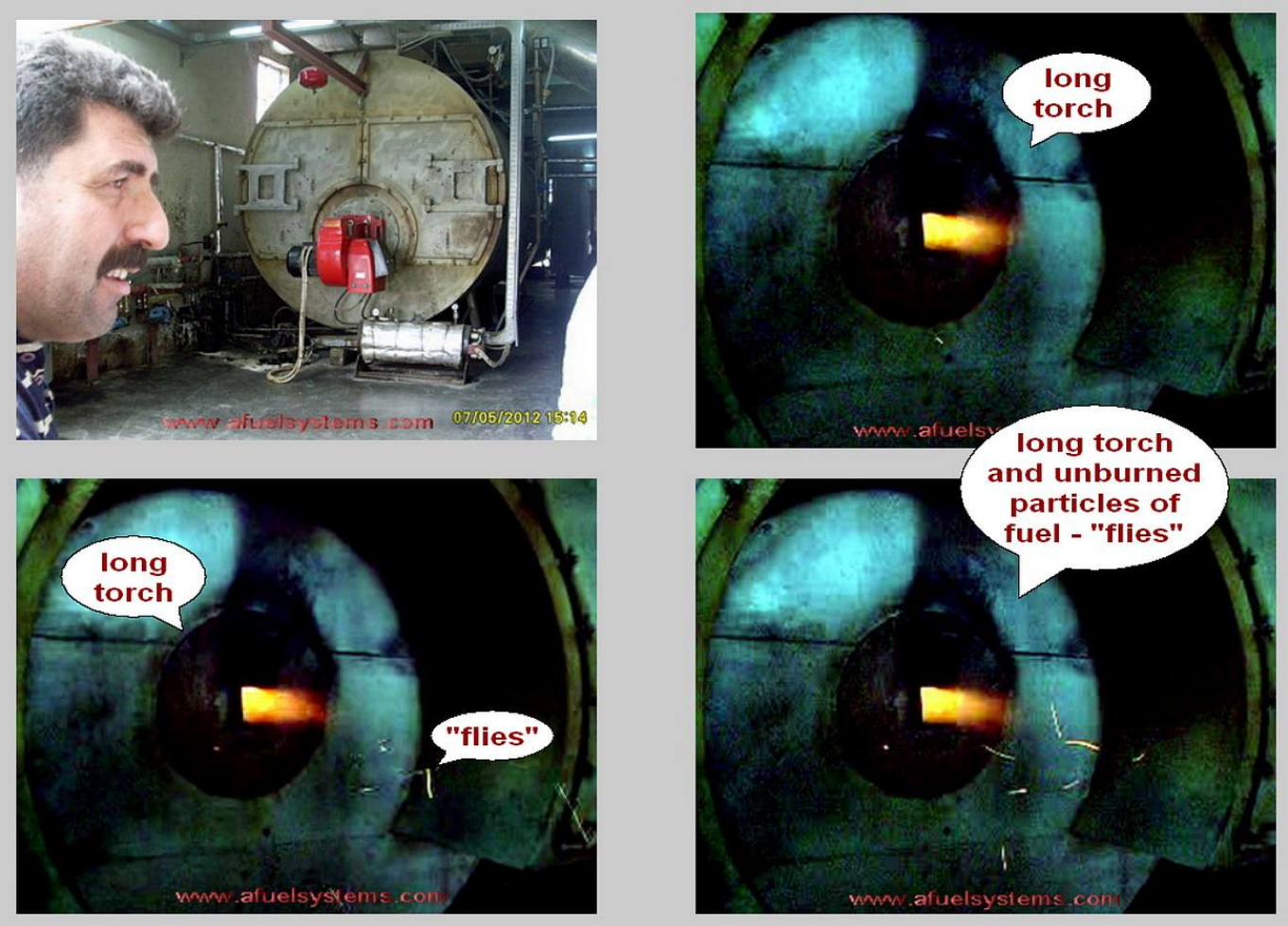
**Optimization of combustion of heavy fuel in small boilers.**

Optimization of combustion of liquid fuel, provides a reduction in specific fuel consumption and harmful emissions. This is especially true for small boilers. Why?

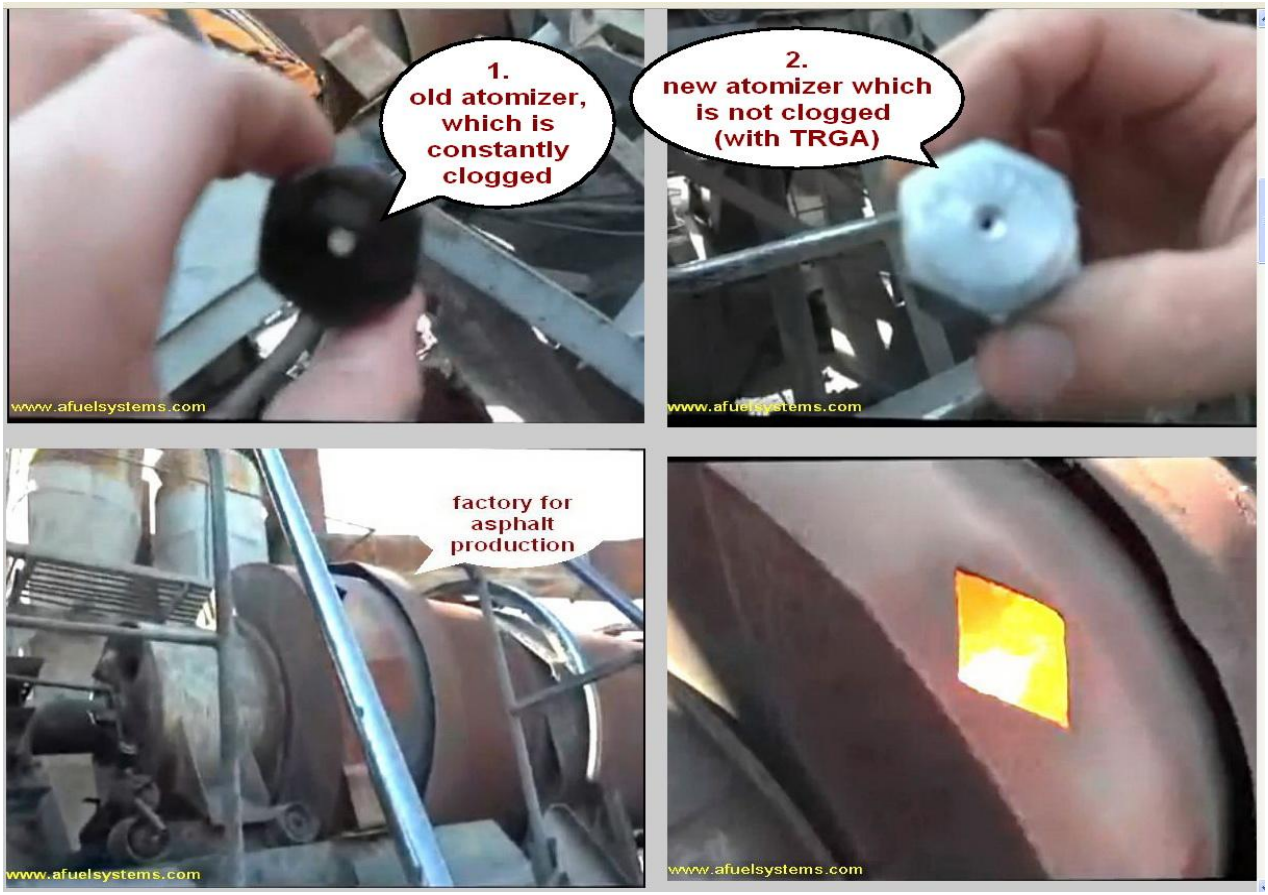
1. Small boilers have a **smaller size of the furnace** and a **lower combustion temperature**. This imposes high demands on the quality of fuel. Any changes in quality - a decrease in viscosity, an increase in the amount of coke particles, the size and quantity of fur impurities, weighting of the fractional composition, watering - lead to an increase in time for complete combustion of fuel. In practice, the fuel burns the back lining, heat exchangers, burns in the pipe. This is a bunch of additional technical and financial problems.




**Example** - burn-out of fuel outside the boiler www.afuelsystems.com/ru/trga/s114.html (ru)
**Example** - melting of the back wall of the boiler www.afuelsystems.com/ru/trga/s266.html (ru)
**Example** - shortening of torch with a homogenizer www.afuelsystems.com/ru/trga/s99.html (ru)

2. Small boilers are **smaller in cross-section** of nozzles, filters and **more gentle pressure pumps**. The deterioration of fuel quality for such boilers is more critical than for large boilers.

**Example** - an italian atomizer, which is constantly clogged with russian fuel oil.
www.afuelsystems.com/ru/trga/s25.html (ru)
**Example** - an chinese atomizer, which is constantly clogged with russian fuel oil.
http://www.afuelsystems.com/ru/trga/s121.html (ru)
**Example** - an russian atomizer, which is constantly clogged with russian fuel oil.
http://www.afuelsystems.com/ru/trga/s196.html (ru)





**Прежняя форсунка**

**Диаметр форсунки = 2 мм.**
**Площадь сечения = 3.14 мм. кв.**

**Новая форсунка**

**Диаметр форсунки = 1.4 мм.**
**Площадь сечения = 1.538 мм. кв.**
**( 49% от площади прежней форсунки**

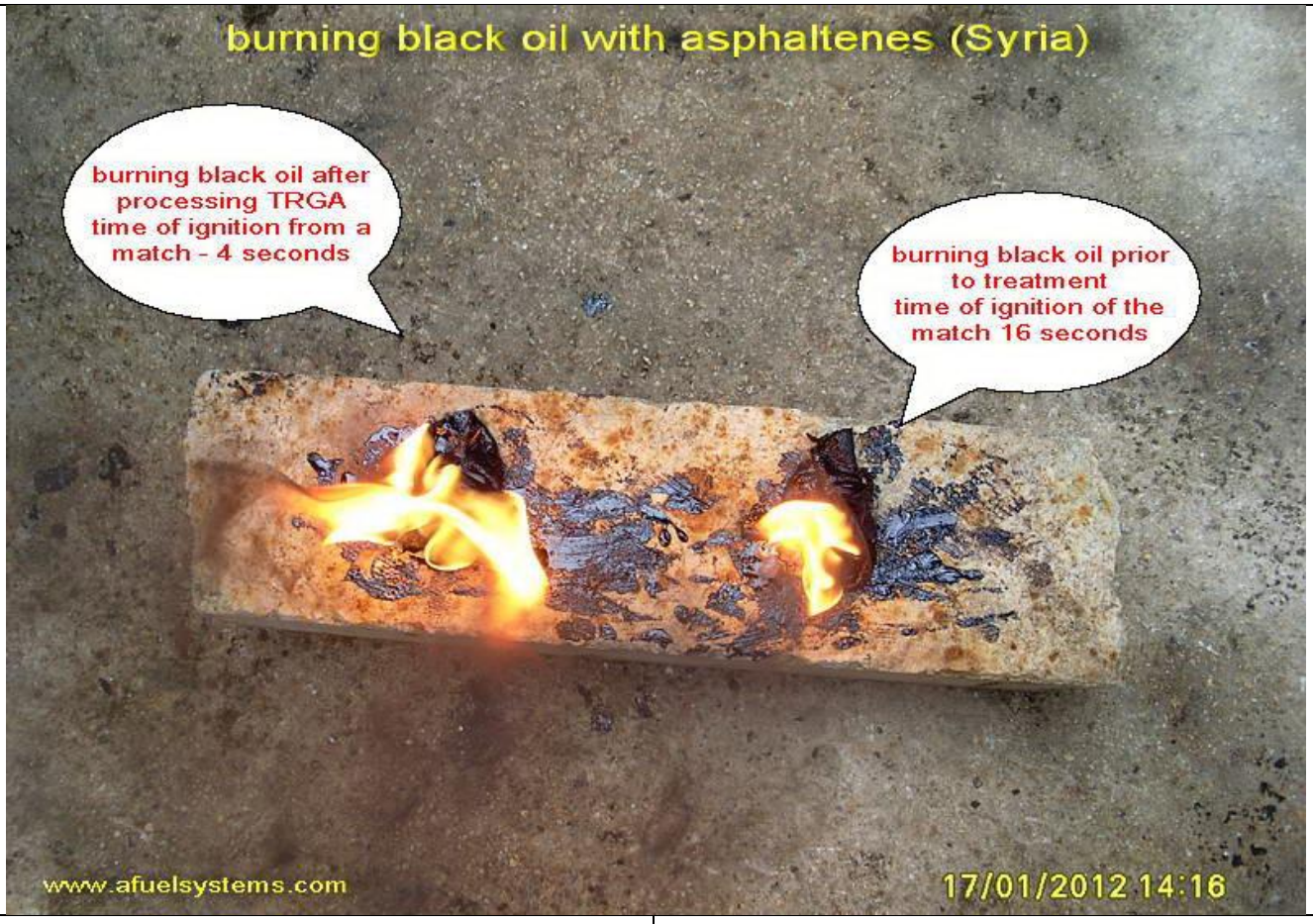
3. Small boilers often have more **owners with "more limited financial resources"** and problems with quality service, as a result - in the reservoirs there is watering and settling, injectors are more often clogged, dispersity of the sprayed decreases and further see item 1.

**Example** - homemade boiler with bad fuel - www.afuelsystems.com/ru/trga/s106.html

**Example** - Improvement of combustion in comparison www.afuelsystems.com/ru/trga/s106_1.html

**Comparative examples** burning heavy fuel oil. www.energy-saving-technology.com/en/hfo_burning_en.html

**Photos - fuel quality**




Burning before

Burning after

4. Objects with small boilers, often **use reservoirs for long-term storage** of heavy fuel of large volumes - which leads to a deterioration in its quality - polymerization, subsidence, delamination and watering.

**Example** - combustion HFO with condensed water, complete absence of smoke and odors - www.afuelsystems.com/ru/trga/s269.html (ru)

**Example** is the reduction of smoke - www.afuelsystems.com/ru/trga/s33.html (ru)

5. **Small boilers are often self-made** (using a purchased active nozzle) or obsolete (designed for fuel of a different quality) or vice versa (in Arab countries) a **combination of the newest boiler with ultrafiltration of fuel and a viscous, paraffin fuel** oil with a high flash point and heavy fractional composition.

**Example** - cardboard factory in Syria, heavy fuel oil, a modern italian boiler and our installation, and here's the result - www.afuelsystems.com/ru/trga/s112.html


**Example** - Chinese asphalt plant - http://youtu.be/vrG9K0aQb5M
www.afuelsystems.com/ru/trga/s117.html www.afuelsystems.com/ru/trga/s121.html

6. One should not think that these problems are absent in the **"developed technical territories"** and only for viscous boiler fuel. Practice shows that even a combination of the German LOSS boiler, the Italian active burner and the Croatian fresh fuel oil (light low-viscosity fuel oil) requires hardware optimization of combustion processes.

**Example** - Croatia. The usingTRGA homogenizer reduced CO and saved 3.7% HFO.
www.afuelsystems.com/ru/inst/inhr01.html www.afuelsystems.com/arhdoc/test-horv-rieka.pdf

**E[ample** - complete elimination of smoke, 4 black oil boilers in operation. Two American (Holman Boiler) and two Russian DE-25 http://youtu.be/Lpga_fS1X5Q


**Improved heavy fuel** - reduces smoke and emissions for internal combustion engines.
**Example - reduction of smoke** - http://www.afuelsystems.com/ru/trga/s206.html
**Example - reduction of smoke** - www.energy-saving-technology.com/ru/trga_ship_films_2_ru.html

| work ship's engine with standard HFO (IFO 180) fuel | engine work at the same HFO fuel, which is processed by technology PSSF |
| --- | --- |
|  |  |



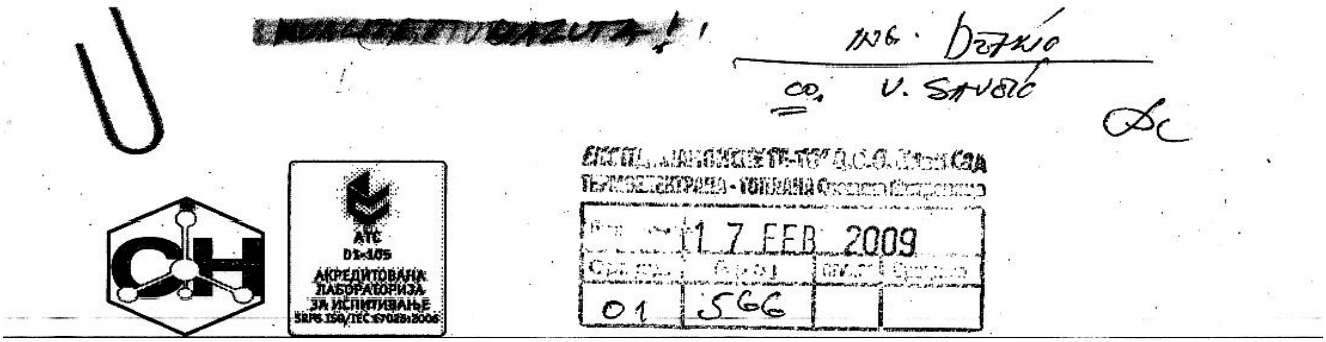
Many problems can be improved by increasing the excess air (alpha), but the thermal losses, NOx and specific consumption are automatically increased. At the same time, problems with clogging of filters, nozzles and wear of pressure pumps are not eliminated.

Do you want to solve the problem of improving the quality of boiler fuel **by filtration?** This does not eliminate water (and therefore corrosion), provides a loss of 0.5-1% of fuel and does not improve the combustion process.

Do you want to solve the problem of improving the quality of fuel oil **by centrifugation?** This results in losses up to 3% of fuel, plus the problem of slurry utilization and does not increase the burning rate of the fuel in the boiler.

And **only the fuel homogenizer** does not create any waste, transforms the sludge into boiler fuel, improves the fractional composition of the fuel, reduces the viscosity and the size of mechanical impurities, and also increases the burning rate of the fuel in the boiler furnace.

An important problem is **sulfur** - $SO_2$ emissions and sulfuric acid corrosion of heat exchangers and pipes. Heavy fuel oil, <u>after treatment,</u> has less mercaptan sulfur (analysis below), which leads to lower emissions and reduced corrosion and repair costs.



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**ZP05/P13**
**Strana 1**
**Ukupno strana 1**

## IZVEŠTAJ O ISPITIVANJU br. 64/09

**Naručilac, adresa:** PD „PANONSKE TE-TO" D.O.O. Novi Sad, Termoelektrana-toplana Sremska Mitrovica; Jarački put bb, Sremska Mitrovica
**Poziv na broj Zahteva naručioca, datum:** Usmeni zahtev, 05.02.2009.
**Zahtev evidentiran u Laboratoriji CH, broj i datum:** 64/09, 09.02.2009.
**Odeljenje Laboratorije CH:** GOMA i CIA
**Uzorci dostavljeni:** 05.02.2009.
**Analize završene:** 06.02.2009.

| Naziv (šifra) uzorka | Metoda | Rezultat |
|---|---|---|
| TE-TO-SM-Mazut | Određivanje sadrzaja ugljenika, vodonika, azota i sumpora (i kiseonika) upotrebom instrumenta za elementalnu analizu **Vario EL III** | Sadrzaj ugljenika: 86,05%<br>Sadrzaj vodonika: 12,10%<br>Sadrzaj azota: 0,33%<br>Sadrzaj sumpora: 2,60% |
| | Određivanje kalorične vrednosti po metodi kalorimetrijske bombe i izračunavanje donje kalorične vrednosti JUS.B.H8.318* | Gornja kalorična vrednost:<br>43133,5 kJ/kg<br>10302,3 kcal/kg<br>Donja kalorična vrednost<br>40637,1 kJ/kg<br>9706,0 kcal/kg |
| Emulzija | Određivanje sadrzaja ugljenika, vodonika, azota i sumpora (i kiseonika) upotrebom instrumenta za elementalnu analizu **Vario EL III** | Sadrzaj ugljenika: 77,66%<br>Sadrzaj vodonika: 12,12%<br>Sadrzaj azota: 0,30%<br>Sadrzaj sumpora: 1,99% |
| | Određivanje kalorične vrednosti po metodi kalorimetrijske bombe i izračunavanje donje kalorične vrednosti JUS.B.H8.318* | Gornja kalorična vrednost:<br>38704,0 kJ/kg<br>9244,3 kcal/kg<br>Donja kalorična vrednost<br>36211,6 kJ/kg<br>8649,0 kcal/kg |

Napomena (*): Metoda nije akreditovana za tečne uzorke.
Prilozi Izveštaju: /.
Analitičar(i): dr Olga Cvetković i dr Snezana Trifunović

Tačnost, preciznost, ponovljivost i reproduktivnost u saglasnosti sa metodama ispitivanja.
Rezultati ispitivanja odnose se isključivo na uzorak koji je ispitan.

Beograd, 09. 02. 2009.

Izveštaj izradio
Trifunović

Izveštaj odobrio
Rukovodilac Odeljenja CIA
Olga Cvetković
Rukovodilac Odeljenja GOM

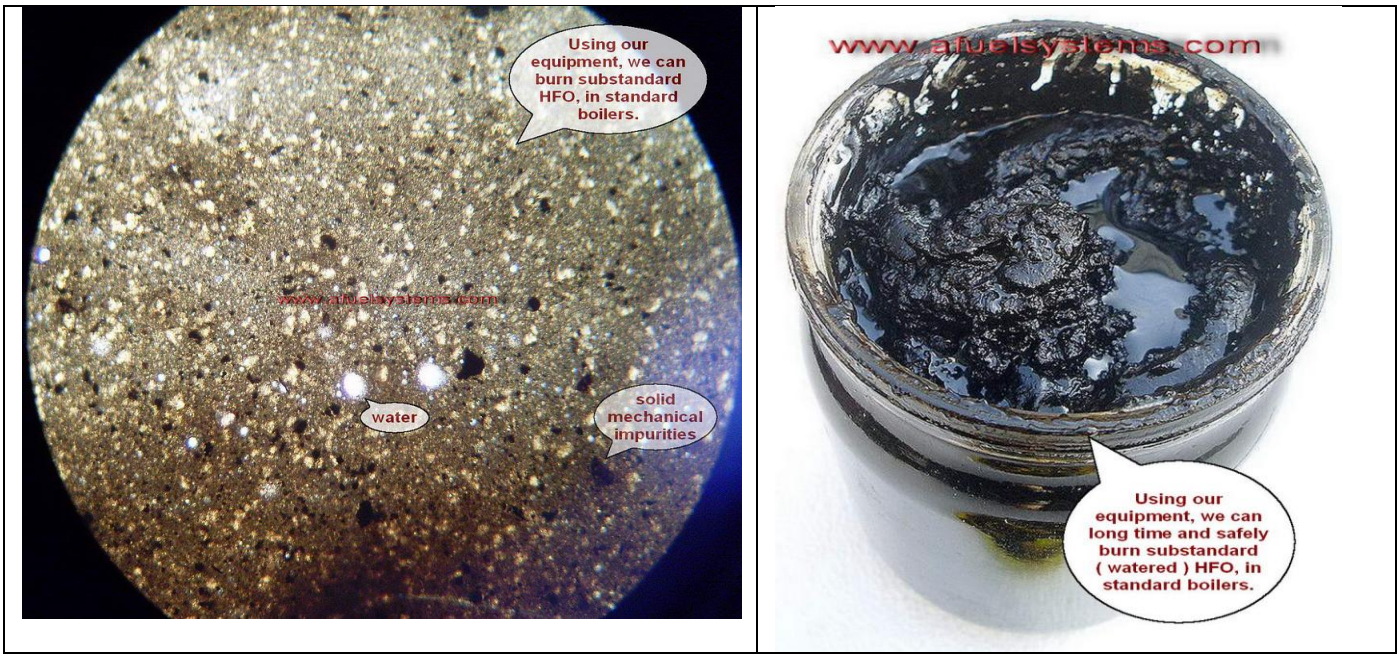
And if the upper data are analyzes of the water-oil emulsion from Belgrade in 2009, the lower ones are analyzes of sulphurous fuel oil from the American laboratory in the Philippines in 2016 www.afuelsystems.com/ru/trga/s_ostrov.html

**The first results summary:**

| | sulfur content | viscosity (cSt) | Calorific (BTU/lb) | density |
|---|---|---|---|---|
| Samp. No. 3 - **original fuel** | 0.531 | 94.33 | 8,875 | 0.9822 |
| Samp. No. 2 - **original fuel processing** by TRGA unit 1 times. | 0.458 | 77.84 | 10,786 | 0.9722 |
| **Percentage comparison** | ( -13.74%) | ( -17.48%) | (+21.53%) | ( -1%) |
| Samp. No. 1 - the starting fuel (HFO) **+ Diesel** 10% + processing by TRGA unit | 0.3 | 9 | 15.179 | 0.9103 |

Some boilers use **natural oil** instead of fuel. We have an absolutely understanding that natural oil can be considered as a boiler fuel of the worst quality.

Look, we have successfully burned such fuel - www.afuelsystems.com/ru/trga/s265.html




And any improvement in the quality of this "fuel" - **averaging the composition, dispersing the inclusions, reducing the viscosity, emulsifying, partially blocking sulfur** - will definitely improve combustion process and reduce the amount of harmful emissions.

At the same time, we remember that only highly reliable homogenizers, with a large proven resource of work, will withstand long-term work with oil from behind the mech. impurities. A homogenizer TRGA - work long, and work long with bad fuel - www.afuelsystems.com/ru/trga/s265.html

Natural Oil as fuel is comparable to an open storage oil sludge - (with which we have experience and obvious results http://www.afuelsystems.com/ru/trga/s158.html )

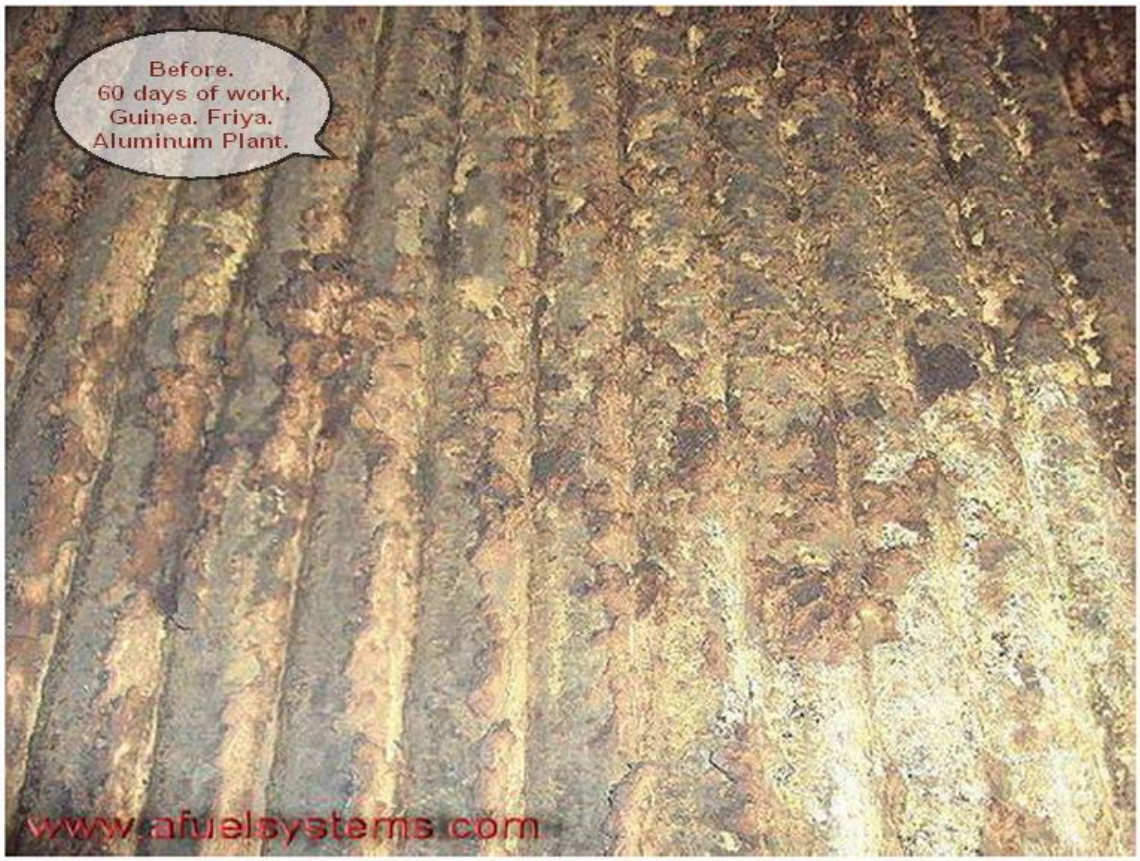

from our practice - natural oil as fuel for asphalt furnaces
**www.afuelsystems.com/ru/trga/s121.html**



**Full description on the links -**
www.afuelsystems.com/ru/trga/s117.html www.afuelsystems.com/ru/trga/s121.html
And the film's here - http://youtu.be/vrG9K0aQb5M

Andrey Ruban 03/03/2018
www.afuelsystems.com
**Some photos in the annex**

**Before and after using the TRGA homogenizer**
**- 2.5 months of operation of two boilers from a single fuel tank**




**Before using TRGA and AFTER, with TRGA systems**

**In work - 4-m oil boiler at the same time.**