Results of Proficiency Test
Benzene & Toluene
April 2010

Organised by: Institute for Interlaboratory Studies (i.i.s.)
Spijkenisse Netherlands

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1 INTRODUCTION

Since 1999, the Institute for Interlaboratory Studies organizes a proficiency test for the analysis of Benzene and Toluene. In the 2010 interlaboratory study on Benzene and Toluene, 48 laboratories from 22 different countries have participated. See appendix 2 for a list of participants in alphabetical country order.
In this report, the results of the proficiency test Benzene and Toluene are presented and discussed.

2 SET UP

The Institute for Interlaboratory Studies (i.i.s.) in Spijkenisse, The Netherlands, was the organizer of this proficiency test. Sample analyses for fit-for-use and homogeneity testing were subcontracted. The participants received depending on their registration: 1 bottle of 1 litre Benzene (sample #1034) and 1 bottle of 1 litre Toluene (sample #1035).
In order to collect sufficient data for a statistical evaluation, the participants were asked to send in rounded and unrounded results. The unrounded were preferred used for statistical evaluation.

2.1 ACCREDITATION

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in accordance with ISO guide 43 and ILAC-G13:2007, (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie), see www.rva.nl. This ensures 100% confidentiality of participant's data. Also, customer's satisfaction is measured on a regular basis by sending out questionnaires. The analysis did subcontract to an accredited laboratory.

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'I.I.S. Interlaboratory Studies: Protocol for the Organization, Statistics and Evaluation' (i.i.s.-protocol, version 3.2) of January 2010.

2.3 CONFIDENTIALITY STATEMENT

All data present in this report must be regarded as confidential and for use by the participating companies only. Disclosure of the information in this report is only allowed by means of the entire report. Use of the contents of this report for third parties is only allowed by written permission of the Institute for Interlaboratory Studies. Disclosure of the identity of one or more of the participating companies will be done only after receipt of a written agreement of the companies involved.

2.4 SAMPLES

BENZENE

The necessary bulk material of Benzene was obtained from a local chemical producer. The approximately 75 litre was spiked with 524.4 mg 1-Methyl-2-Pyrrolidinone (for the Nitrogen determination) and 367.0 mg Chlorotoluene (for the Organic Chlorine determination). The bulk sample was, after homogenisation, divided over 62 amber glass bottles of 1 litre, labelled #1034. The homogeneity of the subsamples #1034 was checked by determination of Organic Chlorine in accordance with ASTM D5808:09a, density @ 20°C in accordance with ASTM D4052:02e1 and Toluene content according to ASTM D4492:10, on 8 stratified random selected samples.

Benzene	Organic Chlorine in mg/kg	Density (20°C) in kg/L	Toluene In %M/M
sample #1034-1	2.0	0.87895	0.060
sample #1034-2	1.9	0.87895	0.059
sample #1034-3	1.8	0.87894	0.058
sample #1034-4	1.8	0.87894	0.060
sample #1034-5	1.8	0.87895	0.057
sample #1034-6	1.7	0.08794	0.057
sample #1034-7	1.9	0.87894	0.059
sample #1034-8	1.9	0.87895	0.061

table 1: homogeneity of results of Benzene sub samples #1034

From the above test results the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibilities of the target methods, in agreement with the procedure of ISO 13528, Annex B2 in the next table;

	Organic Chlorine in mg/kg	Density (20°C) in kg/L	Toluene In %M/M
r (sample #1034)	0.3	0.00002	0.0040
target	ASTM D5808:09a	ASTM D4052:02e1	ASTM D4492:10
0.3*R (target)	0.4	0.00015	0.0084

table 2: repeatabilities of subsamples #1034

The calculated repeatabilities were in agreement with 0.3 times the corresponding target reproducibility. Therefore, homogeneity of the samples was assumed.

TOLUENE

The necessary bulk material of Toluene was purchased from a local chemical supplier. The approximately 60 litre was spiked with 3.64 g Styrene and 2.60 g Benzene. The bulk sample was, after homogenisation, divided over 58 brown glass bottles of 1 litre, labelled #1035. The homogeneity of the subsamples #1035 was checked by determination of Styrene, in accordance with the estimated repeatability limits calculated using the Horwitz equation and density @ 20°C according to ASTM D4052:02e[1].

Toluene	Styrene in mg/kg	Density (20°C) in kg/L
sample #1035-1	67	0.87153
sample #1035-2	67	0.87153
sample #1035-3	67	0.87153
sample #1035-4	67	0.87153
sample #1035-5	69	0.87153
sample #1035-6	68	0.87153
sample #1035-7	68	0.87153
sample #1035-8	67	0.87153

table 3: homogeneity of results of Toluene sub samples #1035

From the above test results the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibilities of the target methods, in agreement with the procedure of ISO 13528, Annex B2 in the next table;

	Styrene in mg/kg	Density (20°C) in kg/L
r (sample #1035)	2.1	0.00000
target	Horwitz	ASTM D4052:02e1
0.3*R (target)	4.8	0.00015

table 4: repeatabilities of subsamples #1035

The calculated repeatabilities were in agreement with 0.3 times the corresponding target reproducibility. Therefore, homogeneity of the samples was assumed.

The analyses for homogeneity determination were subcontracted to an accredited laboratory.
Depending on their registration to each of the participating laboratories one 1 litre bottle of Benzene labelled #1034 and/or one 1 litre bottle of Toluene labelled #1035 were sent on March 30, 2010.

2.5 STABILITY OF THE SAMPLES

The stability of Benzene and Toluene, packed in an amber glass bottles, was checked. The material was found sufficiently stable for the period of the proficiency test.

2.6 ANALYSES

The participants were requested to determine on Benzene sample #1034: Acid Wash Colour, Acidity, Appearance, Bromine Index, Colour Pt/Co, Density @ 20°C, Distillation, Organic Chlorine, Total Nitrogen, Solidification Point, Methylcyclohexane, Toluene, Nonaromatics and Purity.
On Toluene sample #1035 were requested: Acid Wash Colour, Appearance, Copper Corrosion, Colour Pt/Co, Density @ 20°C, Distillation, Purity, Nonaromatics, Benzene and Styrene.

To get maximum information for the statistical calculations, the participants were requested to report unrounded results and results below the usual lower reporting limits, where possible. To get comparable results a detailed report form, on which the units were prescribed, was sent together with each set of samples. Also, a letter of instructions and a SDS was added to the package.

3 RESULTS

During four weeks after sample despatch, the results of the individual laboratories were received. The original reported results are tabulated per determination in appendix 1 of this report. The laboratories are presented by their code numbers.

Directly after the deadline, a reminder fax was sent to those laboratories that had not yet reported any results at that moment.
Shortly after the deadline, the available results were screened for suspect data. A result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the results. Additional or corrected results are used for data analysis and original results are placed under 'Remarks' in the result tables in appendix 1.

3.1 STATISTICS

Statistical calculations were performed as described in the report ‘i.i.s Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation’ (i.i.s.-protocol, version 3.2) of January 2010.
For statistical evaluation the *unrounded* (when available) figures were used instead of the rounded results. Results reported as ‘<…’ or ‘>…’ were not used in the statistical evaluation.

First the normality of the distribution of the various data sets per determination was checked by means of the Lilliefors-test. After removal of outliers this check was repeated. Not all data sets proved to have a normal distribution, in which cases the results of the statistical evaluation should be used with due care.
In accordance to ISO 5725 (1986 and 1994) the original results per determination were subsequently submitted to Dixon and Grubbs outlier tests. Outliers are marked by D(0.01) for the Dixon test and by G(0.01) or DG(0.01) for the Grubbs test. Stragglers are marked by D(0.05) for the Dixon test and by G(0.05) or DG(0.05) for the Grubbs test. Both outliers and stragglers were not included in the calculations of the averages and the standard deviations.
Finally, the reproducibilities were calculated from the standard deviations by multiplying these with a factor of 2.8.

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis.
The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle. Furthermore, Kernel Density Graphs were made. This method is for producing a smooth density approximation to a set of data that avoids some problems associated with histograms (see appendix 3; nr.14 and 15).

3.3 Z-SCORES

To evaluate the performance of the participating laboratories the z-scores were calculated. As it was decided to evaluate the performance of the participants in this proficiency test (PT) against the literature requirements, e.g. ASTM reproducibilities, the z-scores were calculated using a target standard deviation. This target standard deviation was calculated from the literature reproducibility by division with 2.8.
The z-scores were calculated according to:

$$z_{(target)} = (\text{result} - \text{average of PT}) / \text{target standard deviation}$$

Absolute values for z<2 are very common and absolute values for z>3 are very rare. Therefore, the usual interpretation of z-scores is as follows:

$\lvert z \rvert < 1$	good
$1 < \lvert z \rvert < 2$	satisfactory
$2 < \lvert z \rvert < 3$	questionable
$3 < \lvert z \rvert$	unsatisfactory

4 EVALUATION

In this proficiency test, some problems were encountered during the execution. Four laboratories, in Brazil and Kuwait, did receive the samples late. Several participants reported their results after the final reporting date. Not all laboratories were able to perform all analysis requested. Finally, 44 participating laboratories submitted in total 684 results. Observed were 28 outlying results, which is 4.1%. In proficiency studies, outlier percentages of 3% - 7.5% are normal.

4.1 EVALUATION PER SAMPLE AND TEST

In this section, the results are discussed per sample and test. The methods, which are used by the various laboratories, were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the original data. The abbreviations, used in these tables, are listed in appendix 3. In case no suitable test method is available, the Horwitz equation was used.
Not all original data sets proved to have a normal distribution. Not normal distributions were found for sample #1034: Acid Wash Colour, Colour Pt/Co, Density, Distillation, Methylcyclohexane and Purity. For sample #1035 not normal distributions were found for: Acid Wash Colour, Density, Distillation and Styrene. For these determinations the results of the statistical evaluation should be used with due care.

For Benzene sample #1034

Acid Wash Colour: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in full agreement with the requirements of the ASTM D848:09.

Acidity: This determination was not problematic. The way of reporting varies and should be improved in accordance with ASTM D847:08: report "no free acid" (NFA) or, when positive, "acidity as mg NaOH/100 mL".

Appearance: No analytical problems were observed. All labs agreed about the appearance of the sample #1034, which was bright, clear and free of suspended matter. The uniformity of reporting can be improved. A new standardized method is available for Appearance since 2009, being ASTM E2680. According this method the appearance should be reported as ‘pass’ (or ‘fail’).

Bromine Index: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in good agreement with the estimated reproducibility requirement of ASTM D5776:07e1.

Colour Pt/Co: This determination was not problematic. No results were outside the reproducibility limits and the calculated reproducibility is in good agreement with the requirements of ASTM D1209:05e1.

Density @20°C: This determination was problematic for some laboratories. Three statistical outliers were observed. However, the calculated reproducibility, after rejection of the statistical outliers, is in good agreement with the requirements of ASTM D4052:02e1.

Distillation: This determination was not problematic. In total four statistical outliers were observed. All calculated reproducibilities, after rejection of statistical outliers, are in agreement with the requirements of ASTM D850:08e1 (manual). All results should be used with care, due the lack of precision data for the automated procedure in the standard.

Organic Chlorine: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is almost in agreement with the requirements of ASTM D5808:09a. The average recovery of Organic Chlorine (theoretical increment of 1.96 mg/kg) may be good: “less then 96%”, assuming the actual blank is zero (the actual blank Organic Chlorine content is unknown).

Total Nitrogen: This determination was problematic for several laboratories. One statistical outlier was observed and one false negative result was excluded. The calculated reproducibility, after the rejection of the statistical outlier, is not at all in agreement with the requirements of ASTM D6069-06.

Solidification Point: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not at all in agreement with the requirements of ASTM D852:08. Important in this solidification point determination is addition of water and the correct benzene container.

Methylcyclohexane; This determination was problematic for several laboratories. Five statistical outliers were observed. However, the calculated reproducibility, after rejection of statistical outliers, is in agreement with the requirements of ASTM D4492:10.

Toluene: This determination was not problematic. Only two statistical outliers were observed and the calculated reproducibility, after rejection of the statistical outliers, is in good agreement with the reproducibility of ASTM D4492:10.

Nonaromatics: This determination is problematic for several laboratories. Five statistical outliers were observed. After rejection of the statistical outliers, the calculated reproducibility is in good agreement with the reproducibility of ASTM D4492:10.

Purity: This determination was problematic for two laboratories. Only two statistical outliers were observed and the calculated reproducibility after rejection of the statistical outliers, is in good agreement with the estimated reproducibility of ASTM D4492:10.

For Toluene sample #1035

Acid Wash Colour: This determination was not problematic. Three statistical outliers were observed, but the calculated reproducibility, after rejection of the statistical outliers, is in good agreement with the requirements of the ASTM D848:09.

Appearance: No analytical problems were observed. All labs agreed about the appearance of the sample #1035, which was bright, clear and free of suspended matter. The uniformity of reporting can be improved. A new standardized method is available for Appearance since 2009, being ASTM E2680. According this method the appearance should be reported as 'pass' (or 'fail').

Copper Corr: No problems have been observed. Almost all participants agreed on a result of 1 (1A).

Colour Pt/Co: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in good agreement with the requirements of ASTM D1209:05e1.

Density @20°C: This determination was problematic for one laboratory. Only one statistical outlier was observed and the calculated reproducibility, after rejection of the statistical outlier, is in good agreement with the requirements of ASTM D4052:02e1.

Distillation: This determination was problematic for two laboratories. In total two statistical outliers were observed. All the calculated reproducibilities, after rejection of statistical outliers, are in agreement with the requirements of ASTM D850:08e1 (automated and manual mode).
From the reported results of the 50% recovered, it appears that two participants obviously did not correct the results for barometric pressure and thermometer inaccuracy as described in ASTM D850-08e1 (paragraph 11.4).

Purity: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in agreement with the requirements of ASTM D2360:08.

Nonaromatics: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in agreement with the requirements of ASTM D2360:08.

Benzene: This determination may be problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the strict estimated reproducibility limits calculated using the Horwitz equation.

Styrene: This determination was not problematic. No statistical outliers were observed and the calculated reproducibility is in agreement with the strict estimated reproducibility limits calculated using the Horwitz equation.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant standard and the reproducibility as found for the group of participating laboratories. The average results per sample, calculated reproducibilities and reproducibilities derived from literature standards (in casu ASTM standards) are compared in the next table.

Parameter	unit	n	average	2.8 *sd_R	R (lit)
Acid Wash Colour		29	0.65	0.66	2.01
Acidity	mgNaOH/100ml	28	No free acid	n.a.	n.a.
Appearance		32	pass	n.a.	n.a.
Bromine Index	mg Br/100g	27	4.98	3.86	4.60
Colour Pt/Co		18	2.89	3.83	7.00
Density @ 20 ºC	kg/L	29	0.87892	0.00030	0.00050
Distillation, IBP	°C	28	79.83	0.23	0.42
Distillation, 50%	°C	28	80.10	0.00	0.42
Distillation, DP	°C	27	80.43	0.34	0.42
Total Chlorine	mg/kg	23	1.873	1.417	1.300
Total Nitrogen	mg/kg	21	1.885	1.420	0.728
Solidification Point	°C	19	5.446	0.093	0.050
Methylcyclohexane	mg/kg	21	125.01	25.66	58.19
Toluene	mg/kg	32	599.2	71.8	279.0
Nonaromatics	mg/kg	29	274.4	62.1	68.5
Purity	%M/M	32	99.9100	0.0163	0.0270

Table 6: reproducibilities of Benzene sample #1034

Parameter	unit	N	average	2.8 *sd_R	R (lit)
Acid Wash Colour		23	0.70	0.48	2.05
Appearance		30	pass	n.a.	n.a.
Copper corrosion		25	1	n.a.	n.a.
Colour Pt/Co		18	2.97	3.98	7.00
Density @ 20 ºC	kg/L	27	0.86686	0.00023	0.00050
Distillation, IBP	°C	30	110.36	0.29	0.58
Distillation, 50% rec.	°C	28	110.60	0.06	0.16
Distillation, DP	°C	30	110.74	0.34	0.46
Purity	%M/M	26	99.9214	0.0190	0.0210
Nonaromatics	mg/kg	27	530.14	117.79	253.54
Benzene	mg/kg	25	31.80	9.81	8.47
Styrene	mg/kg	25	64.65	13.97	15.46

Table 7: reproducibilities of Toluene sample #1035

Without further statistical calculations, it can be concluded that for most of the tests there is a compliance of the group of participating laboratories with the relevant standards. The tests that are problematic have been discussed in paragraph 4.1.

4.3 COMPARISON OF THE PROFICIENCY TEST OF APRIL 2010 WITH PREVIOUS PTS

	April 2010	April 2009	March 2008	April 2007
Number of reporting labs	44	42	36	38
Number of results reported	684	811	607	656
Statistical outliers	28	28	38	22
Percentage outliers	4.1%	3.5%	6.3%	3.4%

table 8: comparison with previous proficiency tests.

In proficiency tests, outlier percentages of 3% - 7.5% are quite normal.

The performance of the determinations of the proficiency tests was compared against the requirements of the respective standards. The conclusions are given the following table:

Determination	April 2010	April 2009	March 2008	April 2007
Acid Wash Colour	++	++	++	++
Acidity	n.e.	++	n.e.	n.e.
Appearance	n.e.	++	n.e.	n.e.
Bromine Index	++	+/-	++	--
Colour Pt/Co	++	++	++	++
Density @ 20 ºC	++	++	++	++
Distillation, IBP	++	+	++	+/-
Distillation, 50%	++	++	++	+
Distillation, DP	++	--	--	+/-
Total Chlorine	+/-	+/-	++	++
Total Nitrogen	--	--	--	--
Solidification Point	--	--	++	-
Methylcyclohexane	++	--	n.e.	n.e.
Toluene	++	++	++	++
Nonaromatics	+	--	--	--
Purity	++	+	--	++

table 9: comparison determinations on Benzene against the standards

Determination	April 2010	April 2009	March 2008	April 2007
Acid Wash Colour	++	++	++	++
Appearance	+	++	n.e.	n.e.
Copper Corrosion	++	++	+/-	+/-
Colour Pt/Co	++	++	+	++
Density @ 20 ºC	++	++	++	++
Distillation, IBP	++	++	++	++
Distillation, 50%	++	--	--	--
Distillation, DP	++	++	+	+/-
Purity	++	++	n.e.	n.e.
Nonaromatics	++	++	n.e.	n.e.
Benzene	- *)	-- *)	n.e.	n.e.
Styrene	+ *)	+/- *)	- *)	- *)

table 10: comparison determinations on Toluene against the standard
*) against the strict Horwitz equation

The performance of the determinations against the requirements of the respective standards is listed in the above table. The following performance categories were used:

++:	group performed much better than the standard
+ :	group performed better than the standard
+/-:	group performance equals the standard
- :	group performed worse than the standard
-- :	group performed much worse than the standard
n.e.:	not evaluated
n.d.	not determined

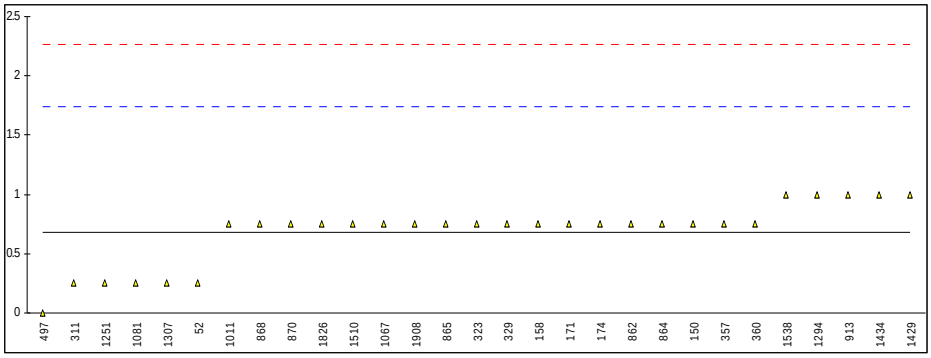
APPENDIX 1

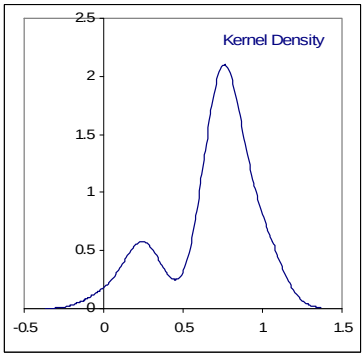
Determination of Acid Wash Colour on Benzene sample #1034

lab	method	value	mark	z(targ)	remarks
52	D848	0+		-0.44	
150	D848	1-		0.03	
158	D848	1-		0.03	
171	D848	1-		0.03	
174	D848	1-		0.03	
311	D848	0+		-0.44	
323	D848	1-		0.03	
329	D848	1-		0.03	
334		-----		-----	
357	D848	1-		0.03	
360	D848	1-		0.03	
444		-----		-----	
497	D848	0		-0.90	
555		-----		-----	
862	D848	1-		0.03	
864	D848	1-		0.03	
865	D848	1-		0.03	
868	D848	1-		0.03	
870	D848	1-		0.03	
913	D848	1		0.49	
974		-----		-----	
1011	D848	1-		0.03	
1040		-----		-----	
1041	D848	<1		-----	
1067	D848	1-		0.03	
1081	D848	0+		-0.44	
1117		-----		-----	
1251	D848	0+		-0.44	
1252		-----		-----	
1264	D848	passing		-----	
1291		-----		-----	
1294	D848	1		0.49	
1307	D848	0+		-0.44	
1429	D848	1		0.49	
1434	D848	1		0.49	
1510	D848	1-		0.03	
1538	D848	1		0.49	
1826	D848	1-		0.03	
1866		-----		-----	
1908	D848	1-		0.03	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	not OK	
n	29	
outliers	0	
mean (n)	0.65	(1-)
st.dev. (n)	0.236	
R(calc.)	0..66	
R(D848:09)	2.01	

*) In the calculation of the mean, standard deviation, the reproducibility and in below graphs, a reported value of 'x-' is changed into x-0.33 (for example 1- into 0.67) and 'x+' is changed into x+0.33 (for example 0+ into 0.33)





Determination of Acidity on Benzene sample #1034; results in mg NaOH per 100mL

lab	method	value	mark	z(targ)	remarks
52	D847	Nil		-----	
150	D847	NFA		-----	
158	D847	NFA		-----	
171	D847	n.d.		-----	
174	D847	n.d.		-----	
311	D847	NFA		-----	
323	D847	NFA		-----	
329	D847	NFA		-----	
334		-----		-----	
357	D847	NFA		-----	
360	D847	NFA		-----	
444		-----		-----	
497	D847	0.3		-----	
555		-----		-----	
862	D847	NFA		-----	
864	D847	NFA		-----	
865	D847	NFA		-----	
868	D847	NFA		-----	
870	D847	NFA		-----	
913	D847	Nil		-----	
974		-----		-----	
1011	D847	Nil		-----	
1040		-----		-----	
1041		-----		-----	
1067	D847	0.00044		-----	
1081	D847	0		-----	
1117	INH839	NFA		-----	
1251	D847	NFA		-----	
1252		-----		-----	
1264		-----		-----	
1291		-----		-----	
1294		-----		-----	
1307	D847	<0.1		-----	
1429	D847	0.35		-----	
1434	D847	Nil		-----	
1510	D847	NFA		-----	
1538	D847	0.28		-----	
1826		-----		-----	
1866		-----		-----	
1908	D847	NFA		-----	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	n.a.
n	28
outliers	0
mean (n)	No free Acid
st.dev. (n)	n.a.
R(calc.)	n.a.
R(D847:08)	n.a.

NFA: No Free Acid

Determination of Appearance on Benzene sample #1034

lab	method	value	mark	z(targ)	remarks
52	D4176	B&C		-----	
150	E2680	B&C		-----	
158	E2680	CFSM		-----	
171	E2680	C&F		-----	
174	E2680	C&F		-----	
311	E2680	pass		-----	
323	E2680	CFSM		-----	
329	E2680	CFSM		-----	
334		-----		-----	
357	E2680	pass		-----	
360	E2680	B&C		-----	
444	E2680	pass		-----	
497	E2680	B&C		-----	
555		-----		-----	
862	E2680	B&C		-----	
864	E2680	pass		-----	
865	E2680	pass		-----	
868	E2680	pass		-----	
870	E2680	pass		-----	
913	E2680	CFSM		-----	
974		-----		-----	
1011	Visual	B&C		-----	
1040	E2680	B&C		-----	
1041	E2680	CWWFS		-----	
1067	Visual	B&C		-----	
1081	In house	B&C		-----	
1117	INH-554	On spec		-----	
1251	E2680	B&C		-----	
1252		-----		-----	
1264	Visual	CLEAR		-----	
1291		-----		-----	
1294		-----		-----	
1307	In house	B&C		-----	
1429	Visual	B&C		-----	
1434		-----		-----	
1510	Visual	B&C		-----	
1538	Visual	B&C		-----	
1826	Visual	C&F		-----	
1866		-----		-----	
1908	Visual	B&C		-----	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

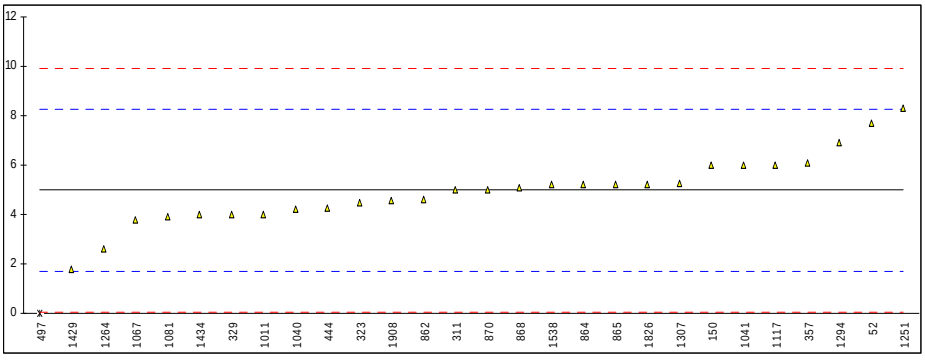
Abbreviations:

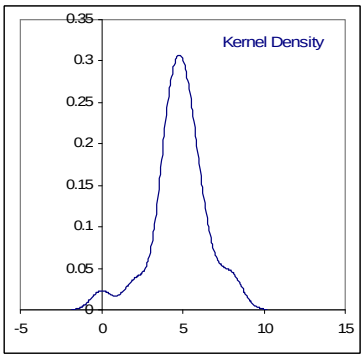
C	= clear
B&C	= bright and clear
C&F	= clear and free
CFSM	= clear and free from suspended matter
CWWFFWEM	= clear water white free from water and extraneous matter
CLFSH	= clear liquid free of sediment and haze
CWWL	= clear water white liquid
CFFMS	= clear free from matter in suspension

Determination of Bromine Index on Benzene sample #1034; results in mg Br/100g

lab	method	value	mark	z(targ)	remarks
52	D1492	7.7		1.66	
150	D1492	6		0.62	
158	D5776	<0.05		<-3.00	False negative result?
171		-----		-----	
174		-----		-----	
311	D5776	5.0		0.01	
323	D5776	4.5		-0.29	
329	D5776	4.0		-0.60	
334		-----		-----	
357	D5776	6.1		0.68	
360		-----		-----	
444	D5776	4.27		-0.43	
497	D5776	0	ex	-3.03	Result excluded, not a real result
555		-----		-----	
862	D5776	4.6		-0.23	
864	D5776	5.2		0.13	
865	D5776	5.2		0.13	
868	D5776	5.1		0.07	
870	D5776	5.0		0.01	
913		-----		-----	
974		-----		-----	
1011	D2710	4.02		-0.58	
1040	DIN51774	4.2		-0.48	
1041	D5776	6		0.62	
1067	DIN51774/2	3.8		-0.72	
1081	D1492	3.9		-0.66	
1117	INH-1797	6.0		0.62	
1251	D5776	8.3		2.02	
1252		-----		-----	
1264	D5776	2.62		-1.44	
1291		-----		-----	
1294	D1209	6.9		1.17	
1307	D5776	5.28		0.18	
1429	D5776	1.8		-1.94	
1434	D5776	4.0		-0.60	
1510		-----		-----	
1538	D1492	5.2		0.13	
1826	D5776	5.2		0.13	
1866		-----		-----	
1908	D5776	4.58		-0.24	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	OK
n	27
outliers	0
mean (n)	4.98
st.dev. (n)	1.380
R(calc.)	3.86
R(D5776:07e1)	4.60

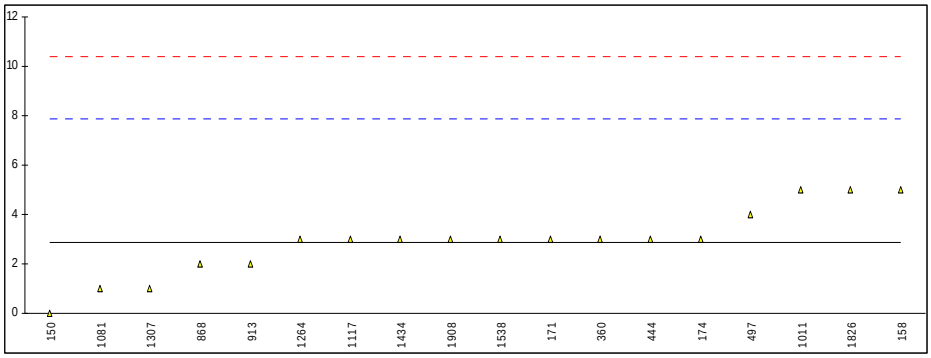


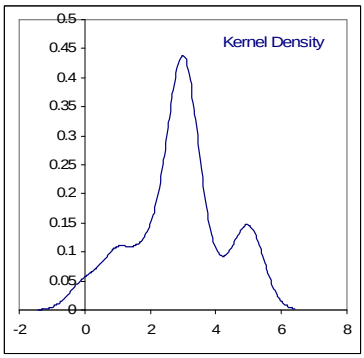


Determination of Colour Pt/Co on Benzene sample #1034

lab	method	value	mark	z(targ)	remarks
52	D1209	<5		-----	
150	D1209	0		-1.16	
158	D1209	5		0.84	
171	D1209	3		0.04	
174	D1209	3		0.04	
311	D1209	<5		-----	
323	D1209	<5		-----	
329	D1209	<5		-----	
334		-----		-----	
357	D1209	<5		-----	
360	D1209	3		0.04	
444	D5386	3		0.04	
497	D1209	4		0.44	
555		-----		-----	
862	D1209	<5		-----	
864	D1209	<5		-----	
865	D1209	<5		-----	
868	D1209	2		-0.36	
870	D1209	<5		-----	
913	D1209	2		-0.36	
974		-----		-----	
1011	D1209	5		0.84	
1040	ISO6271	<5		-----	
1041	D1209	<5		-----	
1067	D1209	<1		-----	
1081	D5386	1		-0.76	
1117	INH-409	3		0.04	
1251	D1209	<5		-----	
1252	D1209	<5		-----	
1264	D1209	3.0		0.04	
1291		-----		-----	
1294		-----		-----	
1307	D1209	1		-0.76	
1429	D1209	<5		-----	
1434	D1209	3		0.04	
1510	D1209	<2.5		-----	
1538	D1209	3		0.04	
1826	D1209	5		0.84	
1866		-----		-----	
1908	D1209	3		0.04	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	not OK
n	18
outliers	0
mean (n)	2.89
st.dev. (n)	1.367
R(calc.)	3.83
R(D1209:05e1)	7.00

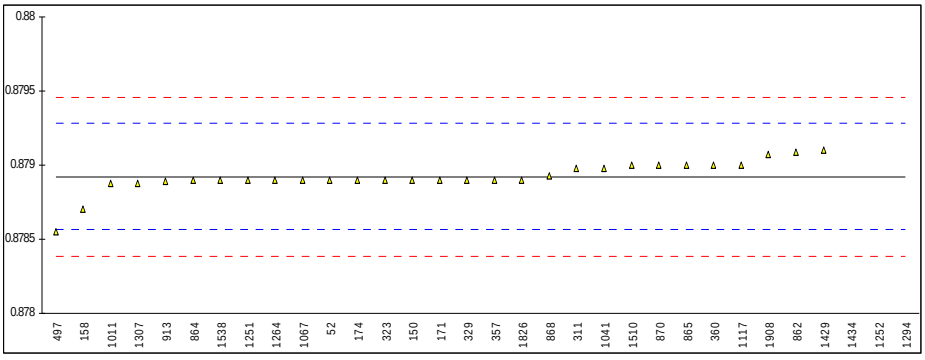


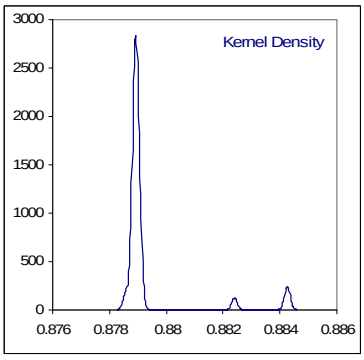


Determination of Density @ 20°C on Benzene sample #1034; results in kg/L

lab	method	value	mark	z(targ)	remarks
52	D4052	0.8789		-0.12	
150	D4052	0.8789		-0.12	
158	D4052	0.8787		-1.24	
171	D4052	0.8789		-0.12	
174	D4052	0.8789		-0.12	
311	D4052	0.87898		0.32	
323	D4052	0.8789		-0.12	
329	D4052	0.8789		-0.12	
334		-----		-----	
357	D4052	0.8789		-0.12	
360	D4052	0.8790		0.44	
444		-----		-----	
497	D4052	0.87855		-2.08	
555		-----		-----	
862	D4052	0.87909		0.94	
864	D4052	0.8789		-0.12	
865	D4052	0.8790		0.44	
868	D4052	0.87893		0.04	
870	D4052	0.8790		0.44	
913	D4052	0.87889		-0.18	
974		-----		-----	
1011	D4052	0.87888		-0.24	
1040		-----		-----	
1041	D4052	0.87898		0.32	
1067	D4052	0.8789		-0.12	
1081		-----		-----	
1117	INH-2221	0.8790		0.44	
1251	D4052	0.8789		-0.12	
1252	D4052	0.88424	G(0.01)	29.78	
1264	D4052	0.8789		-0.12	
1291		-----		-----	
1294	D4052	0.88429	G(0.01)	30.06	
1307	D4052	0.87888		-0.24	
1429	D4052	0.8791		1.00	
1434	D4052	0.8824	G(0.01)	19.48	
1510	IP365	0.8790	C	0.44	First reported 879.0
1538	D4052	0.8789		-0.12	
1826	D4052	0.8789	C	-0.12	First reported 878.9
1866		-----		-----	
1908	D4052	0.87907		0.83	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	not OK
n	29
outliers	3
mean (n)	0.87892
st.dev. (n)	0.000106
R(calc.)	0.00030
R(D4052:02e1)	0.00050

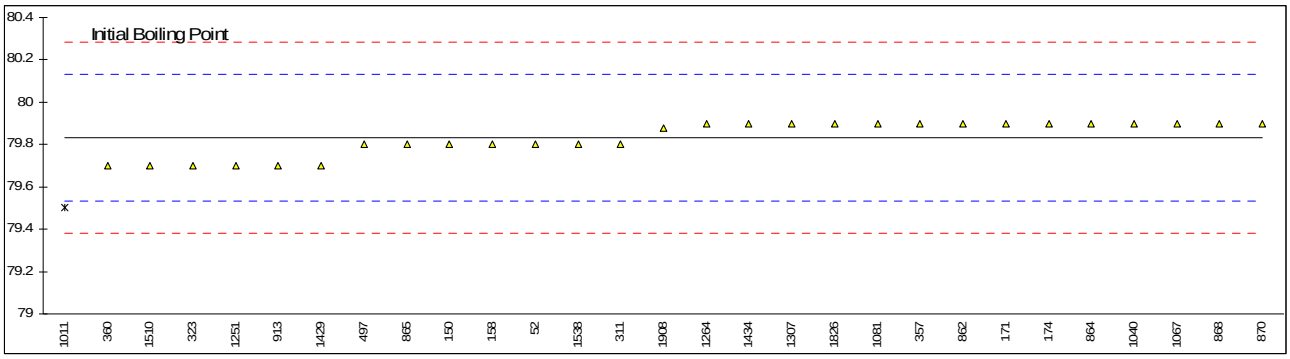


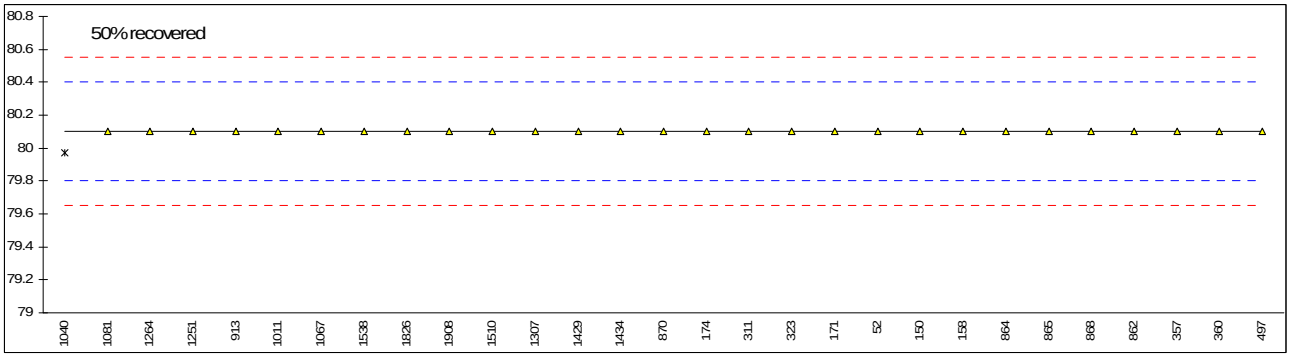


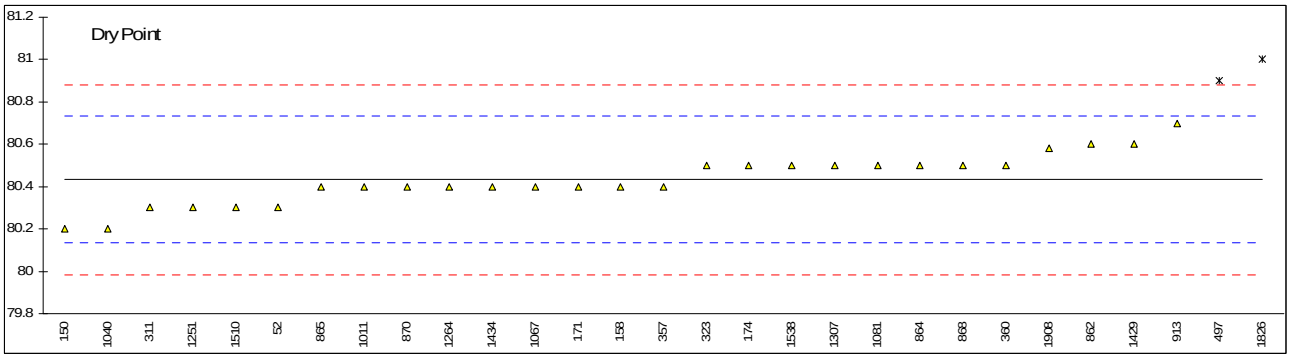
Determination of Distillation on Benzene sample #1034; results in °C

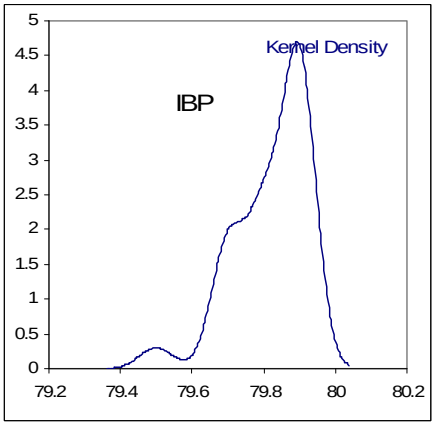
lab	method	IBP	mark	z(targ)	50%	mark	z(targ)	DP	mark	z(targ)	remarks
52	D850-A	79.8		-0.21	80.1		0.00	80.3		-0.88	
150	D850-A	79.8		-0.21	80.1		0.00	80.2		-1.55	
158	D850-A	79.8		-0.21	80.1		0.00	80.4		-0.22	
171	D850-A	79.9		0.46	80.1		0.00	80.4		-0.22	
174	D850-A	79.9		0.46	80.1		0.00	80.5		0.45	
311	D850-A	79.8		-0.21	80.1		0.00	80.3		-0.88	
323	D850-M	79.7		-0.88	80.1		0.00	80.5		0.45	
329		-----		-----	-----		-----	-----		-----	
334		-----		-----	-----		-----	-----		-----	
357	D850-A	79.9		0.46	80.1		0.00	80.4		-0.22	
360	D850-A	79.7		-0.88	80.1		0.00	80.5		0.45	
444		-----		-----	-----		-----	-----		-----	
497	D850-A	79.8		-0.21	80.1		0.00	80.9	G(0.05)	3.12	
555		-----		-----	-----		-----	-----		-----	
862	D850-M	79.9		0.46	80.1		0.00	80.6		1.12	
864	D850-M	79.9		0.46	80.1		0.00	80.5		0.45	
865	D850-M	79.8		-0.21	80.1		0.00	80.4		-0.22	
868	D850-M	79.9		0.46	80.1		0.00	80.5		0.45	
870	D850-M	79.9		0.46	80.1		0.00	80.4		-0.22	
913	D850-M	79.7		-0.88	80.1		0.00	80.7		1.78	
974		-----		-----	-----		-----	-----		-----	
1011	D850-A	79.5	G(0.05)	-2.21	80.1		0.00	80.4		-0.22	
1040	D850-M	79.90		0.46	79.97	G(0.01)	-0.87	80.20		-1.55	
1041		-----		-----	-----		-----	-----		-----	
1067	D850-M	79.9		0.46	80.1		0.00	80.4		-0.22	
1081	D850-A	79.9		0.46	80.1		0.00	80.5		0.45	
1117		-----		-----	-----		-----	-----		-----	
1251	D850-A	79.7		-0.88	80.1		0.00	80.3		-0.88	
1252		-----		-----	-----		-----	-----		-----	
1264	D850-A	79.9		0.46	80.1		0.00	80.4		-0.22	
1291		-----		-----	-----		-----	-----		-----	
1294		-----		-----	-----		-----	-----		-----	
1307	D850-A	79.9		0.46	80.1		0.00	80.5		0.45	
1429	D850-A	79.7		-0.88	80.1		0.00	80.6		1.12	
1434	D850-A	79.9		0.46	80.1		0.00	80.4		-0.22	
1510	D850-A	79.7		-0.88	80.1		0.00	80.3		-0.88	
1538	D850-A	79.8		-0.21	80.1		0.00	80.5		0.45	
1826	D850-M	79.9		0.46	80.1		0.00	81.0	G(0.05)	3.78	
1866		-----		-----	-----		-----	-----		-----	
1908	D850-M	79.88		0.32	80.10		0.00	80.58		0.98	
3163		-----		-----	-----		-----	-----		-----	
9005		-----		-----	-----		-----	-----		-----	
9008		-----		-----	-----		-----	-----		-----	
	normality	not OK			not OK			not OK			
	n	28			28			27			
	outliers	1			1			2			
	mean (n)	79.83			80.10			80.43			
	st.dev. (n)	0.081			0.000			0.120			
	R(calc.)	0.23			0.00			0.34			
	R(D850:08e1)	0.42			0.42			0.42			

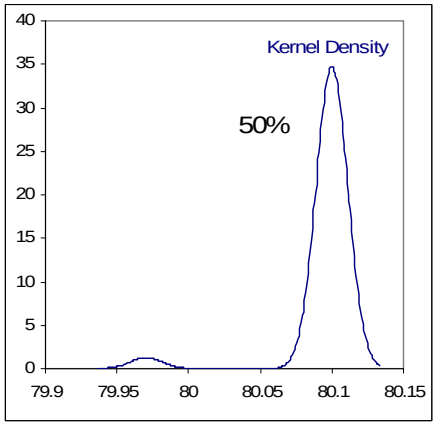
Determination of Distillation on Benzene sample #1034; results in °C - continued -

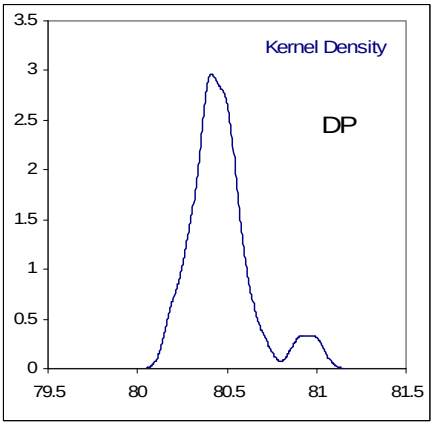








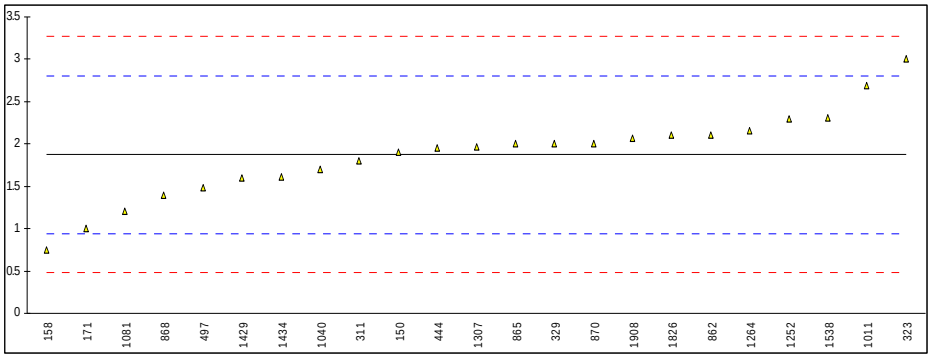


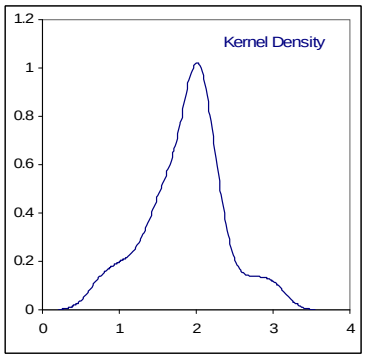


Determination of Organic Chlorine on Benzene sample #1034; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52		-----		-----	
150	D7359	1.9		0.06	
158	D5808	0.75		-2.42	
171	D5808	1.0		-1.88	
174		-----		-----	
311	D5808	1.8		-0.16	
323	D5808	3		2.43	
329	D5808	2		0.27	
334		-----		-----	
357	D5808	<1		<-1.88	
360		-----		-----	
444	IP510	1.95		0.17	
497	D5808	1.48		-0.85	
555		-----		-----	
862	D5808	2.1		0.49	
864		-----		-----	
865	D5808	2.0		0.27	
868	D5808	1.4		-1.02	
870	D5808	2.0		0.27	
913		-----		-----	
974		-----		-----	
1011	D5808	2.69		1.76	
1040	EN14017	1.70		-0.37	
1041		-----		-----	
1067		-----		-----	
1081	D5808	1.2		-1.45	
1117		-----		-----	
1251		-----		-----	
1252	D5194	2.3		0.92	
1264	D5808	2.16		0.62	
1291		-----		-----	
1294		-----		-----	
1307	D5808	1.96		0.19	
1429	IP510	1.6		-0.59	
1434	D5808	1.61		-0.57	
1510		-----		-----	
1538	D5808	2.31		0.94	
1826	In house	2.1		0.49	
1866		-----		-----	
1908	D5808	2.07		0.42	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

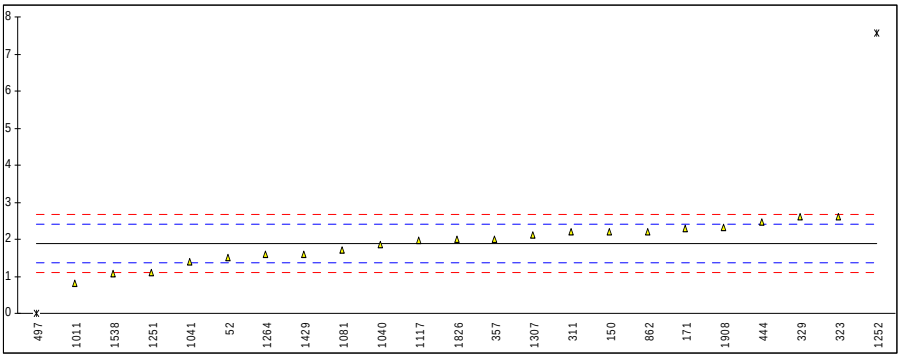
normality	OK		
n	23		
outliers	0	Spike:	
mean (n)	1.873	1.96	Recovery <96%
st.dev. (n)	0.5059		
R(calc.)	1.417		
R(D5808:09a)	1.300		

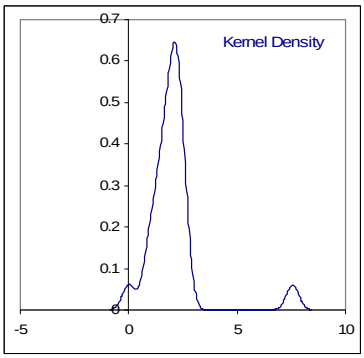




Determination of Total Nitrogen on Benzene sample #1034; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D6069	1.5		-1.48	
150	D6069	2.2		1.21	
158		-----		-----	
171	D5453	2.3		1.60	
174		-----		-----	
311	D6069	2.2		1.21	
323	D4629	2.6		2.75	
329	D4629	2.6		2.75	
334		-----		-----	
357	D6069	2.0		0.44	
360		-----		-----	
444	D4629	2.46		2.21	
497	D6069	0	ex	-7.25	Result excluded, not a real result
555		-----		-----	
862	D6069	2.2		1.21	
864		-----		-----	
865		-----		-----	
868		-----		-----	
870		-----		-----	
913		-----		-----	
974		-----		-----	
1011	D4629	0.81		-4.13	
1040	D6069	1.85		-0.13	
1041	D6069	1.39		-1.90	
1067		-----		-----	
1081	D6069	1.7		-0.71	
1117	INH-4227	1.98		0.37	
1251	D6069	1.1		-3.02	
1252	D6069	7.56	G(0.01)	21.82	
1264	D6069	1.58		-1.17	
1291		-----		-----	
1294		-----		-----	
1307	D6069	2.12		0.90	
1429	D4629	1.6		-1.09	
1434		-----		-----	
1510		-----		-----	
1538	D6069	1.07		-3.13	
1826	D4629	2		0.44	
1866		-----		-----	
1908	D6069	2.32		1.67	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	
	normality	OK			
	n	21			
	outliers	1	Spike:		
	mean (n)	1.885	1.41		Recovery <134%
	st.dev. (n)	0.5070			
	R(calc.)	1.420			
	R(D6069:06)	0.728			

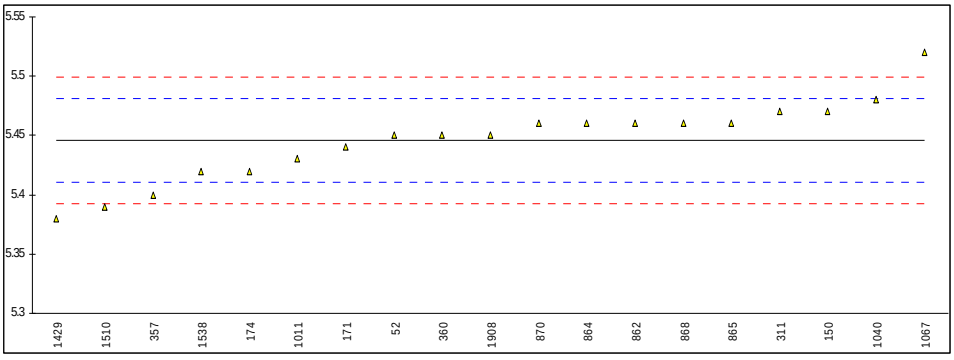


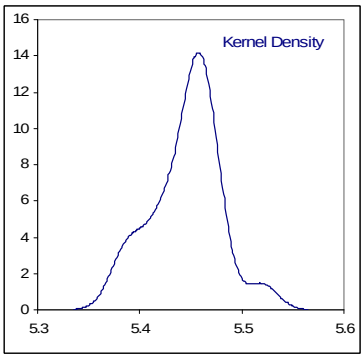


Determination of Solidification Point on anhydrous basis on Benzene sample #1034; results in °C

lab	method	value	mark	z(targ)	remarks
52	D852	5.45		0.24	
150	D852	5.47		1.36	
158		-----		-----	
171	D852	5.44		-0.32	
174	D852	5.42		-1.44	
311	D852	5.47		1.36	
323		-----		-----	
329		-----		-----	
334		-----		-----	
357	D852	5.40		-2.56	
360	D852	5.45		0.24	
444		-----		-----	
497		-----		-----	
555		-----		-----	
862	D852	5.46		0.80	
864	D852	5.46		0.80	
865	D852	5.46		0.80	
868	D852	5.46		0.80	
870	D852	5.46		0.80	
913		-----		-----	
974		-----		-----	
1011	D852	5.43	C	-0.88	First reported 5.15
1040	DIN51798	5.48		1.92	
1041		-----		-----	
1067	D852	5.52		4.16	
1081		-----		-----	
1117		-----		-----	
1251		-----		-----	
1252		-----		-----	
1264		-----		-----	
1291		-----		-----	
1294		-----		-----	
1307		-----		-----	
1429	D852	5.38		-3.68	
1434		-----		-----	
1510	D852	5.39		-3.12	
1538	D852	5.42		-1.44	
1826		-----		-----	
1866		-----		-----	
1908	D852	5.45		0.24	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	OK
n	19
outliers	0
mean (n)	5.446
st.dev. (n)	0.0334
R(calc.)	0.093
R(D852:08)	0.050

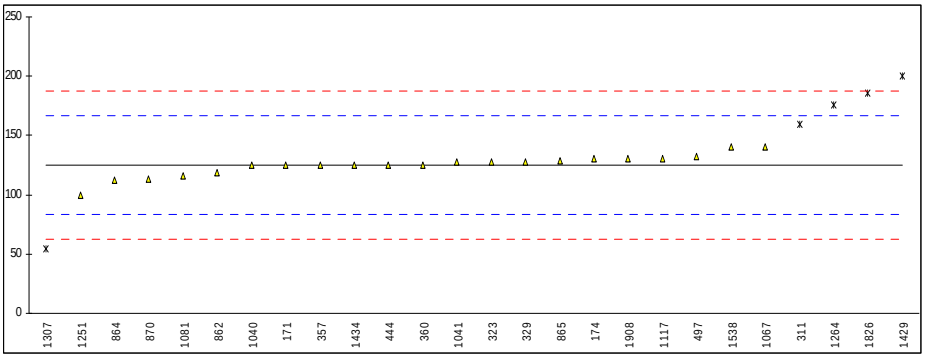


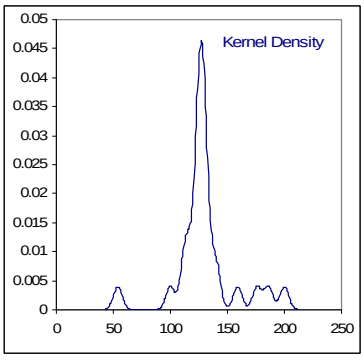


Determination of Methylcyclohexane on Benzene sample #1034 in mg/kg

lab	method	value	mark	z(targ)	remarks
52		-----		-----	
150		-----		-----	
158		-----		-----	
171	D4492	125		0.00	
174	D4492	130		0.24	
311	D5713	159	G(0.05)	1.64	
323	D5713	128		0.14	
329	D4492Mod	128		0.14	
334		-----		-----	
357	INH-055	125		0.00	
360	D4492	125		0.00	
444	D5713	125		0.00	
497		132.5		0.36	
555		-----		-----	
862	D4492	119		-0.29	
864	D4492	112		-0.63	
865	D4492	129		0.19	
868		-----		-----	
870	D4492	113		-0.58	
913		-----		-----	
974		-----		-----	
1011		-----		-----	
1040	D4492Mod	124.7		-0.01	
1041		128		0.14	
1067	In house	140		0.72	
1081	In house	116		-0.43	
1117	INH-1117	130		0.24	
1251		100		-1.20	
1252		-----		-----	
1264		176	G(0.01)	2.45	
1291		-----		-----	
1294		-----		-----	
1307	In house	54.0	D(0.05)	-3.42	
1429		200	G(0.05)	3.61	
1434		125		0.00	
1510		-----		-----	
1538	D4492	140		0.72	
1826	In house	186	G(0.05)	2.93	
1866		-----		-----	
1908	D4492	130		0.24	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	not OK
n	21
outliers	5
mean (n)	125.01
st.dev. (n)	9.163
R(calc.)	25.66
R(D4492:10)	58.19

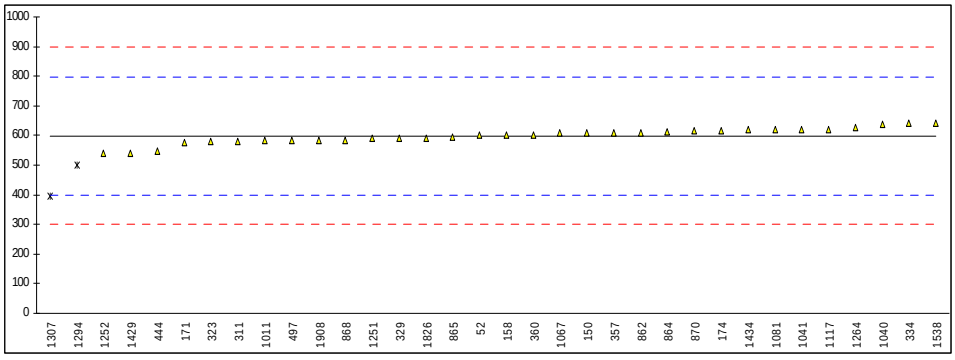


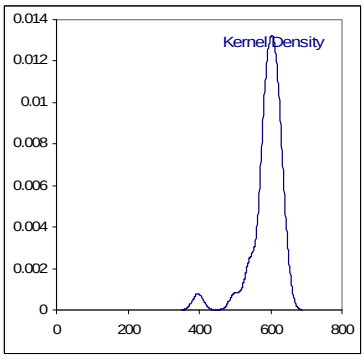


Determination of Toluene on Benzene sample #1034; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D4492	600		0.01	
150	D4492	610		0.11	
158	D2360	600	C	0.01	First reported 0.06
171	D4492	577		-0.22	
174	D4492	615		0.16	
311	D4492	580		-0.19	
323	D4492	580		-0.19	
329	D4492	590		-0.09	
334	D4492	640		0.41	
357	INH-055	610		0.11	
360	D4492	602		0.03	
444	D4492	547.5		-0.52	
497	D4492	582.8		-0.16	
555		-----		-----	
862	D4492	610		0.11	
864	D4492	613		0.14	
865	D4492	594		-0.05	
868	D4492	585		-0.14	
870	D4492	615		0.16	
913		-----		-----	
974		-----		-----	
1011	D2360	582		-0.17	
1040	D4492Mod.	636.2		0.37	
1041	D4492	620		0.21	
1067	In house	610		0.11	
1081	In house	620		0.21	
1117	INH-1117	620		0.21	
1251	D4492	590		-0.09	
1252	D4492	541		-0.58	
1264	D4492	627		0.28	
1291		-----		-----	
1294	D4492	500	CG(0.05)	-1.00	First reported 0.05
1307	In house	396.6	G(0.01)	-2.03	
1429	D4492	541		-0.58	
1434	D4492	620		0.21	
1510		-----		-----	
1538	D4492	641		0.42	
1826	In house	591		-0.08	
1866		-----		-----	
1908	D4492	585		-0.14	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	OK
n	32
outliers	2
mean (n)	599.2
st.dev. (n)	25.63
R(calc.)	71.8
R(D4492:10)	279.0

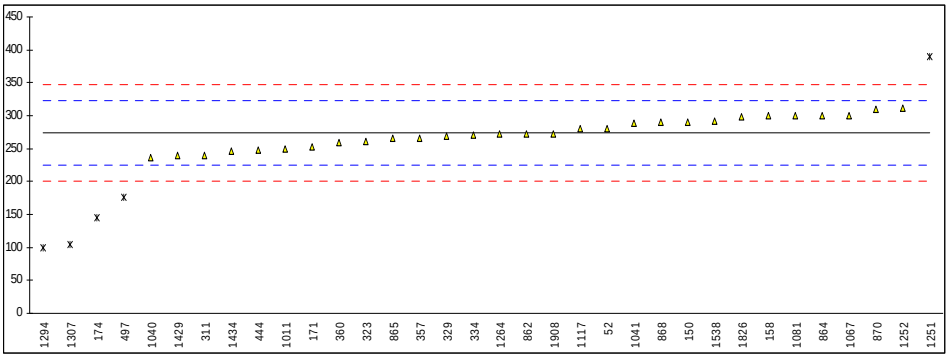


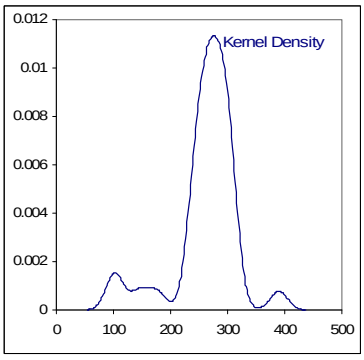


Determination of Nonaromatics on Benzene sample #1034; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D4492	280		0.23	
150	D4492	290		0.64	
158	D2360	300	C	1.05	First reported 0.03
171	D4492	253		-0.87	
174	D4492	145	G(0.05)	-5.29	
311	D4492	240		-1.41	
323	D4492	261		-0.55	
329	D4492	269		-0.22	
334	D4492	270		-0.18	
357	INH-055	265		-0.38	
360	D4492	260		-0.59	
444	D4492	247.5		-1.10	
497	D4492	176.2	G(0.01)	-4.01	
555		-----		-----	
862	D4492	272		-0.10	
864	D4492	300		1.05	
865	D4492	265		-0.38	
868	D4492	290		0.64	
870	D4492	309		1.41	
913		-----		-----	
974		-----		-----	
1011	D2360	249		-1.04	
1040	D4492Mod.	237.1		-1.52	
1041	D4492	288		0.56	
1067	In house	300		1.05	
1081	In house	300		1.05	
1117	INH-1117	280		0.23	
1251	D4492	390	G(0.01)	4.72	
1252	D4492	311		1.50	
1264	D4492	272		-0.10	
1291		-----		-----	
1294	D4492	100	CDG(0.01)	-7.13	First reported 0.01
1307	In house	104.8	DG(0.01)	-6.93	
1429	D4492	240		-1.41	
1434	D4492	246		-1.16	
1510		-----		-----	
1538	D4492	292		0.72	
1826	In house	298		0.96	
1866		-----		-----	
1908	D4492	273		-0.06	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	OK
n	29
outliers	5
mean (n)	274.4
st.dev. (n)	22.18
R(calc.)	62.1
R(D4492:10)	68.5

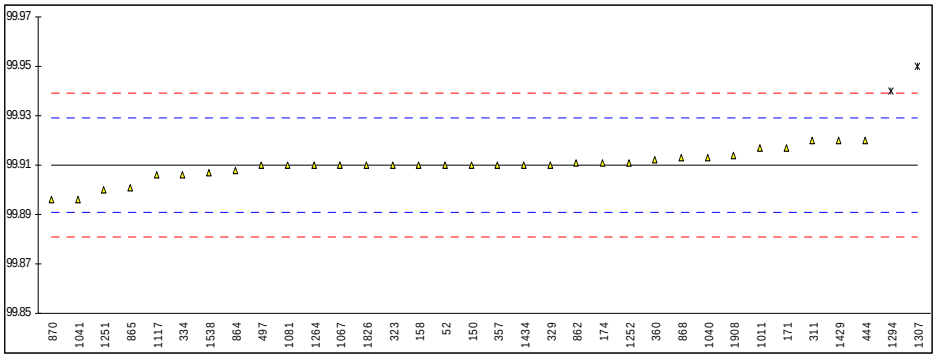


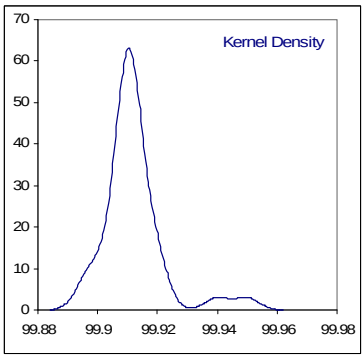


Determination of Purity on Benzene sample #1034; results in %M/M

lab	method	value	mark	z(targ)	remarks
52	D4492	99.91	C	0.00	First reported 99.81
150	D4492	99.91		0.00	
158	D2360	99.91		0.00	
171	D4492	99.917		0.73	
174	D4492	99.911		0.10	
311	D4492	99.92		1.04	
323	D4492	99.91		0.00	
329	D4492	99.91		0.00	
334	D4492	99.906		-0.41	
357	INH-055	99.91		0.00	
360	D4492	99.9123		0.24	
444	D4492	99.9202		1.06	
497	D4492	99.910		0.00	
555		-----		-----	
862	D4492	99.911		0.10	
864	D4492	99.908		-0.21	
865	D4492	99.901		-0.93	
868	D4492	99.913		0.31	
870	D4492	99.896		-1.45	
913		-----		-----	
974		-----		-----	
1011	D2360	99.917		0.73	
1040	D4492Mod.	99.913		0.31	
1041	D4492	99.8963		-1.42	
1067	In house	99.91		0.00	
1081	In house	99.91		0.00	
1117	Calculated	99.906		-0.41	
1251	D4492	99.90		-1.04	
1252	D4492	99.911		0.10	
1264	D4492	99.91		0.00	
1291		-----		-----	
1294	D4492	99.94	G(0.01)	3.11	
1307	In house	99.9499	G(0.01)	4.14	
1429	D4492	99.92		1.04	
1434	D4492	99.91		0.00	
1510		-----		-----	
1538	D4492	99.907		-0.31	
1826	In house	99.91	C	0.00	First reported 99.8812
1866		-----		-----	
1908	D4492	99.914		0.42	
3163		-----		-----	
9005		-----		-----	
9008		-----		-----	

normality	not OK
n	32
outliers	2
mean (n)	99.9100
st.dev. (n)	0.00583
R(calc.)	0.0163
R(D4492:10)	0.0270

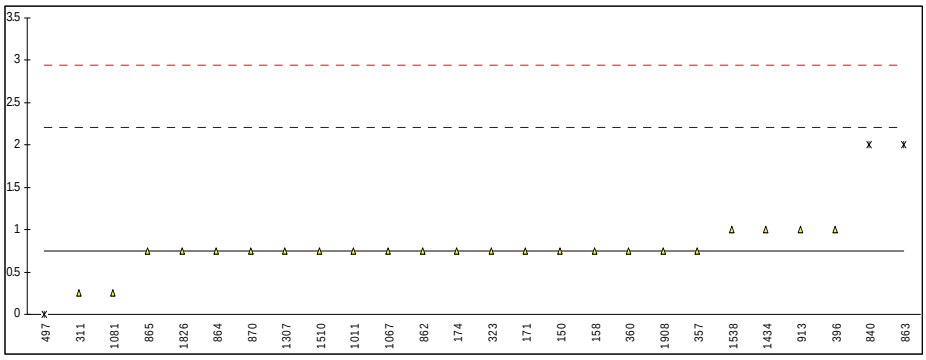


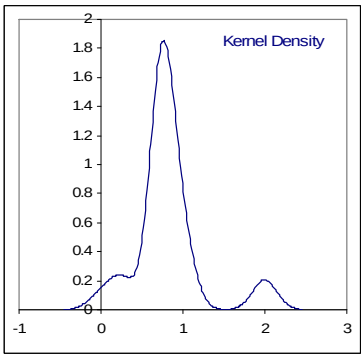


Determination of Acid Wash Colour on Toluene sample #1035

lab	method	value	mark	z(targ)	remarks
150	D848	1-		-0.04	
158	D848	1-		-0.04	
171	D848	1-		-0.04	
174	D848	1-		-0.04	
311	D848	0+		-0.50	
323	D848	1-		-0.04	
334		-----		-----	
357	D848	1-		-0.04	
360	D848	1-		-0.04	
396	D848	1		0.41	
463	D848	pass		-----	
497	D848	0	G(0.05)	-0.96	
555		-----		-----	
840	D848	2	G(0.01)	1.78	
862	D848	1-		-0.04	
863	D848	2	G(0.05)	1.78	
864	D848	1-		-0.04	
865	D848	1-		-0.04	
870	D848	1-		-0.04	
913	D848	1		0.41	
974		-----		-----	
1011	D848	1-		-0.04	
1040		-----		-----	
1041	D848	<1		-----	
1067	D848	1-		-0.04	
1081	D848	0+		-0.50	
1291		-----		-----	
1307	D848	1-		-0.04	
1434	D848	1		0.41	
1510	D848	1-		-0.04	
1538	D848	1		0.41	
1826	D848	1-		-0.04	
1843		-----		-----	
1866		-----		-----	
1908	D848	1-		-0.04	
	normality	not OK			
	n	23			
	outliers	3			
	mean (n)	0.70	(1-)		
	st.dev. (n)	0.172			
	R(calc.)	0.48			
	R(D848:09)	2.05			

*) In the calculation of the mean, standard deviation, the reproducibility and in below graphs, a reported value of ‘x-‘ is changed into x-0.33 (for example 1- into 0.67) and ‘x+’ is changed into x+0.33 (for example 0+ into 0.33)





Determination of Appearance on Toluene sample #1035

lab	method	value	mark	z(targ)	remarks
150	E2680	B&C		-----	
158	E2680	CFSM		-----	
171	E2680	C&F		-----	
174	E2680	C&F		-----	
311	INH-402	C&B		-----	
323	E2680	CFFMS		-----	
334		-----		-----	
357	E2680	pass		-----	
360	E2680	B&C		-----	
396	E2680	pass		-----	
463	D4176	pass		-----	
497	E2680	B&C		-----	
555		-----		-----	
840	E2680	pass		-----	
862	E2680	B&C		-----	
863	E2680	pass		-----	
864	E2680	pass		-----	
865	E2680	pass		-----	
870	E2680	pass		-----	
913	E2680	CFSM		-----	
974		-----		-----	
1011	VISUAL	B&C		-----	
1040	E2680	B&C		-----	
1041	E2680	CWWFS		-----	
1067	VISUAL	B&C		-----	
1081	In house	B&C		-----	
1291		-----		-----	
1307	In house	B&C		-----	
1434	E2680	CLEAR		-----	
1510	VISUAL	B&C		-----	
1538	VISUAL	B&C		-----	
1826	E2680	C&F		-----	
1843	in house	CCLFFSH		-----	
1866		-----		-----	
1908	VISUAL	B&C		-----	

Abbreviations:

B&C	= bright and clear
C&F	= clear and free
CFSM	= clear and free from suspended matter
CWWFS	= clear water white free from sediment
CFFMS	= clear free from matter in suspension
CCLFFSH	= clear colourless liquid free from sediment and haze

Determination of Copper Corrosion on Toluene sample #1035

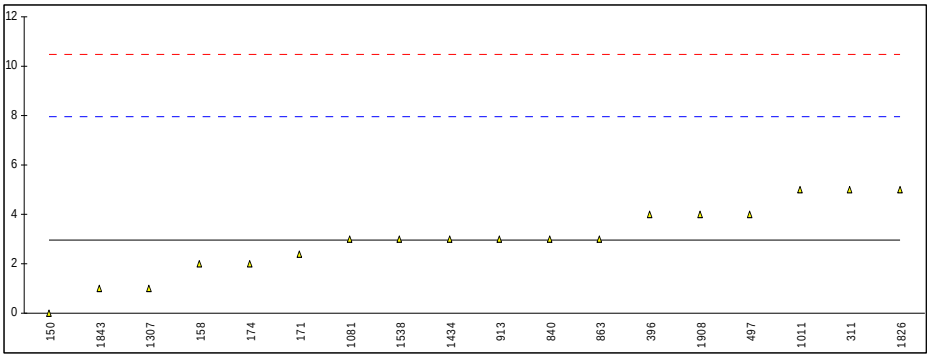
lab	method	value	mark	z(targ)	remarks
150	D849	1A		-----	
158	D849	1A		-----	
171	D849	1A		-----	
174	D849	1A		-----	
311	D849	pass		-----	
323	D849	1A		-----	
334		-----		-----	
357	D849	1A		-----	
360	D849	1A		-----	
396		-----		-----	
463	D849	1A		-----	
497	D849	1A		-----	
555		-----		-----	
840	D849	1A		-----	
862	D849	1A		-----	
863	D849	1A		-----	
864	D849	1A		-----	
865	D849	1A		-----	
870	D849	1A		-----	
913		-----		-----	
974		-----		-----	
1011	D849	1A		-----	
1040	ISO2160	1A		-----	
1041	D849	1		-----	
1067	D849	1A		-----	
1081	D849	pass		-----	
1291		-----		-----	
1307	D849	1A		-----	
1434	D849	1A		-----	
1510	D849	1A		-----	
1538	D849	1A		-----	
1826	D130	1A		-----	
1843		-----		-----	
1866		-----		-----	
1908	D849	1A		-----	

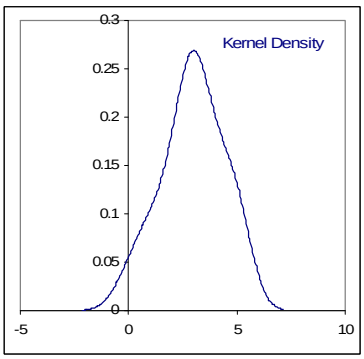
normality	n.a.
n	25
outliers	0
mean (n)	1 (1A)
st.dev. (n)	n.a.
R(calc.)	n.a.
R(D849:05)	n.a.

Determination of Colour (Pt/Co-scale) on Toluene sample #1035

lab	method	value	mark	z(targ)	remarks
150	D1209	0		-1.19	
158	D1209	2		-0.39	
171	D1209	2.4		-0.23	
174	D1209	2		-0.39	
311	D1209	5		0.81	
323	D1209	<5		-----	
334		-----		-----	
357	D1209	<5		-----	
360		-----		-----	
396	D1209	4		0.41	
463	D1209	<5		-----	
497	D1209	4		0.41	
555		-----		-----	
840	D1209	3		0.01	
862	D1209	<5		-----	
863	D1209	3		0.01	
864	D1209	<5		-----	
865	D1209	<5		-----	
870	D1209	<5		-----	
913	D1209	3		0.01	
974		-----		-----	
1011	D1209	5		0.81	
1040	ISO6271	<5		-----	
1041	D1209	<5		-----	
1067	D1209	<5		-----	
1081	D5386	3		0.01	
1291		-----		-----	
1307	D1209	1		-0.79	
1434	D1209	3		0.01	
1510	D1209	<2.5		-----	
1538	D1209	3		0.01	
1826	D1209	5		0.81	
1843	D1209	1		-0.79	
1866		-----		-----	
1908	D1209	4		0.41	

normality	OK
n	18
outliers	0
mean (n)	2.97
st.dev. (n)	1.421
R(calc.)	3.98
R(D1209:05e1)	7.00

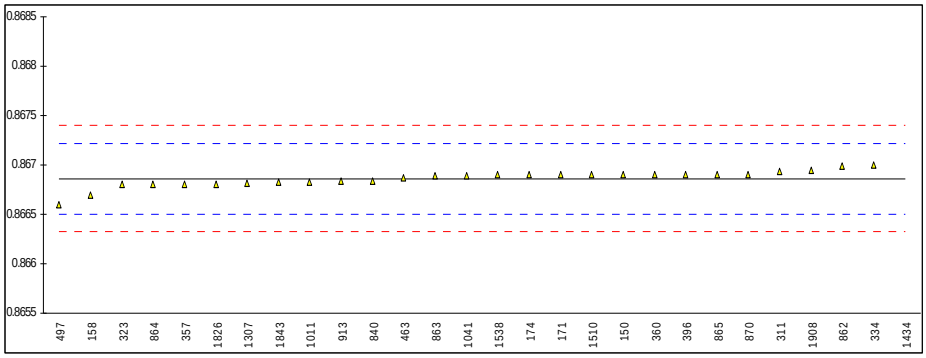


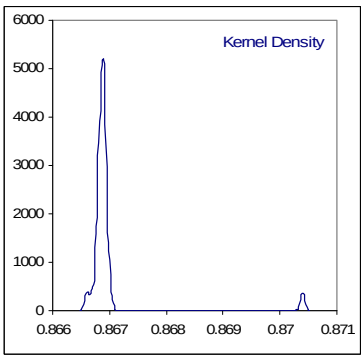


Determination of Density @ 20°C on Toluene sample #1035: results in kg/L

lab	method	value	mark	z(targ)	remarks
150	D4052	0.8669		0.21	
158	D4052	0.8667		-0.91	
171	D4052	0.8669		0.21	
174	D4052	0.8669		0.21	
311	D4052	0.86693		0.38	
323	D4052	0.8668		-0.35	
334	D4052	0.8670		0.77	
357	D4052	0.8668		-0.35	
360	D4052	0.8669		0.21	
396	D4052	0.8669		0.21	
463	D4052	0.86687		0.05	
497	D4052	0.86660		-1.47	
555		-----		-----	
840	D4052	0.86684		-0.12	
862	D4052	0.86699		0.72	
863	D4052	0.86689		0.16	
864	D4052	0.8668		-0.35	
865	D4052	0.8669		0.21	
870	D4052	0.8669		0.21	
913	D4052	0.86684		-0.12	
974		-----		-----	
1011	D4052	0.86683		-0.18	
1040		-----		-----	
1041	D4052	0.86689	C	0.16	First reported 866.89
1067		-----		-----	
1081		-----		-----	
1291		-----		-----	
1307	D4052	0.86681		-0.29	
1434	D4052	0.8704	G(0.01)	19.81	
1510	IP365	0.8669	C	0.21	First reported 866.9
1538	D4052	0.8669		0.21	
1826	D4052	0.8668	C	-0.35	First reported 866.8
1843	D4052	0.86683		-0.18	
1866		-----		-----	
1908	D4052	0.86695		0.49	

normality	not OK
n	27
outliers	1
mean (n)	0.86686
st.dev. (n)	0.000083
R(calc.)	0.00023
R(D4052:02e1)	0.00050





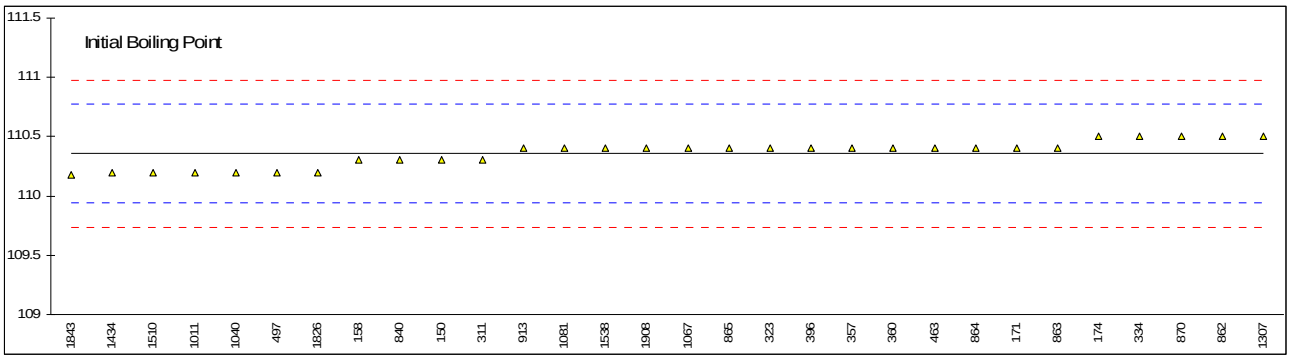
Determination of Distillation on Toluene sample #1035; results in °C

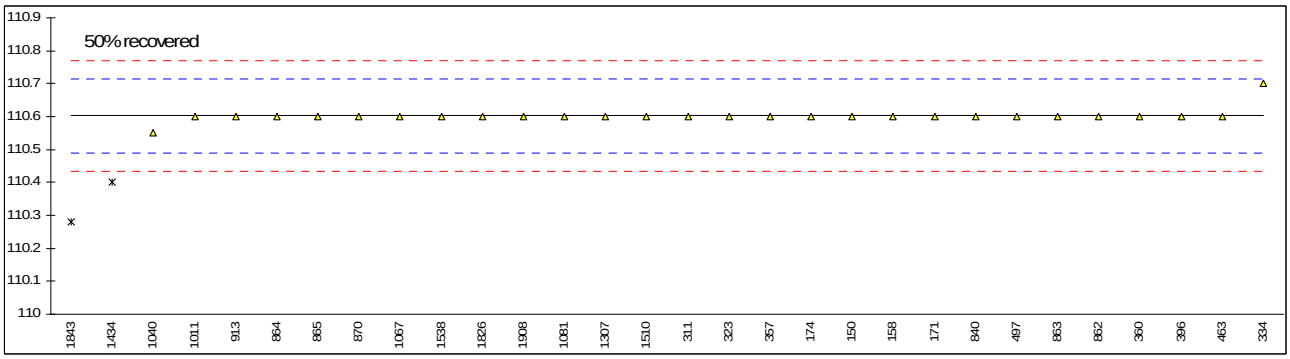
lab	method	IBP	mark	z(targ)	50%	mark	z(targ)	DP	mark	z(targ)	remarks
150	D850-A	110.3		-0.27	110.6		-0.03	110.6		-0.83	
158	D850-A	110.3		-0.27	110.6		-0.03	110.5		-1.45	
171	D850-A	110.4		0.21	110.6		-0.03	110.7		-0.22	
174	D850-A	110.5		0.69	110.6		-0.03	110.8		0.40	
311	D850-A	110.3		-0.27	110.6		-0.03	110.7		-0.22	
323	D850-M	110.4		0.21	110.6		-0.03	110.7		-0.22	
334	D850-A	110.5		0.69	110.7		1.76	110.8		0.40	
357	D850-A	110.4		0.21	110.6		-0.03	110.7		-0.22	
360	D850-A	110.4		0.21	110.6		-0.03	110.7		-0.22	
396	D850-M	110.4		0.21	110.6		-0.03	110.8		0.40	
463	D850-A	110.4	fr 109.9	0.21	110.6	fr 110.1	-0.03	110.5	fr 110.0	-1.45	
497	D850-A	110.2		-0.75	110.6		-0.03	110.8		0.40	
555		-----		-----	-----		-----	-----		-----	
840	D850-A	110.3		-0.27	110.6		-0.03	110.7		-0.22	
862	D850-M	110.5		0.69	110.6		-0.03	110.9		1.01	
863	D850-M	110.4		0.21	110.6		-0.03	110.8		0.40	
864	D850-M	110.4		0.21	110.6		-0.03	110.8		0.40	
865	D850-M	110.4		0.21	110.6		-0.03	110.8		0.40	
870	D850-M	110.5		0.69	110.6		-0.03	110.8		0.40	
913	D850-M	110.4		0.21	110.6		-0.03	110.7		-0.22	
974		-----		-----	-----		-----	-----		-----	
1011	D850-A	110.2		-0.75	110.6		-0.03	110.8		0.40	
1040	DIN51761-M	110.20		-0.75	110.55		-0.93	110.73		-0.03	
1041		-----		-----	-----		-----	-----		-----	
1067	D850-M	110.4		0.21	110.6		-0.03	110.8		0.40	
1081	D850-A	110.4		0.21	110.6		-0.03	110.9		1.01	
1291		-----		-----	-----		-----	-----		-----	
1307	D850-A	110.5		0.69	110.6		-0.03	110.7		-0.22	
1434	D850-A	110.2		-0.75	110.4	G(0.01)	-3.62	110.5		-1.45	
1510	D850-A	110.2		-0.75	110.6		-0.03	110.6		-0.83	
1538	D850-A	110.4		0.21	110.6		-0.03	110.8		0.40	
1826	D850-M	110.2		-0.75	110.6		-0.03	111.0		1.63	
1843	D850-M	110.18		-0.85	110.28	G(0.01)	-5.78	110.58		-0.95	
1866		-----		-----	-----		-----	-----		-----	
1908	D850-M	110.40		0.21	110.60		-0.03	110.85		0.70	
	normality	not OK			not OK			not OK			
	n	30			28			30			
	outliers	0			2			0			
	mean (n)	110.36			110.60			110.74			
	st.dev. (n)	0.105			0.021			0.120			
	R(calc.)	0.29			0.06			0.34			
	R(D850:08e1)	0.58			0.16			0.46			Automated
	R(D850:08e1)	0.47			0.47			0.47			Manually

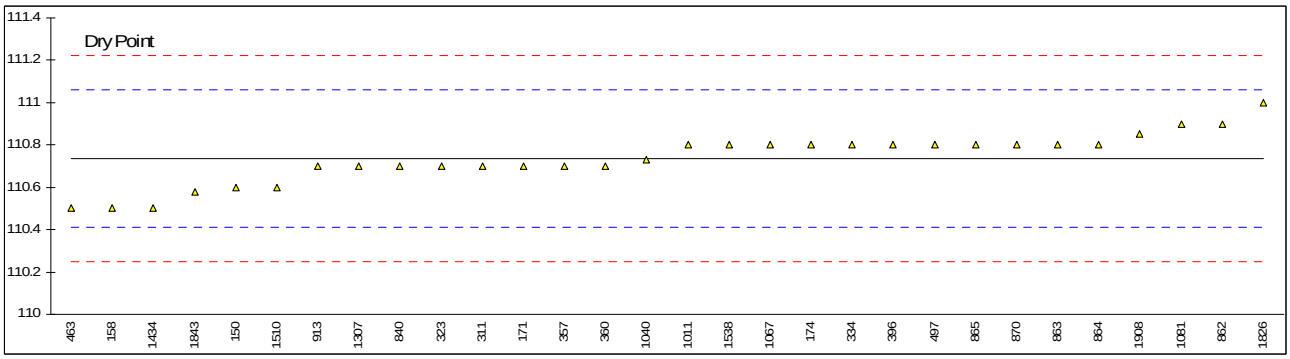
After manual corrections for “50% recovered”

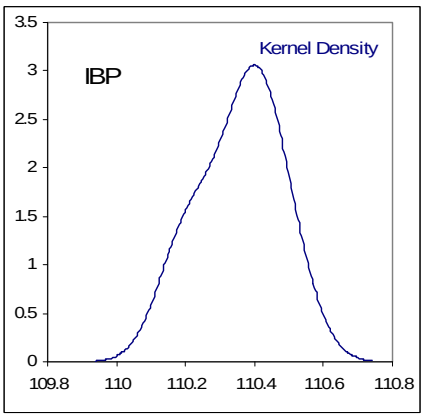
lab	method	IBP	mark	z(targ)	50%	mark	z(targ)	DP	mark	z(targ)	Remarks
1434	D850	110.4		0.13	110.6		-0.02	110.7		-0.32	
1843	D850	110.48		0.52	110.6		-0.38	110.88		0.79	
	normality	not OK			not OK			not OK			
	n	30			30			30			
	outliers	0			0			0			
	mean (n)	110.37			110.60			110.75			
	st.dev. (n)	0.097			0.021			0.111			
	R(calc.)	0.27			0.06			0.31			
	R(D850:08e1)	0.58			0.16			0.46			

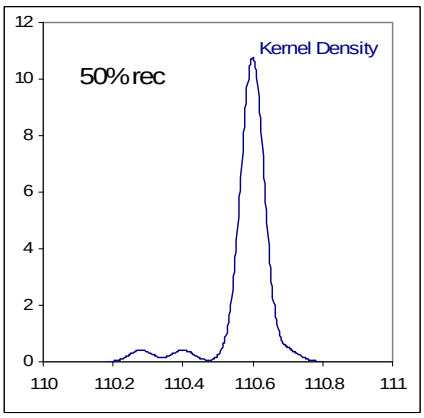
Determination of Distillation on Toluene sample #1035; results in °C -- continue --

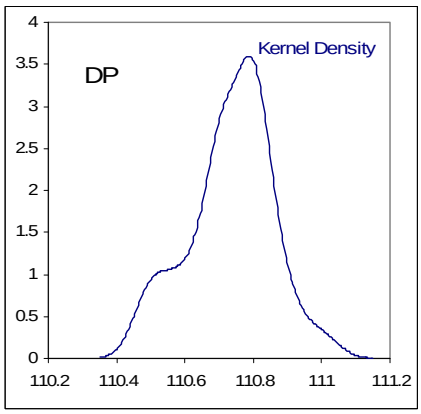








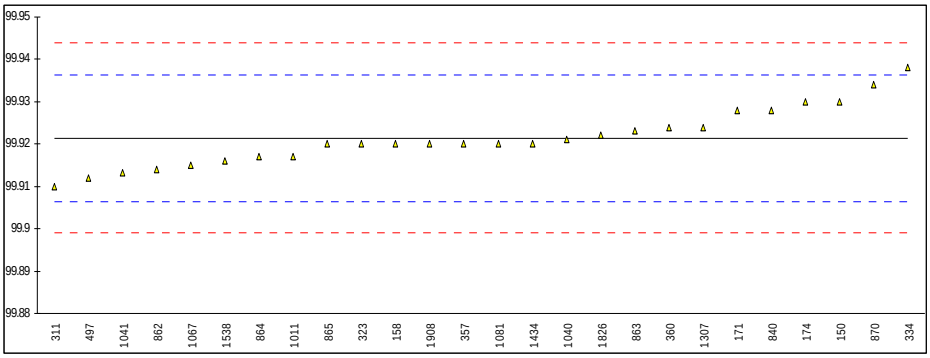


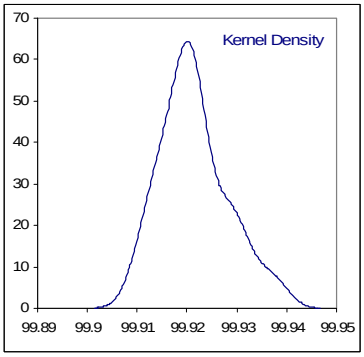


Determination of Purity on Toluene sample #1035; results in %M/M

lab	method	value	mark	z(targ)	remarks
150	D2360	99.93		1.15	
158	D2360	99.92		-0.19	
171	D2360	99.928		0.88	
174	D2360	99.930		1.15	
311	D2360	99.91		-1.52	
323	D2360	99.92		-0.19	
334	D2360	99.938		2.21	
357	INH065	99.92		-0.19	
360	D2360	99.9239		0.33	
396		-----		-----	
463		-----		-----	
497	D2360	99.912		-1.25	
555		-----		-----	
840	D2360	99.928		0.88	
862	D2360	99.914		-0.99	
863	D2360	99.923		0.21	
864	D6526	99.917		-0.59	
865	D2360	99.920		-0.19	
870	D2360	99.934		1.68	
913		-----		-----	
974		-----		-----	
1011	D2360	99.917		-0.59	
1040	D2360Mod	99.921		-0.05	
1041	D2360	99.9133		-1.08	
1067	D2360	99.915		-0.85	
1081	In house	99.92		-0.19	
1291		-----		-----	
1307	In house	99.924		0.35	
1434	D4492	99.92		-0.19	
1510		-----		-----	
1538	D2360	99.916		-0.72	
1826	In house	99.922		0.08	
1843		-----		-----	
1866		-----		-----	
1908	D2360	99.920		-0.19	

normality	OK
n	26
outliers	0
mean (n)	99.9214
st.dev. (n)	0.00677
R(calc.)	0.0190
R(D2360:08)	0.0210

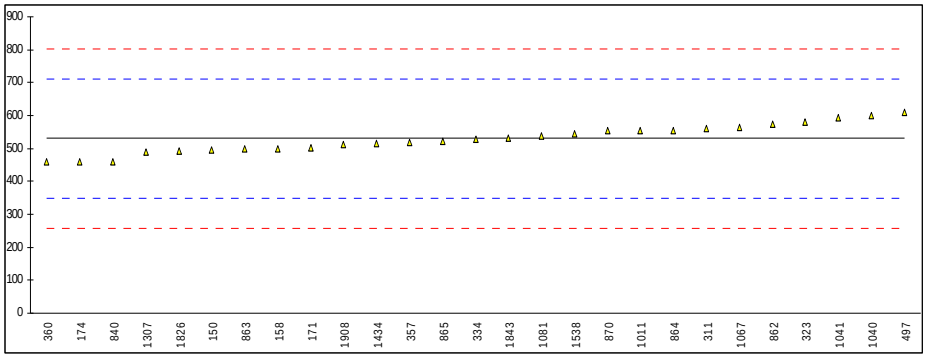


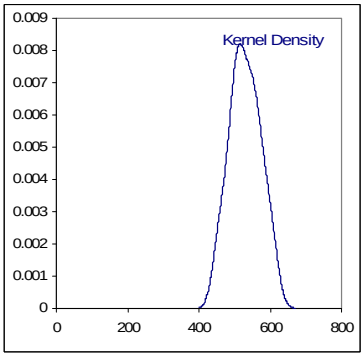


Determination of Nonaromatics on Toluene sample #1035; results in mg/kg

lab	method	value	mark	z(targ)	remarks
150	D2360	497		-0.37	
158	D2360	500		-0.33	
171	D2360	503.1		-0.30	
174	D2360	460		-0.77	
311	D2360	560		0.33	
323	D2360	580		0.55	
334	D2360	528		-0.02	
357	INH065	520		-0.11	
360	D2360	459		-0.79	
396		-----		-----	
463		-----		-----	
497	D2360	609		0.87	
555		-----		-----	
840	D2360	460		-0.77	
862	D2360	573		0.47	
863	D2360	499		-0.34	
864	D6526	555		0.27	
865	D2360	522		-0.09	
870	D2360	554		0.26	
913		-----		-----	
974		-----		-----	
1011	D2360	554.4		0.27	
1040	D2360Mod	601		0.78	
1041	D2360	594		0.71	
1067	D2360	565		0.39	
1081	In house	537		0.08	
1291		-----		-----	
1307	In house	490.2		-0.44	
1434	D4492	515		-0.17	
1510		-----		-----	
1538	D2360	543		0.14	
1826	In house	494		-0.40	
1843	D2360	530		0.00	
1866		-----		-----	
1908	D2360	511		-0.21	

normality	OK
n	27
outliers	0
mean (n)	530.14
st.dev. (n)	42.069
R(calc.)	117.79
R(D2360:08)	253.54

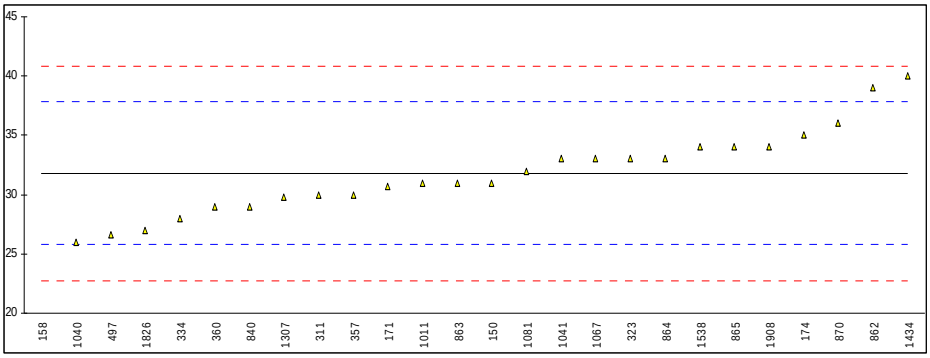


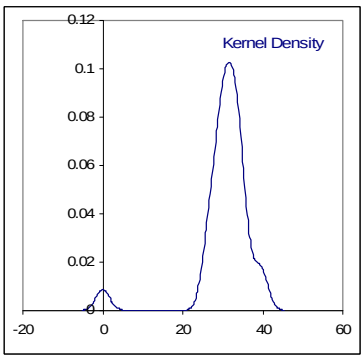


Determination of Benzene on Toluene sample #1035; results in mg/kg

lab	method	value	mark	z(targ)	remarks
150	D2360	31		-0.27	
158	D2360	0.00	ex	-10.52	Result excluded, not a real result
171	D2360	30.7		-0.37	
174	D2360	35		1.06	
311	D2360	30		-0.60	
323	D2360	33		0.40	
334	D2360	28		-1.26	
357	INH065	30		-0.60	
360	D2360	29		-0.93	
396		-----		-----	
463		-----		-----	
497	D2360	26.6		-1.72	
555		-----		-----	
840	D2360	29		-0.93	
862	D2360	39		2.38	
863	D2360	31		-0.27	
864	D6526	33		0.40	
865	D2360	34		0.73	
870	D2360	36		1.39	
913		-----		-----	
974		-----		-----	
1011	D2360	31.0		-0.27	
1040	D2360Mod	26		-1.92	
1041	D2360	33		0.40	
1067	D2360	33		0.40	
1081	InHouse	32		0.06	
1291		-----		-----	
1307	InHouse	29.8		-0.66	
1434	D4492	40		2.71	
1510		-----		-----	
1538	D2360	34	C	0.73	First reported 45
1826	InHouse	27		-1.59	
1843		-----		-----	
1866		-----		-----	
1908	D2360	34		0.73	

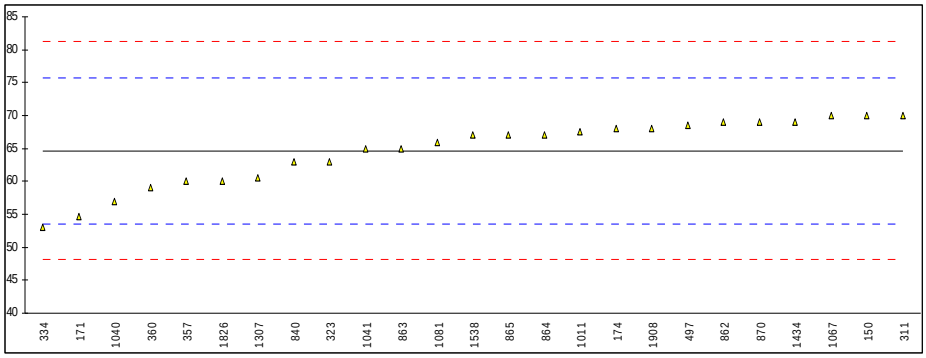
normality	OK
n	25
outliers	1
mean (n)	31.80
st.dev. (n)	3.504
R(calc.)	9.81
R(Horwitz)	8.47

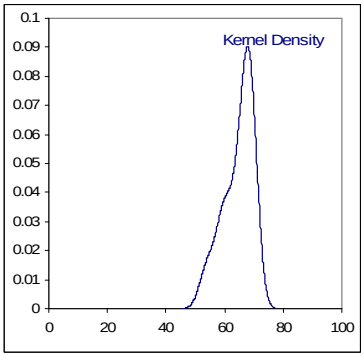




Determination of Styrene on Toluene sample #1035; results in mg/kg

lab	method	value	mark	z(targ)	remarks
150	D2360	70		0.97	
158		-----		-----	
171	D2360	54.7		-1.80	
174	D2360	68		0.61	
311	D2360	70		0.97	
323	D2360	63		-0.30	
334	D2360	53		-2.11	
357	INH065	60		-0.84	
360	D2360	59		-1.02	
396		-----		-----	
463		-----		-----	
497	D2360	68.5		0.70	
555		-----		-----	
840	D2360	63		-0.30	
862	D2360	69		0.79	
863	D2360	65		0.06	
864	D6526	67		0.43	
865	D2360	67		0.43	
870	D2360	69		0.79	
913		-----		-----	
974		-----		-----	
1011	D2360	67.5		0.52	
1040	D2360Mod	57		-1.38	
1041	D2360	65		0.06	
1067	InHouse	70		0.97	
1081	InHouse	66		0.24	
1291		-----		-----	
1307	InHouse	60.5		-0.75	
1434	D4492	69		0.79	
1510		-----		-----	
1538	D2360	67		0.43	
1826	InHouse	60	C	-0.84	First reported 2
1843		-----		-----	
1866		-----		-----	
1908	D2360	68		0.61	
	normality	not OK			
	n	25			
	outliers	0	Spike:		
	mean (n)	64.65	68.0		Recovery (<95%)
	st.dev. (n)	4.991			
	R(calc.)	13.97			
	R(Horwitz)	15.46			





APPENDIX 2

List of participants

Number of laboratories	Country
1 laboratory in	AUSTRALIA
3 laboratories in	BELGIUM
2 laboratories in	BRAZIL
1 laboratory in	BULGARIA
1 laboratory in	CANADA
1 laboratory in	FINLAND
1 laboratory in	FRANCE
3 laboratories in	GERMANY
1 laboratory in	INDIA
1 laboratory in	ISRAEL
1 laboratory in	ITALY
2 laboratories in	KUWAIT
7 laboratories in	P.R. of CHINA
1 laboratory in	POLAND
1 laboratory in	PORTUGAL
3 laboratories in	SAUDI ARABIA
1 laboratory in	SWEDEN
7 laboratories in	THE NETHERLANDS
2 laboratories in	U.A.E.
4 laboratories in	U.S.A.
3 laboratories in	UNITED KINGDOM
1 laboratory in	VIETNAM

APPENDIX 3

Abbreviations:

C	= final result after checking of first reported suspect result
D(0.01)	= outlier in Dixon's outlier test
D(0.05)	= straggler in Dixon's outlier test
G(0.01)	= outlier in Grubbs' outlier test
G(0.05)	= straggler in Grubbs' outlier test
DG(0.01)	= outlier in Double Grubbs' outlier test
DG(0.05)	= straggler in Double Grubbs' outlier test
E	= error in calculations
ex	= excluded from calculations
n.a.	= not applicable
fr	= first reported
U	= reported in different unit
SDS	= Safety Data Sheet

Literature:

1 I.I.S. Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, January 2010
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8 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
9 W.J. Youden and E.H. Steiner, Statistical Manual of the AOAC, (1975)
10 IP 367/84
11 DIN 38402 T41/42
12 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
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