OIL AERATION TESTING PROCEDURE FOR LUBRICANTS AND ADDITIVES

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Oil Aeration Research Study

- Project to investigate oil aeration with use of different antifoams and used oils with fuel dilutions
- Evaluated with agitated samples creating a vortex that produces a windage in the sample, strong enough to be sustained.
- Test of different types of antifoam blended into reference base oil
- Test also samples of used oil with different % of fuel dilution, not considering the contents of soot, water, and overall composition
- **For accomplishing the project, developed a new method for testing aeration with high reliability and repeatability**

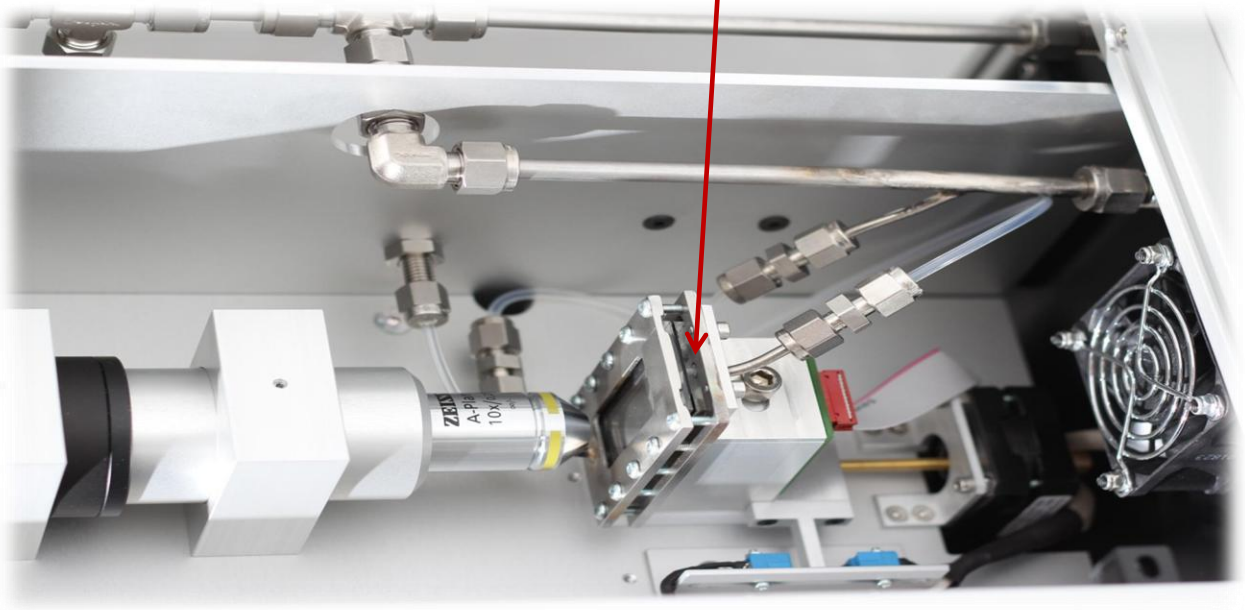
Oilpas Measurement

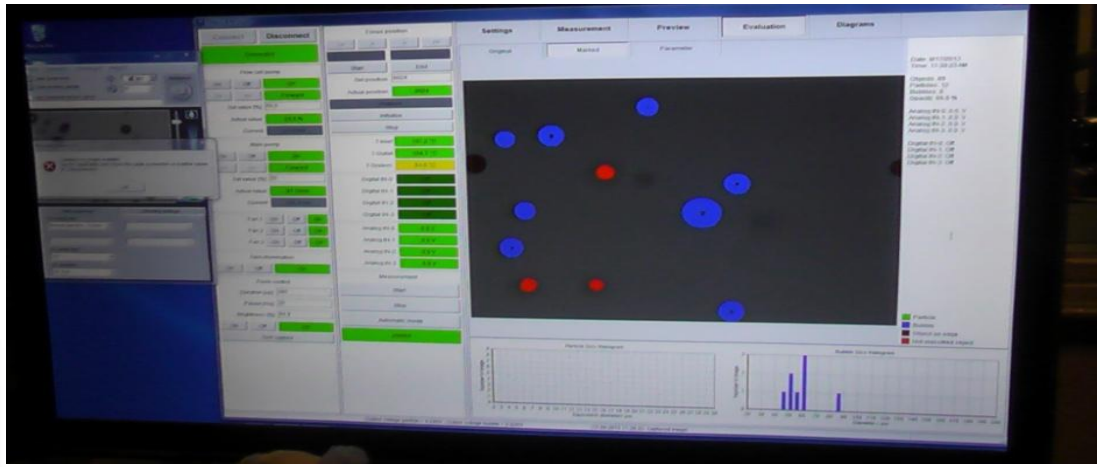
- Using Oilpas instrument to measure aeration in real-time opened possibility to measure aeration and deaeration speeds, and variations over time
- Measurement achieved by sampling a small volume of oil and circulating it through a test cell in an imaging instrument.
- The dispersed air separates in bubbles and it is recorded by an optical method
- Using air bubble count and size distribution, a value for the dispersed gas concentration is calculated in real-time, and it shows good correlation to the dynamic machine operation

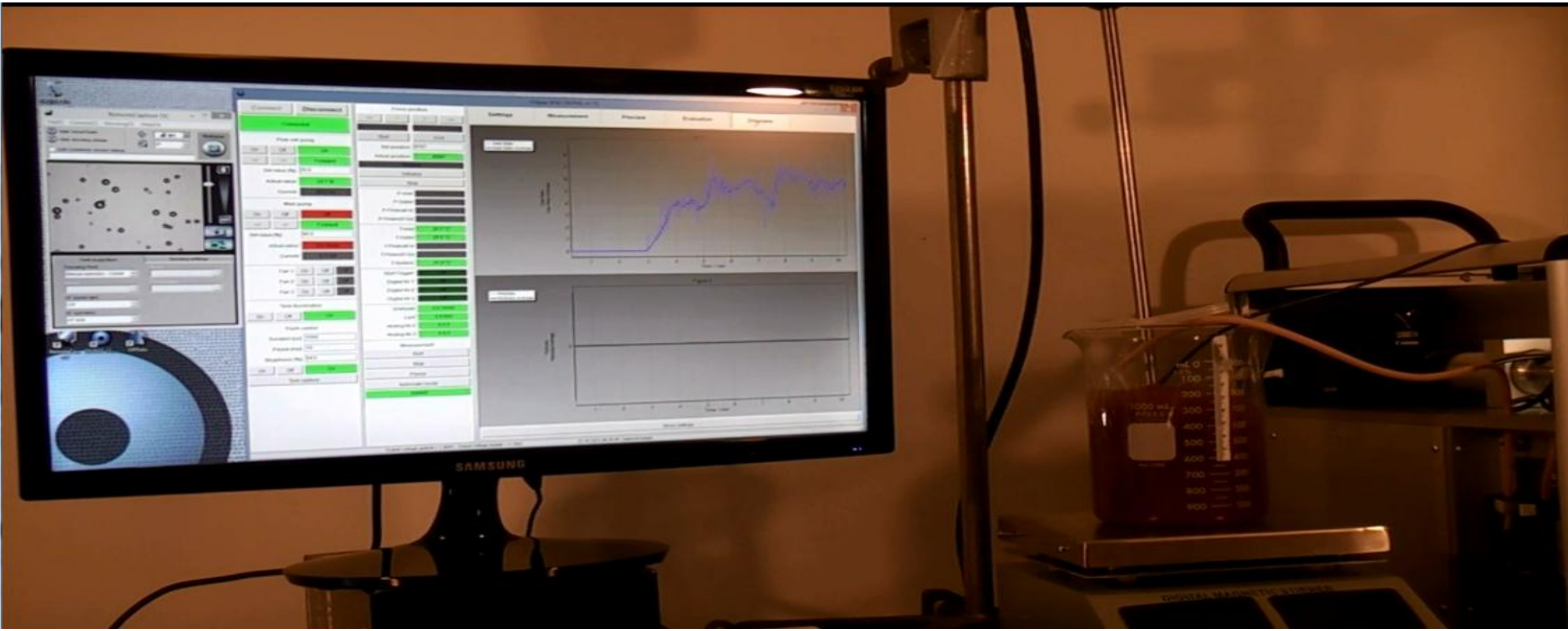
Setup







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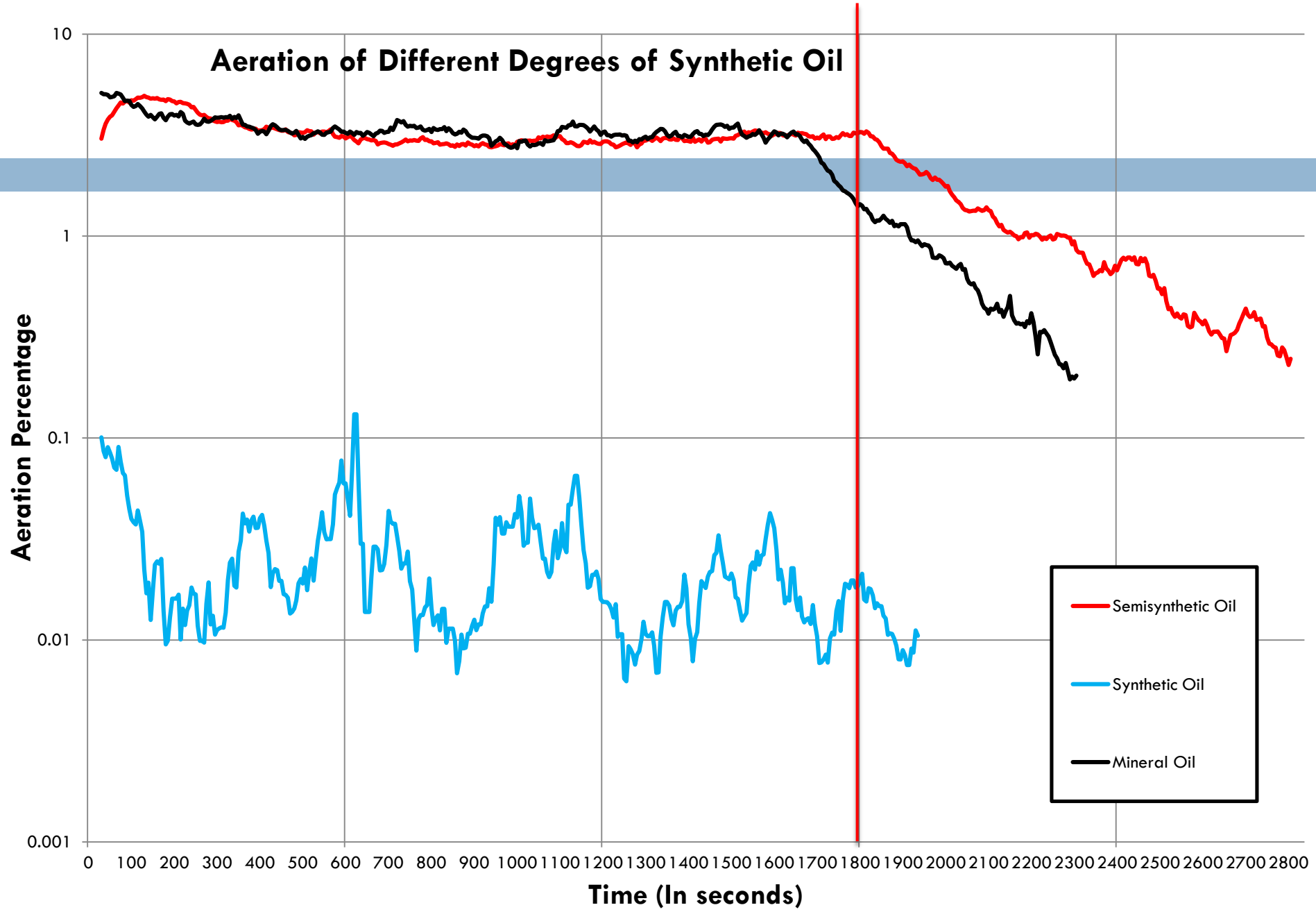
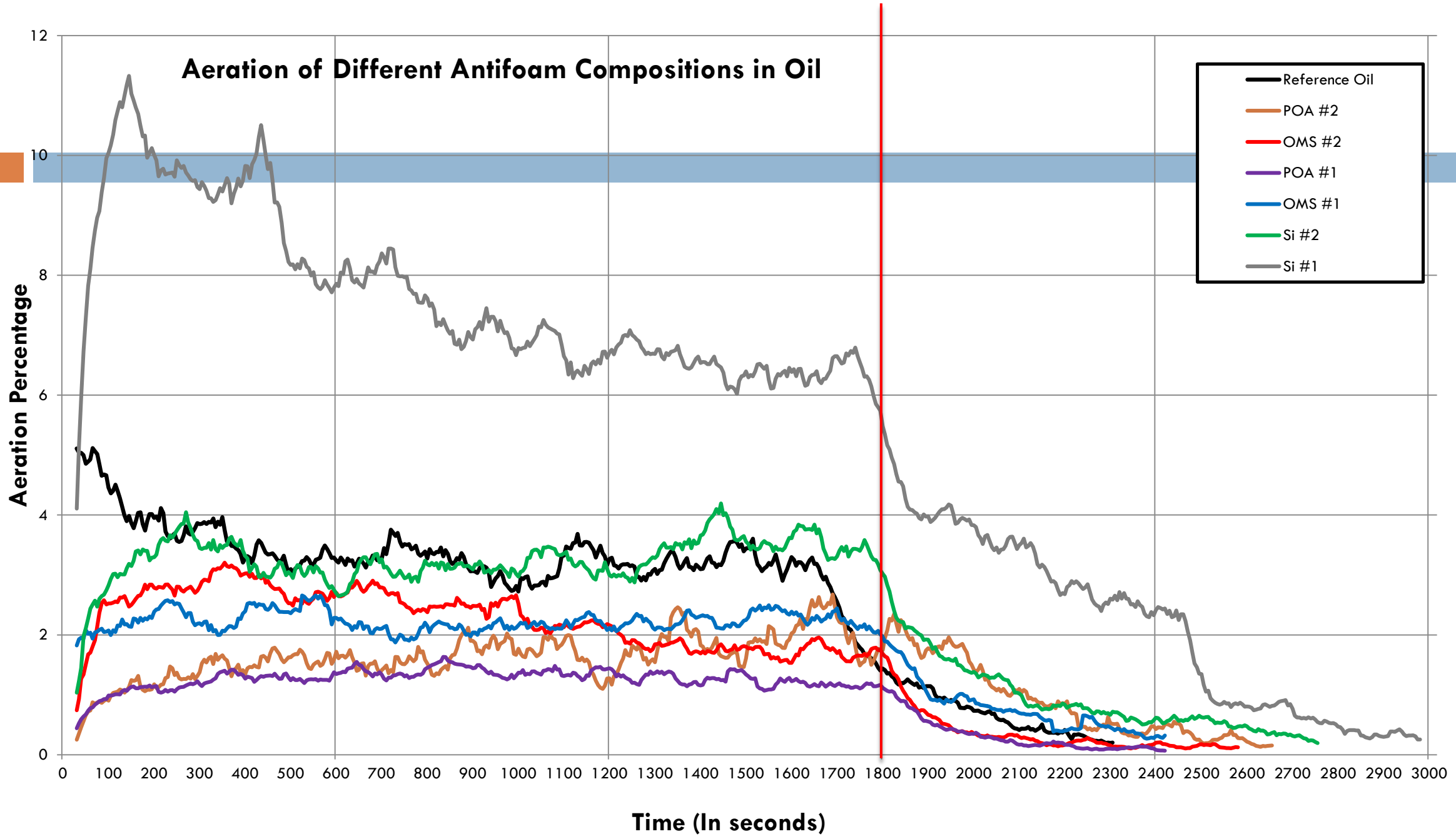

Aeration of Different Degrees of Synthetic Oil
Aeration Percentage
10
1
0.1
0.01
0.001
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800
Time (In seconds)
Semisynthetic Oil
Synthetic Oil
Mineral Oil

Evaluation

OIL	Aeration % when Stable	Aeration % after 5 min. of Deaeration	Highest Aeration % Level Reached
Synthetic Oil	0.05	0.01>	0.2
Semi-Synthetic Oil (5W-20)	5	1	6.0
Mineral Oil	5	0.5	6.0

Different base oils show noticeable differences in the aeration levels and in the deaeration speed.


Aeration of Different Antifoam Compositions in Oil
Aeration Percentage
Time (In seconds)
Reference Oil
POA #2
OMS #2
POA #1
OMS #1
Si #2
Si #1
0
2
4
6
8
10
12
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000

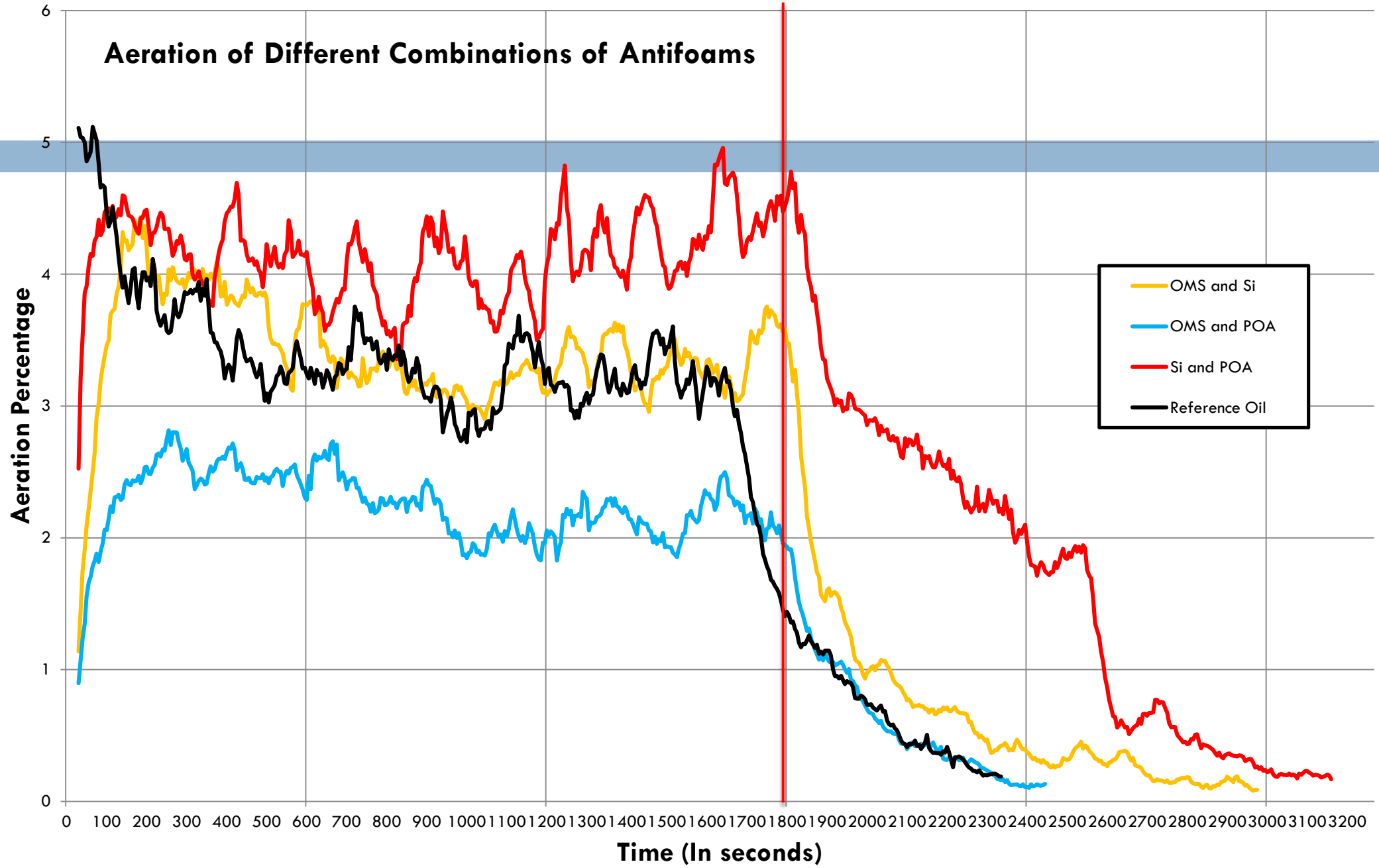
Evaluation

OIL	Aeration % when Stable	Aeration % after 5 min. of Deaeration	Highest Aeration % Level Reached
Reference Oil	3.5	0.6	5.0
Si Antifoam #1	6.2	2.7	11.2
Si Antifoam #2	3.0	1.0	4.1
OMS Antifoam #1	2.0	0.7	2.7
OMS Antifoam #2	2.0	0.3	3.0
POA Antifoam #1	1.5	0.2	1.5
POA Antifoam #2	1.9	0.2	2.3

Traditional antifoam agents may cause a negative effect in oil aeration

Some chemical families have a positive effect at lowering oil aeration

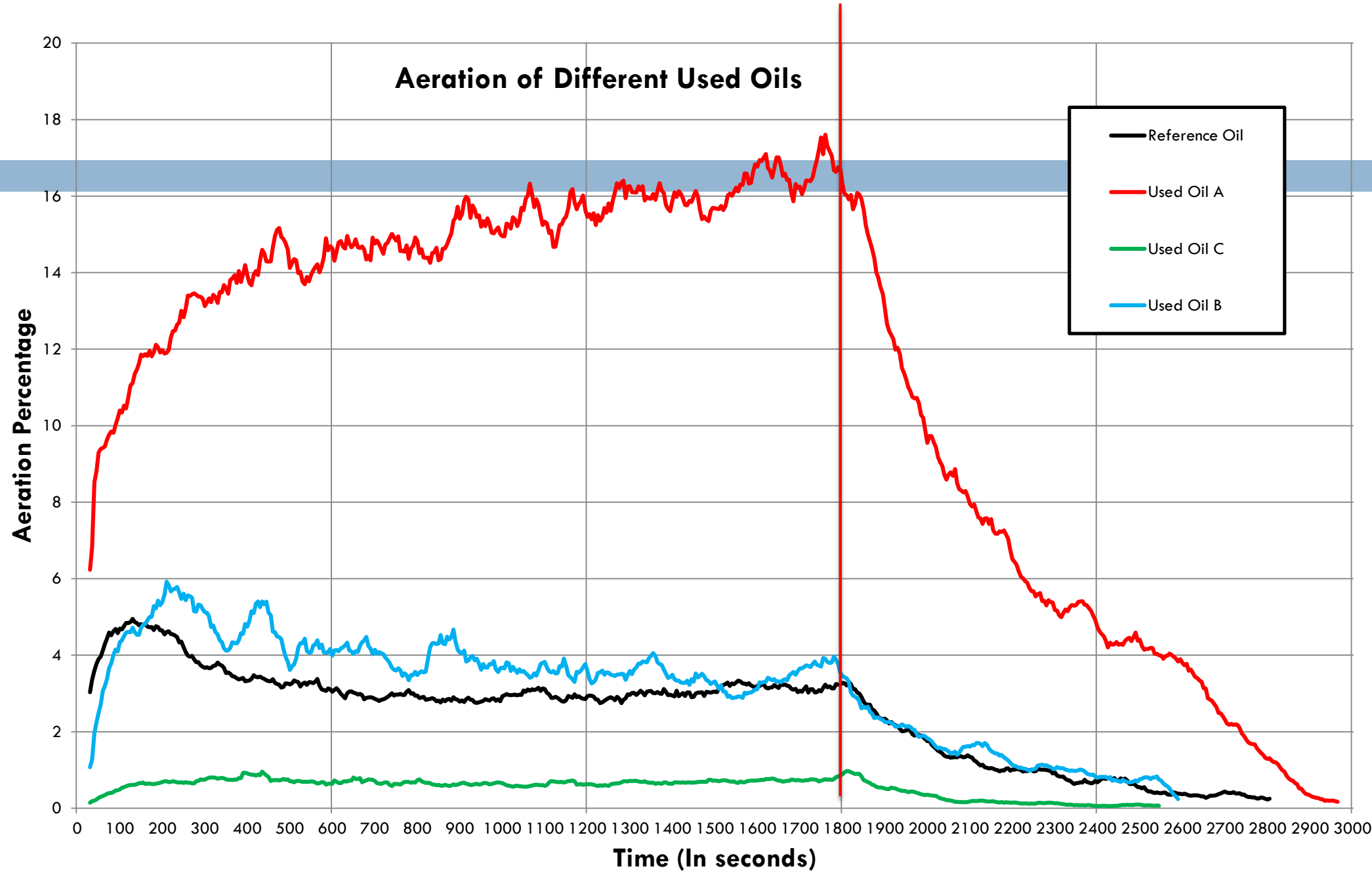
Differentiation between defoamers and deaerators, two different effects and processes in oil


Aeration of Different Combinations of Antifoams
Aeration Percentage
Time (In seconds)
OMS and Si
OMS and POA
Si and POA
Reference Oil
0
1
2
3
4
5
6
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200

Evaluation

OIL	Aeration % when Stable	Aeration % after 5 min. of Deaeration	Highest Aeration % Level Reached
Reference Oil	3.2	0.5	5.1
Si and POA	4.0	2.6	5.0
Si and OMS	3.3	0.7	4.5
OMS and POA	2.2	0.5	2.7

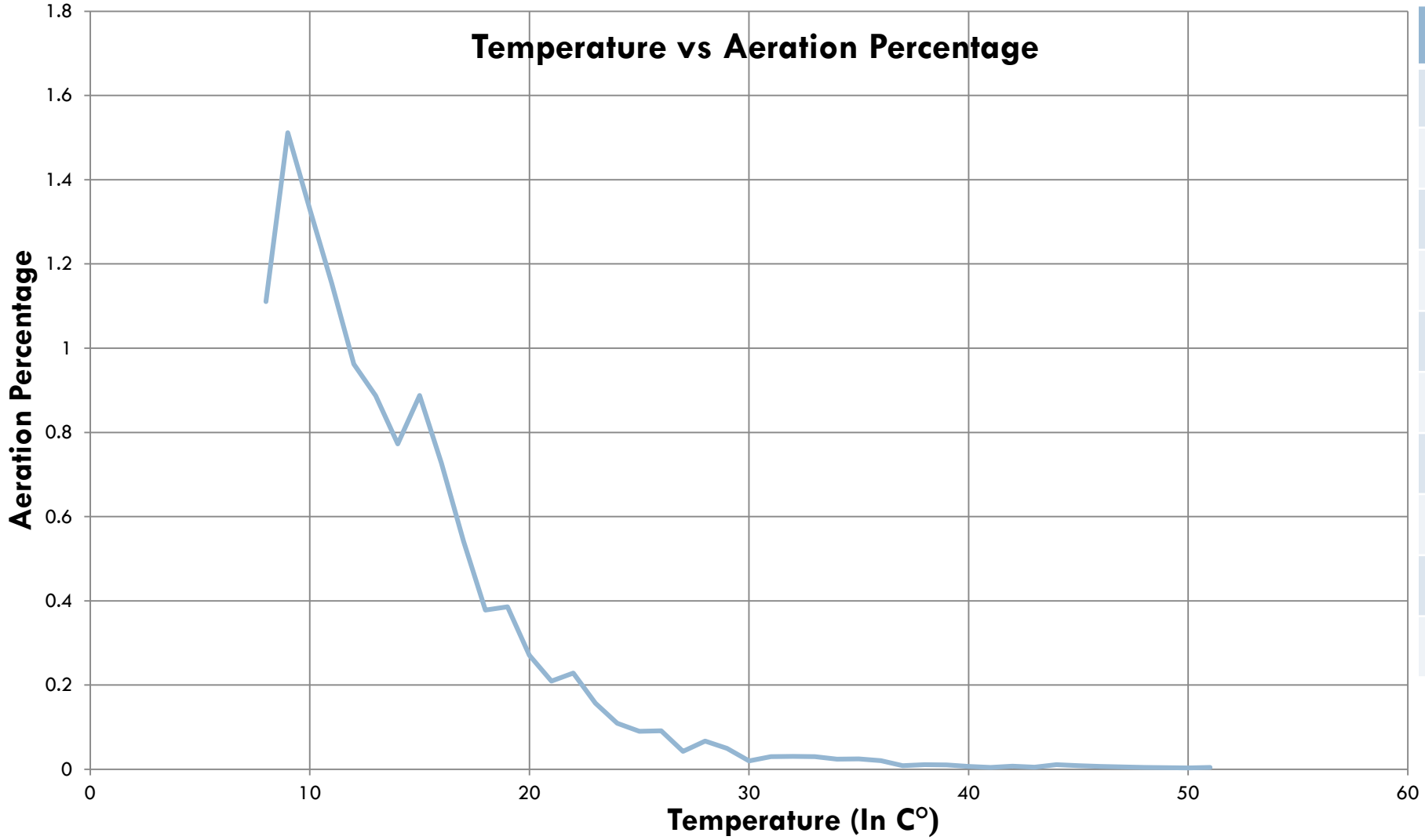
A combination of defoamers and deaerators might solve tribological challenges in drive train


Aeration of Different Used Oils
Aeration Percentage
Time (In seconds)
Reference Oil
Used Oil A
Used Oil C
Used Oil B
0
2
4
6
8
10
12
14
16
18
20
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000

Evaluation

OIL	Description of Oil	Aeration % when Stable	Aeration % after 5 min. of Deaeration	Highest Aeration % Level Reached
Reference Oil	Semi synthetic SN 5W-20	3.0	1.7	5.0
Used Oil A	Light contamination	15.2	7.5	17.8
Used Oil B	Medium contamination	3.9	1.7	6.0
Used Oil C	Heavy contamination	0.8	0.2	1.0

Counter-intuitive results for used oil samples. Oil A with fewer hours show high spikes of aeration
Oil with high soot, water, and high degree of fuel dilution showed an extreme low aeration level
Base oil blend, additive package, aging of oil, and contamination are influencing aeration levels
Fully formulated oils require more detailed testing to study the correlation and influence of additives



Temp. [C°]	Aeration [%]
6	1.5
12	1.0
15	0.7
20	0.2
25	0.1
30	0.05
35	0.03
40	0.02
45	0.01
50	0.01>

Conclusions

- **Method** developed clearly identifies different aspects of oil aeration
- Opportunity for scanning a large number of formulations in short time
- Capability for studying lubricants, additives, and base oils
- Testing is available for specific oil aeration projects

RESULTS

- Additives and antifoams are not deaerators and some cause detriment
- Oil aeration is directly proportional to viscosity/temperature
- Counter intuitive results of used oil aeration measurement
- Slope of aeration and deaeration speed varies with components

Thank you for your attention



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