IMPACT OF UPDATING MM CALIBRATION AND INTRODUCING NEW FILTERS: Third meeting

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5/11/2017

Performance you can rely on.

Outline

- Summary
- Data description
- Data Visualization
- Model
- Impact of CF: Options 1 to 3
- Standard deviations based on 50 tests by Technology
- Appendices
  - Appendix 1:
    COAT: Proposal for introducing new filters
  - Appendix 2: Aeration profiles for the 9 tests (updated MM calibration and 08/08/2016 filters) by Lab
  - Appendix 3: Modeling Avg. Aeration
  - Appendix 4:
    - ltms by lab with current targets and standard deviations
    - ltms by lab with current targets and revised standard deviations

Summary

- **For oil 833:** 4 out of 5 test results with updated MM calibration and 08/08/2016 filters, are below the target (one test is very close to target)
- **For oil 832:** 2 out of 4 test results with updated MM calibration and 08/08/2016 filters, are below the target
- Oils similar to 832 with respect to aeration would require a smaller CF when compared to oils at 833 aeration level. Three CF options are summarized in the table below.

Options	Predicted	Target	ICF	
1- based on 833 & 832	10.88	11.305	1.039	Under-corrects 833 and over-corrects 832
2- based on oil 833	11.37	11.94	1.05	Over-corrects 832
3-based on oil 832	10.39	10.67	1.027	Under-corrects 833

- **Variability has increased over time.**
- **Discrimination between 832 and 833 is present.**
- **Recommendation:** SP may want to revise the standard deviations by oil and also the one applied to severity adjustments. Appendix 4b shows what how the new ltms would look like.
- **Option 4:** Labs would continue running with new MM calibration and filter applying Severity adjustments to correct candidate data. For now, no industry correction factors applied. Collect more data over time.
- Jim Gutzwiller suggested looking at **operational data** for each new test and comparing labs.

Data

	Oil Comb	N Rows
1	PC11H	3
2	PC11I	3
3	PC11J	3
4	PC11L	3
5	832	15
6	833	23

- ltms file (Chart = Yes) May 2017
  - Note that 1005, VGRA tests are chart = No
  - Total of 50 tests
    - 22 matrix tests,
    - 19 after matrix but before recent changes,
    - 9 tests, three from each lab, were run under the updated MM calibration and 08/08/2016 filters
  - Out of the 19 after matrix but before recent changes, labs identified
    - 12 with steep aeration profiles and
    - 5 (2016 filters) with shallow aeration profiles
    - Aeration profile for the remaining 2 tests are missing: I assumed they are steep because they are from May 2015, right after the end of matrix
  - 9 tests (updated MM calibration and 08/08/2016 filters)
    - All 9 tests present shallow aeration profiles (see Appendix 2)

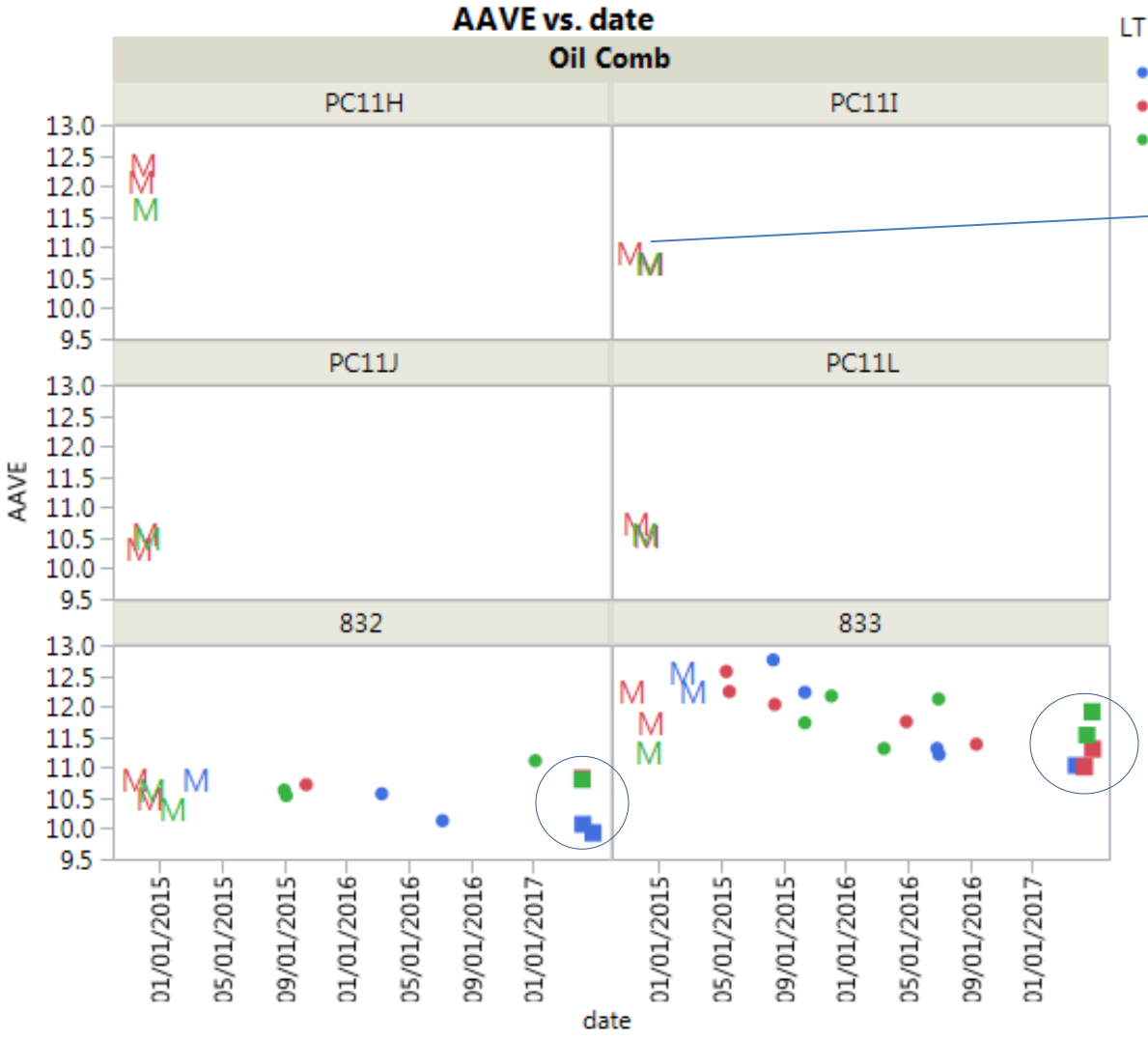
Summary of ltms

- Lab A triggered Zi alarm
- Lab B: no alarm
- Lab G: no alarm

Data visualization

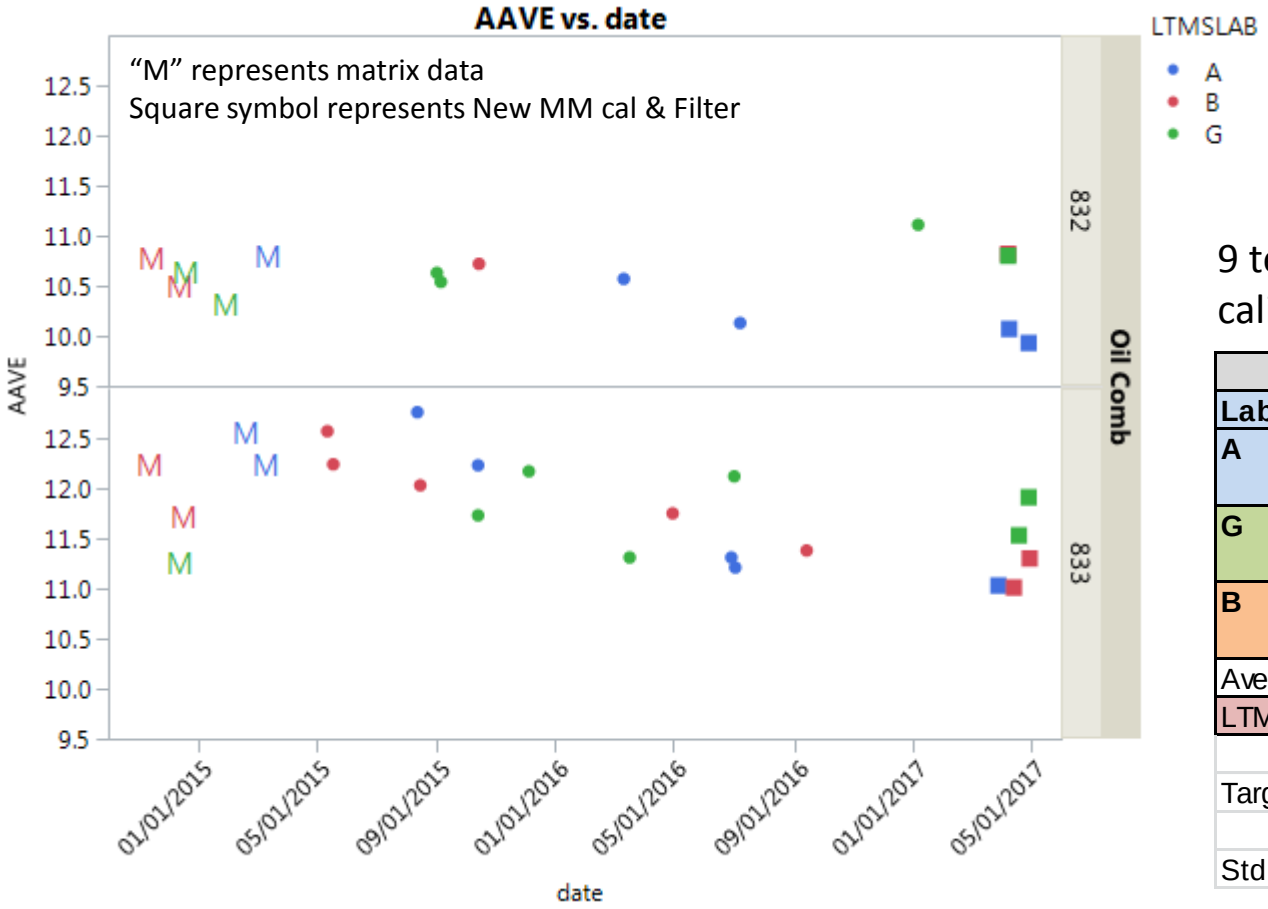
Average Aeration vs. date by Oil and Lab

Looking at the recent data, it seems that 833 have decreased



Average Aeration vs. date by Oil and Lab

Zooming in oils 832 and 833

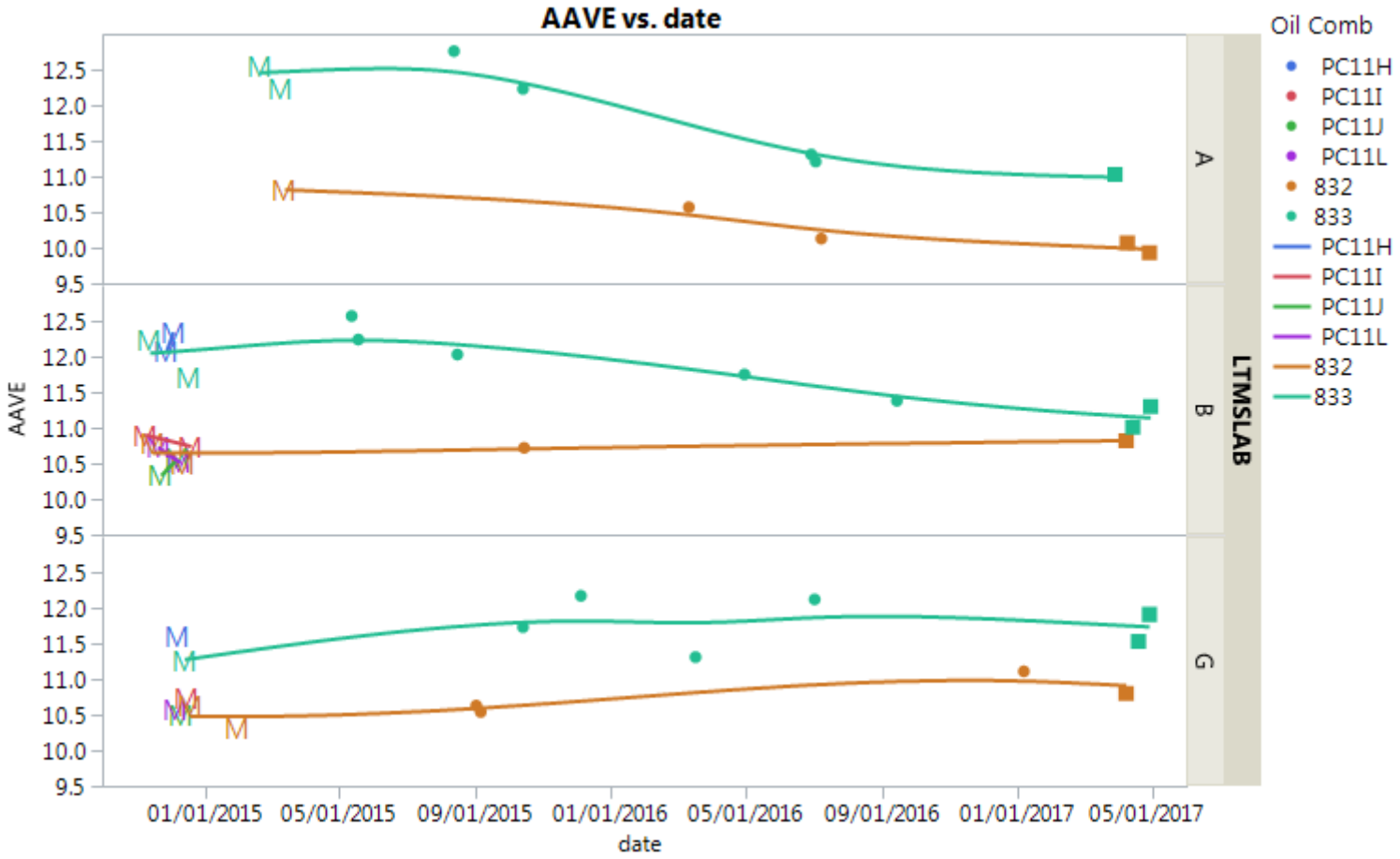


9 test results for updated MM calibration and 08/08/2016 filters

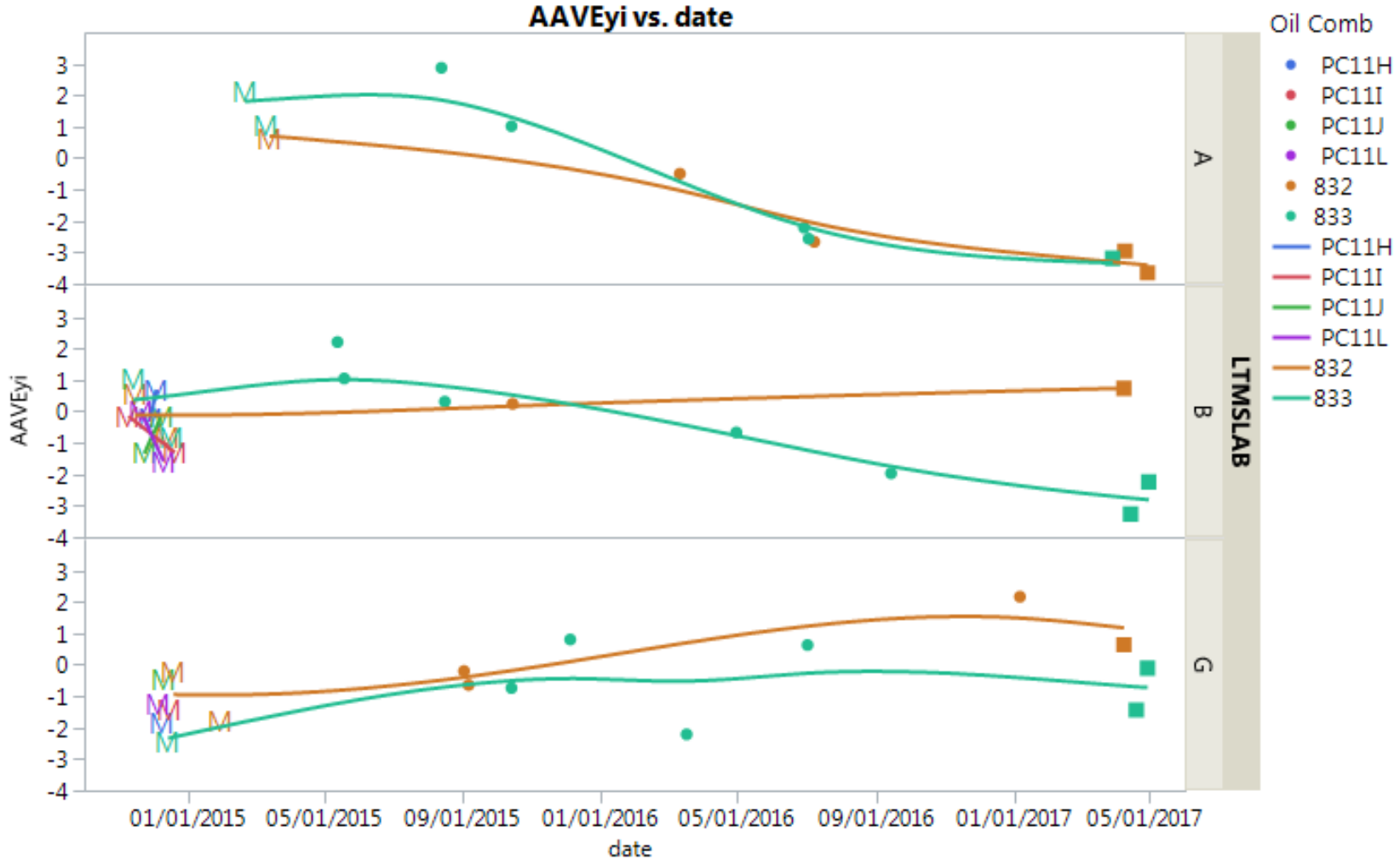
	Oil	
Lab	**833**	**832**
A	11.03	10.07
		9.93
G	11.53	10.8
	11.91	
B	11.01	10.82
	11.3	
Average	11.36	10.41
LTMS target	11.94	10.67
Target/ Avg	1.05142656	1.025468525
Std	0.3763	0.4712

Average Aeration vs. date by Lab and Oil

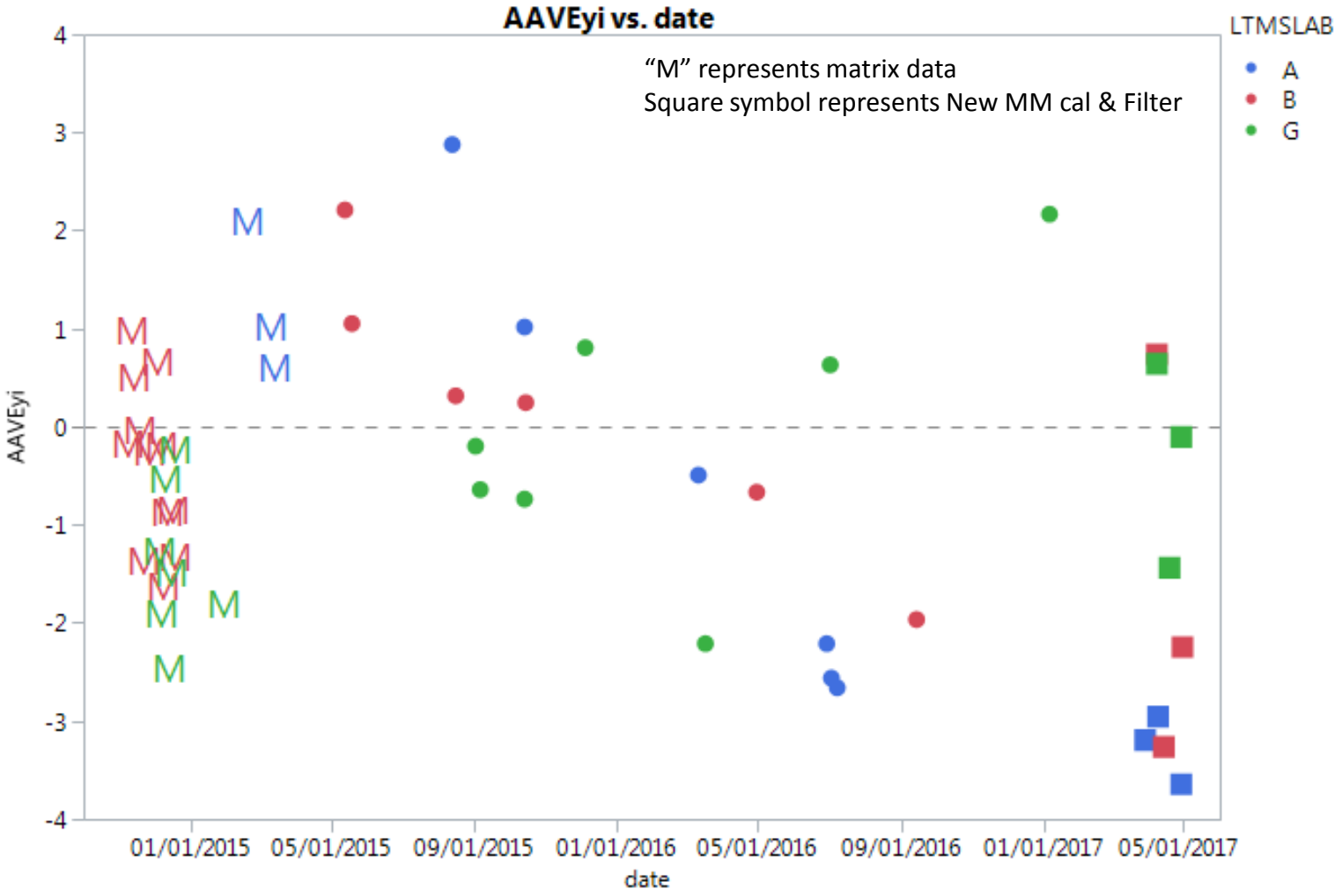
"M" represents matrix data
Square symbol represents New MM cal & Filter



Average Aeration yi vs. date by Lab and Oil

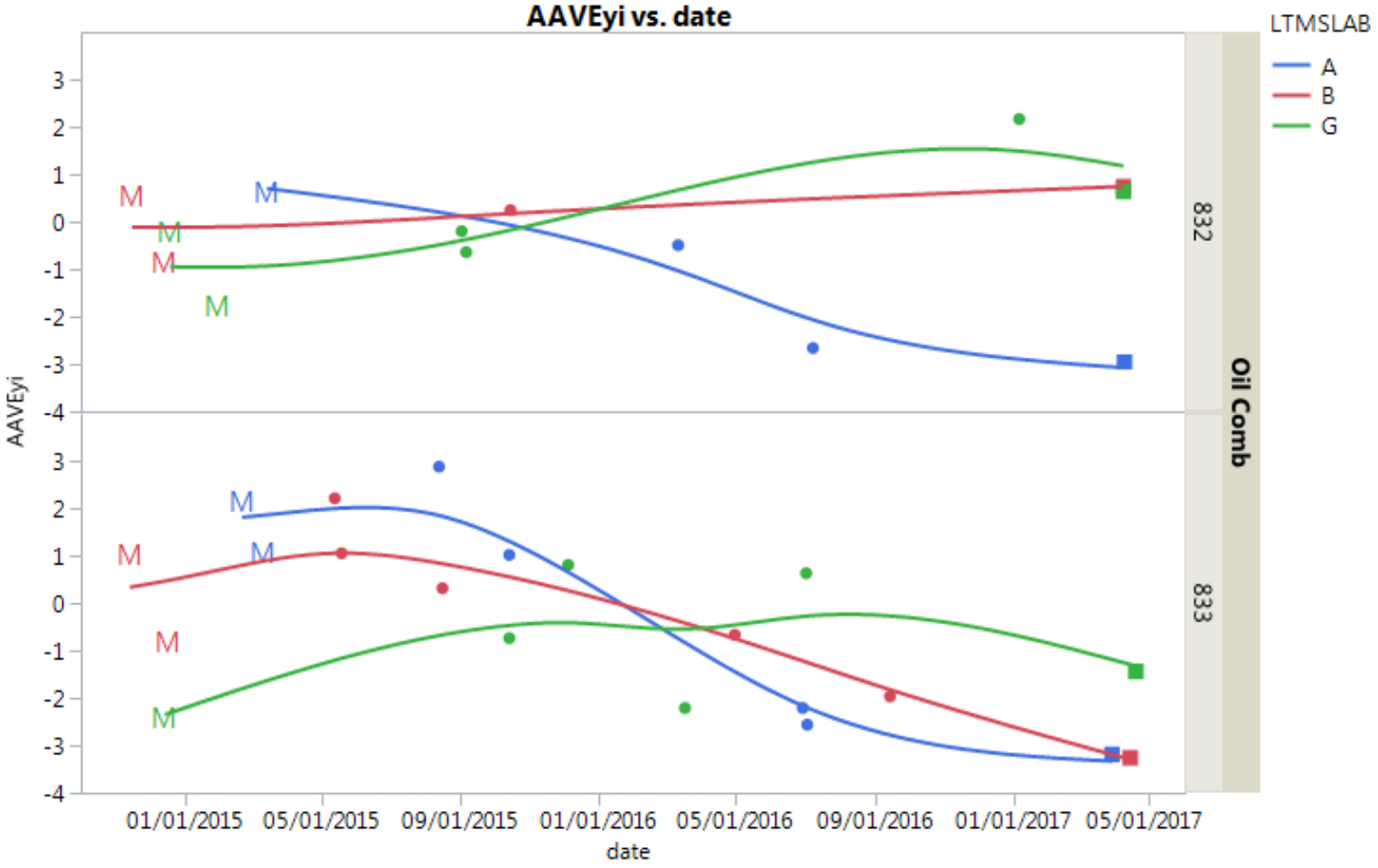


Average Aeration yi vs. date by Lab



Average Aeration yi vs. date by Lab and Oil (subset of oils 832 and 833)

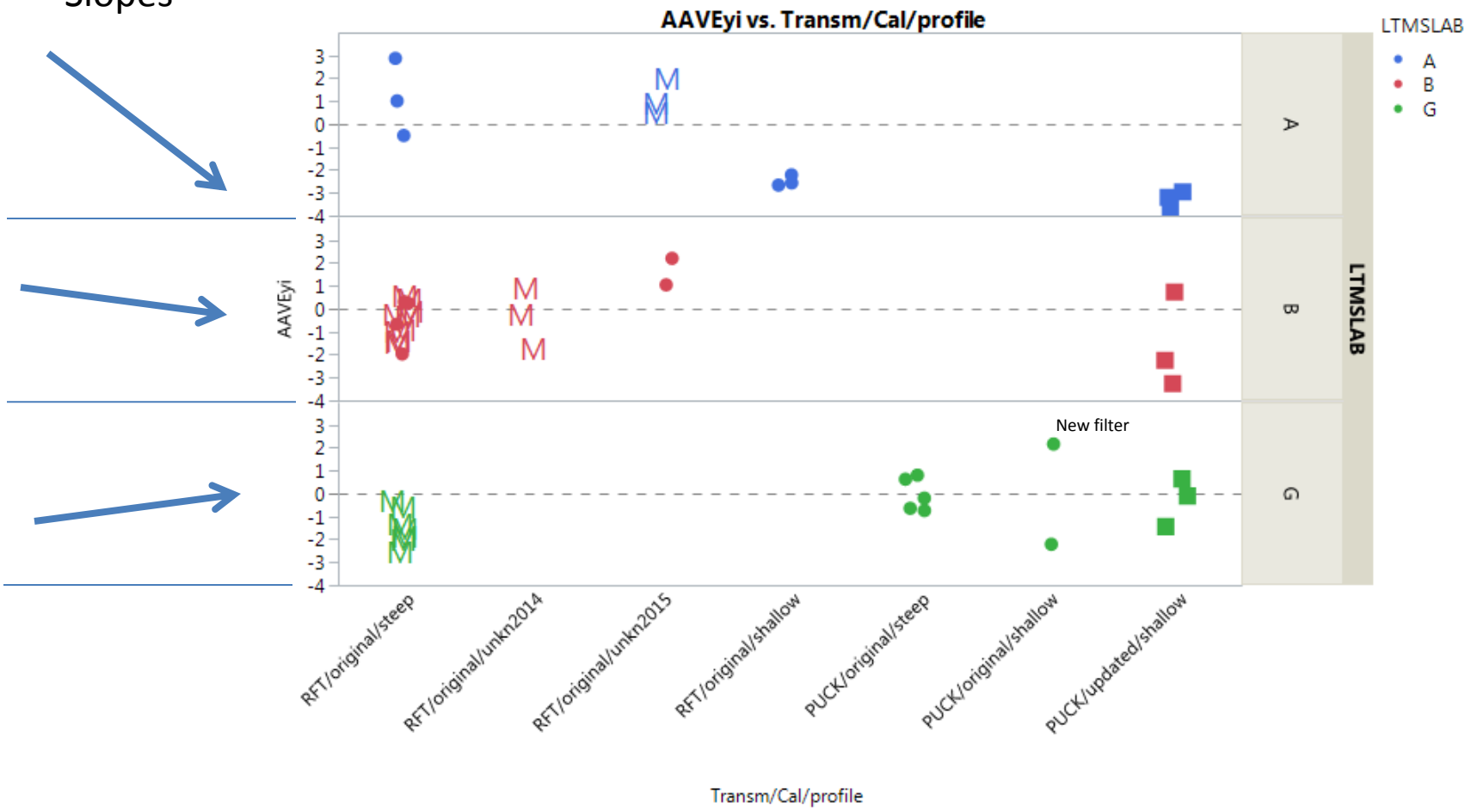
"M" represents matrix data
Square symbol represents New MM cal & Filter



Average Aeration yi vs. “time” by Lab

another way to look at time (using the Transmitter type, MM Calibration, Aeration profile)

Slopes

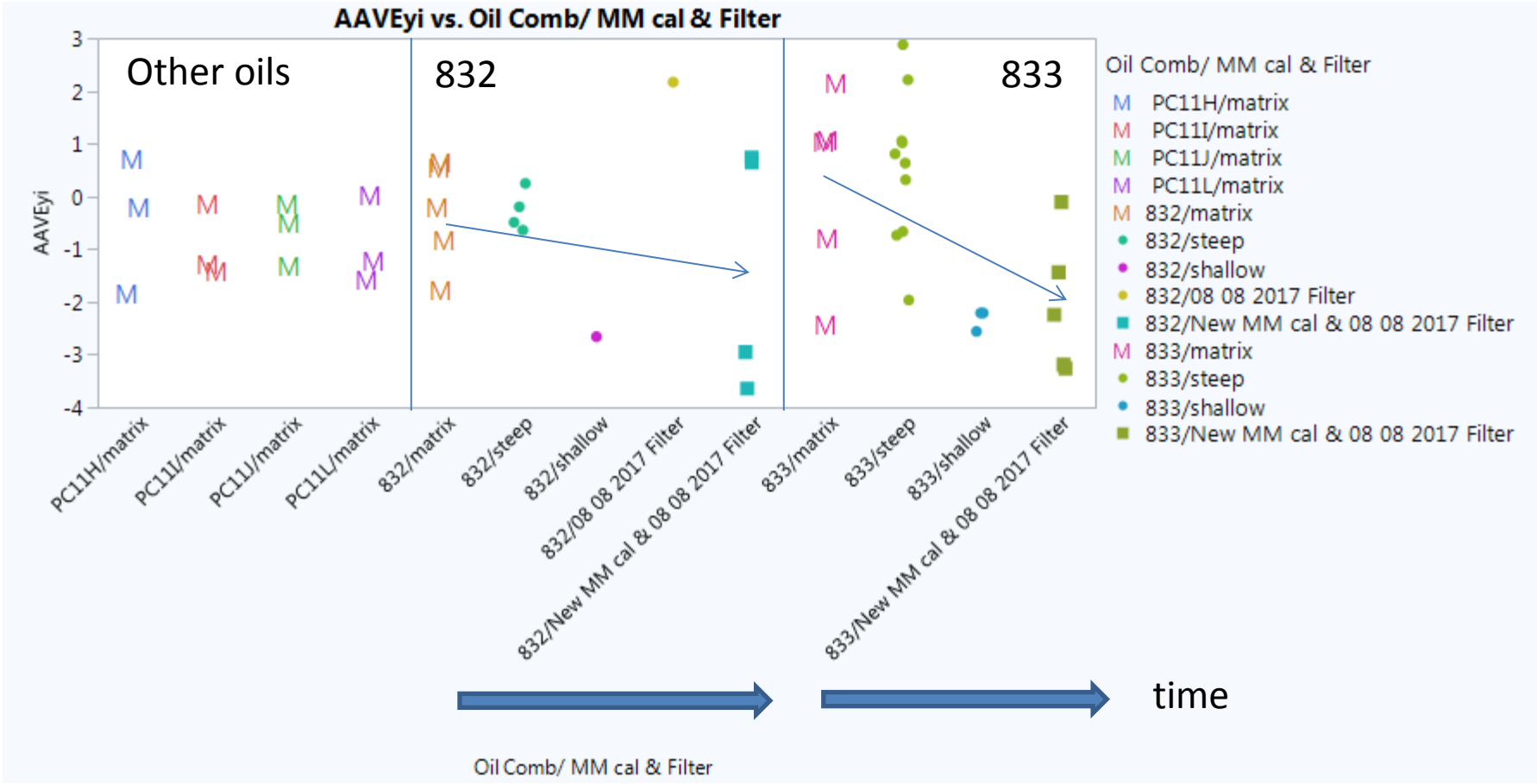


“M” represents matrix data

Square symbol represents New MM cal & Filter

Average Aeration yi vs. “time”

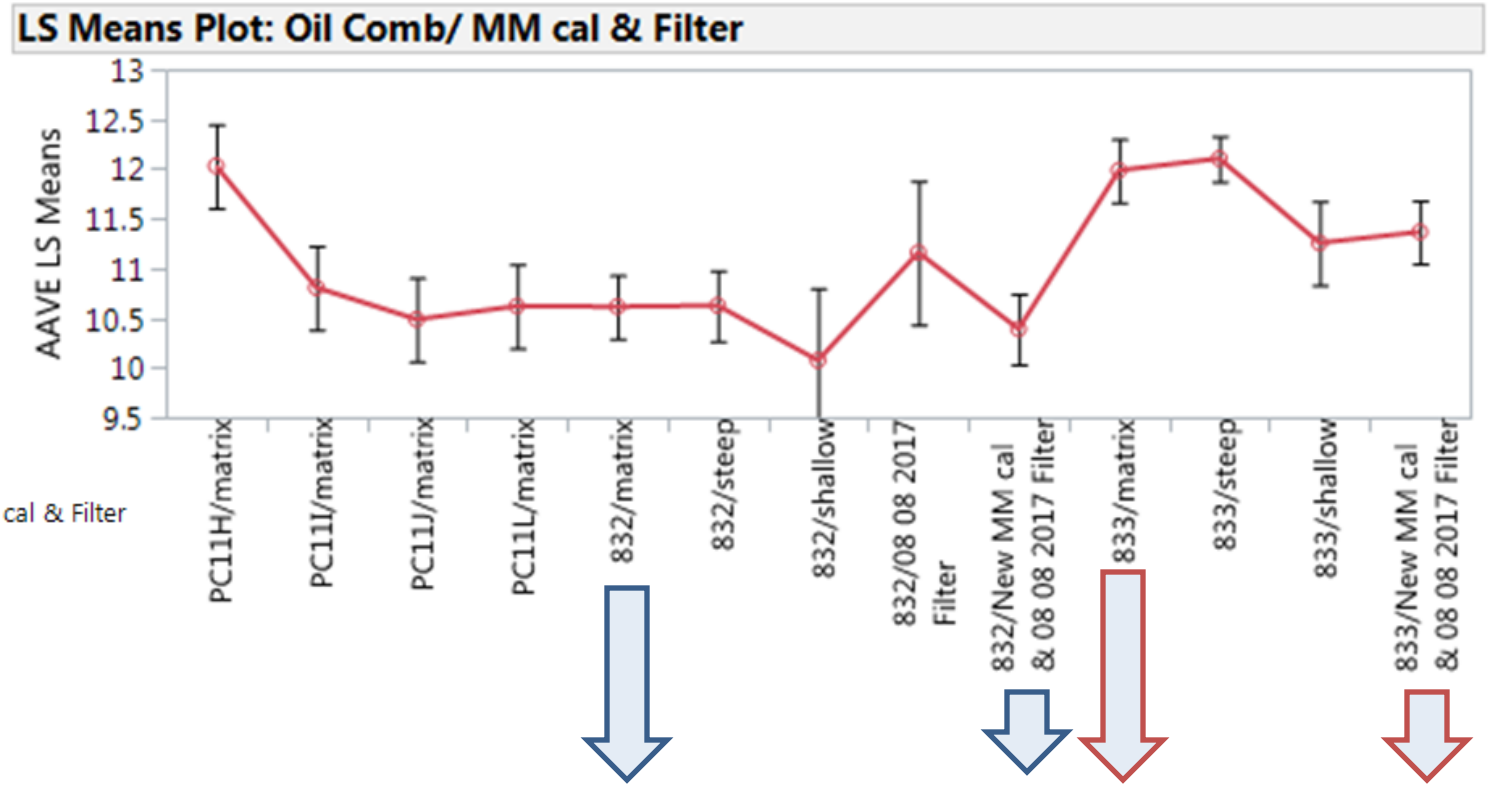
Matrix versus “New MM cal and Filter”



“M” represents matrix data
Square symbol represents New MM cal & Filter

Model 1: Lab, Oil comb/MM cal & Filter

Comparing “oil/matrix” and “oil/New MM cal & 08/08/2017 filter”



Impact of CF: Options 1 to 3

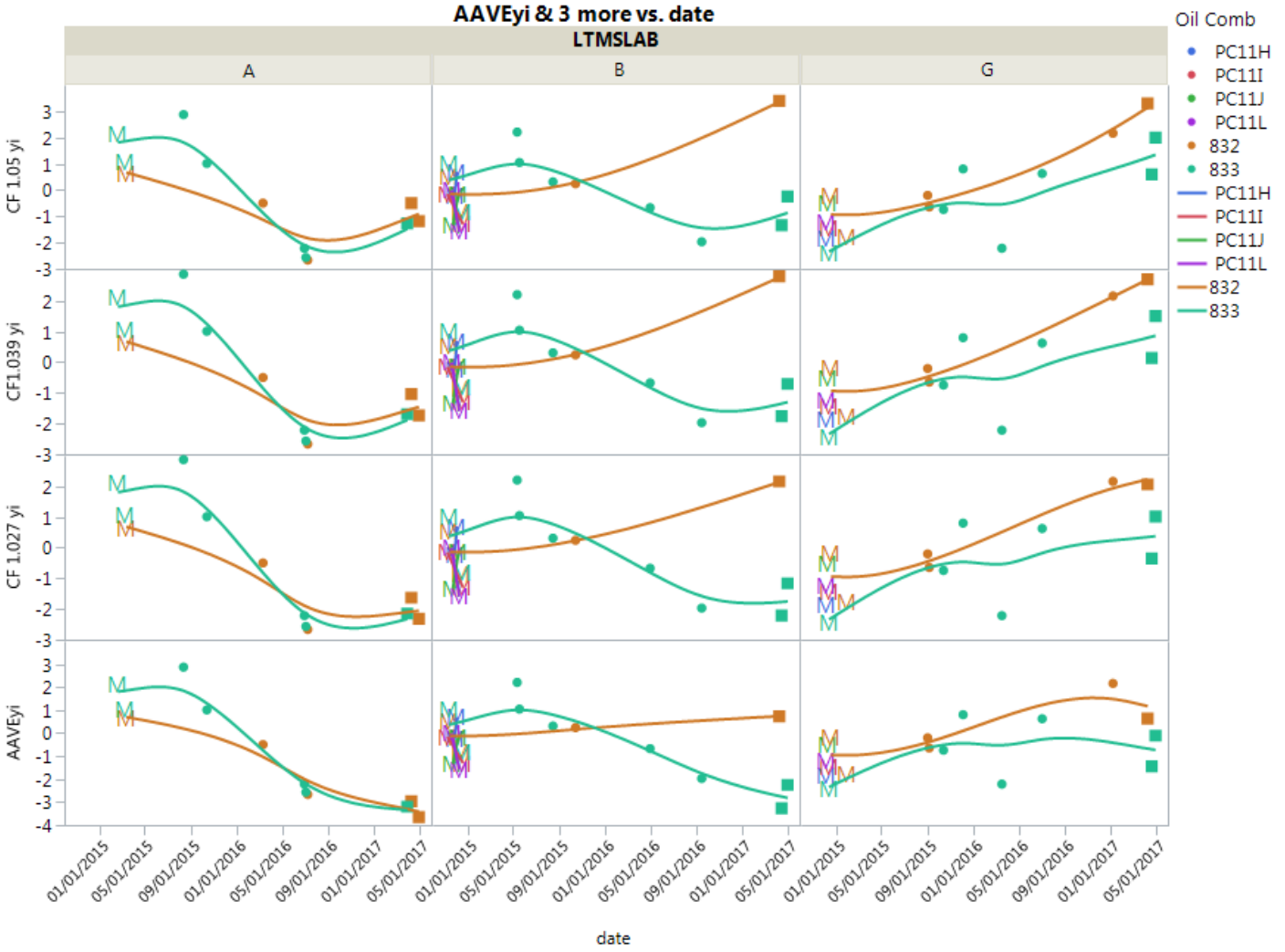
How the *(aeration-mean)/std* looks like under each CF option by lab and oil

CF based on 833

CF based on avg. 832 & 833

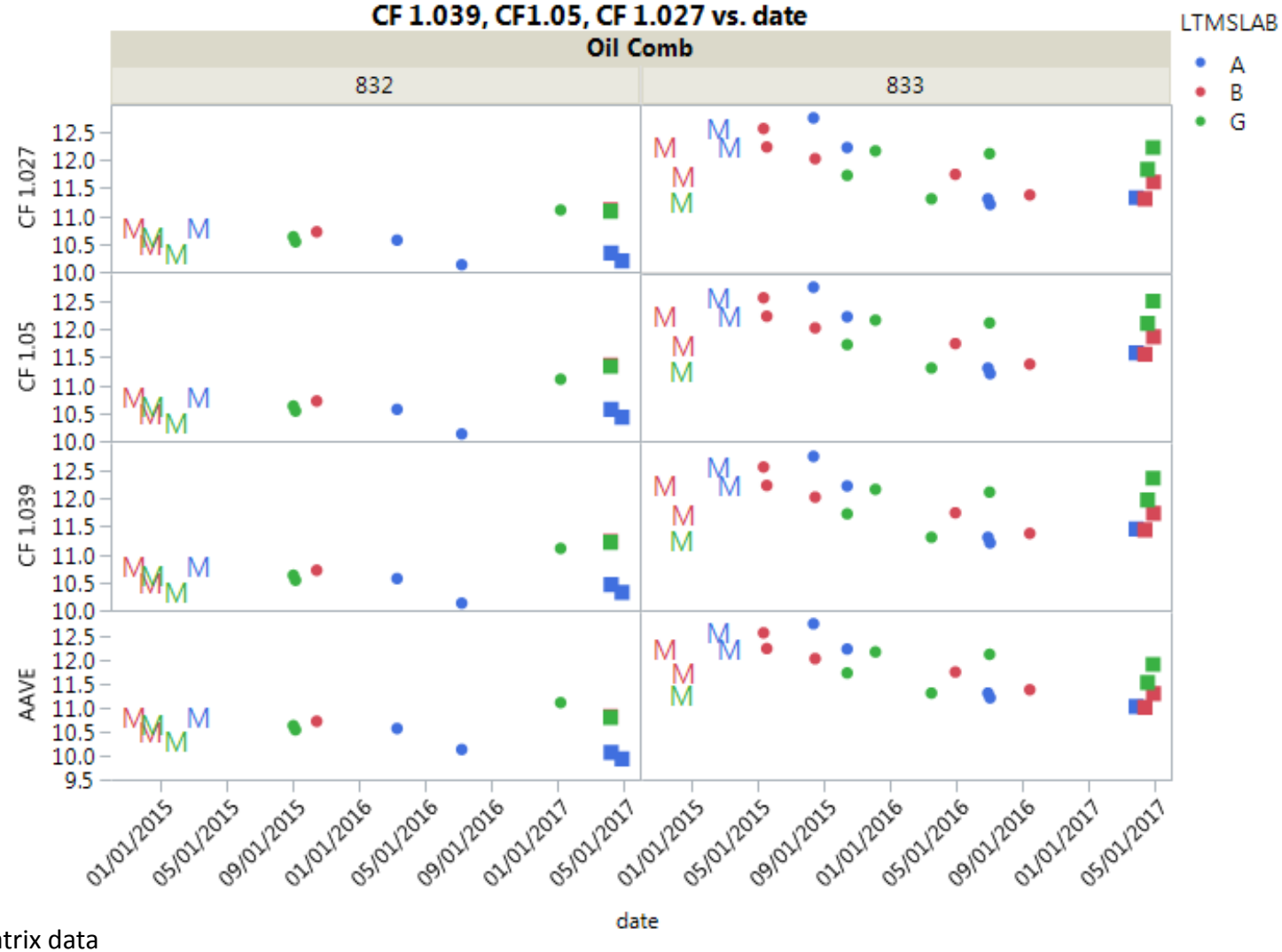
CF based on 832

Original data



Look at CFs applied to 832 for each lab – Can Severity adjustments do a better job?

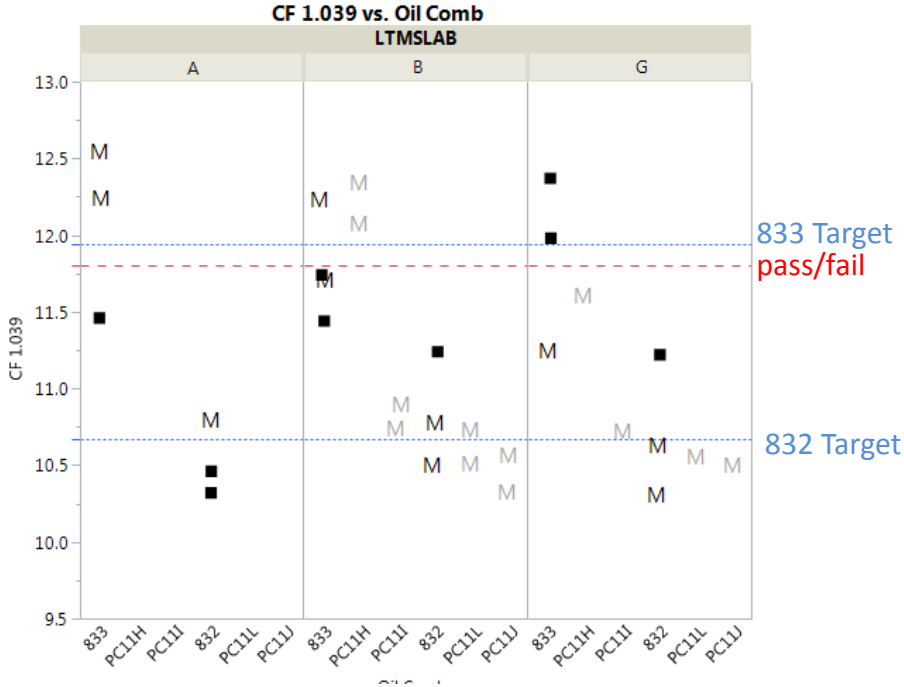
CF Option 1, 2 and 3 applied to latest 9 test results to illustrate the CF effect on future candidate data – only for oils 832 and 833

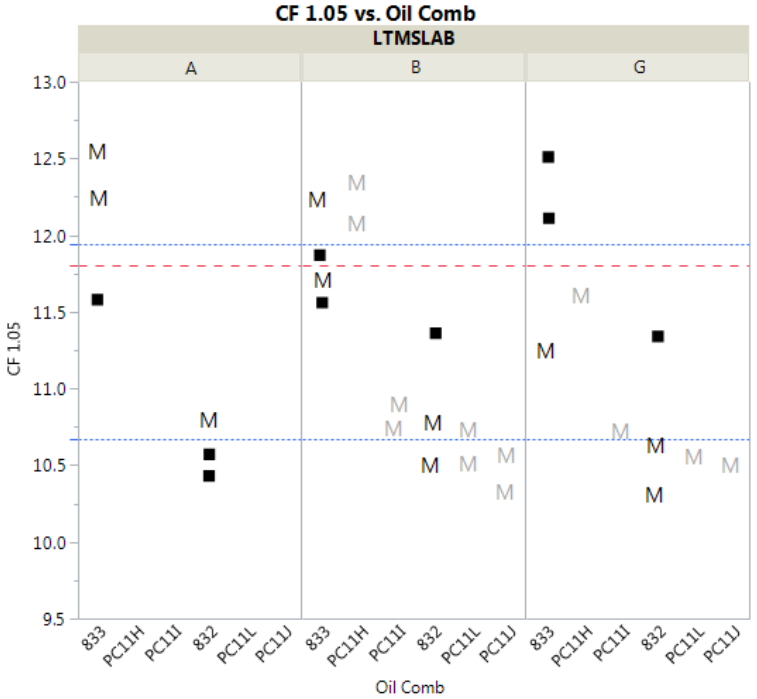


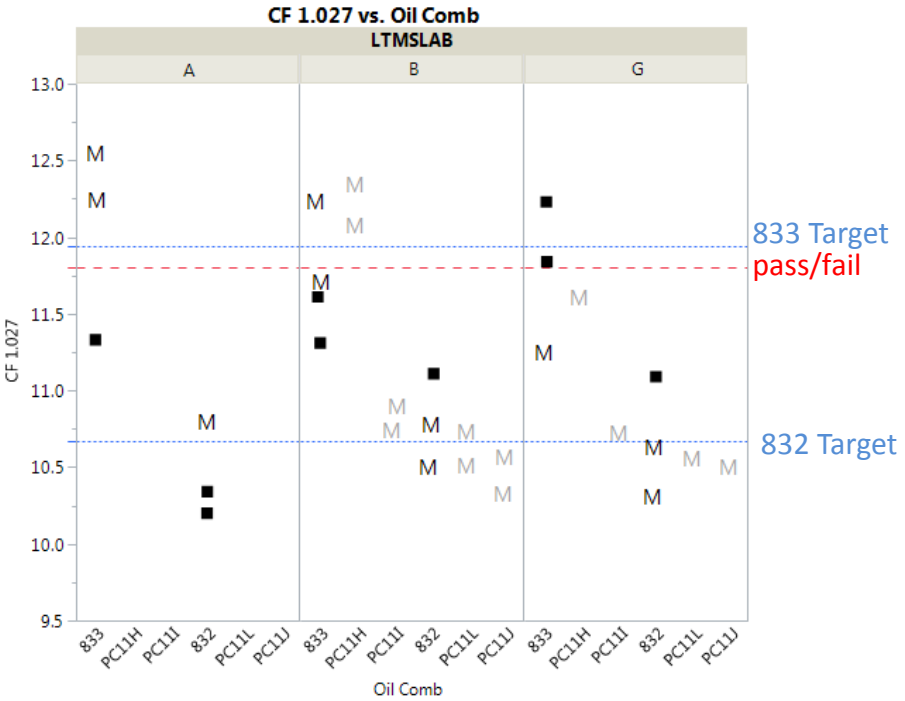
"M" represents matrix data
Square symbol represents New MM cal & Filter

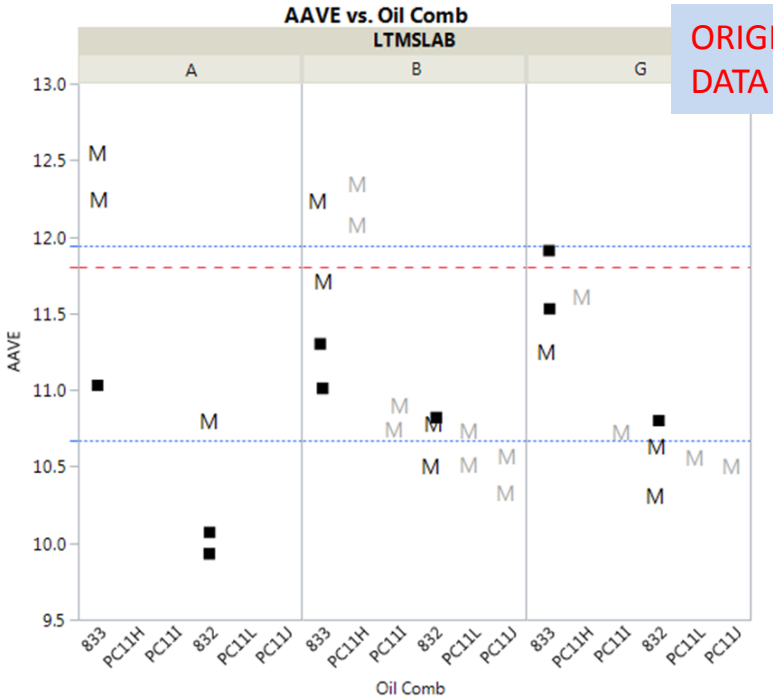
CF applied to the 9 tests with new MM cal and Filters

TESTKEY	LTMSLAB	Oil	AAVE	CF 1.039	CF 1.05	CF 1.027
118883-COAT	A	833	11.03	11.46	11.58	11.33
119478-COAT	B	832	10.82	11.24	11.36	11.11
111344-COAT	G	832	10.8	11.22	11.34	11.09
111348-COAT	A	832	10.07	10.46	10.57	10.34
120248-COAT	B	833	11.01	11.44	11.56	11.31
116607-COAT	G	833	11.53	11.98	12.11	11.84
116608-COAT	G	833	11.91	12.37	12.51	12.23
126228-COAT	A	832	9.93	10.32	10.43	10.2
120249-COAT	B	833	11.3	11.74	11.87	11.61









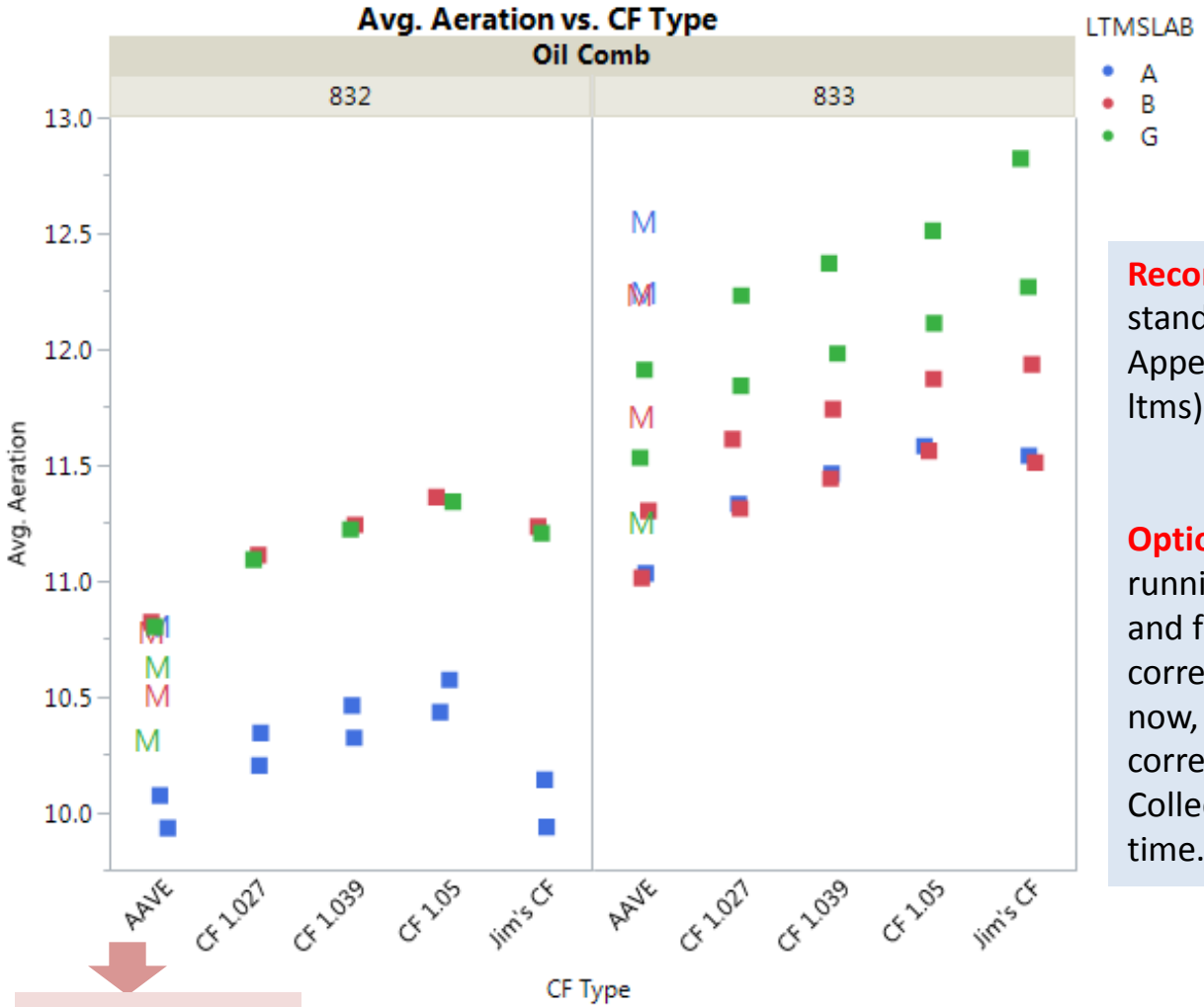
ORIGINAL DATA

Standard deviations based on 50 tests by Technology

tech	N Rows	Sum(residual squared)	allocating DF proportional to ...	stand dev by tech	divided by N-2
tech1	18	1.6608767328	14.04	0.343941948	0.3221875165
tech2	26	3.206432732	20.28	0.3976281213	0.3655152033
tech3	6	0.0924518889	4.68	0.1405513326	0.152029511

For reevaluating ltms, I used 0.344 for tech 1, 0.398 for tech 2 and 0.141 for tech 3. Standard deviation for SA = 0.398 (corresponding to oil 833 – close to the pass/fail limit).

Correction factors comparison by Oil



Based on oil 832, one could argue that there is no need for a CF, leaving severity adjustments to do the job.

Original data: Matrix tests (M) and recent test with new MM cal. and filters

Recommendation: revise standard deviations (see Appendix 4b for impact on ltms)

Option 4: Labs continue running with new MM cal. and filter applying SAs to correct candidate data. For now, no industry correction factors applied. Collect more data over time.

"M" represents matrix data
Square symbol represents New MM cal & Filter

APPENDICES

Appendix 1:
COAT: Proposal for introducing new filters

- Proposal:
  - Run two tests at each laboratory: one test with reference oil 833 and one test with reference oil 832
  - Level 2 alarm system in place
    - Lab runs a third test if **second** test result triggers level 2 alarm
  - Correction factor implemented if all three labs have level 2 alarms in the same direction
  - Allocation:

	Lab		
Run #	**A**	**B**	**G**
1	833	832	832
2	832	833	833
3	832	833	833

- Additional information
  - Test 111343 (01/04/2017) has been run on oil 832 (11.11% aeration); filter NONOUL => 08/08/2016 filter); Severe

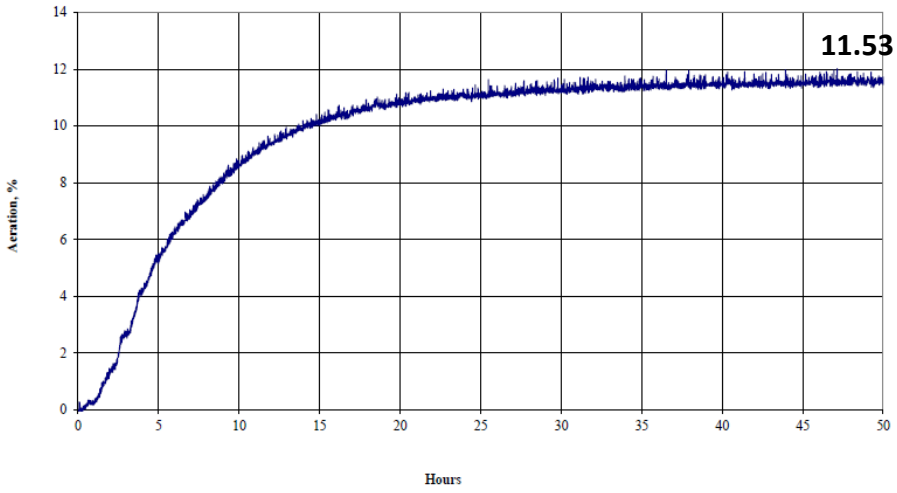
Appendix 2: Aeration profiles for the 6 tests (updated MM calibration and 08/08/2016 filters) by Lab

Intertek

Oil 833

Caterpiller Oil Aeration Test
Form 5
Oil Aeration Plot

Lab	EG	EOT Date	20170419	EOT Time	12:52
Test Number	8-85-0				
Oil Code	EG-0034/CMIR-116607				
Formulation Stand Code					

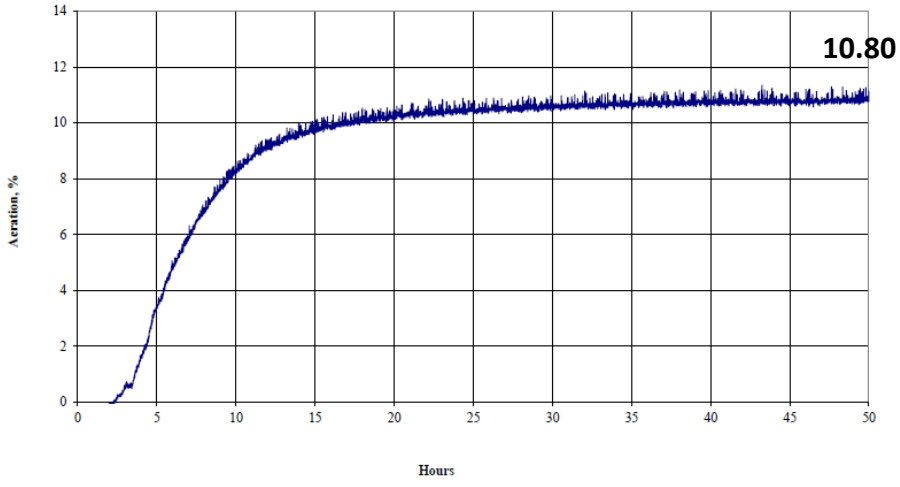


40-50 Hr Aeration Slope	0.0108

Oil 832

Caterpiller Oil Aeration Test
Form 5
Oil Aeration Plot

Lab	EG	EOT Date	20170408	EOT Time	20:24
Test Number	8-84-0				
Oil Code	EG-0023/CMIR-111344				
Formulation Stand Code					



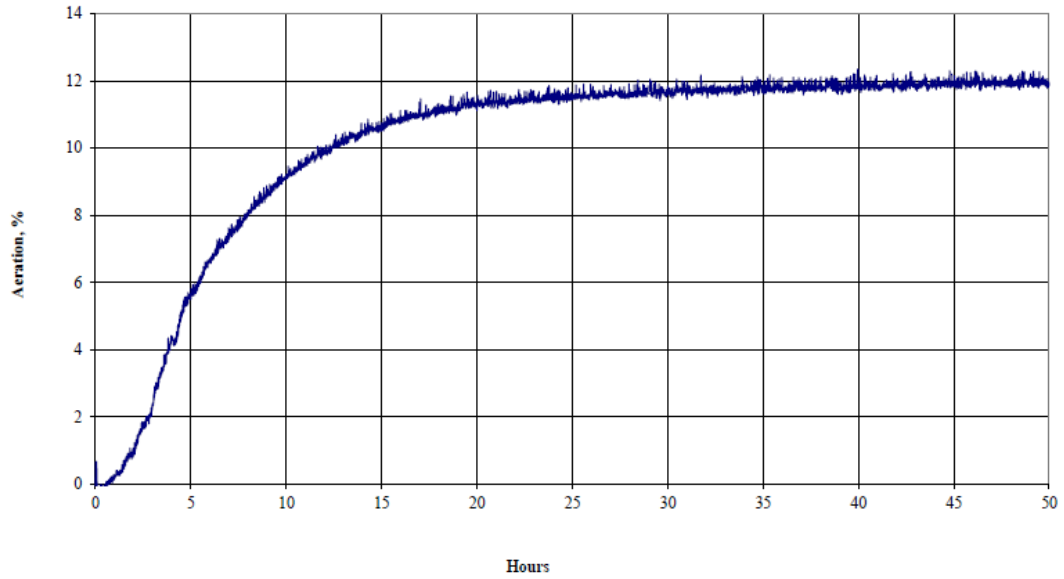
40-50 Hr Aeration Slope	0.0077

Last test from Intertek: 833

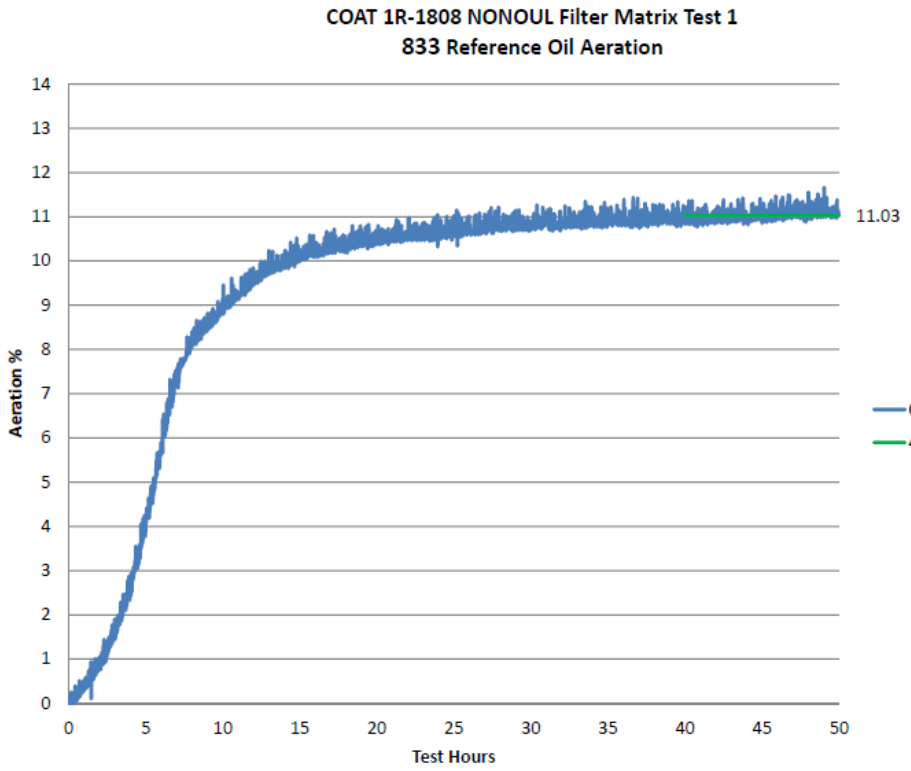
intertek

Caterpiller Oil Aeration Test
Form 5
Oil Aeration Plot

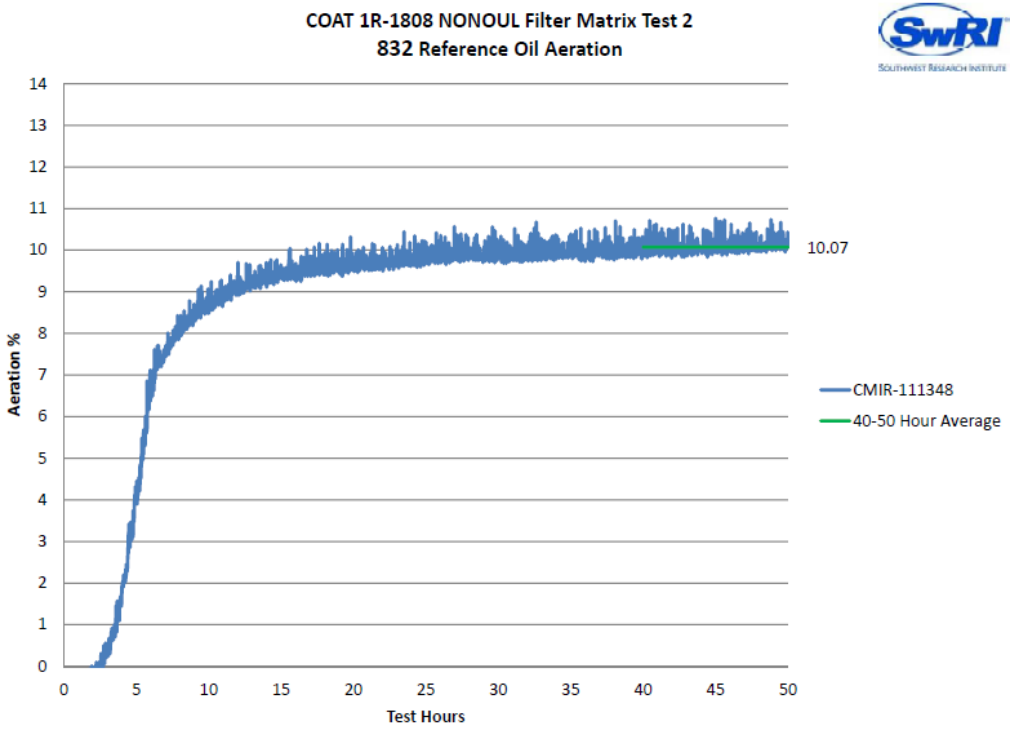
Lab	EG	EOT Date	20170429	EOT Time	14:52
Test Number	8-86-0				
Oil Code	EG-0035/CMIR-116608				
Formulation Stand Code					



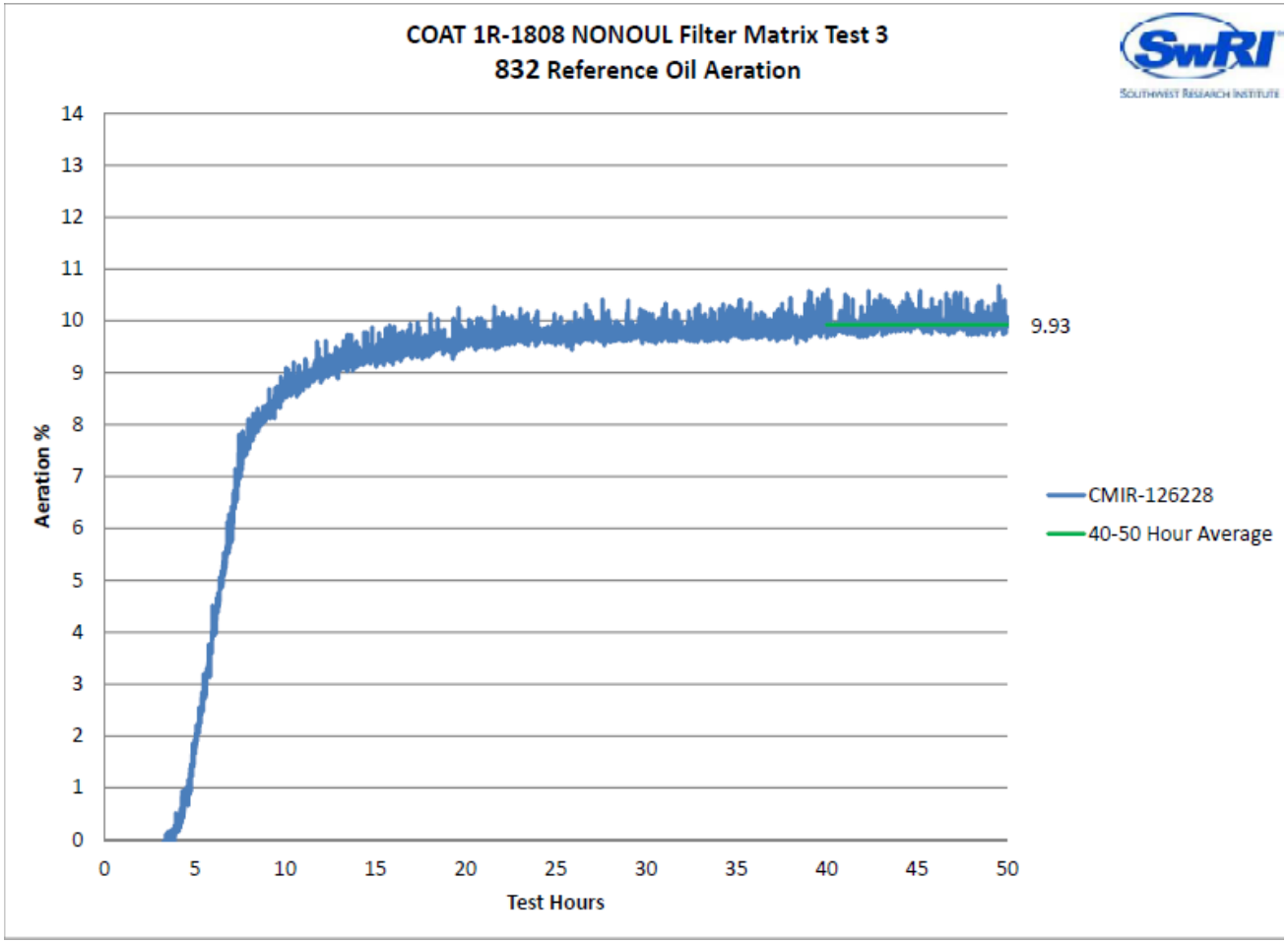
40-50 Hr Aeration Slope	0.0122


COAT 1R-1808 NONOUL Filter Matrix Test 1
833 Reference Oil Aeration
Aeration %
Test Hours
11.03
CMIR-118883
40-50 Hour Average

SwRI

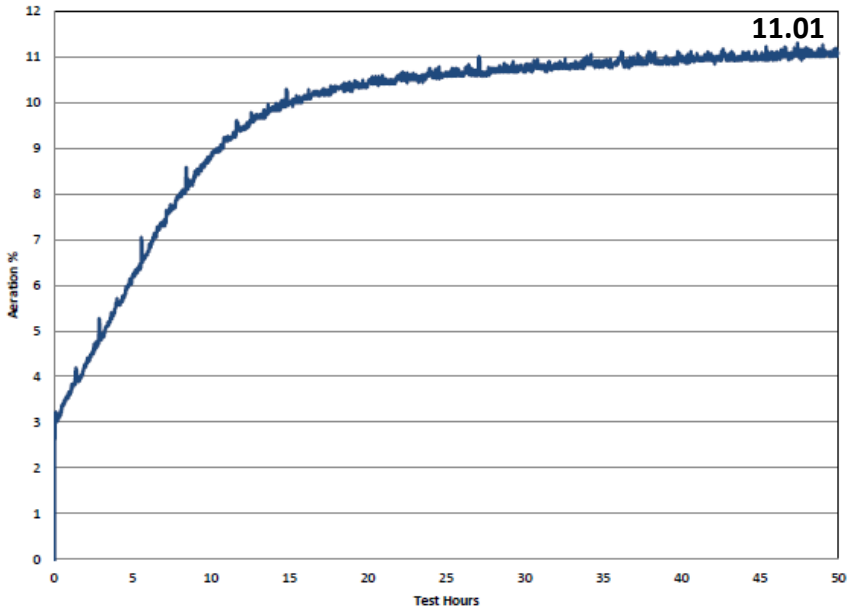

COAT 1R-1808 NONOUL Filter Matrix Test 2
832 Reference Oil Aeration
Aeration %
Test Hours
10.07
CMIR-111348
40-50 Hour Average

Last test from SwRI: 832

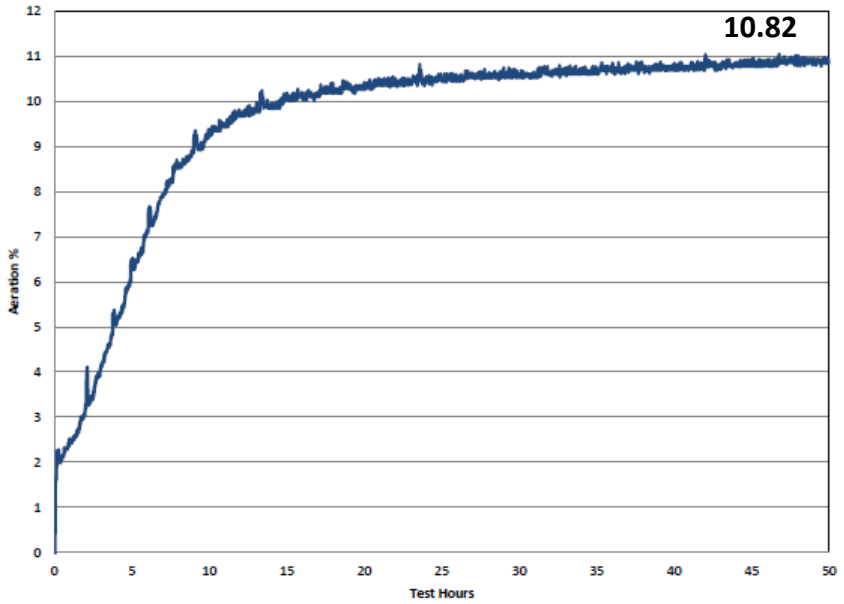


Lubrizol

Oil 833



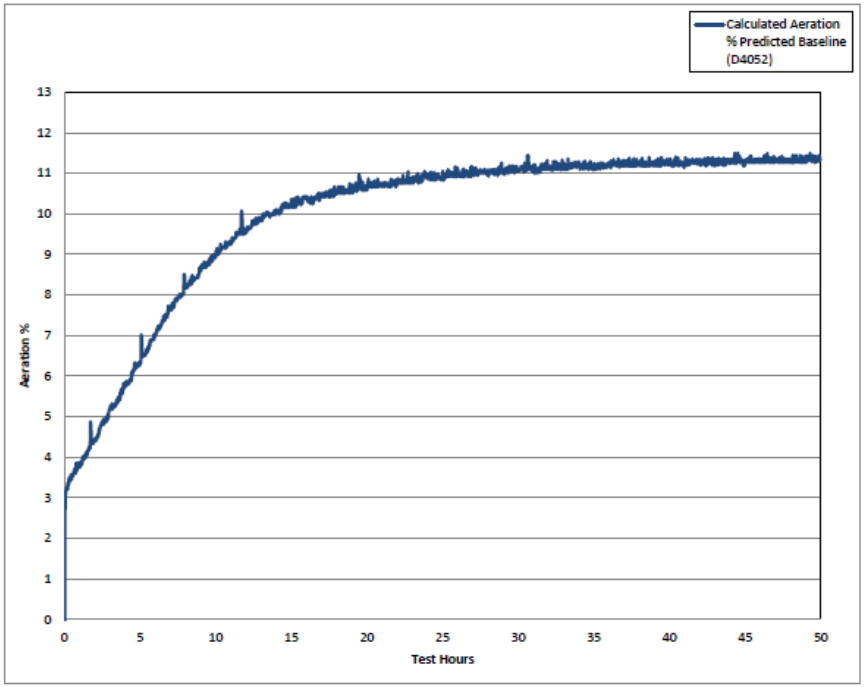
Oil 832



Last test from Lubrizol: 833

Caterpiller Oil Aeration Test
Form 5
Test Aeration Graph

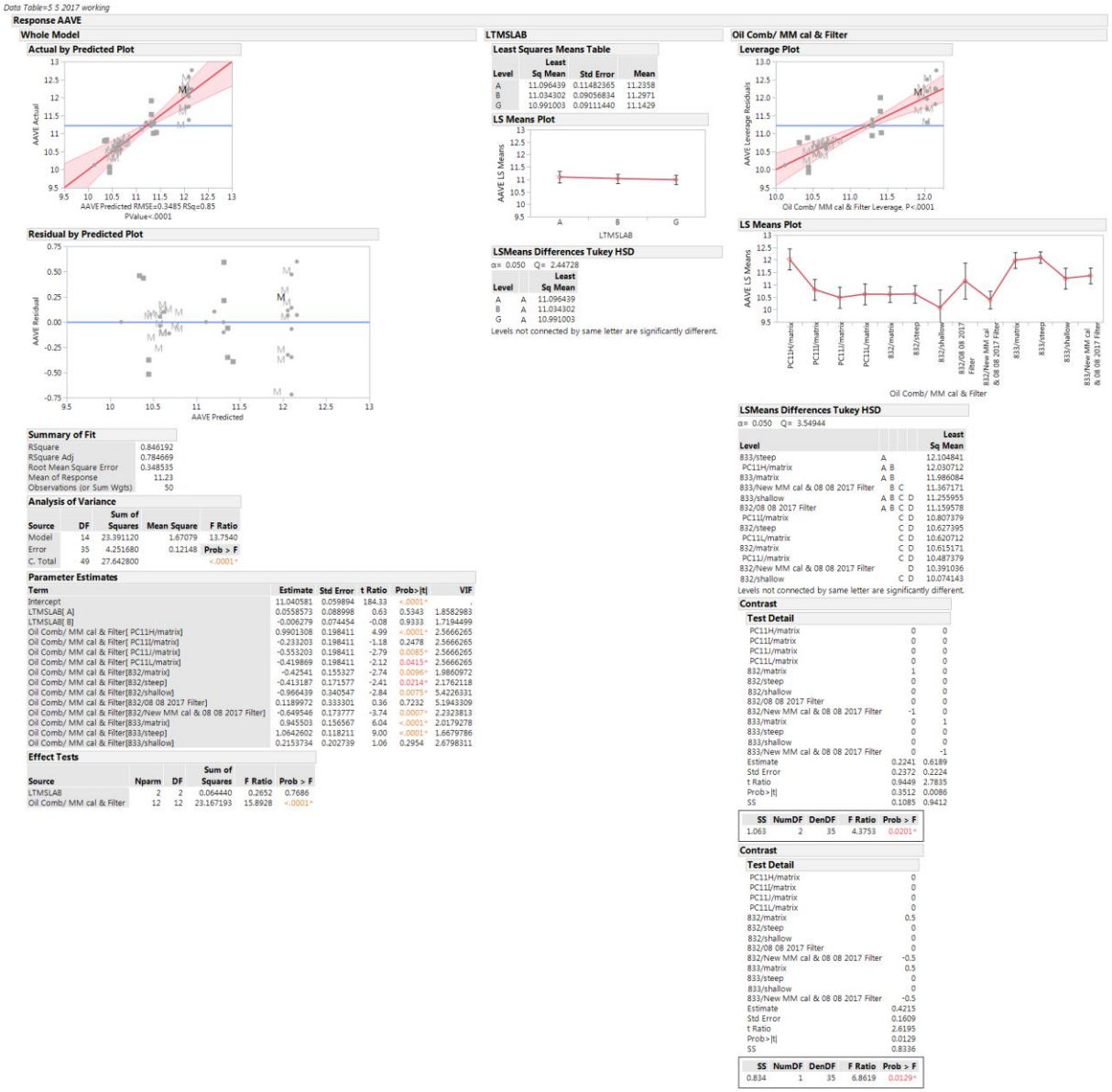
Laboratory: LZ	EOT Date: 20170430	EOT Time: 11:38
Test Number : 602-218B-0		
Oil Code: 120249		
Formulation / Stand Code:		



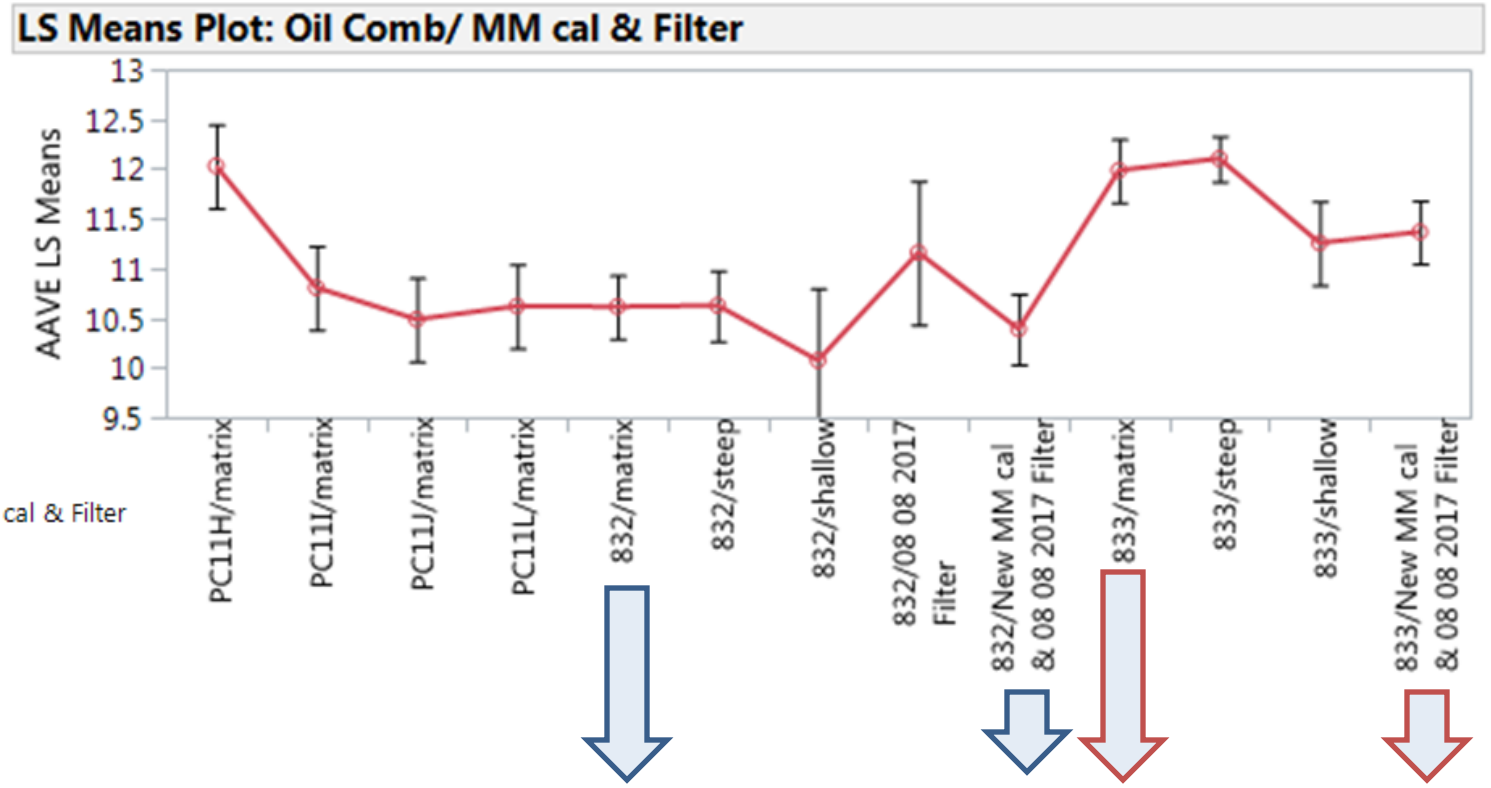
40-50 Hr Aeration Slope	0.010569497

Appendix 3: Models

Model 1: Lab,
Oil Comb/MM cal & Filter



Model 1: Comparing oil/matrix and oil/New MM cal & 08/08/2017 filter



"832 matrix" vs. "recent tests" intervals overlap

"833 matrix" vs. "recent tests" intervals do not overlap

CF calculations based on model 1

Parameter Estimates													
Term	Estimate	Std Error	t Ratio	Prob>|t|	VIF				**Predicted**	**Target**	**ICF**		
Intercept	11.04058	0.059894	184.33	<.0001	.	1	1	1	10.88	11.305	1.039	avg	
LTMSLAB[A]	0.055857	0.088998	0.63	0.5343	1.858298	0.3333	0.3333	0.3333	11.37	11.94	1.05		833
LTMSLAB[B]	-0.00628	0.074454	-0.08	0.9333	1.71945	0.3333	0.3333	0.3333	10.39	10.67	1.027		832
LTMSLAB[G]	-0.04958					0.3333	0.3333	0.3333					
Oil Comb/ MM cal & Filter[PC11H/matrix]	0.990131	0.198411	4.99	<.0001	2.566627	0	0	0					
Oil Comb/ MM cal & Filter[PC11I/matrix]	-0.2332	0.198411	-1.18	0.2478	2.566627	0	0	0					
Oil Comb/ MM cal & Filter[PC11J/matrix]	-0.5532	0.198411	-2.79	0.0085	2.566627	0	0	0			example		
Oil Comb/ MM cal & Filter[PC11L/matrix]	-0.41987	0.198411	-2.12	0.0415	2.566627	0	0	0		orig result	11.2		
Oil Comb/ MM cal & Filter[832/matrix]	-0.42541	0.155327	-2.74	0.0096	1.986097	0	0	0		avg	11.6368		
Oil Comb/ MM cal & Filter[832/steep]	-0.41319	0.171577	-2.41	0.0214	2.176212	0	0	0		833	11.76		
Oil Comb/ MM cal & Filter[832/shallow]	-0.96644	0.340547	-2.84	0.0075	5.422633	0	0	0		832	11.5024		
Oil Comb/ MM cal & Filter[832/08 08 2017 Filter]	0.118997	0.333301	0.36	0.7232	5.194331	0	0	0					
Oil Comb/ MM cal & Filter[832/New MM cal & 08 08 2017 Filter]	-0.64955	0.173777	-3.74	0.0007	2.232381	0.5	0	1					
Oil Comb/ MM cal & Filter[833/matrix]	0.945503	0.156567	6.04	<.0001	2.017928	0	0	0					
Oil Comb/ MM cal & Filter[833/steep]	1.06426	0.118211	9	<.0001	1.667979	0	0	0					
Oil Comb/ MM cal & Filter[833/shallow]	0.215373	0.202739	1.06	0.2954	2.679831	0	0	0					
Oil Comb/ MM cal & Filter[833/New MM cal& Filter	0.32659					0.5	1	0					

Model 2 - used to obtain the standard deviation by technology: Lab, Matrix/transmitter/ cal/ aeration profile, Technology

Appendix 4a: ltms by lab with current targets and standard deviations

Lab A

TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	ei Fail (level 3)	ei Fail (level 2)	SA
									1.277792			1.277792				
106980-COAT	OO	1	A	PC11K	12.55	11.94	0.285	2.140351	1.53656	0.862559	2.140351	1.53656	0.862559	0	0	-0.43792
107256-COAT	AO	1	A	PC11K	12.24	11.94	0.285	1.052632	1.391381	-0.48393	1.052632	1.391381	0.483928	0	0	-0.39654
107255-COAT	AO	1	A	PC11G	10.8	10.67	0.203	0.640394	1.166085	-0.75099	0.640394	1.166085	0.750987	0	0	-0.33233
108379-COAT	AC	1	A	833	12.76	11.94	0.285	2.877193	1.679418	1.711108	2.877193	1.679418	1.711108	0	0	-0.47863
108380-COAT	AC	1	A	833	12.23	11.94	0.285	1.017544	1.480855	-0.66187	1.017544	1.480855	0.661874	0	0	-0.42204
111341-COAT	AC	1	A	832	10.57	10.67	0.203	-0.49261	0.888816	**-1.97347**	-0.49261	0.888816	**1.973466**	0	**1**	-0.25331
108860-COAT	OC	1	A	833	11.31	11.94	0.285	-2.21053	-0.04099	**-3.09934**	-2.21053	-0.04099	**3.099342**	**1**	**1**	0.011681
116584-COAT	OC	1	A	833	11.21	11.94	0.285	-2.5614	-0.79711	**-2.52042**	-2.5614	-0.79711	**2.520416**	**1**	**1**	0.227177
111342-COAT	AC	1	A	832	10.13	10.67	0.203	-2.6601	-1.35601	**-1.86299**	-2.6601	-1.35601	**1.862987**	0	**1**	0.386462
118883-COAT	PC	1	A	833	11.03	11.94	0.285	-3.19298	**-1.9071**	**-1.83697**	-3.19298	-1.9071	**1.836975**	0	**1**	0.543524
111348-COAT	PC	1	A	832	10.07	10.67	0.203	-2.95567	**-2.22167**	-1.04856	-2.95567	-2.22167	1.048565	0	0	0.633176
126228-COAT	PC	1	A	832	9.93	10.67	0.203	-3.64532	**-2.64876**	-1.42365	-3.64532	-2.64876	1.42365	0	0	0.754898

Lab B

TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	ei Fail (level 3)	ei Fail (level 2)	SA
									0.471844			0.471844				
104081-COAT	AO	1	B	PC11I	10.9	10.92	0.139	-0.14388	0.287125	-0.61573	-0.14388	0.287125	0.615729	0	0	-0.08183
103459-COAT	AO	1	B	PC11K	12.23	11.94	0.285	1.017544	0.506251	0.730419	1.017544	0.506251	0.730419	0	0	-0.14428
103625-COAT	AO	1	B	PC11G	10.78	10.67	0.203	0.541872	0.516937	0.035621	0.541872	0.516937	0.035621	0	0	-0.14733
103957-COAT	AO	1	B	PC11L	10.73	10.73	0.139	0	0.361856	-0.51694	0	0.361856	0.516937	0	0	-0.10313
103465-COAT	AO	1	B	PC11J	10.33	10.6	0.203	-1.33005	-0.14572	-1.69191	-1.33005	-0.14572	1.691905	0	0	0.041529
103452-COAT	AO	1	B	PC11H	12.08	12.14	0.285	-0.21053	-0.16516	-0.06481	-0.21053	-0.16516	0.064811	0	0	0.04707
103453-COAT	AO	1	B	PC11H	12.34	12.14	0.285	0.701754	0.094915	0.866913	0.701754	0.094915	0.866913	0	0	-0.02705
103466-COAT	AO	1	B	PC11J	10.57	10.6	0.203	-0.14778	0.022106	-0.2427	-0.14778	0.022106	0.242698	0	0	-0.0063
103958-COAT	AO	1	B	PC11L	10.51	10.73	0.139	-1.58273	-0.45935	-1.60484	-1.58273	-0.45935	1.604839	0	0	0.130914
103626-COAT	AO	1	B	PC11G	10.5	10.67	0.203	-0.83744	-0.57277	-0.37809	-0.83744	-0.57277	0.378092	0	0	0.163241
103460-COAT	AO	1	B	PC11K	11.71	11.94	0.285	-0.80702	-0.64305	-0.23424	-0.80702	-0.64305	0.234244	0	0	0.183268
105877-COAT	AO	1	B	PC11I	10.74	10.92	0.139	-1.29496	-0.83862	-0.65192	-1.29496	-0.83862	0.651917	0	0	0.239007
108857-COAT	OC	1	B	833	12.57	11.94	0.285	2.210526	0.076122	**3.049148**	2.210526	0.076122	**3.049148**	**1**	**1**	-0.02169
108858-COAT	AC	1	B	833	12.24	11.94	0.285	1.052632	0.369075	0.976509	1.052632	0.369075	0.976509	0	0	-0.10519
110230-COAT	AC	1	B	833	12.03	11.94	0.285	0.315789	0.353089	-0.05329	0.315789	0.353089	0.053286	0	0	-0.10063
110736-COAT	AC	1	B	832	10.72	10.67	0.203	0.246305	0.321054	-0.10678	0.246305	0.321054	0.106784	0	0	-0.0915
111033-COAT	AC	1	B	833	11.75	11.94	0.285	-0.66667	0.024738	-0.98772	-0.66667	0.024738	0.987721	0	0	-0.00705
115075-COAT	AC	1	B	833	11.38	11.94	0.285	-1.96491	-0.57216	**-1.98965**	-1.96491	-0.57216	**1.98965**	0	**1**	0.163065
119478-COAT	PC	1	B	832	10.82	10.67	0.203	0.738916	-0.17884	1.311073	0.738916	-0.17884	1.311073	0	0	0.050968
120248-COAT	PC	1	B	833	11.01	11.94	0.285	-3.26316	-1.10413	**-3.08432**	-3.26316	-1.10413	**3.084323**	**1**	**1**	0.314678
120249-COAT	PC	1	B	833	11.3	11.94	0.285	-2.24561	-1.44658	-1.14148	-2.24561	-1.44658	1.141482	0	0	0.412274

Lab G

TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	ei Fail (level 3)	ei Fail (level 2)	SA
									-1.19176			-1.19176				
103954-COAT	AO	1	G	PC11L	10.56	10.73	0.139	-1.22302	-1.20114	-0.03126	-1.22302	-1.20114	0.031261	0	0	0.342325
103455-COAT	OO	1	G	PC11H	11.61	12.14	0.285	-1.85965	-1.39869	-0.65851	-1.85965	-1.39869	0.65851	0	0	0.398627
103468-COAT	AO	1	G	PC11J	10.5	10.6	0.203	-0.49261	-1.12687	0.906081	-0.49261	-1.12687	0.906081	0	0	0.321157
103462-COAT	OO	1	G	PC11K	11.25	11.94	0.285	-2.42105	-1.51512	-1.29419	-2.42105	-1.51512	1.294185	0	0	0.43181
104083-COAT	AO	1	G	PC11I	10.72	10.92	0.139	-1.43885	-1.49224	0.076274	-1.43885	-1.49224	0.076274	0	0	0.425289
103629-COAT	AO	1	G	PC11G	10.63	10.67	0.203	-0.19704	-1.10368	1.295197	-0.19704	-1.10368	1.295197	0	0	0.314549
106458-COAT	AO	1	G	PC11G	10.31	10.67	0.203	-1.7734	-1.3046	-0.66972	-1.7734	-1.3046	0.669717	0	0	0.37181
110235-COAT	AC	1	G	832	10.63	10.67	0.203	-0.19704	-0.97233	1.107553	-0.19704	-0.97233	1.107553	0	0	0.277114
110728-COAT	AC	1	G	832	10.54	10.67	0.203	-0.64039	-0.87275	0.331937	-0.64039	-0.87275	0.331937	0	0	0.248734
111346-COAT	AC	1	G	833	11.73	11.94	0.285	-0.73684	-0.83198	0.135908	-0.73684	-0.83198	0.135908	0	0	0.237114
111347-COAT	AC	1	G	833	12.17	11.94	0.285	0.807018	-0.34028	1.638995	0.807018	-0.34028	1.638995	0	0	0.09698
112704-COAT	AC	1	G	833	11.31	11.94	0.285	-2.21053	-0.90135	**-1.87025**	-2.21053	-0.90135	**1.870247**	0	**1**	0.256886
112705-COAT	AC	1	G	833	12.12	11.94	0.285	0.631579	-0.44147	1.532932	0.631579	-0.44147	1.532932	0	0	0.12582
111343-COAT	OC	1	G	832	11.11	10.67	0.203	2.167488	0.341215	**2.608961**	2.167488	0.341215	2.608961	**1**	**1**	-0.09725
111344-COAT	PC	1	G	832	10.8	10.67	0.203	0.640394	0.430969	0.299179	0.640394	0.430969	0.299179	0	0	-0.12283
116607-COAT	PC	1	G	833	11.53	11.94	0.285	-1.4386	-0.1299	**-1.86957**	-1.4386	-0.1299	**1.869565**	0	**1**	0.037022
116608-COAT	PC	1	G	833	11.91	11.94	0.285	-0.10526	-0.12251	0.024638	-0.10526	-0.12251	0.024638	0	0	0.034915

Appendix 4b: ltms by lab with current targets and revised standard deviations

Lab A

TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	revised rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	ei Fail Level 3	ei Fail level 2	SA
									0.888113			0.88811305				
106980-COAT	OO	1	A	PC11K	12.55	11.94	0.398	1.532663	1.081478	0.64455	1.532663317	1.08147813	0.64455	0	0	-0.43043
107256-COAT	AO	1	A	PC11K	12.24	11.94	0.398	0.753769	0.983165	-0.32771	0.753768844	0.98316534	0.327709	0	0	-0.3913
107255-COAT	AO	1	A	PC11G	10.8	10.67	0.344	0.377907	0.801588	-0.60526	0.377906977	0.80158783	0.605258	0	0	-0.31903
108379-COAT	AC	1	A	833	12.76	11.94	0.398	2.060302	1.179202	1.258714	2.060301508	1.17920194	1.258714	0	0	-0.46932
108380-COAT	AC	1	A	833	12.23	11.94	0.398	0.728643	1.044034	-0.45056	0.728643216	1.04403432	0.450559	0	0	-0.41553
111341-COAT	AC	1	A	832	10.57	10.67	0.344	-0.2907	0.643615	-1.33473	-0.290697674	0.64361472	1.334732	0	0	-0.25616
108860-COAT	OC	1	A	833	11.31	11.94	0.398	-1.58291	-0.02434	**-2.22653**	-1.582914573	-0.02434407	**2.226529**	**1**	**1**	0.009689
116584-COAT	OC	1	A	833	11.21	11.94	0.398	-1.83417	-0.56729	**-1.80983**	-1.834170854	-0.5672921	**1.809827**	0	**1**	0.225782
111342-COAT	AC	1	A	832	10.13	10.67	0.344	-1.56977	-0.86803	-1.00248	-1.569767442	-0.8680347	1.002475	0	0	0.345478
118883-COAT	PC	1	A	833	11.03	11.94	0.398	-2.28643	-1.29355	-1.4184	-2.286432161	-1.29355394	1.418397	0	0	0.514834
111348-COAT	PC	1	A	832	10.07	10.67	0.344	-1.74419	-1.42874	-0.45063	-1.744186047	-1.42874357	0.450632	0	0	0.56864
126228-COAT	PC	1	A	832	9.93	10.67	0.344	-2.15116	-1.64547	-0.72242	-2.151162791	-1.64546934	0.722419	0	0	0.654897

Lab B

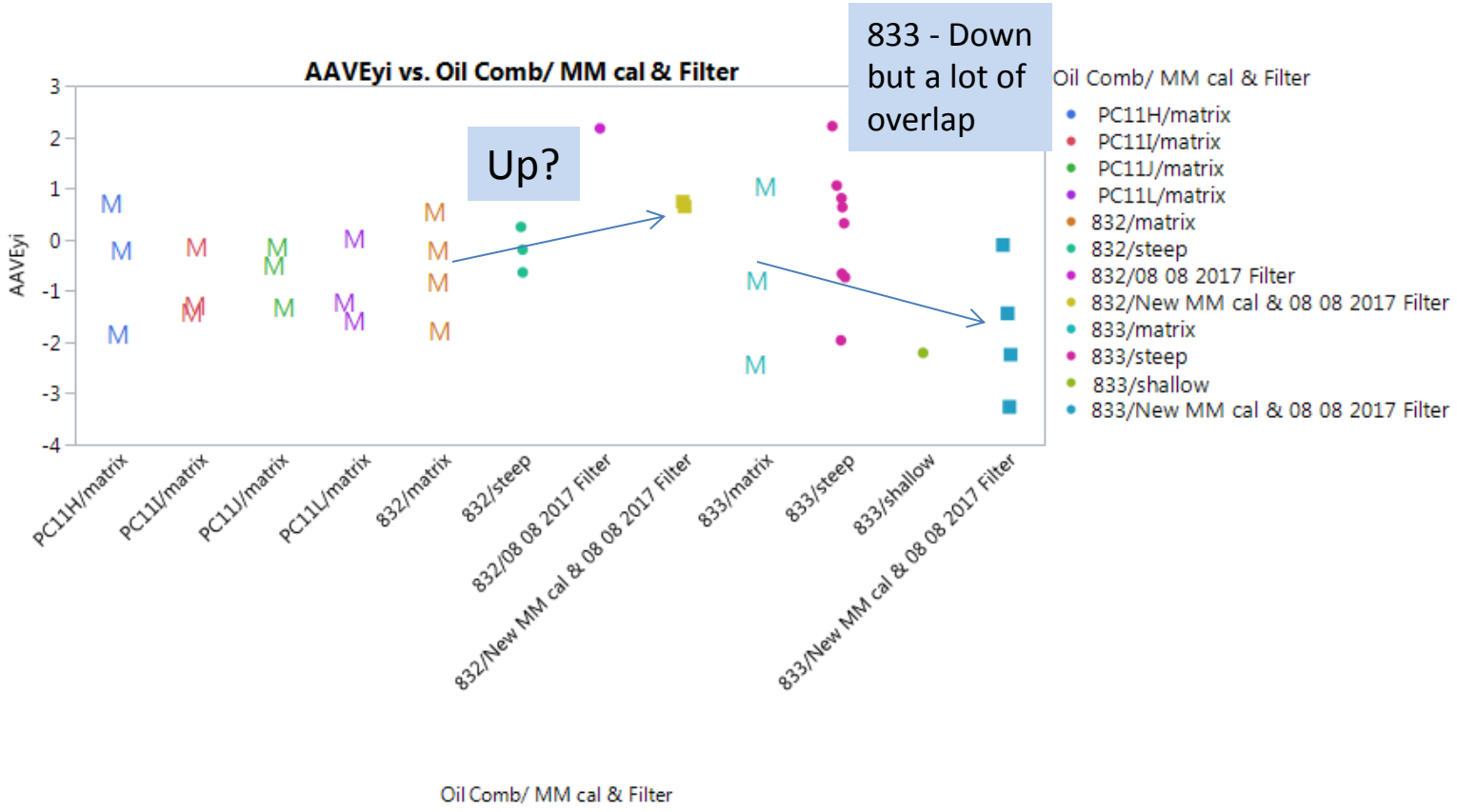
TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	revised rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	level 3 ei alarm	level 2 ei alarm	SA
												0.3021889				
104081-COAT	AO	1	B	PC11I	10.9	10.92	0.141	-0.14184	0.169	-0.44403	-0.14	0.17	0.444033	0	0	-0.06725
103459-COAT	AO	1	B	PC11K	12.23	11.94	0.398	0.728643	0.337	0.559664	0.73	0.34	0.559664	0	0	-0.13408
103625-COAT	AO	1	B	PC11G	10.78	10.67	0.344	0.319767	0.332	-0.01711	0.32	0.33	0.017111	0	0	-0.13203
103957-COAT	AO	1	B	PC11L	10.73	10.73	0.141	0	0.232	-0.33175	0.00	0.23	0.331745	0	0	-0.09242
103465-COAT	AO	1	B	PC11J	10.33	10.6	0.344	-0.78488	-0.073	-1.01711	-0.78	-0.07	1.017105	0	0	0.029018
103452-COAT	AO	1	B	PC11H	12.08	12.14	0.398	-0.15075	-0.096	-0.07784	-0.15	-0.10	0.077844	0	0	0.038313
103453-COAT	AO	1	B	PC11H	12.34	12.14	0.398	0.502513	0.083	0.598776	0.50	0.08	0.598776	0	0	-0.03318
103466-COAT	AO	1	B	PC11J	10.57	10.6	0.344	-0.08721	0.032	-0.17058	-0.09	0.03	0.170579	0	0	-0.01281
103958-COAT	AO	1	B	PC11L	10.51	10.73	0.141	-1.56028	-0.446	-1.59248	-1.56	-0.45	1.59248	0	0	0.177328
103626-COAT	AO	1	B	PC11G	10.5	10.67	0.344	-0.49419	-0.460	-0.04864	-0.49	-0.46	0.048638	0	0	0.183135
103460-COAT	AO	1	B	PC11K	11.71	11.94	0.398	-0.57789	-0.495	-0.11775	-0.58	-0.50	0.11775	0	0	0.197195
105877-COAT	AO	1	B	PC11I	10.74	10.92	0.141	-1.2766	-0.730	-0.78113	-1.28	-0.73	0.781131	0	0	0.290462
108857-COAT	OC	1	B	833	12.57	11.94	0.398	1.582915	-0.036	2.312718	1.58	-0.04	2.312718	1	1	0.014323
108858-COAT	AC	1	B	833	12.24	11.94	0.398	0.753769	0.201	0.789757	0.75	0.20	0.789757	0	0	-0.07997
110230-COAT	AC	1	B	833	12.03	11.94	0.398	0.226131	0.208	0.025192	0.23	0.21	0.025192	0	0	-0.08298
110736-COAT	AC	1	B	832	10.72	10.67	0.344	0.145349	0.190	-0.06315	0.15	0.19	0.063148	0	0	-0.07544
111033-COAT	AC	1	B	833	11.75	11.94	0.398	-0.47739	-0.011	-0.66694	-0.48	-0.01	0.666939	0	0	0.004191
115075-COAT	AC	1	B	833	11.38	11.94	0.398	-1.40704	-0.429	-1.39651	-1.41	-0.43	1.396506	0	0	0.170934
119478-COAT	PC	1	B	832	10.82	10.67	0.344	0.436047	-0.170	0.865528	0.44	-0.17	0.865528	0	0	0.06759
120248-COAT	PC	1	B	833	11.01	11.94	0.398	-2.33668	-0.820	**-2.16686**	-2.34	-0.82	**2.16686**	**1**	**1**	0.326313
120249-COAT	PC	1	B	833	11.3	11.94	0.398	-1.60804	-1.056	-0.78816	-1.61	-1.06	0.788159	0	0	0.420419

Lab G

TESTKEY	VAL	LTMSAPP	LTMSLAB	IND	Aeration	Target	revised rmse	Yi	Zi	ei	effective Yiv2	effective Ziv2	abs(ei)	level 3 ei alarm	level 2 ei alarm	SA
									-0.94268			-0.94267657				
103954-COAT	AO	1	G	PC11L	10.56	10.73	0.141	-1.20567	-1.02158	-0.263	-1.205673759	-1.02157573	0.262997	0	0	0.406587
103455-COAT	OO	1	G	PC11H	11.61	12.14	0.398	-1.33166	-1.1146	-0.31008	-1.331658291	-1.1146005	0.310083	0	0	0.443611
103468-COAT	AO	1	G	PC11J	10.5	10.6	0.344	-0.2907	-0.86743	0.823903	-0.290697674	-0.86742965	0.823903	0	0	0.345237
103462-COAT	OO	1	G	PC11K	11.25	11.94	0.398	-1.73367	-1.1273	-0.86624	-1.733668342	-1.12730126	0.866239	0	0	0.448666
104083-COAT	AO	1	G	PC11I	10.72	10.92	0.141	-1.41844	-1.21464	-0.29114	-1.418439716	-1.2146428	0.291138	0	0	0.483428
103629-COAT	AO	1	G	PC11G	10.63	10.67	0.344	-0.11628	-0.88513	1.098364	-0.11627907	-0.88513368	1.098364	0	0	0.352283
106458-COAT	AO	1	G	PC11G	10.31	10.67	0.344	-1.04651	-0.93355	-0.16138	-1.046511628	-0.93354706	0.161378	0	0	0.371552
110235-COAT	AC	1	G	832	10.63	10.67	0.344	-0.11628	-0.68837	0.817268	-0.11627907	-0.68836666	0.817268	0	0	0.27397
110728-COAT	AC	1	G	832	10.54	10.67	0.344	-0.37791	-0.59523	0.31046	-0.377906977	-0.59522876	0.31046	0	0	0.236901
111346-COAT	AC	1	G	833	11.73	11.94	0.398	-0.52764	-0.57495	0.067591	-0.527638191	-0.57495159	0.067591	0	0	0.228831
111347-COAT	AC	1	G	833	12.17	11.94	0.398	0.577889	-0.2291	1.152841	0.577889447	-0.22909928	1.152841	0	0	0.091182
112704-COAT	AC	1	G	833	11.31	11.94	0.398	-1.58291	-0.63524	-1.35382	-1.582914573	-0.63524387	1.353815	0	0	0.252827
112705-COAT	AC	1	G	833	12.12	11.94	0.398	0.452261	-0.30899	1.087505	0.452261307	-0.30899231	1.087505	0	0	0.122979
111343-COAT	OC	1	G	832	11.11	10.67	0.344	1.27907	0.167426	1.588062	1.279069767	0.16742631	1.588062	0	0	-0.06664
111344-COAT	PC	1	G	832	10.8	10.67	0.344	0.377907	0.230571	0.210481	0.377906977	0.23057051	0.210481	0	0	-0.09177
116607-COAT	PC	1	G	833	11.53	11.94	0.398	-1.03015	-0.14765	-1.26072	-1.030150754	-0.14764587	1.260721	0	0	0.058763
116608-COAT	PC	1	G	833	11.91	11.94	0.398	-0.07538	-0.12597	0.072269	-0.075376884	-0.12596517	0.072269	0	0	0.050134

Extra tables and plot

Labs B and G only



Mean and Standard deviation by Oil: 50 tests

Oil Comb	N Rows	Mean(AAVE)	Std Dev(AAVE)
PC11H	3	12.01	0.37
PC11I	3	10.7866666666667	0.0986576572463
PC11J	3	10.4666666666667	0.1234233905438
PC11L	3	10.6	0.1153256259467
832	15	10.556	0.3226408883839
833	23	11.807391304348	0.5222174520194

Mean and Standard deviation by Oil: 9 tests , before and after CF applied

Oil Comb	LTMSLAB	N Rows	Mean(AAVE)	Mean(CF 1.027)	Mean(CF 1.039)	Mean(CF 1.05)	Std Dev(AAVE)
832	A	2	10	10.27	10.39	10.5	0.0989949493661
832	B	1	10.82	11.11	11.24	11.36	•
832	G	1	10.8	11.09	11.22	11.34	•
833	A	1	11.03	11.33	11.46	11.58	•
833	B	2	11.155	11.46	11.59	11.715	0.2050609665441
833	G	2	11.72	12.035	12.175	12.31	0.2687005768509