C13A MATRIX TESTING RESULTS UPDATE / REVIEW

January 16, 2015

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Available data from TMC as of 1/15/15

New data since last update on 12/18:

- SW Test 11, 12, 13
- LZ Test 10, 11, 12
- EG Test 12, 13

38 tests total posted as of 1/15/15.

Oil K (Test 14) is currently running at SwRI as of 1/15/15.

FTP directory /refdata/diesel/coat/data/matrix op data/ at ftp.astmtmc.cmu.edu.

	<DIR>	..
12/03/14 02:53PM [GMT]	16,955	CAT Aeration Data Template.xlsx
12/18/14 02:38PM [GMT]	9,299	CAT Matrix Oil Codes.xlsx
11/19/14 01:20PM [GMT]	9,142,177	Lubrizol_Test#1_CMIR#104081 (i R1 Repeat).xlsx
12/17/14 04:29PM [GMT]	10,630,335	Lubrizol_Test#10_CMIR#103626 (g R2).xlsx
12/23/14 11:56AM [GMT]	10,845,910	Lubrizol_Test#11_CMIR#103460 (k R2).xlsx
12/23/14 11:58AM [GMT]	11,000,909	Lubrizol_Test#12_CMIR#105877 (i R2).xlsx
11/19/14 01:20PM [GMT]	8,711,519	Lubrizol_Test#2_CMIR#103459 (k R1).xlsx
11/19/14 01:22PM [GMT]	8,849,810	Lubrizol_Test#3_CMIR#103625 (g R1).xlsx
12/02/14 01:47PM [GMT]	9,466,330	Lubrizol_Test#4_CMIR#103957 (l R1).xlsx
12/02/14 01:47PM [GMT]	9,623,934	Lubrizol_Test#5_CMIR#103465 (j R1).xlsx
12/02/14 01:47PM [GMT]	9,912,453	Lubrizol_Test#6_CMIR#103452 (h R1).xlsx
12/11/14 10:09AM [GMT]	9,994,023	Lubrizol_Test#7_CMIR#103453 (h R2).xlsx
12/11/14 10:10AM [GMT]	10,232,770	Lubrizol_Test#8_CMIR#103466 (j R2).xlsx
12/12/14 01:38PM [GMT]	10,393,965	Lubrizol_Test#9_CMIR#103958 (l R2).xlsx
11/18/14 11:18AM [GMT]	5,281,983	SwRI Test 1 Oil K Run 1 CMIR-103457 (TMC Template).xlsx
12/16/14 02:28PM [GMT]	8,635,271	SwRI Test 10 Oil L Run 2 CMIR-103956 (TMC Template).xlsx
12/26/14 10:44AM [GMT]	8,054,040	SwRI Test 11 Oil G Run 2 CMIR-1033624 (TMC Template).xlsx
12/26/14 11:20AM [GMT]	8,359,907	SwRI Test 12 Oil J Run 2 CMIR-103464 (TMC Template).xlsx
01/08/15 06:16PM [GMT]	8,354,496	SwRI Test 13 Oil K Run 3 CMIR-103458 (TMC Template).xlsx
11/18/14 11:17AM [GMT]	5,829,532	SwRI Test 2 Oil J Run 1 CMIR-103463 (TMC Template).xlsx
11/18/14 11:17AM [GMT]	6,216,000	SwRI Test 3 Oil G Run 1 CMIR-103623 (TMC Template).xlsx
11/18/14 11:39AM [GMT]	6,353,424	SwRI Test 4 Oil L Run 1 CMIR-103955 (TMC Template).xlsx
11/24/14 02:01PM [GMT]	6,620,378	SwRI Test 5 Oil H Run 1 CMIR-103450 (TMC Template).xlsx
12/02/14 02:19PM [GMT]	6,851,146	SwRI Test 6 Oil I Run 1 CMIR-104078 (TMC Template).xlsx
12/03/14 10:57AM [GMT]	7,143,343	SwRI Test 7 Oil K Run 2 CMIR-103456 (TMC Template).xlsx
12/03/14 10:25AM [GMT]	7,768,659	SwRI Test 8 Oil I Run 2 CMIR-104079 (TMC Template).xlsx
12/11/14 10:13AM [GMT]	8,164,223	SwRI Test 9 Oil H Run 2 CMIR-103451 (TMC Template).xlsx
12/19/14 10:49AM [GMT]	4,777,643	TMC EG10 STRUN19 SOT141216.xlsx
12/02/14 10:02PM [GMT]	4,377,273	TMC EG11 STRUN12 SOT141124.xlsx
12/11/14 02:15PM [GMT]	5,262,778	TMC EG12 STRUN14 SOT141204 Revised.xlsx
12/09/14 06:35PM [GMT]	4,971,665	TMC EG13 STRUN8 SOT141105 revised.xlsx
12/19/14 09:47AM [GMT]	4,762,879	TMC EG14 STRUN18 SOT141214 revised.xlsx
12/10/14 05:05PM [GMT]	5,640,880	TMC EG2 STRUN11 SOT141114 revised.xlsx
12/11/14 02:56PM [GMT]	4,769,315	TMC EG3 STRUN15 SOT141206 Revised.xlsx
12/10/14 12:06PM [GMT]	4,796,092	TMC EG4 STRUN9 SOT141107 revised.xlsx
12/17/14 09:46AM [GMT]	4,760,410	TMC EG5 STRUN17 SOT141212 Revised.xlsx
12/10/14 02:39PM [GMT]	4,921,896	TMC EG6 STRUN10 SOT141111 revised.xlsx
12/17/14 09:59AM [GMT]	4,948,256	TMC EG7 STRUN16 SOT141209 revised.xlsx
12/08/14 05:57PM [GMT]	4,645,423	TMC EG8 STRUN7 SOT141029 revised.xlsx
12/11/14 11:19AM [GMT]	4,403,200	TMC EG9 STRUN13 SOT141201 revised.xlsx

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Aeration results - summary table

Sample\Lab	SW	LZ	EG
Oil G	10.53, 10.19	10.70, 10.47	11.72**, 10.73, 10.51
Oil H	11.09, 11.25	11.99, 12.27	11.70, 11.47
Oil I	10.61, 10.60	10.78, 10.71	11.14, 10.58
Oil J	10.81, 10.30	10.26, 10.50	10.88, 10.38
Oil K	~~10.49~~*, 11.08, 10.85	12.15, 11.65	11.68, 11.11
Oil L	10.56, 10.51	10.64, 10.47	10.97, 10.39

Notes: Aeration values are 30-50 hr averages in %.

* = invalidated due to high pump speed signal output

** = potentially severe result due to high delta temp across MM

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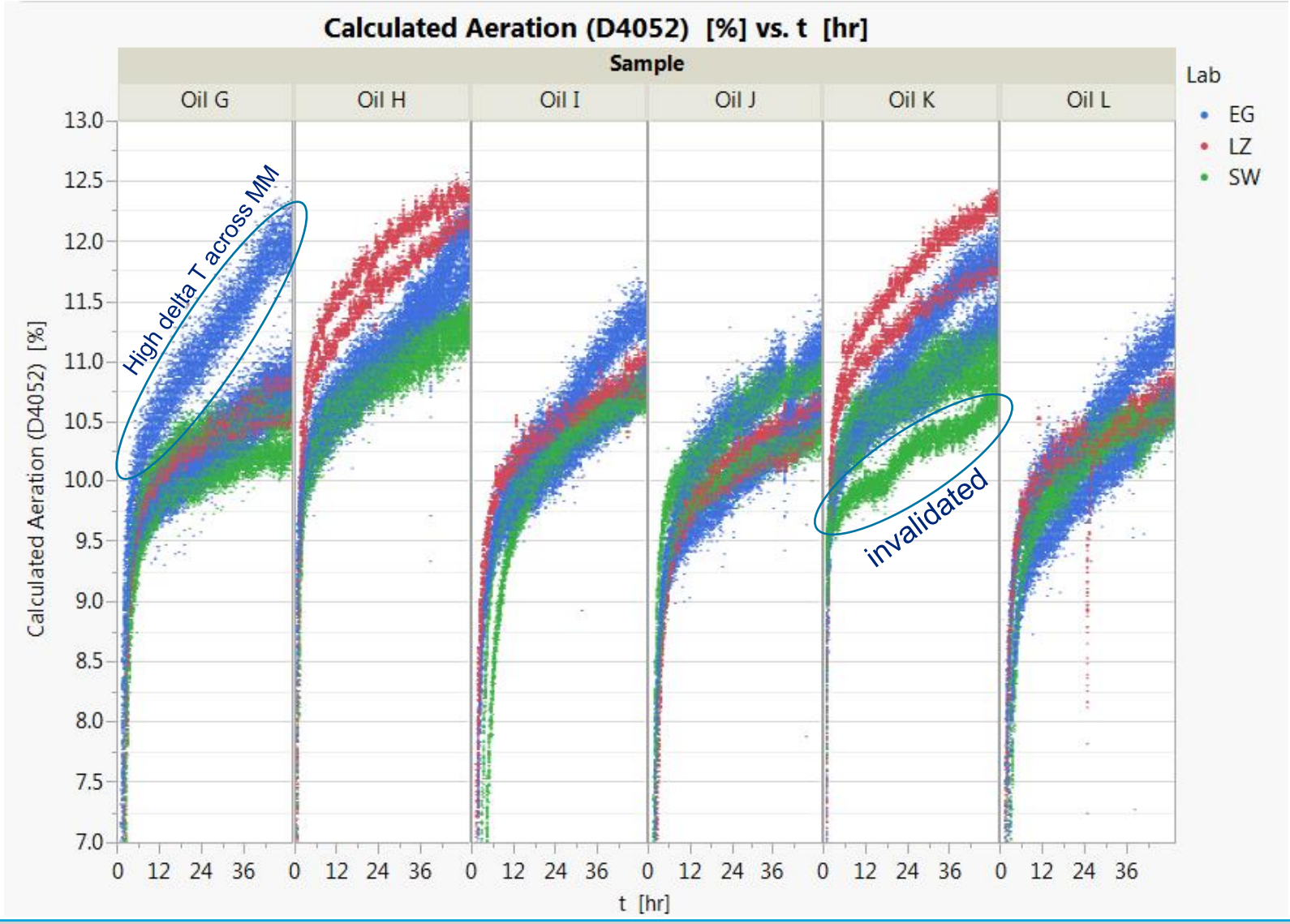
Aeration plots by sample



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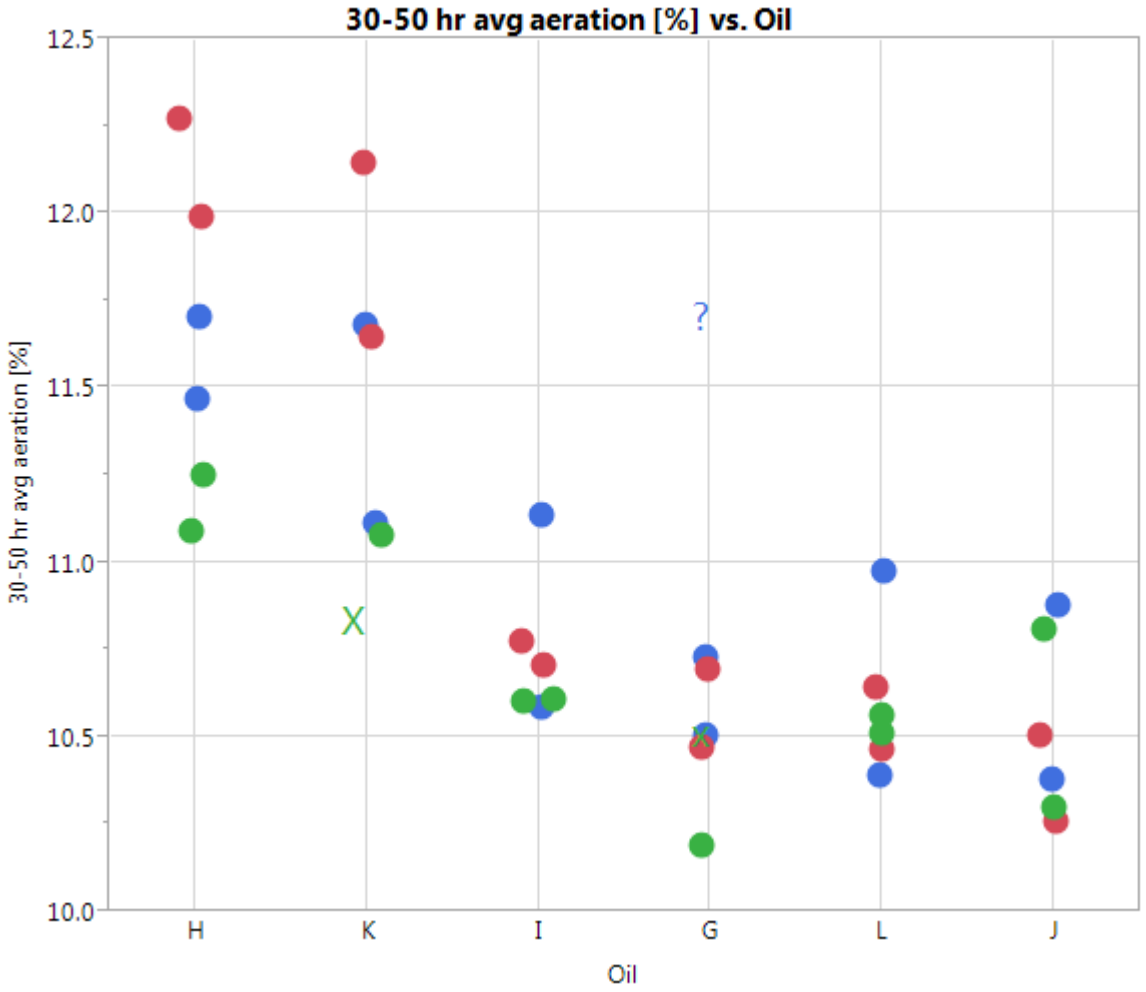
30-50 hr. avg. aeration [%] vs. Oil by Lab: ordered from highest to lowest oil mean



Markers:

? – Oil G from EG under investigation
Run #1, avg. aer. 11.72

X capital – filter 2604; oil K

x lower case – may be filter 2604; oil G

Oil	N Rows	Mean(30-50 hr avg aeration [%])	Std Dev(30-50 hr avg aeration [%])
H	6	11.63	0.448
K	6	11.42	0.485
I	6	10.74	0.21
G	7	10.69	0.487
L	6	10.59	0.206
J	6	10.52	0.264

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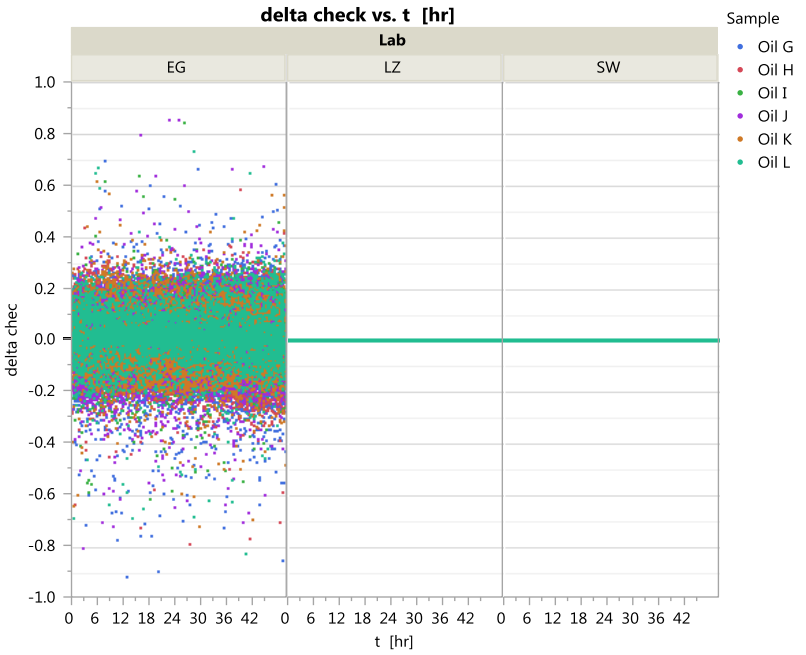
Aeration calculation

- Oil Aeration, $\% = 100 * \frac{\text{Baseline Oil Density} - \text{Temp Corrected Density}}{\text{Temp Corrected Density} - \text{Air Density}}$
  - Baseline Oil Density, g/ml, D4052 at 90 º C
  - Temp. Corrected Density, g/mL $=$ Sample Oil Density $+ \left(\text{Thermal Coef.} * (90 - \text{Sample Oil Temp})\right)$
  - Thermal Expansion Coef., g/mLº C, Linear slope of density from D4052 30ºC to 90ºC

- Temp corrected density values at EG lab were not able to be replicated and accounted for some variation. However, the averages of the differences between lab-calculations vs recalculations hovered around zero as seen in the plot.



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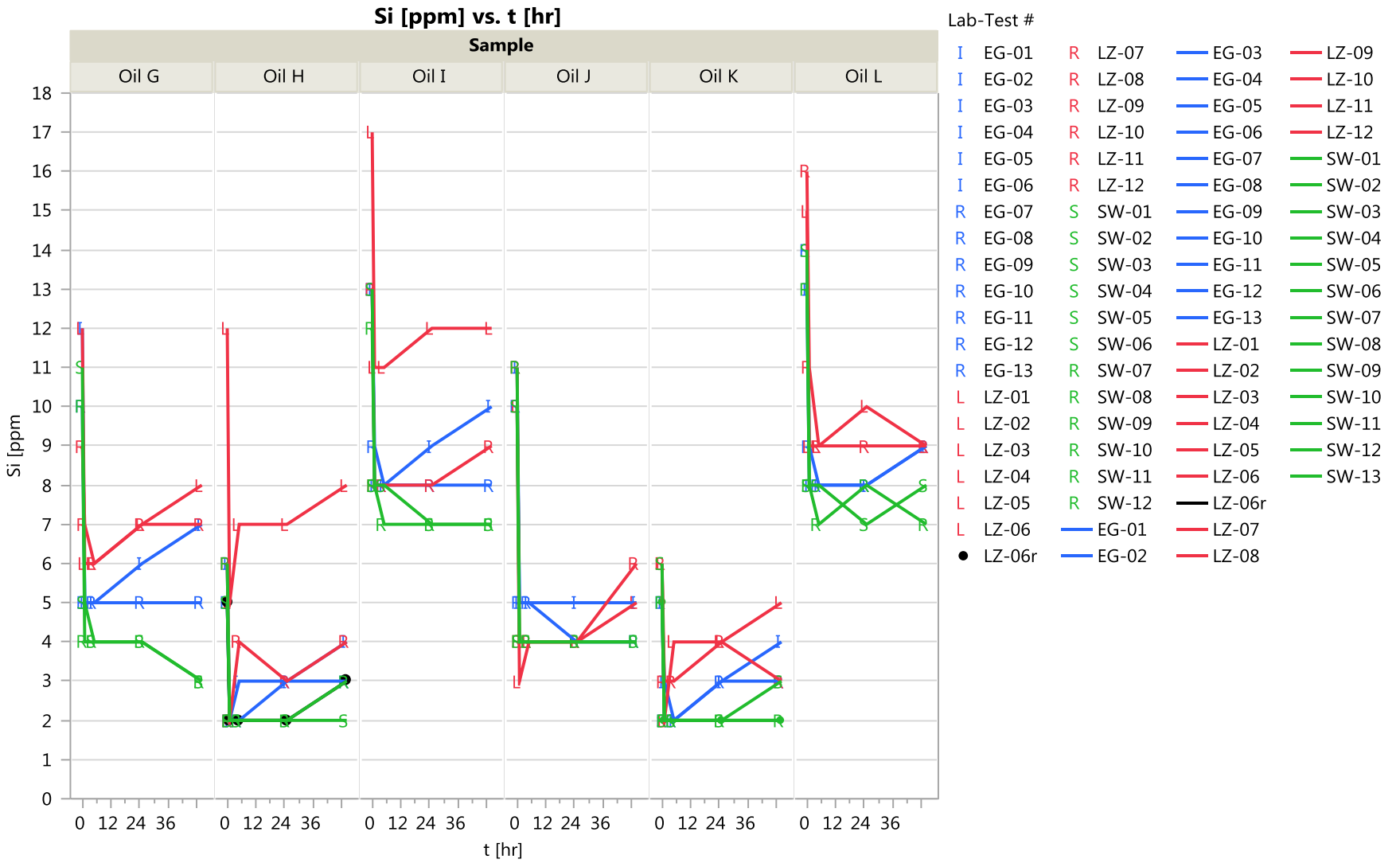
Si data



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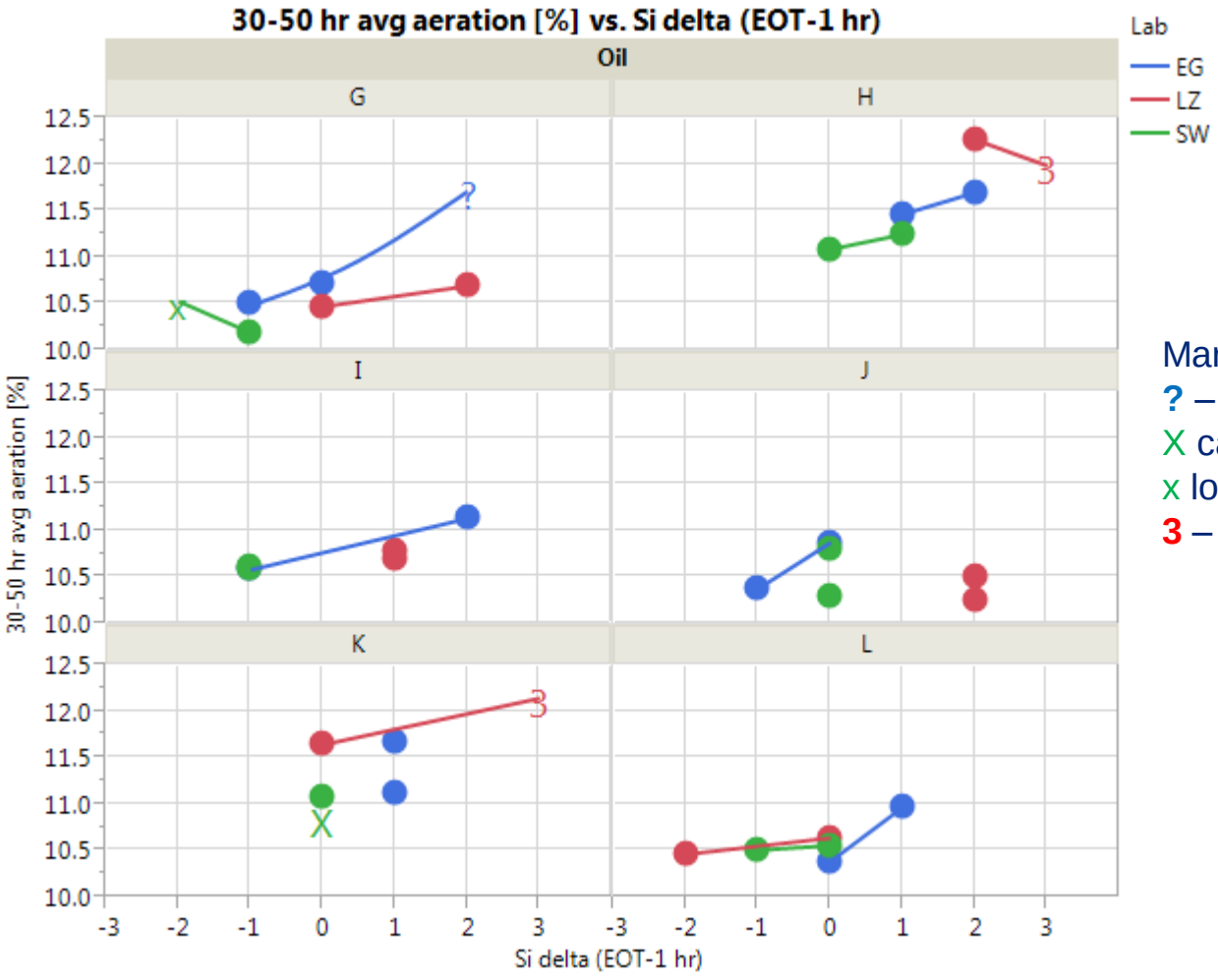
Aeration (%) vs. Si delta (EOT – 1 hour) by Lab



Markers:

? – Oil G from EG under investigation

X capital – filter 2604; oil K

x lower case – may be filter 2604; oil G

3 – highest Si delta, oils H and K

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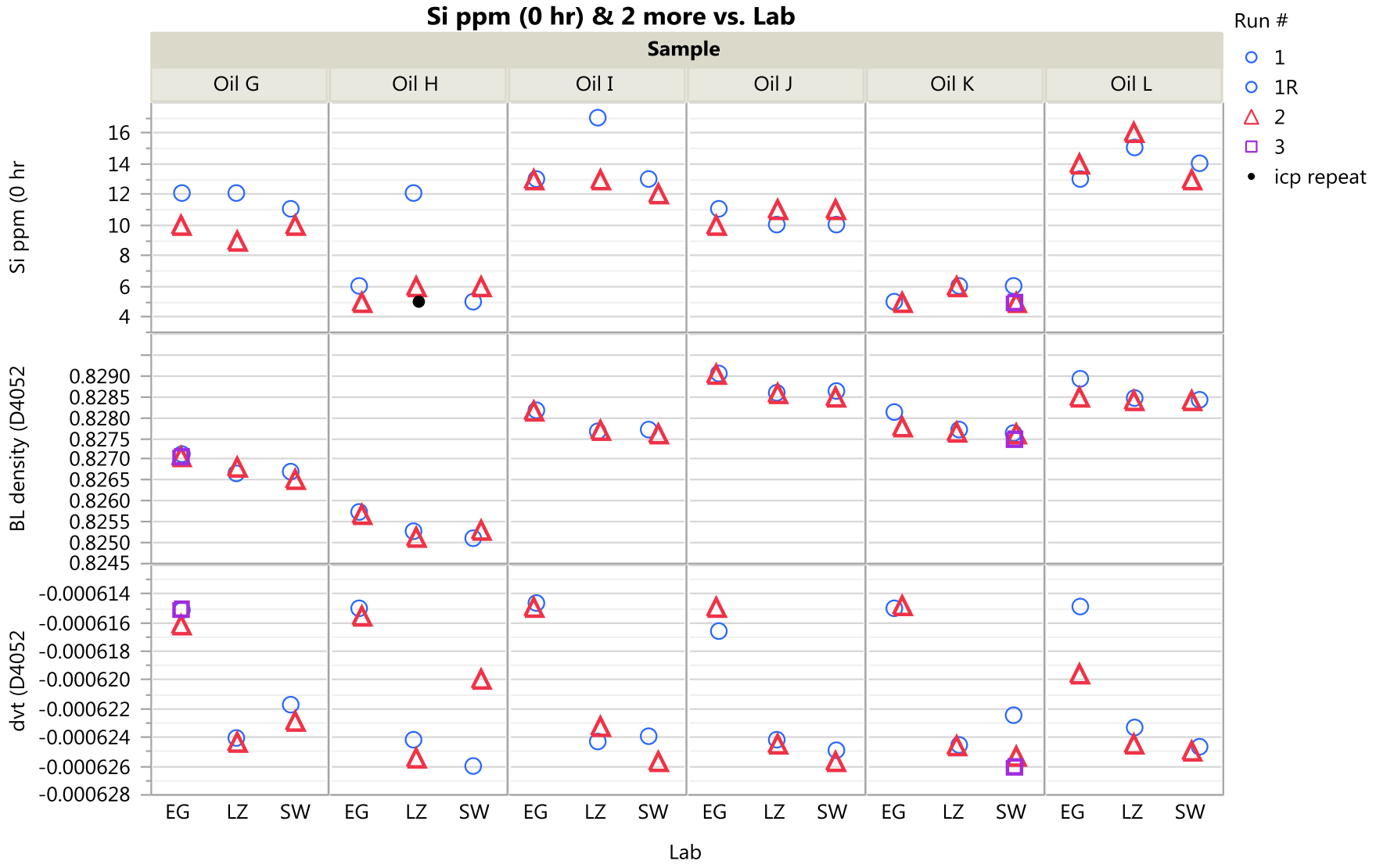
D4052 and Si ICP data



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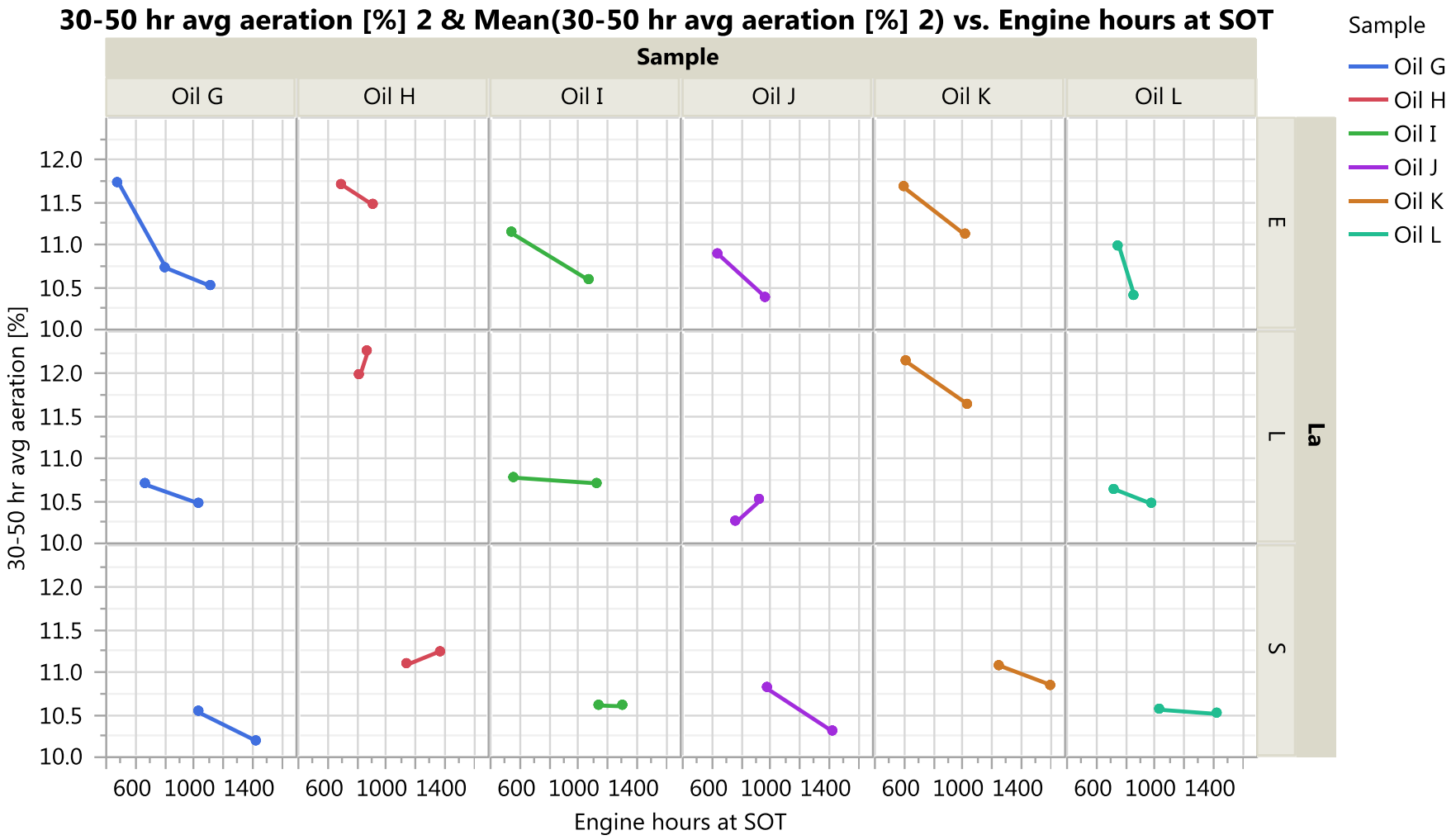
Avg aeration vs engine hours



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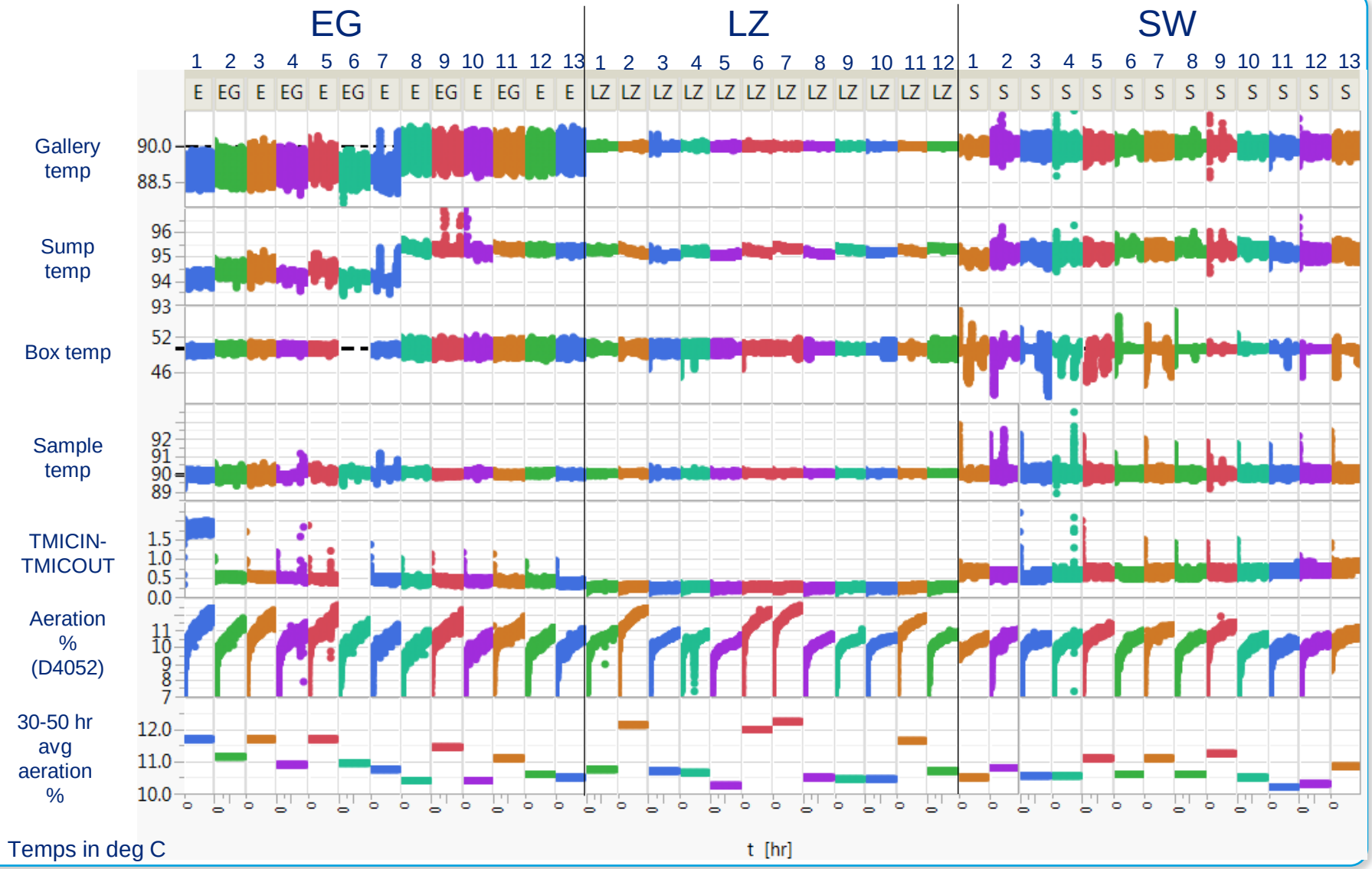
Selected operational parameters by run

Control of some parameters has improved.

Oil G · Oil H · Oil I · Oil J · Oil K · Oil L



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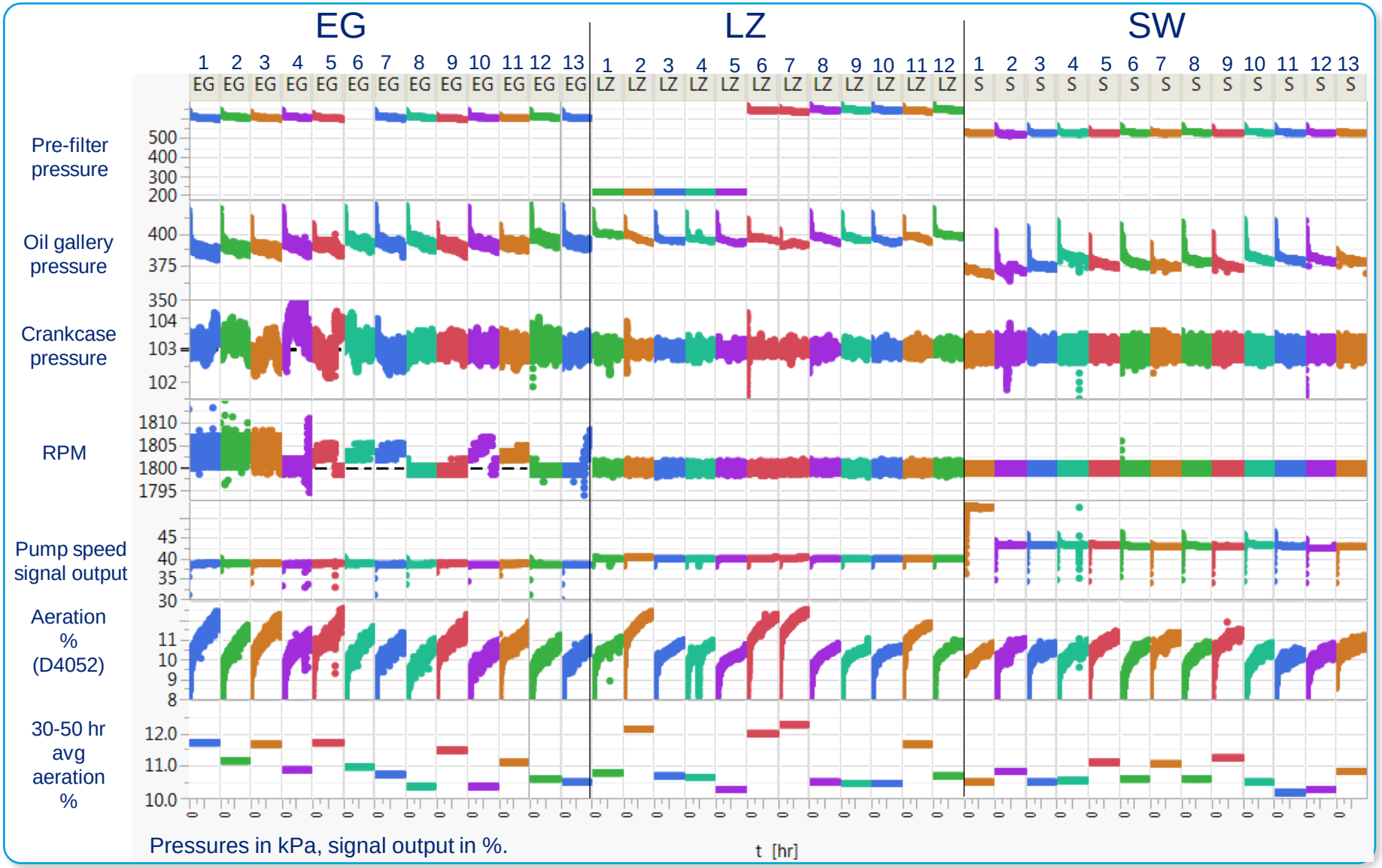

Pressures in kPa, signal output in %.

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