

THERMAL STABILITY OF MOTOR OILS

Introduction

Engines running on clean wood gas fuel are subject especially to thermal stress. Purpose of this test was to find out if the large price differences of motor oils are justified. Especially the expensive full synthetic motor oils are advertised to have superior resistance against high temperatures and extreme operation conditions.

Experimental

Sample tubes were placed into the holes of solid steel disk. Temperature of the heater was measured with two thermometers at accuracy of 1 °C. Each oil sample was 3 ml.

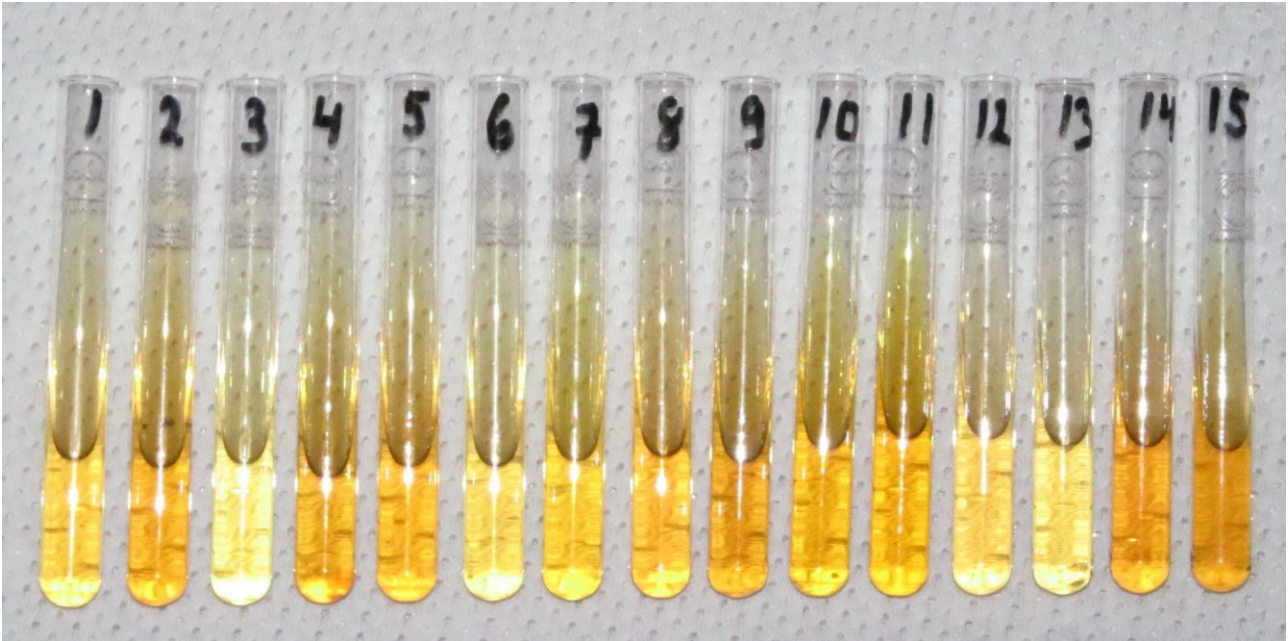
I -stage	12 hours	180 °C
II -stage	3 hours	200 °C
III -stage	1 hour	250 °C
IV -stage	3 hours	250 °C



Any other analyses were not done. Only the change of the colour was observed and photographed.

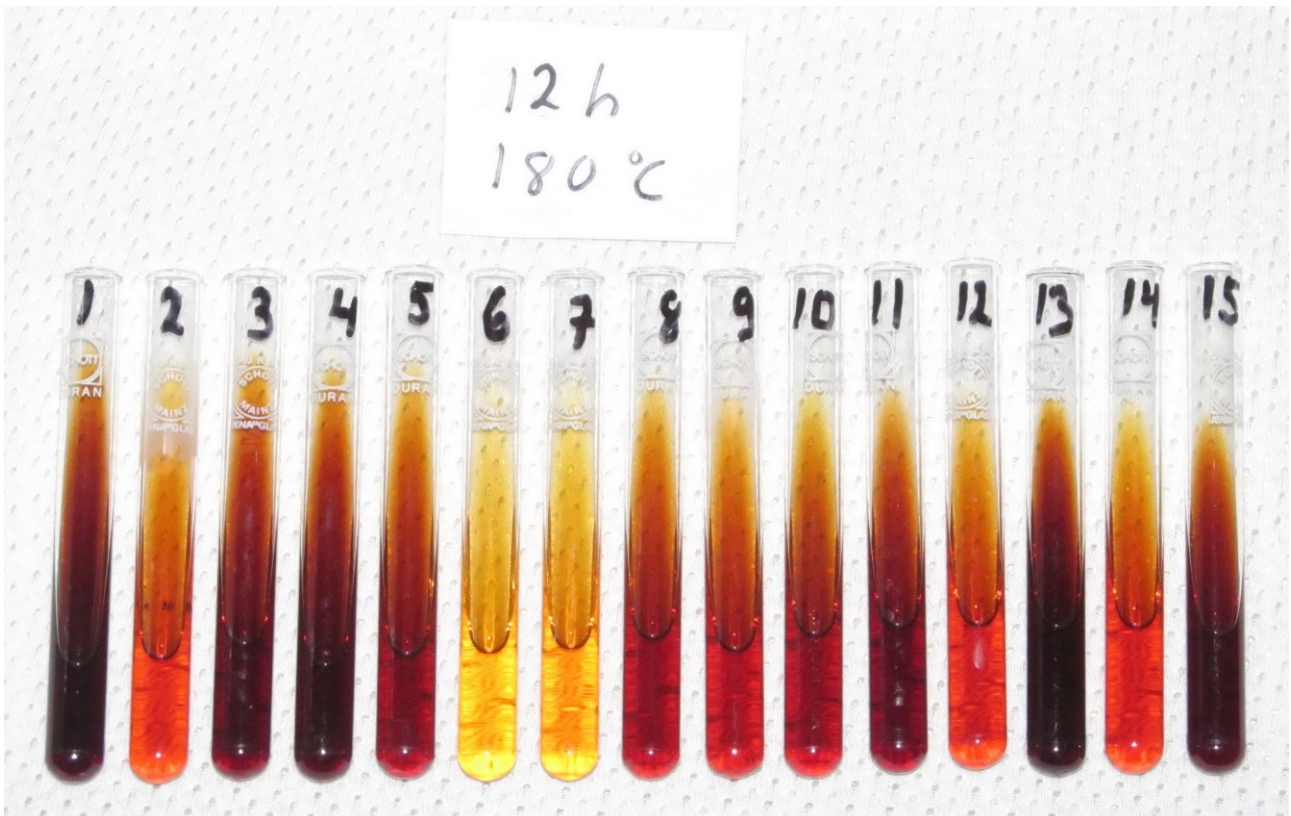
The motor oils in this test were the following:

- 1 Belco Full Synthetic Motor Oil 5W-40
- 2 Shell Rimula R3 15W-40 (Photo of the sales package missing)
- 3 Shell Helix Longlife 0W-30
- 4 Teboil Diamond Diesel 5W-40
- 5 Teboil Monitra plus 10W-30
- 6 Teboil 10W-30 Classic mineral motor oil
- 7 Teboil 15W-40 Classic mineral motor oil
- 8 Teboil 5W-40 Gold S Fully synthetic motor oil
- 9 Q8 Formula Excel 5W-40
- 10 Mobil 1 5W-50
- 11 Mobil Super Fe 10W-30
- 12 Mobil Super 3000 xi 5W-40
- 13 Mobil Super S (semisynth) 10W-40
- 14 Castrol SLX Professional Longlife 0W-30
- 15 Castrol Edge 5W-30



PICTURE 1: Oil samples placed in the test tubes before the heating test

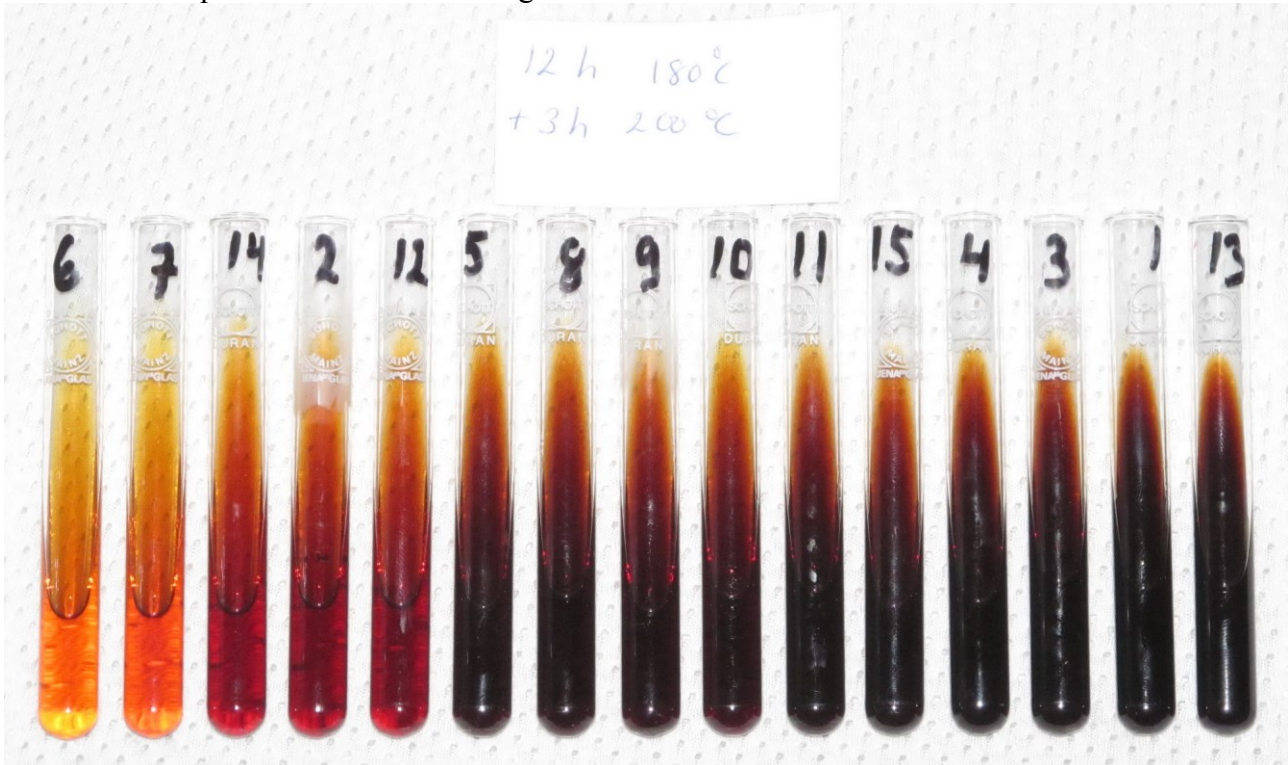
The heater was preheated to 180 °C and samples were placed into the heater for 12 hours. Some of the samples were almost unchanged after 12 hours but on the other hand seems that the most sensitive samples did not withstand the lowest 180 °C temperature.



PICTURE 2: Samples after 12 h treatment at 180 °C in original order.

Part of the samples turned dark during the first treatment at 180 °C. The most darkened were Belco Full Synthetic Motor Oil 5W-40 (No: 1), Teboil Diamond Diesel 5W-40 (No: 4), Mobil Super S semisynth 10W-40 (No: 13) and Castrol Edge 5W-30 (No: 15)

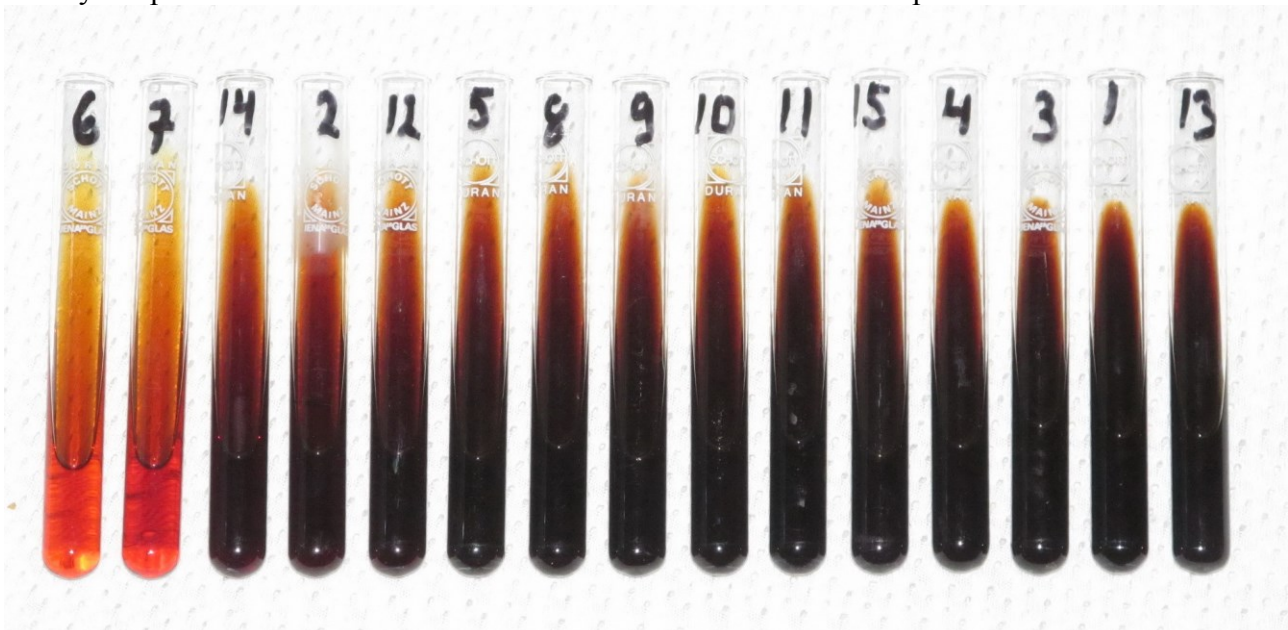
Next the temperature was raised to 200 °C and samples were placed back into the heater for three hours. The samples were the same during the whole test.



PICTURE 3: Oil samples after 12 h at 180 °C + 3 h at 200 °C thermal treatment arranged according to the colour. At dark end differences in colour were negligible.

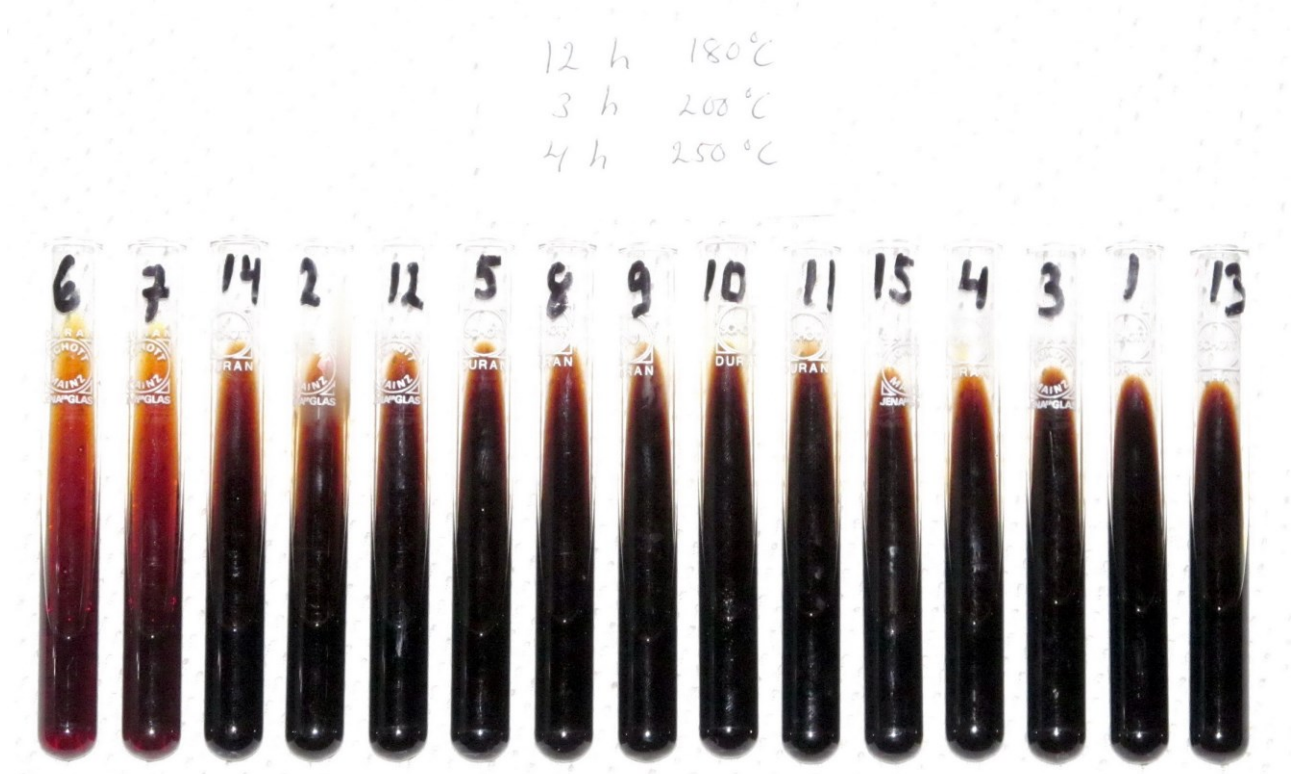
Teboil 10W-30 Classic mineral oil (No: 6) and Teboil 15W-40 Classic mineral oil (No: 7) were little affected by the treatment at 200 °C. Relatively moderate change in colour showed also Shell Rimula R3 15W-40 (No: 2), Mobil Super 3000 xi 5W-40 (No: 12) and Castrol SLX Professional Longlife 0W-30 (No: 14)

Finally temperature was raised to 250 °C and first treatment at this temperature was 1 hour.



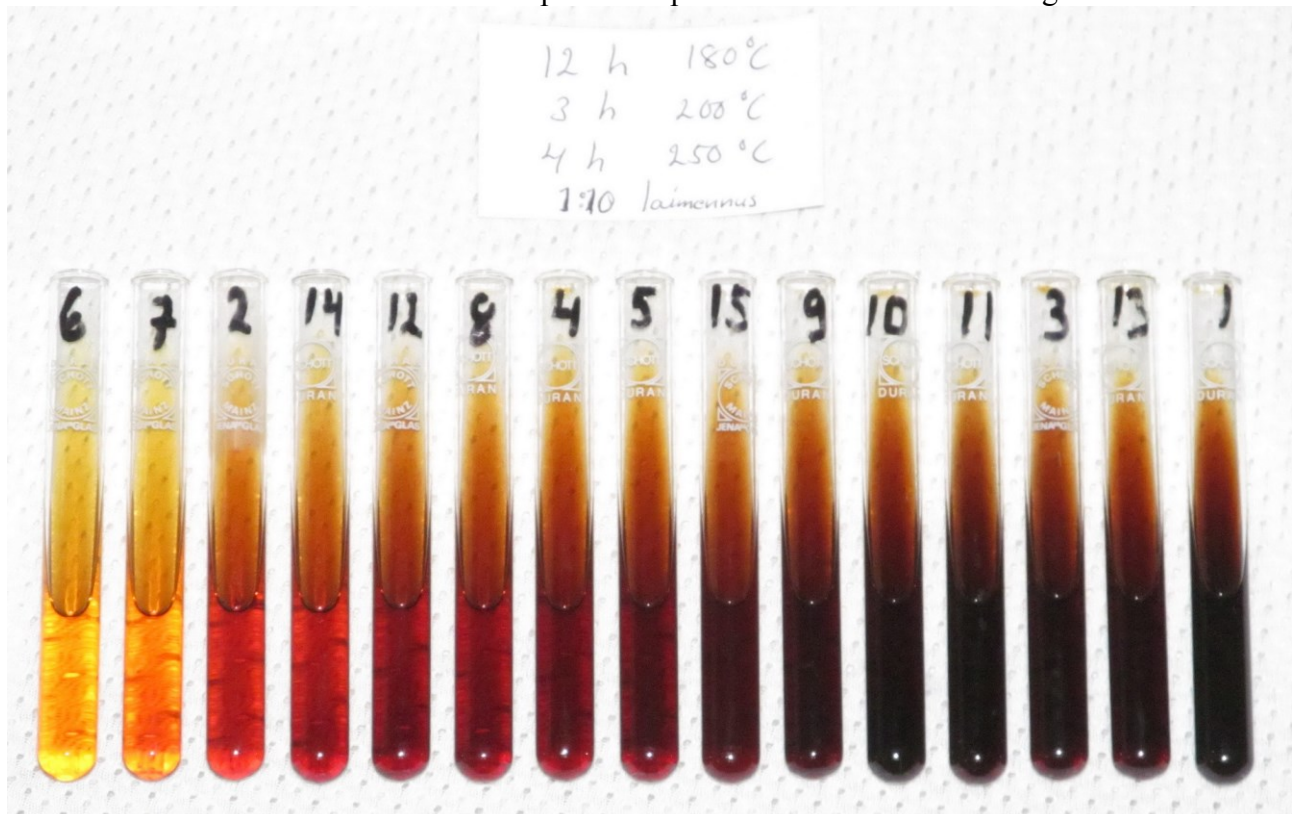
PICTURE 4: Sample tubes after 12 h at 180 °C + 3 h at 200 °C + 1 h at 250 °C thermal treatment. It was impossible to see differences between the dark end samples and this is why the order of the tubes is the same as after the treatment at 200 °C.

Heat treatment was continued for 3 hours at 250 °C, which means total 4 hours at 250 °C. Most of the samples were at this stage too dark to detect any differences in colour.



PICTURE 5: Sample tubes after 12 h 180 °C + 3 h 200 °C + 4 h 250 °C heat treatment

To make differences of almost black tubes visible, samples were diluted 1:10 with turpentine. Dilution revealed the differences and samples were placed in new order according to their colour.



PICTURE 6: Samples after 12 h 180 °C + 3 h 200 °C + 4 h 250 °C treatment diluted 1:10.

RESULTS

The best and the most tolerant against thermal stress were the samples No: 6 and 7

*Teboil 10W-30 Classic mineral oil (No: 6)

*Teboil 15W-40 Classic mineral oil (No: 7)

There was practically no change in colour at 180 °C. Even after heating at 200 °C change of colour was very moderate and these two samples showed clearly the least darkening of all the tested samples. Treatment at 250 °C exceeded the durability of all tested oil samples but compared to others, darkening of these two oils was still very moderate.

Moderate resistance against thermal stress showed No: 2, 14, 12, 8, 4 and 5

*Shell Rimula R3 15W-40 (No: 2)

*Castrol SLX Professional Longlife 0W-30 (No: 14)

*Mobil Super 3000 xi 5W-40 (No: 12)

*Teboil 5W-40 Gold S Fully synthetic motor oil (No: 8)

*Teboil Diamond Diesel 5W-40 (No: 4)

*Teboil Monitra plus 10W-30 (No: 5)

Change of colour was remarkable at 180 °C and change continued while temperature was increased. However, only treatment at 250 °C turned these oils black.

The worst of the tested samples were No: 15, 9, 10, 11, 3, 13 and 1

*Castrol Edge 5W-30 (No: 15)

*Q8 Formula Exel 5W-40 (No: 9)

*Mobil 1 5W-50 (No: 10)

*Mobil Super Fe 10W-30 (No: 11)

*Shell Helix Longlife 0W-30 (No: 3)

*Mobil Super S semisynth 10W-40 (No: 13)

*Belco Full Synthetic Motor Oil 5W-40 (No: 1)

The most sensitive against extreme thermal stress were Belco Full Synthetic Motor Oil 5W-40 (No: 1), Mobil Super S semisynth 10W-40 (No: 13), and Castrol Edge 5W-30 (No: 15). These oils started to darken already at 180 °C. Also Teboil Diamond Diesel 5W-40 (No: 4) darkened significantly already at 180 °C but at elevated temperatures darkening did not propagate very strong and this justifies relatively good final ranking. The highest 250 °C temperature clearly exceeded thermal stability of all tested oil grades. The ranking of the samples was slightly changed after the most severe treatment and dilution of the samples when smaller differences became again visible.

Conclusions

Seems that only high price doesn't guarantee better thermal stability in motor oils. The best oils were the cheapest Teboil mineral oils. All synthetic oils were clearly worse compared to these classic mineral oils. Among the synthetic oils, extremely expensive Castrol SLX was clearly the best against extreme heat. Many famous brands like for example Castrol Edge, Mobil 1 and Shell Helix longlife made practically no difference to cheap Belco full synthetic motor oil.

One must remember, that ranking in this test does not tell anything about lubrication ability of the oils. Ranking according to thermal stability is based only on colour change behaviour showed in the pictures. Colours of the pictures have not been treated by any means and in general, the pictures should show pretty well how the samples looked like after each stage of the test.

