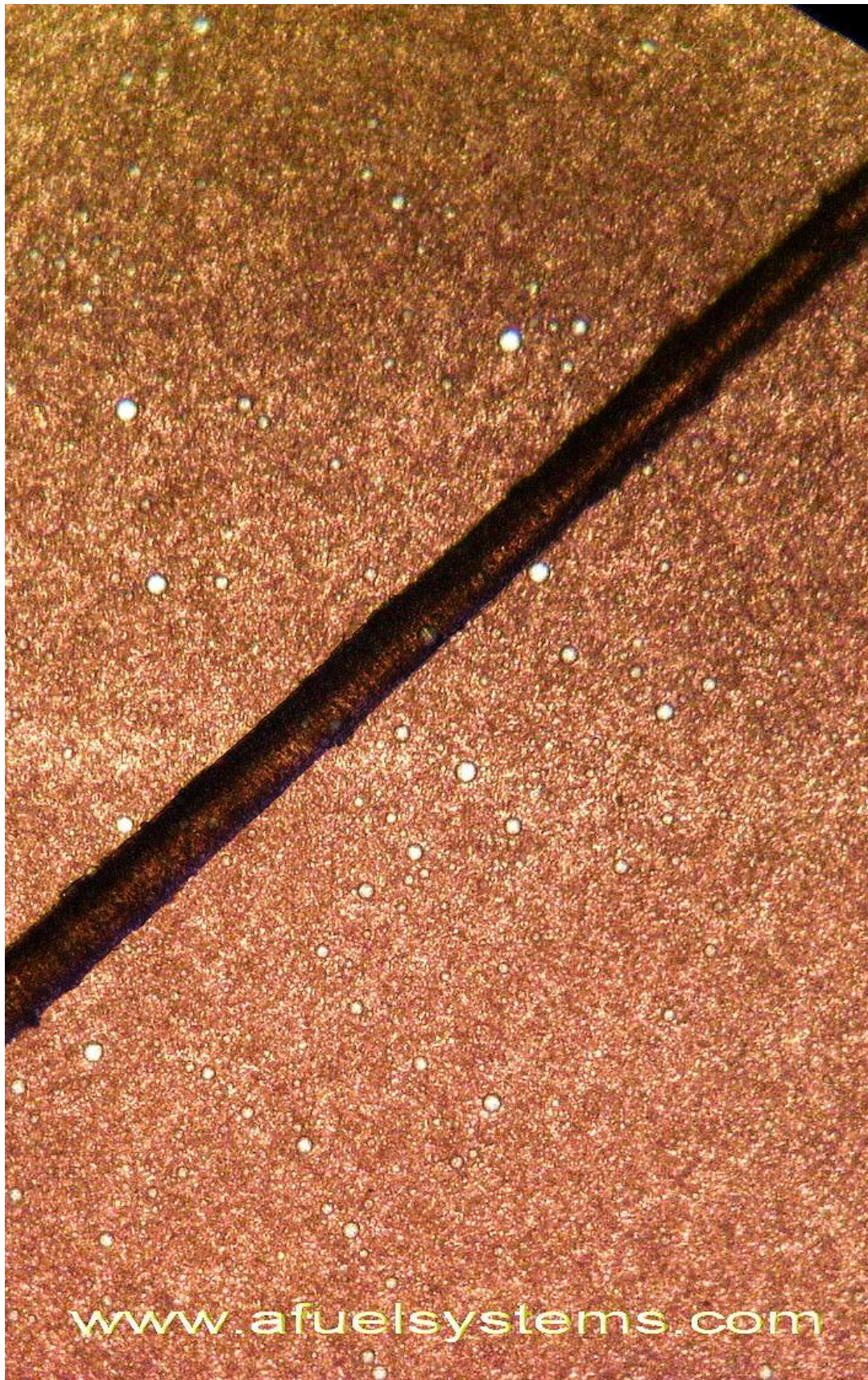
**Photo below** M100 fuel oil with 4% water - after homogenization ...  
4% water not disappeared - but it is not visible and  
no need to do complicated and expensive injection system.



black oil M-100  
after homogenization with TRGA  
increase of 150 times  
diameter of the hair 90 microns  
[www.afuelsystems.com](http://www.afuelsystems.com)



**Photo below M100 fuel oil with 20 % water -**  
**after homogenization under low pressure ( 2 bar ) ... thick hair is 90 microns**  
**large droplets are visible, but remember that 20% of water here ...**

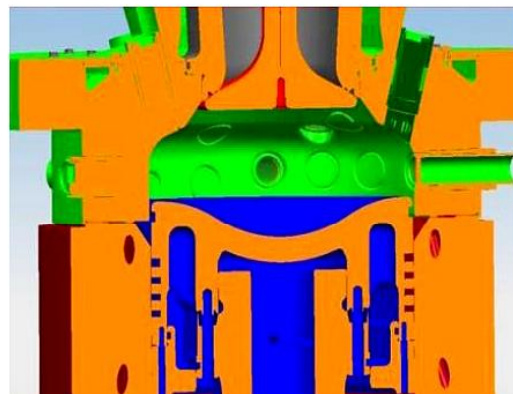
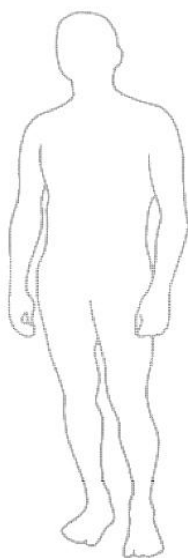




## Comparison - the complexity of the equipment - Project Hercules



### Combustion process visualization development

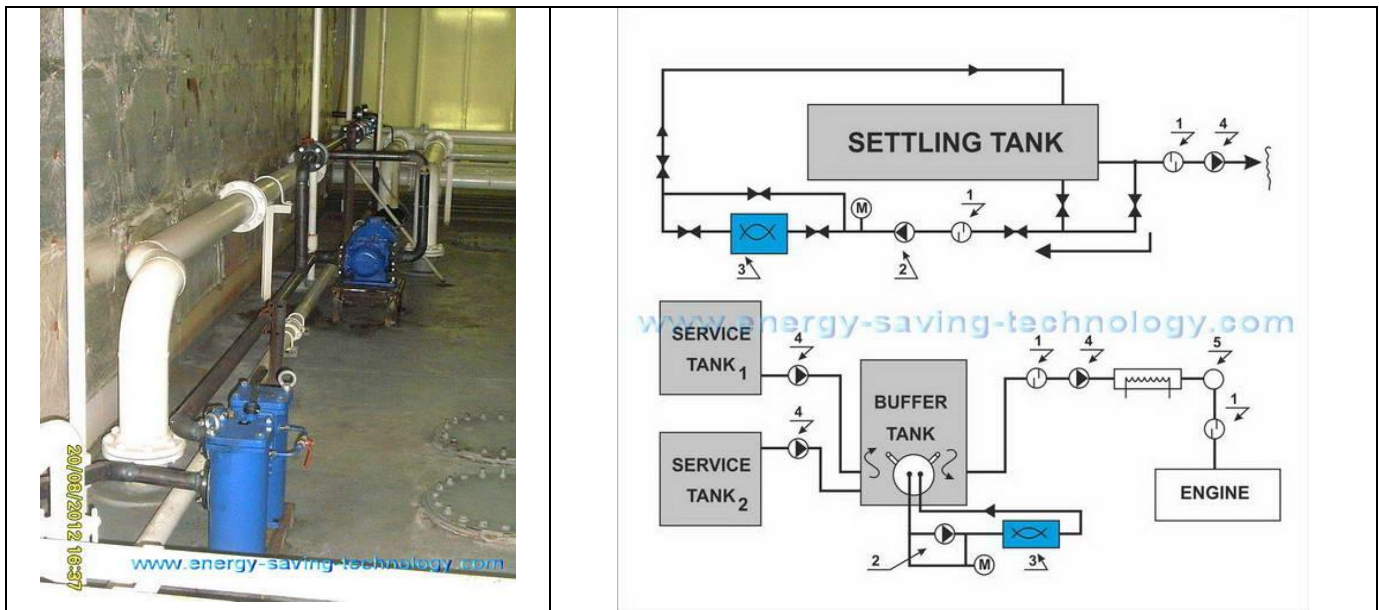


Optical cylinder covers for 2-stroke



**Hercules development costs - more than 100 million euros from the EU funds.**  
**practical result - 0, expensive, difficult to operate and maintain, no place need to upgrade the engine**

Comparison - the complexity of the equipment – PSSF system,  
cheap, reliable operation in a parallel system that does not require changes in the  
engine and easy to maintain the ship's crew [TYPE APPROVAL Certificate of IACS](#)



The overall results of the use of ship's modules TRGA  
testing on ro-ro ship Larkspur "from 19 to 22 08. 2012

	Operation on the standard fuel	Using module TRGA only on the buffer tank	Using module TRGA only on the settling tank	Using module TRGA on the buffer tank and on the settling tank
<b>The main observed effects</b>				
<b>Flue gas temperature St. (C)</b>	325 326 337	356 356 357	353 347 353	<b>368 370 370</b>
<b>Level CO</b>	100%	- 3.8 – 6.4 % -5.27 – 6%	-6.47 – 10.39%	<b>-10 – 14.97 % -12.34 – 13.67</b>
<b>Visual amount of smoke  length in meters of water followed</b>	100% at startup – a lot of smoke  during the driving 30-80 meters	at startup – less for 30%  during the driving 5-40 meters	<b>at startup – less for 40%  during the driving 5 - 10 meters</b>	at startup – less for 30%  during the driving 5 - 20 meters
<b>The amount of fuel sludge from the separator</b>	0.692 tonnes per day  Of which the fuel is 415 kg	0.692 tonnes per day  Of which the fuel is 415 kg	0	<b>0</b>
	1	2	3	4

**Additional effects of the installation of ship modules TRGA**

1. Additional heating fuel. TRGA modul provides heating fuel in a buffer tank on the temperature of 85-90 degrees, what reduces the viscosity of the fuel, using fuel or high binding in the case of poor fuel heaters lining the resin, which is the build-up. TRGA module provides heating fuel in settling tank so that the fuel is heated to 5 ° C in a streaming through the module.
2. Reducing the amount and size of solid particles in the fuel directly affects the speed and reduce the amount of fuel sludge to collection tanks for fuel mud tank and, in addition to direct fuel saving, provides cost generated by the fuel acquisition sludge by the port services.
3. Reducing the amount and size of solid particles in the fuel has a direct impact on the reduction of wear separator and saving in the cost of its repair and maintenance.



4. Reducing the amount and size of solid particles in the fuel has an indirect impact on reducing pollution **settling tank** and the costs incurred in cleaning.
5. Using a modul TRGA back to the **buffer tank** provides a softer transition from a heavy fuel engine and vice versa, which, in addition to reducing the heat load allow to start the transition process in less fuel earlier, which also saves on diesel.

Reliable operation of modul TRGA

**Module TRGA on the buffer tank has worked continuously from 28. 11. 2011 to 15. 8. 2012, which means for 9 months.** TRGA module did not require continuous monitoring or any maintenance. TRGA module did not require any cleaning, adjustment, or replacement of any parts or regulation. TRGA module was turned off before testing in August 2012, and after the test is still working. Review of TRGA module during testing showed that the module is in an excellent and perfect mechanical condition and has no traces of wear.

**Module TRGA in a settling tank has worked continuously from 19. 8. 2011 to 18. 10. 2012.** The module did not require continuous monitoring or any maintenance. The TRGA module did not require cleaning, adjustment, replacement of any parts or regulation.

Marine Company Transeuropa Shipping Lines d.o.o.  
(Transeuropa Ferries) Koper Slovenija  
www.transeuropaferrries.com  
Direktor – ing. Rihard Stergulec



**More info - [www.energy-saving-technology.com/en/trga\\_ship\\_en.html](http://www.energy-saving-technology.com/en/trga_ship_en.html)**

## Additional documents

### 0. [Ship fuel economy - Pilot project](#)

1. The [official report](#) laboratory of group INA, Zagreb, Croatia on the nature of changes in the ship's fuel before and after treatment.
2. The [official conclusion](#) of the pilot project - installation of PSSF on the ship.
3. [PSSF technology certification](#).
4. [PSSF technology presentation](#).
5. Movies (1-4) - [marine fuel savings, reduced smoke](#).
6. Movies (5-8) - [marine fuel savings, reduced smoke](#).
7. [TYPE APPROVAL Certificate of IACS](#)

## Comparison - shipboard fuel before and after treatment (column 0, 1 and 2)

### 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	<u>138.5</u>	<u>117.8</u>	<u>117.6</u>	129.1	136	<u>super</u>
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	<u>14.06</u>	<u>8.53</u>	<u>8.18</u>	<u>8.19</u>	<u>7.63</u>	<u>super</u>
flow point	8	°C	<= 30	<u>+30</u>	<u>+24</u>	<u>+24</u>	+21	+24	<u>super</u>
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	<u>125</u>	<u>122</u>	<u>120</u>	<u>115</u>	<u>112</u>	<u>super</u>
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.

This technology to improve the quality of ship fuel can be used on the beach, storage tank farms or production ship fuel.

**Andrew Ruban**

[www.energy-saving-technology.com](http://www.energy-saving-technology.com)