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Reply to:

Scott Parke
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December 2, 2005

To: Single Cylinder Diesel Surveillance Panel

Enclosed are the minutes of the SCOTE Surveillance panel teleconference held September 28, 2005. Please address any corrections during the time allotted for minutes approval at the next meeting.

Scott Parke
Secretary SCOTE Surveillance Panel

Attachments

cc: <ftp://ftp.astmtmc.cmu.edu/docs/diesel/scote/minutes/TELECONFERENCE%202005-09-28.pdf>

distribution: Email

TELECONFERENCE MINUTES

SINGLE CYLINDER DIESEL SURVEILLANCE PANEL

HELD SEPTEMBER 28, 2005

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13:00cdt CALL TO ORDER

The teleconference began at 13:00 cdt; the participants are listed in attachment 1.

13:01cst UPDATED ANALYSIS OF 1N LINER (1Y3998) PERFORMANCE

Elisa Santos (Infinium) has compiled a revised and updated analysis of 1Y3998 liner performance (attachment 2). Chairman Jim McCord (Southwest Research) began discussion by leading Elisa through highlighting certain sections of the various analysis scenarios.

Abdul Cassim (Caterpillar) asked Scott Parke (TMC) to comment on any conclusions he would draw from Elisa's analysis. Scott declined to draw any of his own conclusions but took the opportunity to state his conviction that, in deciding between the scenarios presented, the panel should choose the one they felt most comfortable with and stay within it. He felt it would not be legitimate to select different components of different scenarios and attempt to put them together cafeteria style. Jim Rutherford (ChevronTexaco) and Abdul voiced strong agreement.

Elisa was asked to explain what the purpose was for the analysis considering all blends of 1004 to be the same oil (as mentioned on page 2 of attachment 2). She explained that whether or not to do this was a judgment call that the panel could make when they choose a scenario. Combining the oils probably gives a better estimate of the precision of the data because there is more of it but the cost is that doing so could cloud what might be a real performance difference between oils. Neither approach would be wrong, per se.

The panel was keen to know whether any of the performance difference seen thus far occurs with other oils. All were in agreement that the next round of testing needed to be on another oil. Scott Parke advised that oil 809-1 was probably the best choice of the remaining available oils. Jim McCord was concerned that the other oil not be from the same supplier or of the same technology. After the meeting, Scott determined that 809-1 was indeed from a different supplier.

With discussion of the analysis over, Bob Campbell (Afton) moved to enact the following conclusions:

1. Accept the first scenario used in Elisa's analysis (that is all oils, 250 tests, and model including lab, oil, and liner type).
2. Enact the following resulting correction factors: TGFCOR=0, WDCOR=0, TTLHCCOR=-0.451, and BSOCF=0 effective for any 1N test using 1Y3998 liner that ends on or after September 28, 2005.
3. Use oil 809-1 for the next round of reference testing.

The motion passed by a vote of 8-0-0 (for-against-waive).

Elisa was asked to update her analysis once further tests are completed. She agreed to update once 8 further tests complete on oil 809-1.

14:05cdt OTHER BUSINESS

Chris Mazuca (PerkinElmer) pointed out that the procedure requires R_a surface finish measurement and that the 1Y3998 liners don't meet the spec. Chuck Dutart (Caterpillar) replied that R_a is not a valid measurement for plateau-honed liners (such as 1Y3998). After brief discussion of the usefulness of the measurement, Jim McCord moved that the requirement for surface finish measurement be removed from the 1K/1N procedure. The Motion passed 8-0-0.

The teleconference ended at 14:24cdt.

Attendance:

Representative

Abdul Cassim
Chuck Dutart
Jim Gutzwiller
Jerry Brys
Jim McCord
Bob Campbell
Chris Mazuca
Riccardo Conti
Jim Rutherford
Elisa Santos
Scott Parke

Organization

Caterpillar
Caterpillar
Infineum
Lubrizol
Southwest Research
Afton Chemical
PerkinElmer
ExxonMobil
ChevronTexaco
Infineum
Test Monitoring Center

Analysis of 1N by parameter: Elisa Santos Sept 16th 2005

Objective: To respond the question – Is the performance of liner 1Y3998 equivalent to the performance of 1Y3555? If not, what is the performance offset?

LN TGF Rated: No liner discrimination

There are four analyses for TGF: LN transformation was used for the analyses.

1. All oils - 250 tests with Chart = Yes: Presented below, model with Lab, Oil type and Liner type; the analysis shows that there is **no evidence that the liners are different**. Oil type seems to be marginally significant.
2. Analysis with oils 1004, 1004-1, 1004-2, 1004-3: Presented below, model with Lab, Oil type and Liner type; the analysis shows that there is **no evidence that the liners are different**. There seems to be borderlines differences among some of the labs.
3. Analysis with oil 1004-3 ONLY - because all the tests with new liners ran on oil 1004-3 - model with Lab and Liner type; the analysis shows that there is **no evidence that the liners are different (with and without test 51111)**.

WDN Rated: Marginal discrimination for oil 1004-3 ONLY

There are three analyses for WDN: No transformation was used for the analysis.

4. All oils - 250 tests with Chart = Yes: Presented below, model with Lab, Oil type and Liner type; the analysis shows that there is **no evidence that the liners are different**. Difference between Oil 1004 and 1004-3 is significant.
5. Analysis with oils 1004-1, 1004-2, 1004-3: model with Lab, Oil type and Liner type; the analysis shows that there is **no evidence that the liners are different**. There seems to be differences among labs.
6. Analysis with oil **1004-3 ONLY** - because all the tests with new liners ran on oil 1004-3 - model with Lab and Liner type; the analysis shows that there is **marginal evidence that the liners are different** (the analysis is presented below). The difference between the liners is 7.033 and applies just to oil 1004-3: liner 1Y3555 higher than 1Y3998. There is evidence that Lab B1 has higher values of WDN.

LN TLHC Rated plus one: Liner discrimination

7. All oils - 250 tests with Chart = Yes: Presented below, model with Lab, Oil type and Liner type; the analysis shows that **there is evidence that the liners are different**. The difference between the liners is -0.451 and applies to all oils: liner 1Y3555 lower than 1Y3998. There is also evidence of oil discrimination. The transformation used for the analysis was pre determined.

LN BSOC Rated: No liner discrimination

There are two analyses for BSOC: LN transformation was used for the analyses.

8. All oils - 250 tests with Chart = Yes: Presented below, model with Lab, Oil type and Liner type; the analysis shows that there is **no evidence that the liners are different**. There is evidence of Oil type discrimination and lab differences.
9. Analysis with oil 1004-3 ONLY - because all the tests with new liners ran on oil 1004-3 - model with Lab and Liner type; the analysis shows that there is **no evidence that the liners are different**. The analysis is presented below.

The transformations applied to TGF rated and BSOC rated seem to result in a small improvement with respect to the hypothesis of constant variance. The transformations can be dropped if the working group deems appropriate.

Additional analysis: Analysis considering the several re-blends of oil 1004 equivalent, as requested by Scott Parke

Summary:

- TGF rated (no transformation): **No liner discrimination**
- WDN rated (no transformation): **Liner discrimination**
 - The conclusion based on the analysis for oil 1004-3 ONLY – Marginal significant difference between liners – changes and the difference is now clearly significant when re-blends of 1004 are considered equivalent. The difference between the liners is 11.864: liner 1Y3555 higher than 1Y3998.
- LN TLHC plus one: **Liner discrimination** liner differences for Marginal
 - The difference between the liners is -0.358; liner 1Y3555 lower than 1Y3998.
- BSOC rated (no transformation) **No liner discrimination** with or without test 18077 (test with BSOC=1.1)

Detailed analyses by parameter:

LN TGF Rated: Analysis with all oils

Summary of Fit

RSquare	0.106695
RSquare Adj	0.041237
Root Mean Square Error	0.602184
Mean of Response	3.126563
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	17	10.048225	0.591072	1.6300
Error	232	84.129169	0.362626	Prob > F
C. Total	249	94.177394		0.0579

Lack Of Fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	28	12.336797	0.440600	1.2520
Pure Error	204	71.792372	0.351923	Prob > F
Total Error	232	84.129169		0.1893
				Max RSq
				0.2377

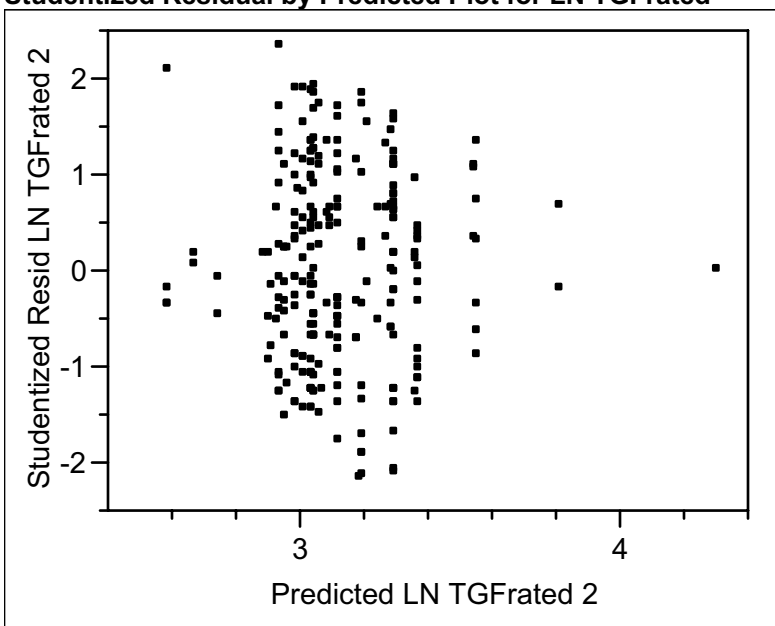
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	3.1923342	0.150151	21.26	<.0001
LTMSLAB [A]	-0.031624	0.098013	-0.32	0.7473
LTMSLAB [B]	-0.106485	0.118823	-0.90	0.3711
LTMSLAB [B1]	-0.190809	0.256453	-0.74	0.4576
LTMSLAB [C]	-0.159384	0.154113	-1.03	0.3021
LTMSLAB [D]	0.1393925	0.171736	0.81	0.4178
LTMSLAB [F]	0.408836	0.253031	1.62	0.1075
LTMSLAB [G]	-0.107188	0.085784	-1.25	0.2127
LTMSLAB [I]	0.1469444	0.111498	1.32	0.1888
LTMSLAB [J]	-0.049241	0.185765	-0.27	0.7912
LTMSLAB [K]	-0.191329	0.17015	-1.12	0.2620
IND [1004]	-0.227947	0.161566	-1.41	0.1596
IND [1004-1]	-0.201205	0.109718	-1.83	0.0680
IND [1004-2]	-0.123887	0.137006	-0.90	0.3668
IND [1004-3]	-0.257417	0.16854	-1.53	0.1280
IND [809-1]	0.0534	0.130971	0.41	0.6839
IND [810-2]	1.0612185	0.520189	2.04	0.0425
LINERPN[1Y3555]	0.1577008	0.126793	1.24	0.2148

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	3.7044693	1.0216	0.4259
IND	6	6	3.9607064	1.8204	0.0959
LINERPN	1	1	0.5609639	1.5469	0.2148

Studentized Residual by Predicted Plot for LN TGFrated



LAB: Least Squares Means Table

Level		Least Sq Mean
F	A	3.6011702
I	A	3.3392786
N	A	3.3332221
D	A	3.3317267
A	A	3.1607104
J	A	3.1430928
B	A	3.0858490
G	A	3.0851457
C	A	3.0329505
B1	A	3.0015250
K	A	3.0010050

Oil Type: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1004	2.9643867	0.19752714	3.06334
1004-1	2.9911296	0.13785227	3.10620
1004-2	3.0684474	0.17243350	3.22555
1004-3	2.9349167	0.14711242	2.88673
809-1	3.2457342	0.16471933	3.37838
810-2	4.2535527	0.61932162	4.30407
811-1	2.8881719	0.17078739	3.01828

LINER PN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	3.3500350	0.10701207	3.14429
1Y3998	3.0346334	0.25649936	2.70101

LN TGF Rated: Analysis with 1004 oils - 186 tests

Summary of Fit

RSquare	0.11893
RSquare Adj	0.06323
Root Mean Square Error	0.552499
Mean of Response	3.091084
Observations (or Sum Wgts)	186

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	11	7.169545	0.651777	2.1352
Error	174	53.114441	0.305255	Prob > F
C. Total	185	60.283987		0.0202

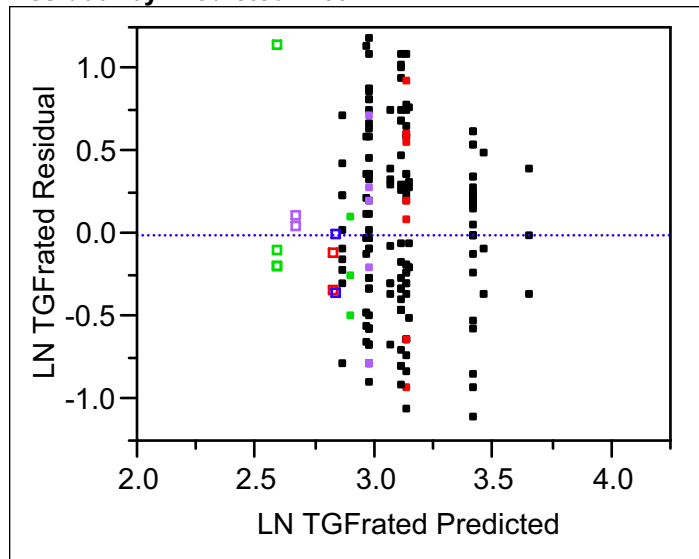
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	3.0026606	0.104713	28.68	<.0001
LTMSLAB [A]	-0.022427	0.103732	-0.22	0.8291
LTMSLAB [B]	-0.045309	0.116909	-0.39	0.6988
LTMSLAB [B1]	-0.258728	0.222367	-1.16	0.2462
LTMSLAB [C]	-0.188858	0.156494	-1.21	0.2291
LTMSLAB [D]	-0.006389	0.178891	-0.04	0.9716
LTMSLAB [F]	0.310721	0.294837	1.05	0.2934
LTMSLAB [G]	-0.179595	0.092522	-1.94	0.0539
LTMSLAB [J]	0.2587308	0.116909	2.21	0.0282
LTMSLAB [J]	-0.080281	0.17728	-0.45	0.6512
LTMSLAB [K]	-0.28755	0.169272	-1.70	0.0912
LINERPN[1Y3555]	0.1564791	0.10389	1.51	0.1338

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	5.5615031	1.8219	0.0599
LINERPN	1	1	0.6925110	2.2686	0.1338

Residual by Predicted Plot:

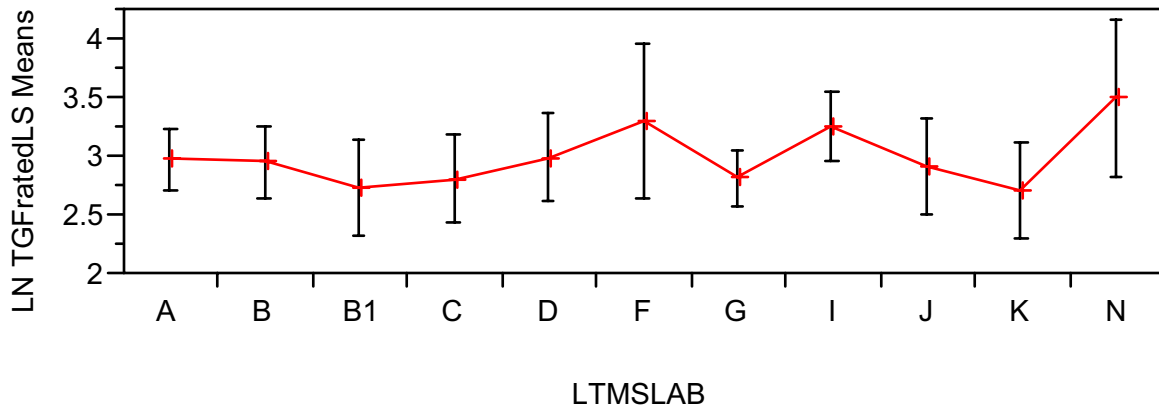


LAB: LSMeans Differences Tukey HSD

Level	Least Sq Mean	
N	A	3.5023456
F	A	3.3133815
I	A	3.2613914
D	A	2.9962720
A	A	2.9802332
B	A	2.9573514
J	A	2.9223793
G	A	2.8230657
C	A	2.8138024
B1	A	2.7439330
K	A	2.7151108

Levels not connected by same letter are significantly different

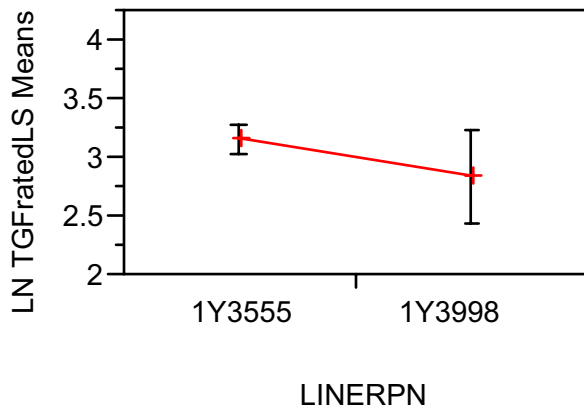
LS Means Plot



LINER PN: Least Squares Means Table

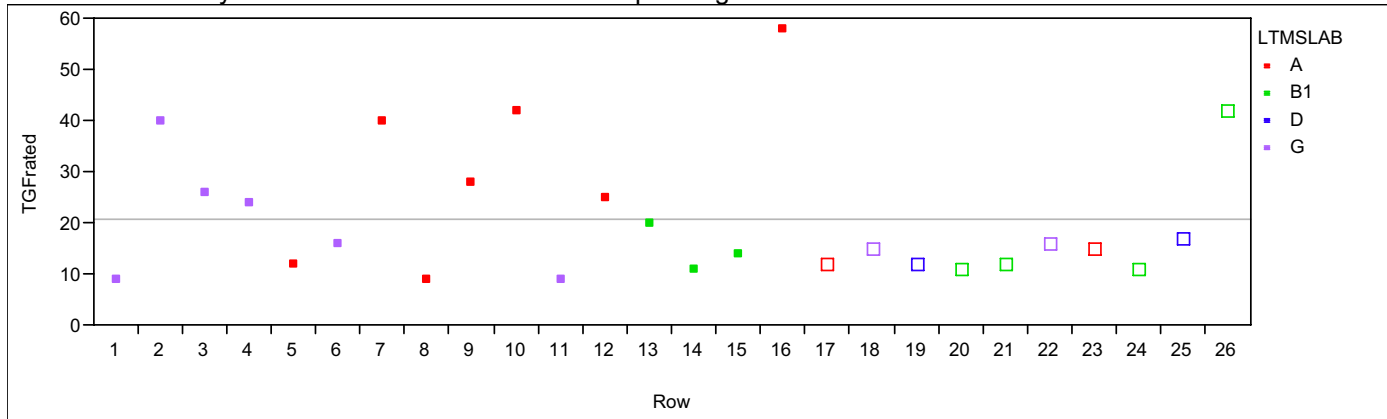
Level	Least Sq Mean	Std Error	Mean
1Y3555	3.1591397	0.06064313	3.11325
1Y3998	2.8461815	0.19959547	2.70101

LS Means Plot



LN TGF Rated: Analysis with 1004-3 ONLY - 26 tests

TGFrated versus time: the square symbols represent the tests with new liner; different colors are used to identify Lab. Test 51111 is the test corresponding to row 26.



WDN Rated: Analysis with all oils

Summary of Fit

RSquare	0.504679
RSquare Adj	0.468384
Root Mean Square Error	27.83367
Mean of Response	211.9608
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	17	183128.97	10772.3	13.9049
Error	232	179733.45	774.7	Prob > F
C. Total	249	362862.42		<.0001

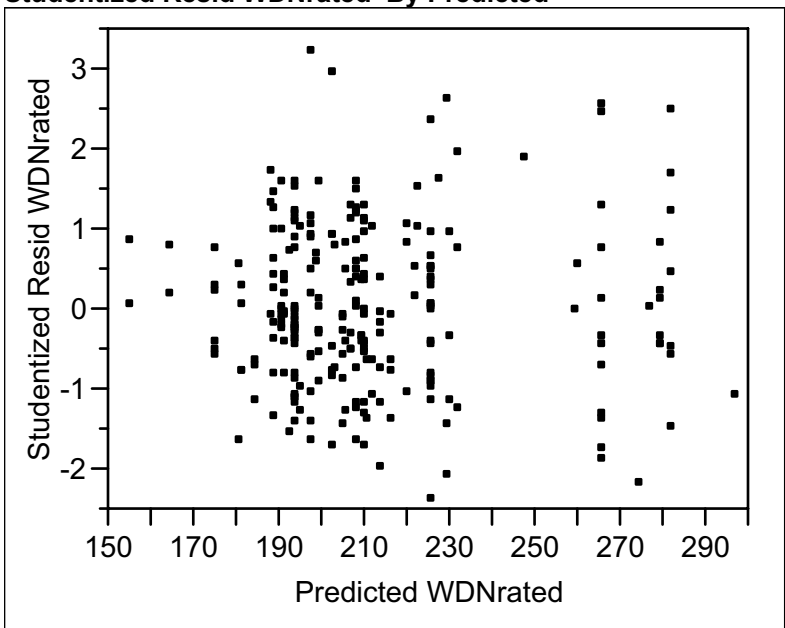
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	219.95233	6.940146	31.69	<.0001
LTMSLAB [A]	5.3283407	4.530295	1.18	0.2407
LTMSLAB [B]	20.735343	5.492142	3.78	0.0002
LTMSLAB [B1]	34.179071	11.85356	2.88	0.0043
LTMSLAB [C]	-16.10425	7.123308	-2.26	0.0247
LTMSLAB [D]	-20.38212	7.937856	-2.57	0.0109
LTMSLAB [F]	-9.638759	11.6954	-0.82	0.4107
LTMSLAB [G]	-10.83853	3.965052	-2.73	0.0067
LTMSLAB [I]	3.2547645	5.153552	0.63	0.5283
LTMSLAB [J]	0.7441703	8.586259	0.09	0.9310
LTMSLAB [K]	-5.110983	7.86454	-0.65	0.5164
IND [1004]	2.0197068	7.467792	0.27	0.7871
IND [1004-1]	-20.17257	5.071308	-3.98	<.0001
IND [1004-2]	-23.10242	6.332592	-3.65	0.0003
IND [1004-3]	-39.10905	7.79014	-5.02	<.0001
IND [809-1]	-16.31619	6.053642	-2.70	0.0075
IND [810-2]	45.12975	24.04377	1.88	0.0618
LINERPN[1Y3555]	5.1564447	5.860532	0.88	0.3798

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	38505.85	4.9703	<.0001
IND	6	6	141026.37	30.3395	<.0001
LINERPN	1	1	599.75	0.7742	0.3798

Studentized Resid WDNrated By Predicted



LTMSLAB: Least Squares Means Table

Level		Least Sq Mean
B1	A	254.13140
B	A	240.68768
A	A B	225.28067
I	A B	223.20710
J	A B	220.69650
N	A B	217.78529
K	A B	214.84135
F	A B	210.31357
G	B	209.11381
C	B	203.84808
D	B	199.57021

Levels not connected by same letter are significantly different

OIL Type:

Level	Least Sq Mean	Std Error	Mean
1004	221.97204	9.129940	224.719
1004-1	199.77976	6.371697	204.793
1004-2	196.84991	7.970082	199.597
1004-3	180.84328	6.799712	188.177
809-1	203.63614	7.613524	204.568
810-2	265.08208	28.625784	259.400
811-1	271.50311	7.893997	274.245

Oil Type LSMeans Differences Tukey HSD

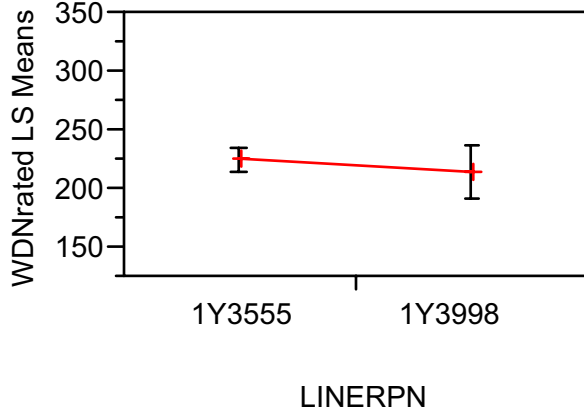
Level		Least Sq Mean
811-1	A	271.50311
810-2	A B C	265.08208
1004	B	221.97204
809-1	B C	203.63614
1004-1	B C	199.77976
1004-2	B C	196.84991
1004-3	C	180.84328

Levels not connected by same letter are significantly different

LINER PN: Least Squares Means Table

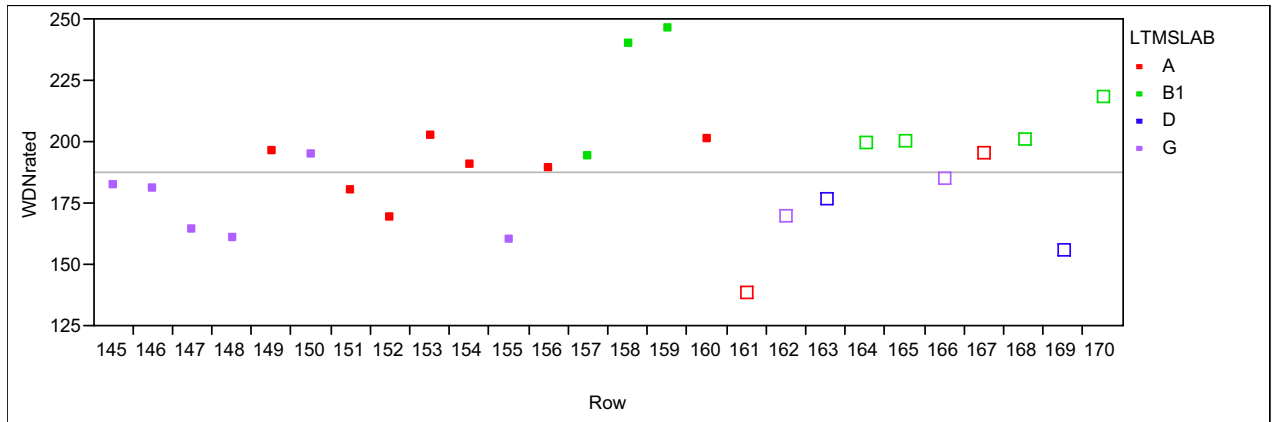
Level	Least Sq Mean	Std Error	Mean
1Y3555	225.10878	4.946226	213.118
1Y3998	214.79589	11.855706	184.180

LS Means Plot



WDN Rated: Analysis with OIL 1004-3 ONLY

WDNrated versus time: the square symbols represent the tests with new liner; different colors are used to identify Lab.



Summary of Fit

RSquare	0.561713
RSquare Adj	0.47823
Root Mean Square Error	17.46268
Mean of Response	188.1769
Observations (or Sum Wgts)	26

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	4	8207.235	2051.81	6.7284
Error	21	6403.852	304.95	Prob > F
C. Total	25	14611.086		0.0012

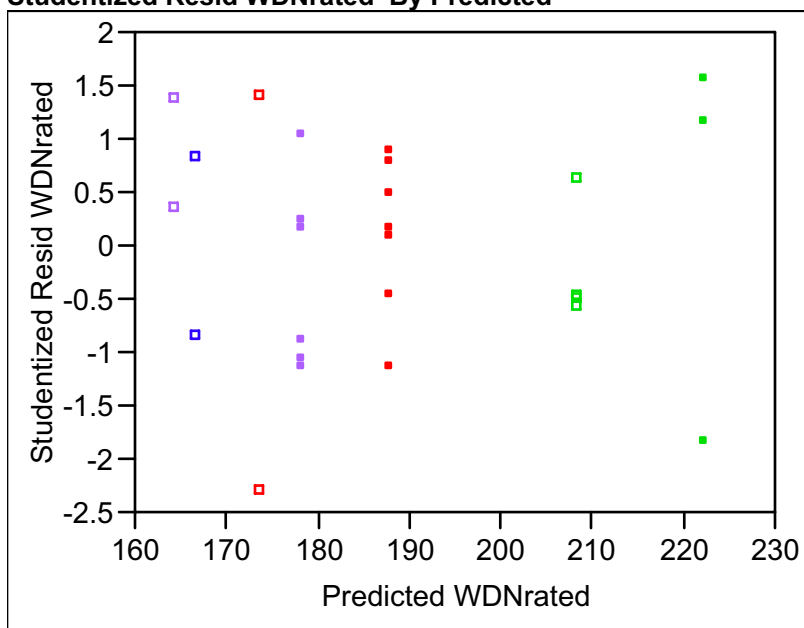
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	185.19368	4.093891	45.24	<.0001
LTMSLAB [A]	-4.500915	6.246756	-0.72	0.4791
LTMSLAB [B1]	30.096755	6.226417	4.83	<.0001
LTMSLAB [D]	-11.66065	10.40584	-1.12	0.2751
LINERPN[1Y3555]	7.0330283	3.997873	1.76	0.0931

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	3	3	7947.6344	8.6875	0.0006
LINERPN	1	1	943.7319	3.0948	0.0931

Studentized Resid WDNrated By Predicted



LAB Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
A	180.69276	6.230236	184.600
B1	215.29043	6.624938	214.286
D	173.53303	12.979047	166.500
G	171.25849	6.489523	174.775

Lab: LSMeans Differences Tukey HSD

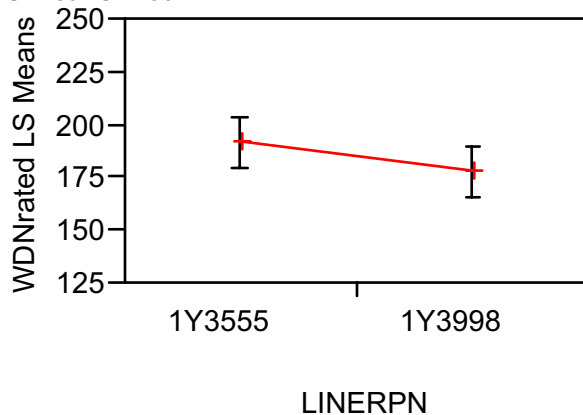
Level	Least Sq Mean
B1 A	215.29043
A B	180.69276
D B	173.53303
G B	171.25849

Levels not connected by same letter are significantly different

LINER PN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	192.22671	5.7827850	190.675
1Y3998	178.16065	5.6608535	184.180

LS Means Plot



LN TLHC rated plus 1: Analysis with all oils

Summary of Fit

RSquare	0.14855
RSquare Adj	0.086159
Root Mean Square Error	0.82006
Mean of Response	0.591183
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	17	27.22022	1.60119	2.3810
Error	232	156.01958	0.67250	Prob > F
C. Total	249	183.23980		0.0021

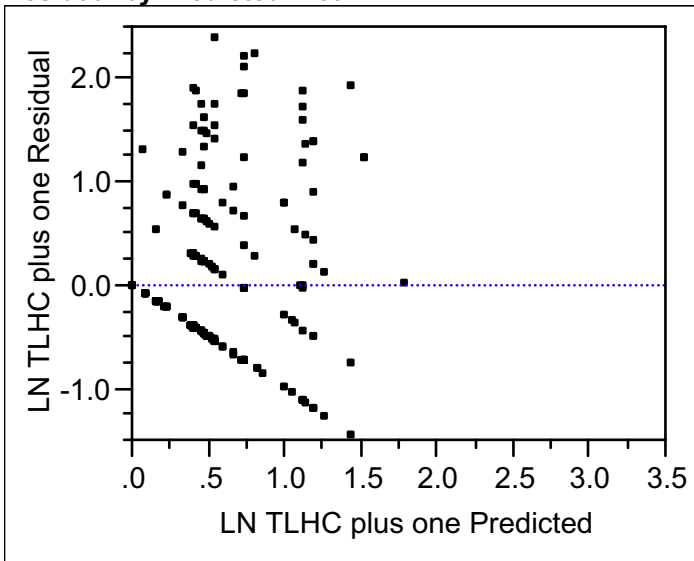
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	1.2198128	0.204477	5.97	<.0001
LTMSLAB [A]	-0.073671	0.133476	-0.55	0.5815
LTMSLAB [B]	0.2506496	0.161814	1.55	0.1227
LTMSLAB [B1]	-0.148858	0.34924	-0.43	0.6703
LTMSLAB [C]	0.0686655	0.209873	0.33	0.7438
LTMSLAB [D]	-0.472553	0.233872	-2.02	0.0445
LTMSLAB [F]	0.3382309	0.34458	0.98	0.3273
LTMSLAB [G]	-0.00947	0.116822	-0.08	0.9355
LTMSLAB [I]	-0.055834	0.151838	-0.37	0.7134
LTMSLAB [J]	-0.390925	0.252976	-1.55	0.1236
LTMSLAB [K]	-0.148947	0.231712	-0.64	0.5210
IND [1004]	-0.161625	0.220023	-0.73	0.4633
IND [1004-1]	-0.284214	0.149415	-1.90	0.0584
IND [1004-2]	-0.200061	0.186576	-1.07	0.2847
IND [1004-3]	-0.524436	0.22952	-2.28	0.0232
IND [809-1]	0.4313895	0.178358	2.42	0.0163
IND [810-2]	1.0324527	0.708399	1.46	0.1463
LINERP[1Y3555]	-0.451036	0.172668	-2.61	0.0096

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	8.155172	1.2127	0.2836
IND	6	6	17.018741	4.2178	0.0005
LINERP	1	1	4.588688	6.8233	0.0096

Residual by Predicted Plot



LAB: LSMeans Differences Tukey HSD

Level		Least Sq Mean
N	A	1.8625250
F	A	1.5580437
B	A	1.4704624
C	A	1.2884783
G	A	1.2103424
I	A	1.1639786
A	A	1.1461422
B1	A	1.0709543
K	A	1.0708661
J	A	0.8288882
D	A	0.7472598

Levels not connected by same letter are significantly different

Oil Type: Least Squares Means Table

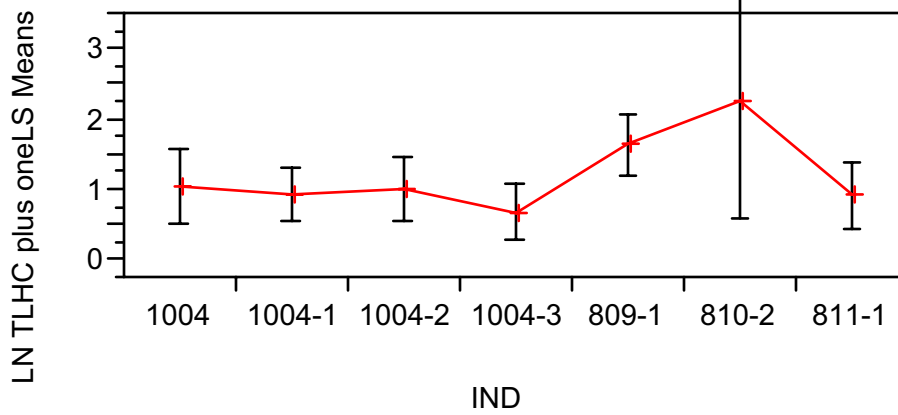
Level	Least Sq Mean	Std Error	Mean
1004	1.0581875	0.26899427	0.56170
1004-1	0.9355989	0.18772849	0.50758
1004-2	1.0197518	0.23482152	0.44187
1004-3	0.6953771	0.20033904	0.48645
809-1	1.6512023	0.22431629	1.17232
810-2	2.2522655	0.84339785	1.79176
811-1	0.9263065	0.23257984	0.46171

LSMeans Differences Tukey HSD

Level		Least Sq Mean
810-2	A B	2.2522655
809-1	A	1.6512023
1004	A B	1.0581875
1004-2	B	1.0197518
1004-1	B	0.9355989
811-1	B	0.9263065
1004-3	B	0.6953771

Levels not connected by same letter are significantly different

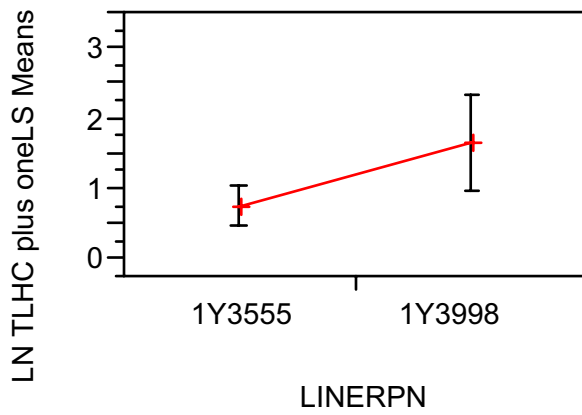
LS Means Plot



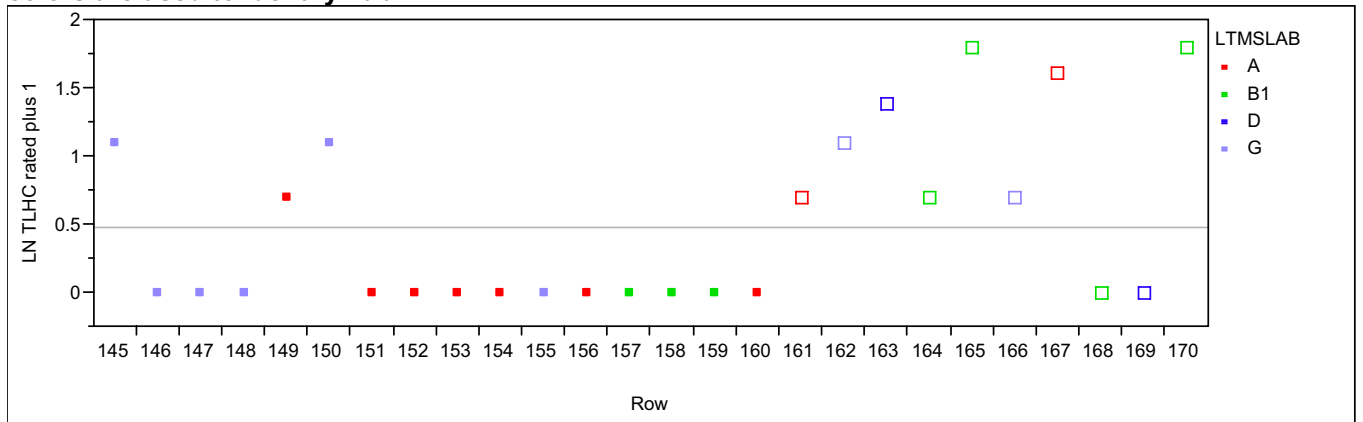
LINER PN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	0.7687772	0.14573002	0.575160
1Y3998	1.6708484	0.34930317	0.975731

LS Means Plot



LN TLHC versus time: the square symbols represent the tests with new liner; different colors are used to identify Lab.



LN BSOC Rated: Analysis with all oils

Summary of Fit

RSquare	0.301351
RSquare Adj	0.250157
Root Mean Square Error	0.290045
Mean of Response	-1.6305
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	17	8.418461	0.495204	5.8864
Error	232	19.517266	0.084126	Prob > F
C. Total	249	27.935726		<.0001

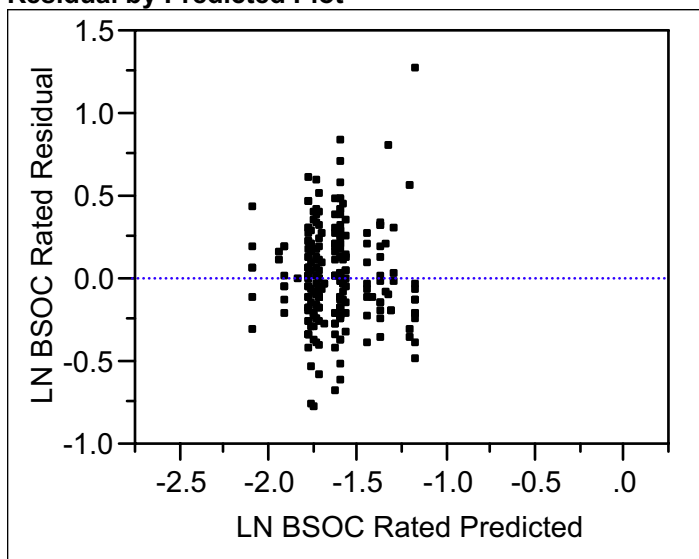
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-1.541744	0.072321	-21.32	<.0001
LTMSLAB [A]	0.0661507	0.047209	1.40	0.1625
LTMSLAB [B]	0.0632953	0.057232	1.11	0.2699
LTMSLAB [B1]	0.2323655	0.123522	1.88	0.0612
LTMSLAB [C]	-0.067873	0.07423	-0.91	0.3615
LTMSLAB [D]	0.0396922	0.082718	0.48	0.6318
LTMSLAB [F]	-0.087447	0.121874	-0.72	0.4738
LTMSLAB [G]	-0.12045	0.041318	-2.92	0.0039
LTMSLAB [I]	-0.053372	0.053703	-0.99	0.3213
LTMSLAB [J]	-0.06997	0.089474	-0.78	0.4350
LTMSLAB [K]	-0.102006	0.081954	-1.24	0.2145
IND [1004]	-0.006334	0.077819	-0.08	0.9352
IND [1004-1]	-0.032682	0.052846	-0.62	0.5369
IND [1004-2]	-0.029225	0.06599	-0.44	0.6583
IND [1004-3]	-0.347322	0.081178	-4.28	<.0001
IND [809-1]	0.3848296	0.063083	6.10	<.0001
IND [810-2]	-0.090515	0.250552	-0.36	0.7182
LINERPN[1Y3555]	-0.079873	0.061071	-1.31	0.1922

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	1.8238627	2.1680	0.0205
IND	6	6	7.0201190	13.9079	<.0001
LINERPN	1	1	0.1439016	1.7105	0.1922

Residual by Predicted Plot



LAB: LSMeans Differences Tukey HSD

Level			Least Sq Mean
B1	A	B	-1.309378
N	A	B	-1.442130
A	A		-1.475593
B	A	B	-1.478449
D	A	B	-1.502052
I	A	B	-1.595115
C	A	B	-1.609616
J	A	B	-1.611714
F	A	B	-1.629191
K	A	B	-1.643750
G		B	-1.662194

Levels not connected by same letter are significantly different

OIL TYPE: Least Squares Means Table

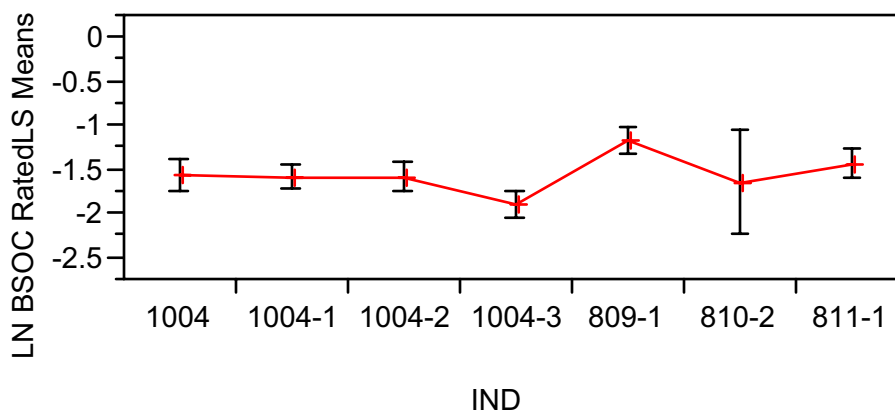
Level	Least Sq Mean	Std Error	Mean
1004	-1.548078	0.09513996	-1.6773
1004-1	-1.574426	0.06639725	-1.6851
1004-2	-1.570969	0.08305348	-1.6802
1004-3	-1.889066	0.07085745	-1.8560
809-1	-1.156914	0.07933791	-1.2764
810-2	-1.632259	0.29829943	-1.8326
811-1	-1.420495	0.08226062	-1.5444

LSMeans Differences Tukey HSD

Level			Least Sq Mean
809-1	A		-1.156914
811-1		B	-1.420495
1004		B	-1.548078
1004-2		B	-1.570969
1004-1		B	-1.574426
810-2	A	B C	-1.632259
1004-3		C	-1.889066

Levels not connected by same letter are significantly different

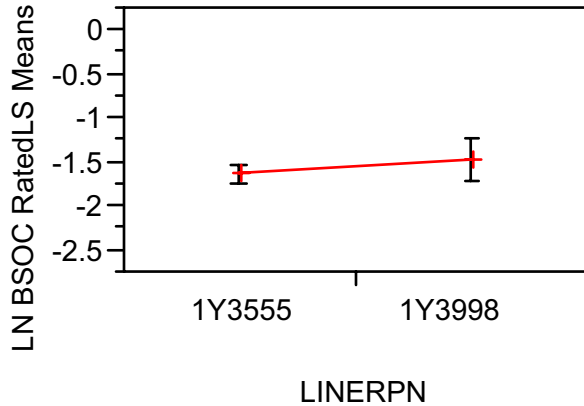
LS Means Plot



LINER PN: Least Squares Means Table

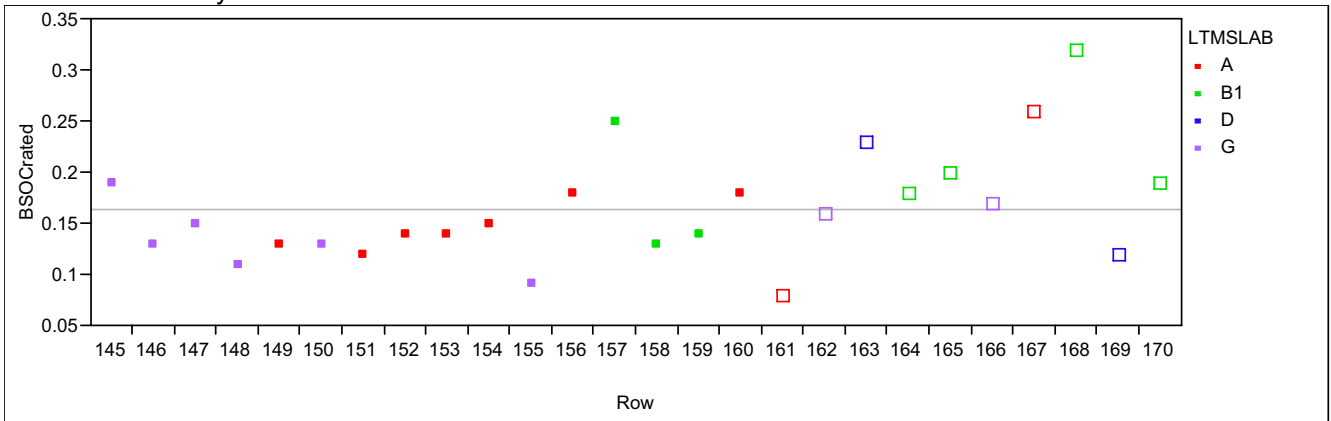
Level	Least Sq Mean	Std Error	Mean
1Y3555	-1.621617	0.05154291	-1.6268
1Y3998	-1.461871	0.12354423	-1.7192

LS Means Plot



LN BSOC Rated: Analysis with OIL 1004-3 ONLY

BSOC rated versus time: the square symbols represent the tests with new liner; different colors are used to identify Lab.



Summary of Fit

RSquare	0.241847
RSquare Adj	0.097437
Root Mean Square Error	0.302735
Mean of Response	-1.85605
Observations (or Sum Wgts)	26

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	4	0.6139468	0.153487	1.6747	
Error	21	1.9246237	0.091649		0.1934
C. Total	25	2.5385704			

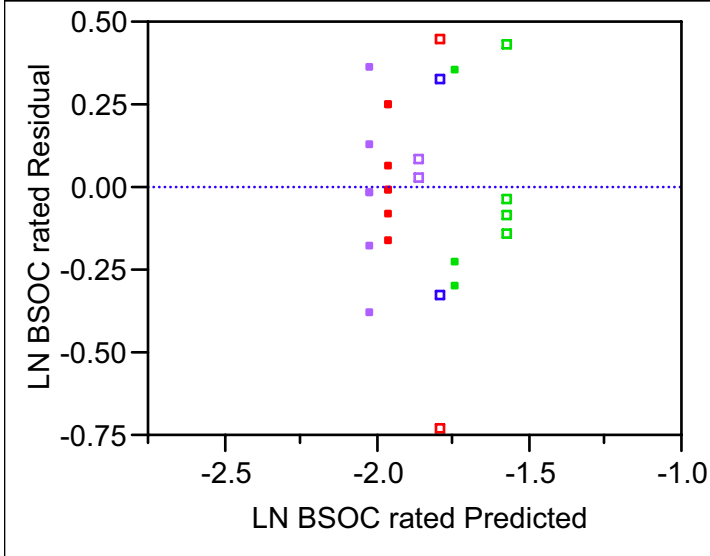
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-1.837768	0.070972	-25.89	<.0001
LTMSLAB [A]	-0.037779	0.108295	-0.35	0.7307
LTMSLAB [B1]	0.1806984	0.107942	1.67	0.1090
LTMSLAB [D]	-0.039662	0.180397	-0.22	0.8281
LINERP[1Y3555]	-0.082461	0.069308	-1.19	0.2474

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	3	3	0.30948504	1.1256	0.3613
LINERPN	1	1	0.12973495	1.4156	0.2474

Residual by Predicted Plot



LTMSLAB: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
A	-1.875547	0.10800820	-1.9214
B1	-1.657070	0.11485082	-1.6453
D	-1.877430	0.22500650	-1.7950
G	-1.941026	0.11250325	-1.9823

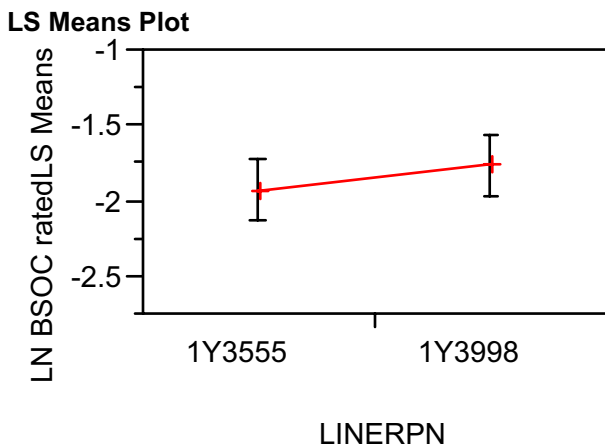
LSMeans Differences Tukey HSD

Level	Least Sq Mean
B1 A	-1.657070
A A	-1.875547
D A	-1.877430
G A	-1.941026

Levels not connected by same letter are significantly different

LINER PN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	-1.920229	0.10025114	-1.9416
1Y3998	-1.755308	0.09813732	-1.7192



General information about the 1N:

There are 250 tests with Chart = YES.

Distribution of tests by Oil

IND	N
1004-1	114
1004-2	30
1004-3	26
809-1	34
810-2	1
811-1	29
1004	16

Distribution of tests by Oil/ Lab

IND	LTMSLAB	N Rows	N
1004-1	A	16	16
1004-1	B	22	22
1004-1	C	10	10
1004-1	D	3	3
1004-1	F	3	3
1004-1	G	29	29
1004-1	I	16	16
1004-1	J	4	4
1004-1	K	8	8
1004-1	N	3	3
1004-2	A	6	6
1004-2	B	2	2
1004-2	D	4	4
1004-2	G	8	8
1004-2	I	6	6
1004-2	J	4	4
1004-3	A	9	9
1004-3	B1	7	7
1004-3	D	2	2
1004-3	G	8	8
809-1	A	7	7
809-1	B	3	3
809-1	C	2	2
809-1	D	3	3

IND	LTMSLAB	N Rows	N
809-1	F	2	2
809-1	G	12	12
809-1	I	3	3
809-1	K	2	2
810-2	G	1	1
811-1	A	7	7
811-1	B	1	1
811-1	C	1	1
811-1	G	12	12
811-1	I	6	6
811-1	J	1	1
811-1	N	1	1
1004	A	3	3
1004	B	1	1
1004	C	2	2
1004	G	4	4
1004	I	3	3
1004	J	1	1
1004	K	2	2

Distribution of tests by Lab/Stand:

LTMSLAB	LTMSAPP	N
A	1	7
A	11	9
A	12	1
A	2	3
A	3	11
A	4	4
A	5	6
A	6	2
A	7	1
A	8	3
A	9	1
B	1	6
B	10	4
B	2	3
B	3	1
B	4	2
B	5	2
B	6	4
B	7	2
B	8	3
B	9	2
B1	1A	4
B1	3A	3
C	1	4
C	2	3
C	3	4
C	5	2
C	7	2
D	1	12
F	1	2
F	2	1
F	3	1
F	5	1
G	1	6
G	10	2
G	11	3
G	12	2
G	13	2
G	14	1
G	18	1
G	2	4
G	3	2
G	4	3
G	5	6

LTMSLAB	LTMSAPP	N
G	6	6
G	7	6
G	8	13
G	9	17
I	5A	2
I	1	4
I	2	4
I	3	6
I	4	5
I	5	5
I	7	5
I	8	3
J	1	5
J	2	5
K	1	1
K	2	5
K	3	3
K	4	3
N	1	1
N	2	2
N	3	1

Analysis considering the several re-blends of oil 1004 equivalent, as requested by Scott Parke

Summary:

- ❑ **TGFrated** (no transformation): **No liner discrimination**
- ❑ **WDN rated** (no transformation): **Liner discrimination**
 - The conclusion based on the analysis for oil 1004-3 ONLY – Marginal significant difference between liners – changes and the difference is now clearly significant when re-blends of 1004 are considered equivalent. The difference between the liners is 11.864: liner 1Y3555 higher than 1Y3998.
- ❑ **LN TLHC plus one:** **Liner discrimination** liner differences for Marginal
 - The difference between the liners is -0.358; liner 1Y3555 lower than 1Y3998.
- ❑ **BSOC rated** (no transformation) **No liner discrimination** with or without test 18077 (test with BSOC=1.1)

Detailed analyses by parameter:

TGFrated: no transformation
No liner discrimination

Summary of Fit

RSquare	0.124743
RSquare Adj	0.0726
Root Mean Square Error	16.25376
Mean of Response	27.44
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	14	8848.193	632.014	2.3923
Error	235	62083.407	264.185	Prob > F
C. Total	249	70931.600		0.0039

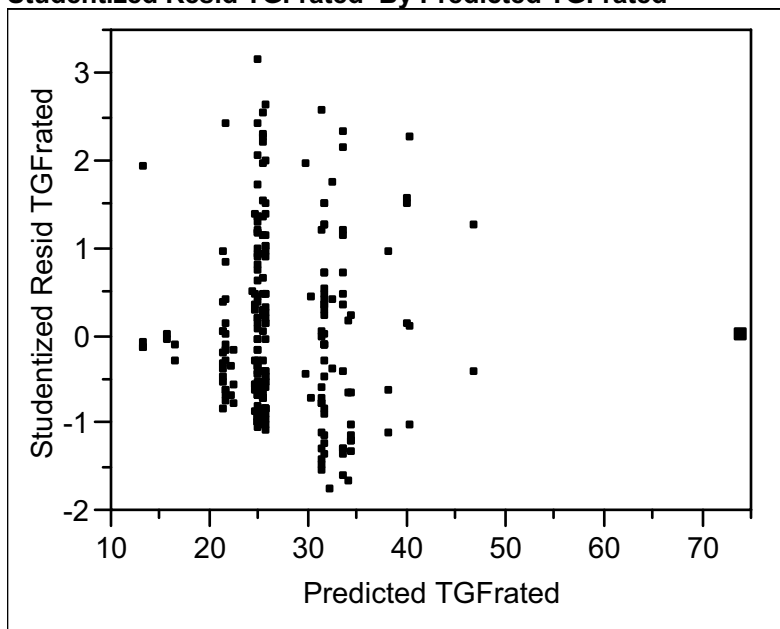
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	37.128784	5.193651	7.15	<.0001
LTMSLAB [A]	-1.555909	2.610792	-0.60	0.5518
LTMSLAB [B]	-1.693263	3.15359	-0.54	0.5918
LTMSLAB [B1]	-4.849064	6.497679	-0.75	0.4562
LTMSLAB [C]	-5.532144	4.105133	-1.35	0.1791
LTMSLAB [D]	4.0656332	4.557474	0.89	0.3733
LTMSLAB [F]	10.953489	6.805726	1.61	0.1089
LTMSLAB [G]	-2.271492	2.312906	-0.98	0.3271
LTMSLAB [J]	4.4053025	2.980863	1.48	0.1408
LTMSLAB [J]	-2.67496	4.923729	-0.54	0.5875
LTMSLAB [K]	-5.997955	4.531822	-1.32	0.1869
IND2[1004]	-14.33687	4.330999	-3.31	0.0011
IND2[809-1]	-5.700202	4.676213	-1.22	0.2241
IND2[810-2]	34.542776	12.28905	2.81	0.0054
LINERPN[1Y3555]	4.5999319	3.034242	1.52	0.1309

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	3033.4425	1.1482	0.3272
IND2	3	3	4329.5758	5.4628	0.0012
LINERPN	1	1	607.1698	2.2983	0.1309

Studentized Resid TGFrated By Predicted TGFrated



LTMSLAB: LSMeans Differences Tukey HSD

Level	Least Sq Mean
F A	48.082273
N A	42.279148
I A	41.534087
D A	41.194418
A A	35.572875
B A	35.435521
G A	34.857292
J A	34.453824
B1 A	32.279721
C A	31.596640
K A	31.130830

Levels not connected by same letter are significantly different

Oil Type: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1004	22.791911	2.992262	25.8441
809-1	31.428582	4.140620	35.4706
810-2	71.671560	16.649124	74.0000
811-1	22.623084	4.327169	26.6552

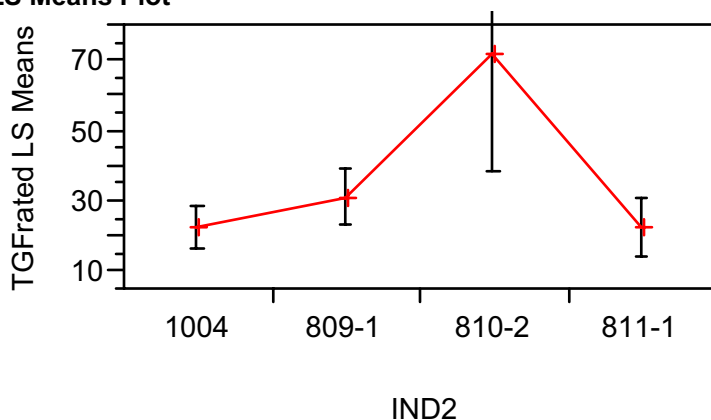
LSMeans Differences Tukey HSD

Mean[i]-Mean[j]	1004	809-1	810-2	811-1
Std Err Dif				
Lower CL Dif				
Upper CL Dif				
1004	0	-8.6367	-48.88	0.16883
	0	3.09947	16.3859	3.32371
	0	-16.657	-91.279	-8.4314
	0	-0.6167	-6.4808	8.76901
809-1	8.63667	0	-40.243	8.8055
	3.09947	0	16.5638	4.19799
	0.6167	0	-83.102	-2.0569
	16.6566	0	2.61622	19.6679
810-2	48.8796	40.243	0	49.0485
	16.3859	16.5638	0	16.5936
	6.48076	-2.6162	0	6.11197
	91.2785	83.1022	0	91.985
811-1	-0.1688	-8.8055	-49.048	0
	3.32371	4.19799	16.5936	0
	-8.769	-19.668	-91.985	0
	8.43136	2.05691	-6.112	0

Level		Least Sq Mean
810-2	A	71.671560
809-1	A B	31.428582
1004	C	22.791911
811-1	B C	22.623084

Levels not connected by same letter are significantly different

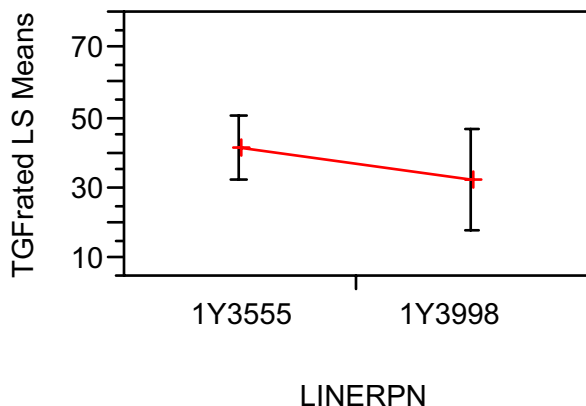
LS Means Plot



LINERPN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	41.728716	4.4404131	27.9042
1Y3998	32.528852	7.2556180	16.3000

LS Means Plot



WDN rated: no transformation

Liner discrimination: Marginal liner differences for oil 1004-3 ONLY are now significant when re-blends of 1004 are considered equivalent. The difference between the liners is 11.864: liner 1Y3555 higher than 1Y3998.

Summary of Fit

RSquare	0.469907
RSquare Adj	0.438327
Root Mean Square Error	28.60968
Mean of Response	211.9608
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	14	170511.64	12179.4	14.8799	
Error	235	192350.78	818.5		Prob > F
C. Total	249	362862.42			<.0001

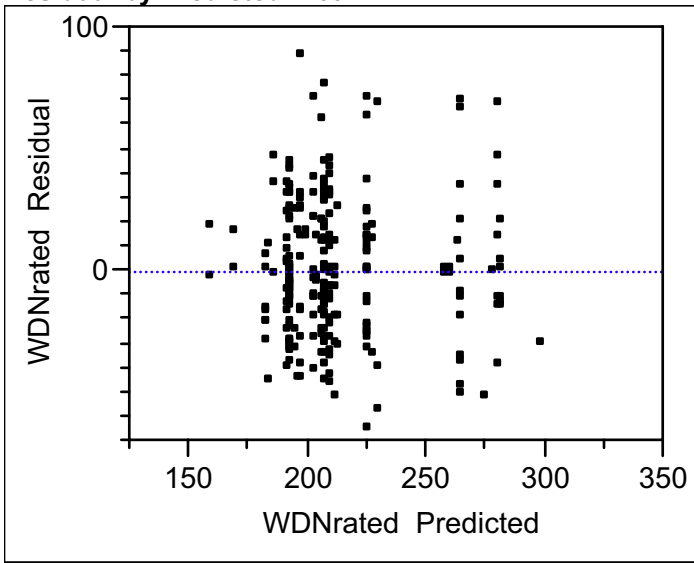
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	228.09419	9.141805	24.95	<.0001
LTMSLAB [A]	3.8897732	4.595487	0.85	0.3982
LTMSLAB [B]	21.902434	5.550914	3.95	0.0001
LTMSLAB [B1]	23.572237	11.43714	2.06	0.0404
LTMSLAB [C]	-12.56941	7.225808	-1.74	0.0833
LTMSLAB [D]	-21.71905	8.022013	-2.71	0.0073
LTMSLAB [F]	-9.141178	11.97936	-0.76	0.4462
LTMSLAB [G]	-11.13572	4.07115	-2.74	0.0067
LTMSLAB [I]	5.2371536	5.24688	1.00	0.3192
LTMSLAB [J]	2.4064774	8.666691	0.28	0.7815
LTMSLAB [K]	-0.817864	7.976862	-0.10	0.9184
IND2[1004]	-35.68582	7.623374	-4.68	<.0001
IND2[809-1]	-31.41447	8.231016	-3.82	0.0002
IND2[810-2]	30.577268	21.63105	1.41	0.1588
LINERP[1Y3555]	11.864267	5.340838	2.22	0.0273

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	36217.70	4.4248	<.0001
IND2	3	3	128409.04	52.2936	<.0001
LINERP	1	1	4039.14	4.9347	0.0273

Residual by Predicted Plot

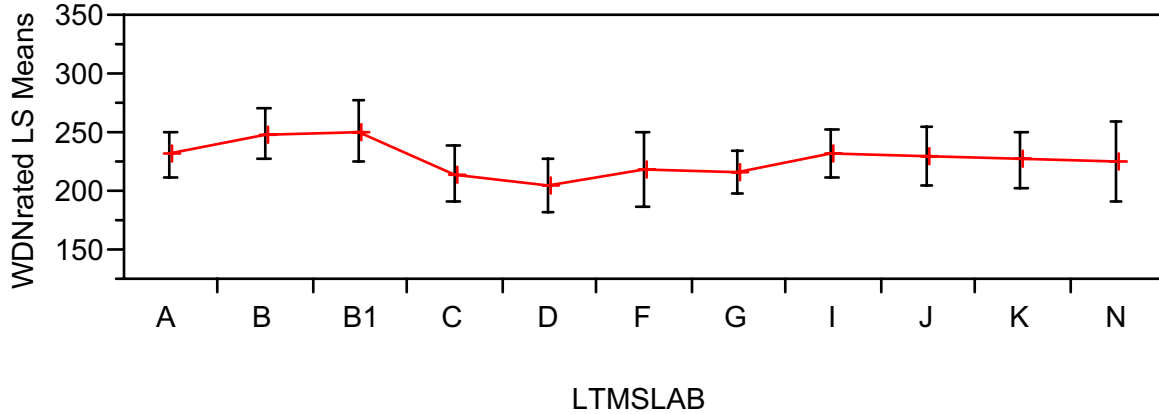


LTMSLAB: LSMeans Differences Tukey HSD

Level			Least Sq Mean
B1	A	B	251.66643
B	A		249.99662
I	A	B	233.33134
A	A	B	231.98396
J	A	B	230.50067
K	A	B	227.27632
N	A	B	226.46934
F	A	B	218.95301
G		B	216.95847
C		B	215.52478
D		B	206.37513

Levels not connected by same letter are significantly different

LS Means Plot



Oil Type: Least Squares Means Table

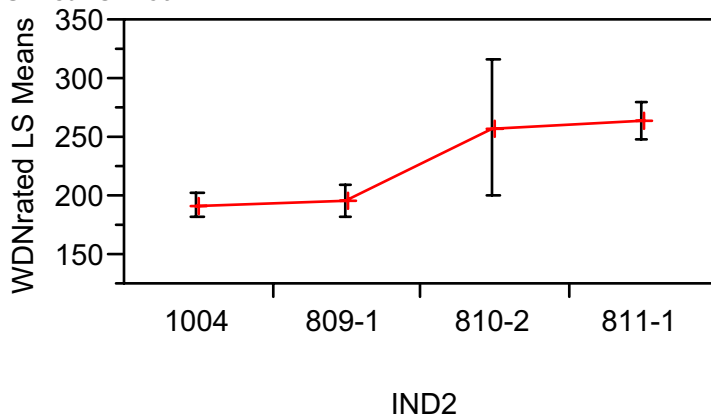
Level	Least Sq Mean	Std Error	Mean
1004	192.40837	5.266946	203.346
809-1	196.67972	7.288272	204.568
810-2	258.67146	29.305598	259.400
811-1	264.61721	7.616633	274.245

LSMeans Differences Tukey HSD

Level			Least Sq Mean
811-1	A		264.61721
810-2	A	B	258.67146
809-1		B	196.67972
1004		B	192.40837

Levels not connected by same letter are significantly different

LS Means Plot



LINERPN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	239.95846	7.815965	213.118
1Y3998	216.22992	12.771256	184.180

LN TLHC plus one: Liner discrimination

The difference between the liners is -0.358; liner 1Y3555 lower than 1Y3998.

Summary of Fit

RSquare	0.141998
RSquare Adj	0.090883
Root Mean Square Error	0.817938
Mean of Response	0.591183
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	14	26.01963	1.85855	2.7780	
Error	235	157.22017	0.66902		
C. Total	249	183.23980			0.0008

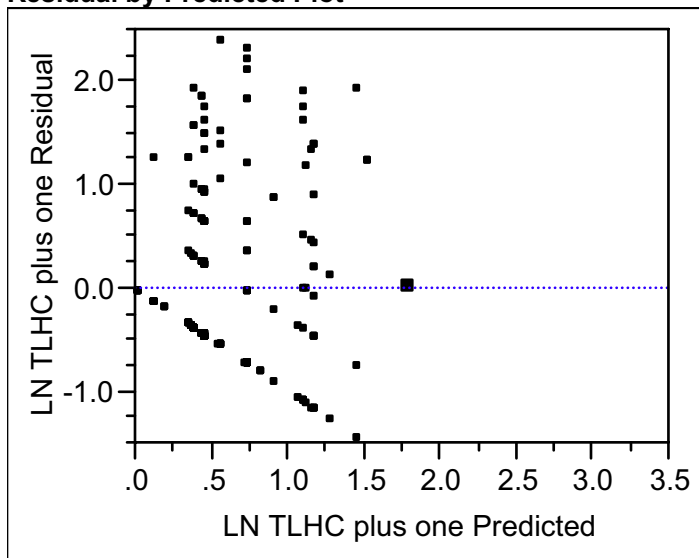
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	1.3473097	0.26136	5.15	<.0001
LTMSLAB [A]	-0.090763	0.131383	-0.69	0.4904
LTMSLAB [B]	0.2624809	0.158698	1.65	0.0995
LTMSLAB [B1]	-0.281337	0.326983	-0.86	0.3904
LTMSLAB [C]	0.0869052	0.206583	0.42	0.6744
LTMSLAB [D]	-0.451589	0.229346	-1.97	0.0501
LTMSLAB [F]	0.3404597	0.342484	0.99	0.3212
LTMSLAB [G]	-0.012683	0.116392	-0.11	0.9133
LTMSLAB [I]	-0.028188	0.150006	-0.19	0.8511
LTMSLAB [J]	-0.343277	0.247777	-1.39	0.1672
LTMSLAB [K]	-0.126662	0.228055	-0.56	0.5791
IND2[1004]	-0.506184	0.217949	-2.32	0.0211
IND2[809-1]	0.2078086	0.235321	0.88	0.3781
IND2[810-2]	0.8152794	0.618422	1.32	0.1887
LINERPN[1Y3555]	-0.358147	0.152692	-2.35	0.0198

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	8.613028	1.2874	0.2383
IND2	3	3	15.818150	7.8812	<.0001
LINERPN	1	1	3.680692	5.5016	0.0198

Residual by Predicted Plot



LTMSLAB : LSMeans Differences Tukey HSD

Level	Least Sq Mean	
N	A	1.9919634
F	A	1.6877695
B	A	1.6097906
C	A	1.4342149
G	A	1.3346268
I	A	1.3191213
A	A	1.2565468
K	A	1.2206475
B1	A	1.0659728
J	A	1.0040325
D	A	0.8957210

Levels not connected by same letter are significantly different

Oil Type: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1004	0.8411254	0.15057955	0.49868
809-1	1.5551183	0.20836834	1.17232
810-2	2.1625892	0.83783353	1.79176
811-1	0.8304060	0.21775602	0.46171

LSMeans Differences Tukey HSD

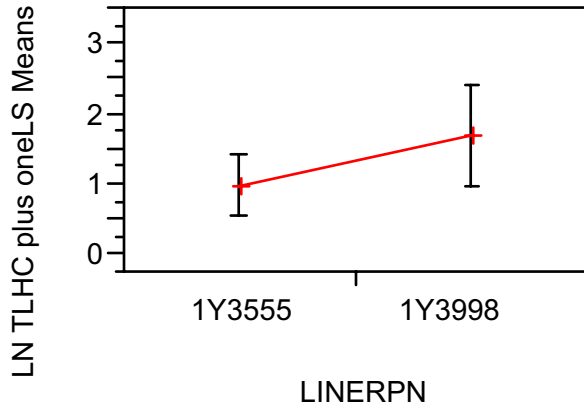
Level	Least Sq Mean	
810-2	A B	2.1625892
809-1	A	1.5551183
1004	B	0.8411254
811-1	B	0.8304060

Levels not connected by same letter are significantly different

LINERPN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	0.9891629	0.22345482	0.575160
1Y3998	1.7054565	0.36512432	0.975731

LS Means Plot



BSOC rated: no transformation

No liner discrimination with or without test 18077 (with BSOC=1.1)

Summary of Fit

RSquare	0.228999
RSquare Adj	0.183067
Root Mean Square Error	0.081273
Mean of Response	0.20832
Observations (or Sum Wgts)	250

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	14	0.4610422	0.032932	4.9856
Error	235	1.5522522	0.006605	Prob > F
C. Total	249	2.0132944		<.0001

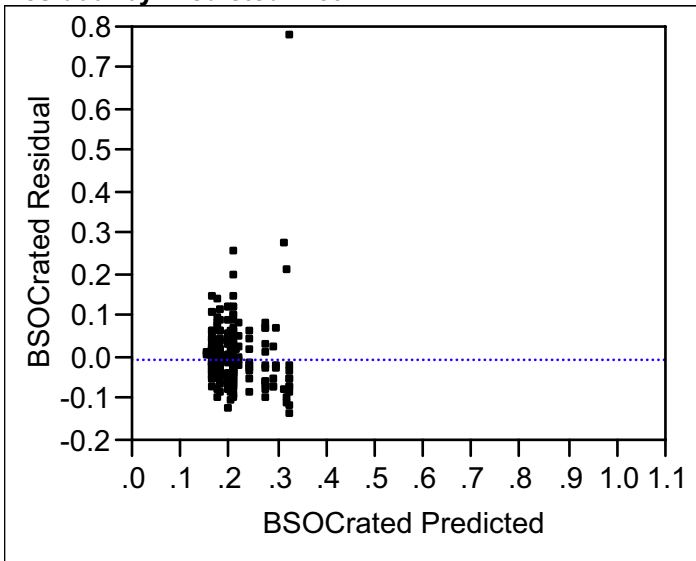
Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	0.2266636	0.02597	8.73	<.0001
LTMSLAB [A]	0.015947	0.013055	1.22	0.2231
LTMSLAB [B]	0.0177731	0.015769	1.13	0.2608
LTMSLAB [B1]	0.0111716	0.03249	0.34	0.7313
LTMSLAB [C]	-0.016276	0.020527	-0.79	0.4286
LTMSLAB [D]	0.0113754	0.022789	0.50	0.6181
LTMSLAB [F]	0.0096189	0.03403	0.28	0.7777
LTMSLAB [G]	-0.029149	0.011565	-2.52	0.0124
LTMSLAB [I]	-0.009194	0.014905	-0.62	0.5379
LTMSLAB [J]	-0.013224	0.02462	-0.54	0.5917
LTMSLAB [K]	-0.014589	0.02266	-0.64	0.5203
IND2[1004]	-0.035847	0.021656	-1.66	0.0992
IND2[809-1]	0.0782626	0.023382	3.35	0.0010
IND2[810-2]	-0.041435	0.061449	-0.67	0.5008
LINERP[1Y3555]	0.0039204	0.015172	0.26	0.7963

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
LTMSLAB	10	10	0.08930980	1.3521	0.2038
IND2	3	3	0.36595516	18.4677	<.0001
LINERP	1	1	0.00044103	0.0668	0.7963

Residual by Predicted Plot



LTMSLAB: LSMeans Differences Tukey HSD

Level		Least Sq Mean
B	A	0.24443675
N	A	0.24320968
A	A	0.24261067
D	A	0.23803903
B1	A	0.23783523
F	A	0.23628252
I	A	0.21746960
J	A	0.21343958
K	A	0.21207465
C	A	0.21038722
G	A	0.19751494

Levels not connected by same letter are significantly different

Oil Type: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1004	0.19081703	0.01496212	0.189624
809-1	0.30492618	0.02070421	0.302353
810-2	0.18522826	0.08325010	0.160000
811-1	0.22568304	0.02163701	0.219655

LSMeans Differences Tukey HSD

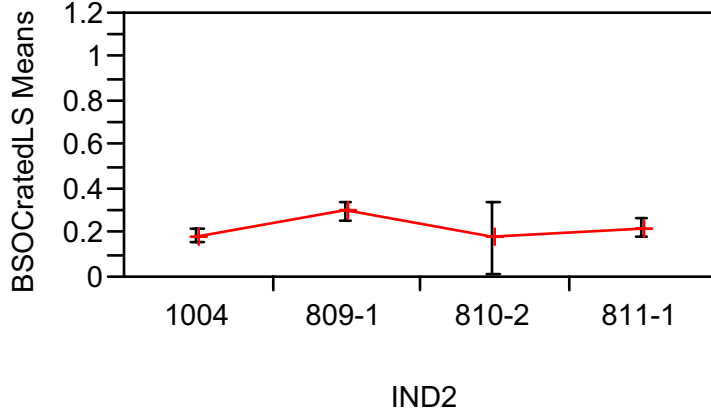
Mean[i]-Mean[j]	1004	809-1	810-2	811-1
Std Err Dif				
Lower CL Dif				
Upper CL Dif				
1004	0	-0.1141	0.00559	-0.0349
	0	0.0155	0.08193	0.01662
	0	-0.1542	-0.2064	-0.0779
	0	-0.074	0.21759	0.00814
809-1	0.11411	0	0.1197	0.07924
	0.0155	0	0.08282	0.02099
	0.07401	0	-0.0946	0.02493
	0.15421	0	0.33401	0.13356
810-2	-0.0056	-0.1197	0	-0.0405
	0.08193	0.08282	0	0.08297
	-0.2176	-0.334	0	-0.2551
	0.20642	0.09461	0	0.17424
811-1	0.03487	-0.0792	0.04045	0

	0.01662	0.02099	0.08297	0
	-0.0081	-0.1336	-0.1742	0
	0.07787	-0.0249	0.25515	0

Level		Least Sq Mean
809-1	A	0.30492618
811-1	B	0.22568304
1004	B	0.19081703
810-2	A B	0.18522826

Levels not connected by same letter are significantly different

LS Means Plot



LINERPN: Least Squares Means Table

Level	Least Sq Mean	Std Error	Mean
1Y3555	0.23058405	0.02220326	0.209042
1Y3998	0.22274320	0.03628004	0.191000

LS Means Plot

