Asia Pacific Laboratory Accreditation Cooperation
Proficiency Testing Programme
APLAC T090
Analysis of Coal

Final Report

Dec. 19 2014

Content

Summary

1. This proficiency testing programme (APLAC T090) was organized by China National Accreditation Service for Conformity Assessment (CNAS) in collaboration with the Technical Center of Shanxi Entry-exit Inspection and Quarantine Bureau (SXCIQTC), under the auspices of Asia-Pacific Laboratory Accreditation Cooperation (APLAC).

2. A total of 156 laboratories from 44 economies registered for the programme. 138 laboratories submitted their results on time (table 1).

3. Assigned values and standard deviations are determined by the robust analysis according to Algorithm A，in Annex C of ISO 13528. The z-score is used as the numerical indicator to assess individual participant's performance in the programme.

4. Summary of participants` statistical results as follow.

	Ash %		Volatile Matter* %				Total Sulfur %		Gross Calorific Value MJ/kg	
	A	B	A(V-1)	A(V-2)	B(V-1)	B(V-2)	A	B	A	B
Number of results	134	134	72	51	72	51	127	126	128	128
x*	11.828	11.420	25.649	26.428	26.690	27.426	0.7418	0.9464	29.2098	29.7069
s*	0.124	0.130	0.421	0.687	0.451	0.597	0.0331	0.0387	0.1182	0.1070
CV%	1.05	1.14	1.64	2.60	1.69	2.18	4.46	4.09	0.40	0.36
Max	12.61	12.09	27.04	30.31	28.04	32.18	0.910	1.141	35.187	36.191
Min	10.80	11.00	23.09	23.58	23.92	24.49	0.240	0.390	26.646	27.024
Range	1.81	1.09	3.95	6.73	4.12	7.69	0.670	0.751	8.541	9.167

Note: * As to volatile matter, it was analyzed separately for two main groups(V-1: 900℃& V-2: 950℃).

5. Summary of the z-scores of the Participants as follow.

z-score	Number of results (Percentage)			
	Ash	Volatile Matter	Total Sulfur	Gross Calorific Value
$\lvert z \rvert \leqslant 2.0$	241(89.9%)	215(89.6%)	220(87.0%)	221(86.3%)
$2.0 < \lvert z \rvert < 3.0$	14(5.2%)	17(7.1%)	16(6.3%)	6(2.3%)
$\lvert z \rvert \geqslant 3.0$	13(4.9%)	8(3.3%)	17(6.7%)	29(11.4%)
Total	268(100%)	240(100%)	253(100%)	256(100%)

1. Introduction

1.1 This report summarizes the results of the APLAC T090 proficiency testing programme on the routine analysis of the coal. The programme was organized by China National Accreditation Service for Conformity Assessment (CNAS) in collaboration with the Technical Center of Shanxi Entry-exit Inspection and Quarantine Bureau (SXCIQTC), under the auspices of Asia-Pacific Laboratory Accreditation Cooperation (APLAC). SXCIQTC has been accredited against ISO/IEC 17043 (CNAS PT0001) for the scope of this PT program.

1.2 Coal is one of the most important energy resources that widely used in electric power industry, metallurgical industry, chemical engineering and other fields. It plays an important role in APEC trade and has large trading volume, and consequently the analysis result of coal will decide its trade value. Today, the item names as “total sulfur” is specified in the environmental standards of all trading countries. Therefore, coal analysis proficiency testing is very significant to all participating laboratories. The main objective of this proficiency testing programme is to evaluate the competence of all participating laboratories on such routine items as ash content, volatile matter, total sulfur and calorific value.

1.3 Each participant was confidentially assigned with a unique laboratory code (001 to 156) which is used throughout the programme. Lab code 1078 was outside the range of the lab codes. Thus, its results were not included in statistical analysis.

1.4 The programme was carried out as the schedule below.

Event	Planned	Responsible
Invitation	Dec 2013 - Jan 2014	CNAS
Dispatch of PT samples	March 2014	SXCIQTC
Submit the results	April 2014	CNAS/SXCIQTC
Draft final report	June-September 2014	CNAS/SXCIQTC

2. Objective

2.1 The main objective of the scheme is to evaluate the competence of participating laboratories on the analysis of Ash, Volatile Matter, Total Sulfur and Gross Calorific Value in coal by means of inter-laboratory comparison. In this programme “competence” is taken to mean the ability to agree closely with other participants.

2.2 Test results from participants were evaluated according to the statistical techniques outlined in ISO 13528:2005 *Statistical methods for use in proficiency testing by inter laboratory comparisons*. The z-score was used as a numerical indicator to assess individual participant’s performance in the scheme.

3. Proficiency Testing Items

3.1 Each registered participant was provided with two bottles labeled as Sample A and Sample B. Each bottle contains about 80g of coal with the particle size less than 0.2 mm. The raw materials were purchased from a local coal mine in China and processed.

3.2 The homogeneity study of the test material was carried out in accordance with the procedures stipulated in APPENDIX B. The results indicated that the test material was considered to be sufficiently homogeneous for the proficiency testing programme. According to the past experience, the samples of coal are stable enough for the operation period of this programme.

3.4 The samples along with relevant documents were distributed by courier service in March 2014. These documents were also provided via e-mail, which can be referred to APPENDIX C.

3.5 Upon receipt of the proficiency test samples, participants were required to immediately check the physical conditions of the bottles and promptly acknowledge SXCIQTC by returning the "Sample Receipt Form" via the e-mail box of the contact. Replacement would be arranged if the proficiency test sample was identified to be not suitable for analysis. SXCIQTC did not receive any complaints in respect to loss/damage of samples.

4. Test Required

Participants were required to:

a) Report the mean value of the 4 test items/parameters on a dry basis using their routine test methods in correspondent units in the required significant figures;

b) Report the significant graphs according to the requirements in "Results Sheet";

c) Provide detailed information of the test methods/conditions applied in this scheme, and

d) Report the measurement uncertainty for each result as possible as they can.

5. Statistical Evaluation

5.1 Participants' performance was evaluated via a numeric indicator, z-score, which is calculated as follows:

$$z = \frac{x - x^*}{s^*}$$

Where x = the reported result of the participant

x* = the robust average according to ISO 13528:2005 , Algorithm A，in Annex C

s* = the robust standard deviation according to ISO 13528:2005,

Algorithm A，in Annex C

5.2 The z-score is commonly interpreted as follows:

$\|z\| \leqslant 2.0$	Satisfactory	
$2.0 < \|z\| < 3.0$	Questionable	Warning Signal
$\|z\| \geqslant 3.0$	Unsatisfactory	Action Signal

5.3 Participants with the action signal should thoroughly investigate their results and find the possible root cause. Participants are encouraged to review their results if with warning signal.

5.4 In addition to tables of the results, z-score, and summary statistics, the ordered z-score histograms are included in the report. On these charts each laboratory's z-score is shown in order of magnitude, and the lab with $|z| \geqslant 3.0$ were marked with its lab code on the graph. From these charts each laboratory can readily compare its performance relative to other laboratories.

6. Results Reported by Participants

6.1 Participants' results

6.1.1 An overview of participants' statistical results is summarized in Table 2 and participants with unsatisfactory results are summarized in Table 3.

6.1.2 Test results received from participants are presented in APPENDIX A.

6.1.3 Participants' results of Ash, Volatile Matter, Total Sulfur and Gross Calorific Value are given in Table A.1 to Table A.5 and presented graphically in Figure A.1 to Figure A.10.

6.2 Statistical analysis of participants' results

6.2.1 Gross stragglers were taken out before statistical analysis. In this programme, for ash results, Lab code 35 (67.73 % & 71.50 %) was not included in the statistical analysis; the same for Lab code 15 & 79 (6965.00 MJ/kg, 7094.00 & 6890.00 MJ/kg) as to Gross Calorific Value. The three participants are encouraged to investigate the reason(s) the same as the warning signal was given out.

6.2.2 Anderson-Darling method was applied to check the normal distribution of the participants' result. The results showed that all of the items fitted normal distribution. Relevant graphs of normality tests are given in Figure 1 to Figure 4 and probability density graphs of the results are presented in Figure 5 to Figure 8.

6.2.3 Participants' z-scores for Ash, Volatile Matter, Total Sulfur, Gross Calorific Value are presented in Figure 11 to Figure 15. In the Scatter Diagram graphs with Uncertainty (Figure 16 to Figure 25), relative location of each participant's test results was marked intuitively.

6.2.4 The number and percentage of z-scores in the satisfactory range ($|z| \leqslant 2.0$), questionable range ($2.0 < |z| < 3.0$) and unsatisfactory range ($|z| \geqslant 3.0$) are summarized in Table 4.

6.3 From the information kindly offered by participants, it can be concluded that ISO and ASTM standards are prevailing methods that participants used. Other methods may be traced back to them (e.g. GB standards involved in this programme are derived from ISO standards). Overview of analysis methods used by participants is summarized in Table A.5 of APPENDIX A.

6.3.1 Different methods and corresponding number of unsatisfactory results are summarized according to items respectively. Detailed information is summarized in Table 6.

6.3.2 According to the information derived from results sheets, the testing parameters of Ash, Volatile Matter and Total Sulfur are summarized in Table 7 to Table 9.

6.4 Measurement uncertainty

6.4.1 Although the measurement uncertainties reported by participants were not requested to be used in assessing the performance of participants, it was one of the important technical requirements of ISO/IEC 17025:2005. Scatter diagrams with uncertainty were presented in Figure 16 to Figure 25, Lab codes of those z-score≥3.0 were marked on the graphs below.

6.4.2 The number of participants reporting measurement uncertainties is given as follows:

	Ash	Volatile Matter	Total Sulfur	Gross Calorific Value
Reported	116	112	108	112
Unreported	18	18	19	16
Percentage	86.6%	86.2%	85.0%	87.5%

6.4.3 Uncertainty of assigned value

According to ISO 13528:2005, standard uncertainty of assigned value is calculated as follow formula:

$$u_x = \frac{1.25 \times s^*}{\sqrt{p}}$$

It shows that the uncertainties of the assigned values are small enough compared with the 0.3s*. Details of uncertainty are summarized in Table 12.

7. Comments

7.1 Influence of Methods

7.1.1 Methods used in Ash testing mostly contain 750℃(A-1) and 815℃(A-2). Few methods involve other temperatures such as 775℃(NBR 8289) and 850℃(GB/T212 Method 4.1). Through experimentation and Student's Test (Table 10 & Table 11), it is compared the difference at different temperatures (750℃ & 815℃). The results show that there was no significant difference between these two temperatures for Sample A but little

difference for Sample B. Details of results for significance test were given in Table 11. For double assurance, additional tests and statistic analysis have been conducted by SXCIQTC. The results show that the difference between A-1 and A-2 is occasional.

7.1.2 Regarding volatile matter, there are two main groups for experimental temperature, 900℃(V-1) and 950℃(V-2). Few participants used other temperatures such as PN-G-0451 (850℃). Due to the nature of the volatile matter, the temperature plays an important role in the results. The difference was looked into between the two main temperature groups by the experimental data from SXCIQTC (Table 10 & Table 11). Significant differences are shown as the indication (Figure 9 & Figure 10). In this programme, results were analyzed in form of subgroups which was grouped as 900℃ and 950℃. Other temperature was not included in statistical analysis because of small number of results. Details of results for significance test were given in Table 11. This kind of participants can make their own judgment on the performance based upon the information provided here.

7.1.3 Methods used in Total Sulfur mostly contain High temperature combustion method (Mark S-1), Eschka method (Mark S-2)and IR spectrometry method (Mark S-3). A very few of participants didn't describe test methods clearly. The results of Student's Test showed that there was no significant difference.

7.1.4 For Gross Calorific Value, there was no significant difference among different test methods.

7.2 Further laboratory capacity building efforts in respect of the estimation of measurement uncertainty are recommended for the participants who showed some difficulties in reporting measurement uncertainty (either the measurement uncertainty was not reported or the reported measurement uncertainty was underestimated or overestimated). Following the idea from the upcoming version of ISO 13258, u_{max} could be $1.5s^*$. u_{min} could vary in some range due to different methods. Those participants with uncertainty larger than $1.5s^*$ are marked in the annex and encouraged to follow ***Guide to the Expression of Uncertainty in Measurement, GUM*** in quantifying measurement uncertainty in analytical measurements.

7.3 Another crucial factor participants need to be considered is the applicability of method they used. (e.g. The method which lab code 1 adopted in testing sulfur is suitable for soil samples.)

7.4 As to Gross Calorific Value, CV% s (0.40% for Sample A & 0.36% for sample) are relatively small. From one side, this brings the positive point that the consistency among participants was good for this occasion, which is the final goal of our global mutual recognition. On the other side, this makes the difference from the assigned value look larger. That means the participants are very easy to receive action signal , ie, $|z| \geqslant 3.0$. The apparent "outliers" are encouraged to look into their results against the accuracy of different methods they applied and make their own judgment on the results, whether or not some further action is needed.

8. Remarks

8.1 Contributions from all accreditation bodies and participants to this programme are gratefully noted. Special thanks are extended to APLAC PT Committee, and their support to the programme.

8.2 If the participants have any queries about this report, please contact the coordinator of this proficiency testing programme as follows:

Technical center, Shanxi Entry-exit Inspection and Quarantine Bureau (SXCIQTC)

Name: Chen Yong

Email: ptesting@163.com

China National Accreditation Service for Conformity Assessment (CNAS)

Name: He Ping

Email: heping@cnas.org.cn

8.3 Use of the report other than the demonstration of the proficiency shall only be allowed with the written permission of the coordinator of this proficiency testing programme.

9. References

[1] ISO/IEC 17043:2010, Conformity assessment–General requirements for proficiency testing

[2] ISO/IEC 17025:2005, Gerneral requirements for the competence of testing and calibration laboratories

[3] ISO 13528:2005, “Statistical methods for use in proficiency testing by interlaboratory comparisons”

[4] BIPM JCGM100, Evaluation of measurement data – Guide to the expression of uncertainty in measurement

[5] EURACHEM/CITAC Guide CG4, “Quantifying Uncertainty in Analytical Measurement”.

Table 1 Geographical Distribution of Participants

Economy	Registered Number	Reported Number	Economy	Registered Number	Reported Number
China	8	8	France	2	2
Taiwan	3	3	Lithuania	2	2
Hong Kong	1	1	Spain	4	4
India	10	9	Slovenia	4	3
Indonesia	7	6	Bulgaria	4	4
Cyprus	2	1	Austria	4	4
Thailand	5	5	Croatia	1	1
Israel	2	2	Estonia	4	2
Malaysia	4	4	Finland	3	3
Sultanate of Oman	2	1	Sweden	4	4
Korea	8	8	Denmark	2	2
Turkey	4	4	Latvia	3	3
Philippines	3	0	Czech Republic	4	3
Australia	6	4	Poland	4	4
New Zealand	5	5	Germany	4	4
Egypt	1	1	Portugal	2	1
Morocco	1	1	Argentina	2	1
Greece	4	4	Brazil	2	2
Bosnia and Herzegovina	4	4	Columbia	4	4
Belgium	1	1	Canada	1	1
Macedonia	1	1	USA	7	7
Serbia	4	4	Guatemala	3	0

Table 2 Summary of Participants' Statistical Results

	Ash%		Volatile Matter%				Total Sulfur%		Gross Calorific Value MJ/kg	
	A	B	A(V-1)	A(V-2)	B(V-1)	B(V-2)	A	B	A	B
Number of results	134	134	72	51	72	51	127	126	128	128
x*	11.828	11.420	25.649	26.428	26.690	27.426	0.7418	0.9464	29.2098	29.7069
s*	0.124	0.130	0.421	0.687	0.451	0.597	0.0331	0.0387	0.1182	0.1070
CV%	1.05	1.14	1.64	2.60	1.69	2.18	4.46	4.09	0.40	0.36
Max	12.61	12.09	27.04	30.31	28.04	32.18	0.910	1.141	35.187	36.191
Min	10.80	11.00	23.09	23.58	23.92	24.49	0.240	0.390	26.646	27.024
Range	1.81	1.09	3.95	6.73	4.12	7.69	0.670	0.751	8.541	9.167

Note: The x* and s* in this paper are on behalf of robust average and robust standard deviation respectively and were estimated according to ISO 13528:2005.

Table 3 Summary of Unsatisfactory Participants

	Ash %	Volatile Matter %	Total Sulfur %	Gross Calorific Value MJ/kg
Lab code	1，3，32，40，81，83，84，106	8，22，86，96，104，112	3，6，9，19，21，22，35，58，110，117，142	3，13，25，32，35，40，45，63，67，75，78，82，86，116，144

Table 4 Summary of Z-scores of Results

z-score	Number of results (Percentage)			
	Ash	Volatile Matter	Total Sulfur	Gross Calorific Value
$\lvert z \rvert \leqslant 2.0$	241(89.9%)	229(93.0%)	220(87.0%)	221(86.3%)
$2.0 < \lvert z \rvert < 3.0$	14(5.2%)	17(6.9%)	16(6.3%)	6(2.3%)
$\lvert z \rvert \geqslant 3.0$	13(4.9%)	10(4.1%)	17(6.7%)	29(11.4%)
Total	268(100%)	246(100%)	253(100%)	256(100%)

Table 5 Summary of Test Method

Method	Ash		Volatile Matter		Total Sulfur		Gross Calorific Value	
	Number of results	Percentage	Number of results	Percentage	Number of results	Percentage	Number of results	Percentage
ISO	44	32.8%	46	34.8%	23	18.1%	43	33.6%
ASTM	53	39.6%	58	43.9%	69	54.3%	47	36.7%
GB	8	6.0%	8	6.1%	8	6.3%	8	6.3%
DIN	4	3.0%	4	3.0%	4	3.1%	6	4.7%
SRPS	3	2.2%	1	0.8%	0	0.0%	3	2.3%
IS	5	3.7%	5	3.8%	4	3.1%	2	1.6%
EN	2	1.5%	1	0.8%	2	1.6%	2	1.6%
Other	15	11.2%	9	6.8%	17	13.4%	17	13.3%
Total	134	100%	132	100%	127	100%	128	100%

Table 6 Summary Test method for Unsatisfied Number

Test of Methods (unsatisfied number of results)			
Ash	Volatile Matter	Total Sulfur	Gross Calorific Value
ISO (7)	ISO(5)	ISO(3)	ISO(6)
ASTM (3)	ASTM(4)	ASTM(7)	ASTM(15)
SS187157 (2)	SRPS(1)	SRPS(2)	EN(4)
NF EN 15403(1)		DIN(1)	SS-187177(2)
		IS(1)	OTHER(2)
		CNS(1)	
		XRF-Own method(2)	

Table 7 Summary of Testing Parameters for Ash

Test Methods for Ash				
Burning Temperature℃	Method	Number of results	Number of results （｜z｜≥3.0)	Mark
107	ASTM(1)	1	0	
550	NF EN(1)	1	1	
625	AFNOR(1)	1	0	
700	ASTM(1)	1	0	
750	ASTM(44)	44	2	A-1
775	ASTM(1); NBR(1)	2	0	
800	ISO(1); SRPS(1)	2	0	
810	IS(1)	1	0	

Test Methods for Ash				
Burning Temperature℃	Method	Number of results	Number of results （｜z｜≥3.0)	Mark
815	ISO(43);ASTM(1); AS(2);DIN(4);GB(7); Gravimetric(2);IS(4);	74	8	A-2
850	GB(1)	1	0	
900	ASTM(1)	1	0	
950	ASTM(3)	3	0	
Unknown		2	2	
Total		134		

Table 8　Summary of Testing Parameters for Volatile Matter

	Test Methods for Volatile Matter			
Burning Temperature℃	Method	Number of results	Number of results （|z|≥3.0)	Mark
750	ASTM(2)	2	0	
850	TGA(1); PN-G-04516(2); PN-G-04560(1)	4	0	
900	ISO(44); GB(8); IS(5); DIN(4); AS(2); EN(1); SRPS(1)	72	6	V-1
950	ASTM(46); ISO(2); NBR(1)	51	2	V-2
970	ASTM(1)	1	0	
Unknown	ASTM(1)	2	0	
Total		132		

Table 9 Summary of Testing Parameters for Total Sulfur

Test Methods for Total Sulfur				
Method Total Sulfur		Number of results	Number of results ($\|z\| \geqslant 3.0$)	Mark
High temperature combustion	ASTM(39); ISO(4); DIN(2)	52	6	S-1
Eschka	ASTM(5); ISO(10); IS(4); GB(2)	26	7	S-2
IR spectrometry	ISO(7); ASTM(12); GB(4)	32	0	S-3
High temperature combustion & IR spectrometry	ASTM(6)	7	0	
Unknown		10	4	
Total		127		

Table 10 Summary Student's Test of Experimentation Results by SXCIQTC

	Ash %				Volatile Matter %	
	750℃(A-1)	775℃	815℃(A-2)	850℃	900℃(V-1)	950℃(V-2)
Denote	1	2	3	4	1	2
Sample A	11.70	11.77	11.72	11.73	25.51	25.91
	11.79	11.75	11.76	11.70	25.35	26.15
	11.73	11.80	11.77	11.76	25.55	26.15
	11.84	11.75	11.68	11.82	25.48	26.18
	11.69	11.76	11.65	11.75	25.79	26.17
	11.72	11.74	11.76	11.78	25.57	26.17

	1 VS. 2	1 VS. 3	1 VS. 4	2 VS. 3	2 VS. 4	3 VS. 4	1 VS. 2	
t	0.60	0.70	0.49	1.91	0.25	1.11	8.61	
Critical value of t				2.57			2.57	
Sample B		11.30	11.34	11.18	11.31		26.11	27.13
		11.30	11.29	11.23	11.29		26.12	27.14
		11.34	11.35	11.26	11.34		26.21	27.07
		11.28	11.24	11.22	11.32		26.20	27.33
		11.26	11.30	11.37	11.29		26.17	27.17
		11.26	11.27	11.31	11.29		26.13	27.18
	1 VS. 2	1 VS. 3	1 VS. 4	2 VS. 3	2 VS. 4	3 VS. 4	1 VS. 2	
t	0.67	0.78	2.08	1.06	0.53	1.39	28.20	
Critical value of t				2.57			2.57	

Table 11 Summary of Student's Test Results

Student's Test		Critical value of t	t
Ash(A)	A-1 vs.A-2	1.98	1.68
Ash(B)	A-1 vs. A-2	1.98	2.34
Volatile Matter(A)	V-1 vs. V-2	1.99	5.14
Volatile Matter(B)	V-1 vs. V-2	1.99	4.74
Total Sulfur(A)	S-1 vs. S-2	2.02	1.63
Total Sulfur(A)	S-1 vs. S-3	1.99	1.90
Total Sulfur(A)	S-2 vs. S-3	2.02	0.07

Total Sulfur(B)	S-1 vs. S-2	2.02	0.78
Total Sulfur(B)	S-1 vs. S-3	1.99	0.70
Total Sulfur(B)	S-2 vs. S-3	2.02	0.24

Table 12 Summary of Uncertainty Associated with Assigned Values

k =2	Ash %		Volatile Matter %				Total Sulfur %		Gross Calorific Value MJ/kg	
	A	B	A(V-1)	A(V-2)	B(V-1)	B(V-2)	A	B	A	B
Standard Uncertainty	0.01	0.01	0.06	0.12	0.07	0.11	0.004	0.004	0.013	0.012
Expanded Uncertainty	0.03	0.03	0.12	0.25	0.14	0.22	0.008	0.009	0.026	0.024
u_{max} (1.5s*)	0.19	0.20	0.63	1.03	0.68	0.90	0.050	0.058	0.177	0.161
U_{max} *(k=2)*	0.37	0.39	1.26	2.06	1.35	1.79	0.099	0.116	0.355	0.321

Figure 1 Graph of Normality Test for Ash

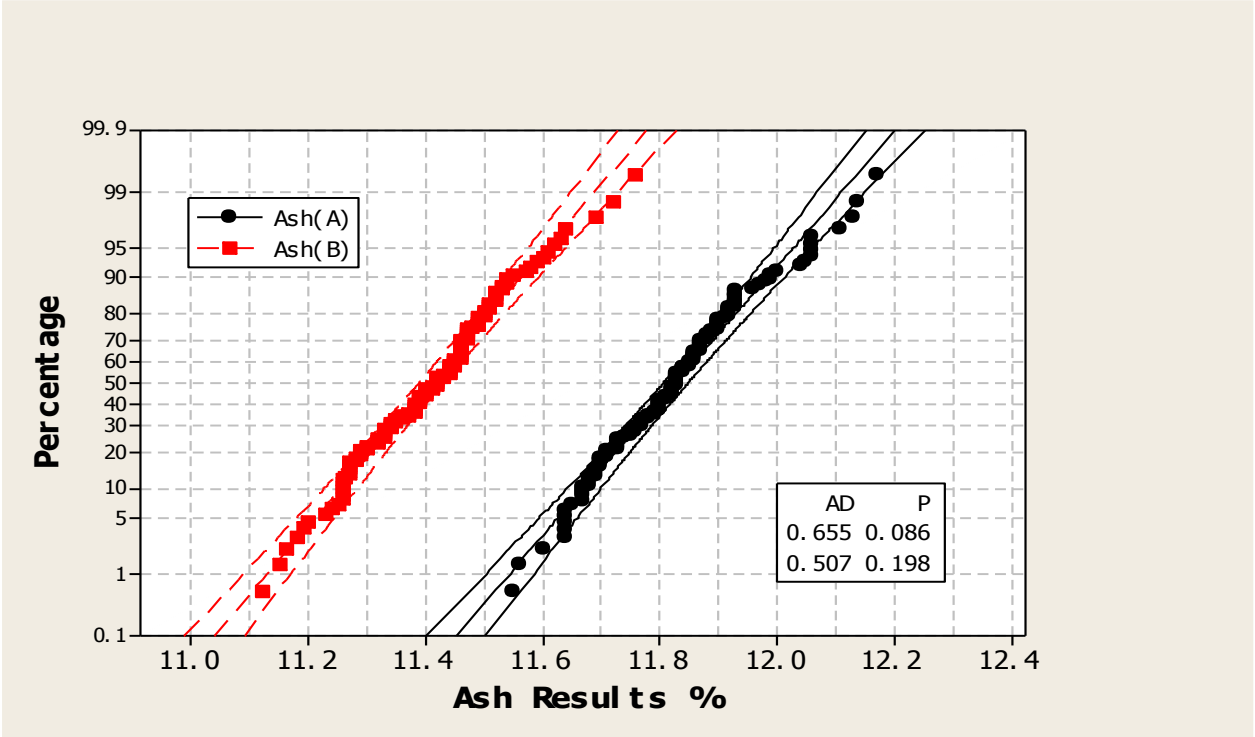


Figure 2 Graph of Normality Test for Volatile Matter

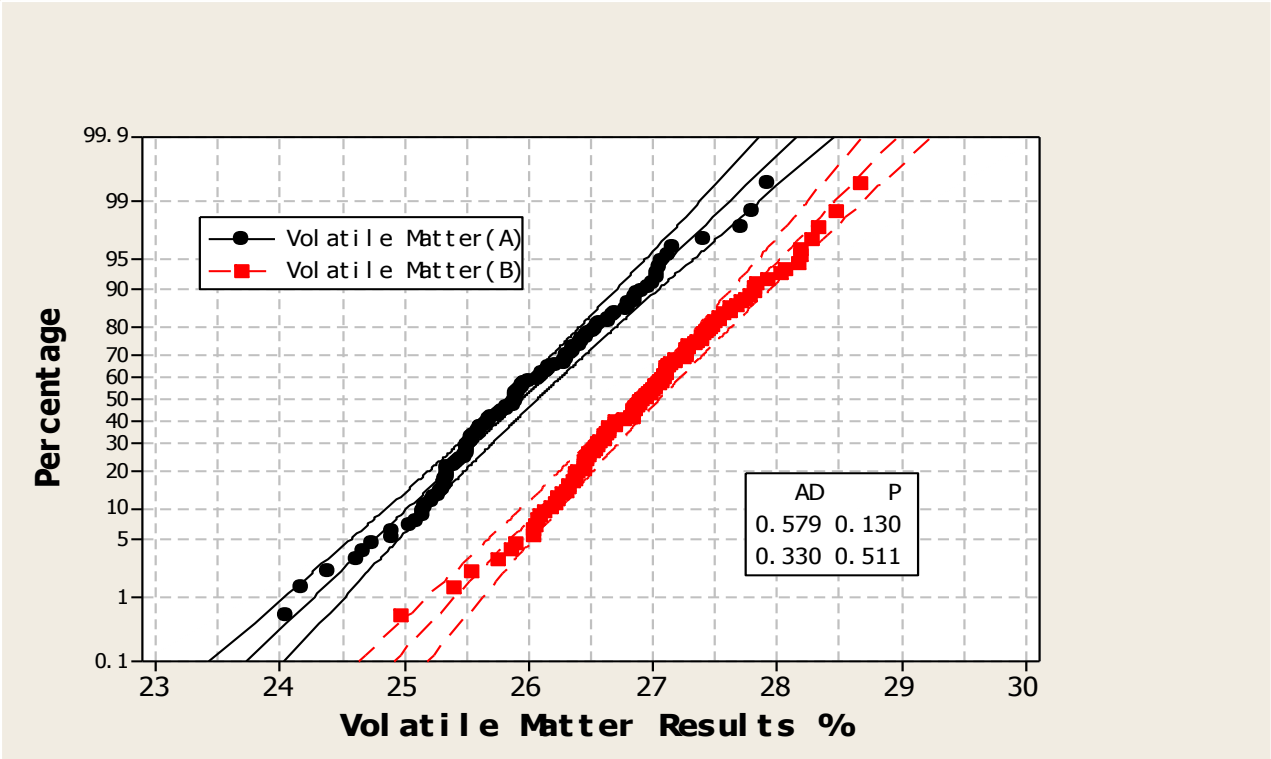


Figure 3 Graph of Normality Test for Total Sulfur

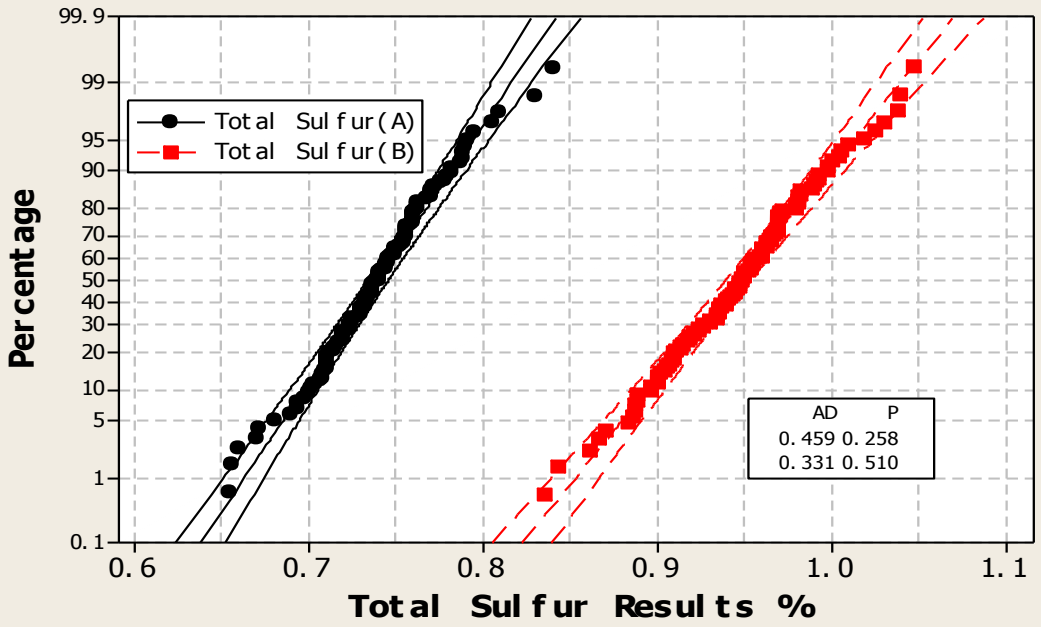


Figure 4 Graph of Normality Test for Gross Calorific Value

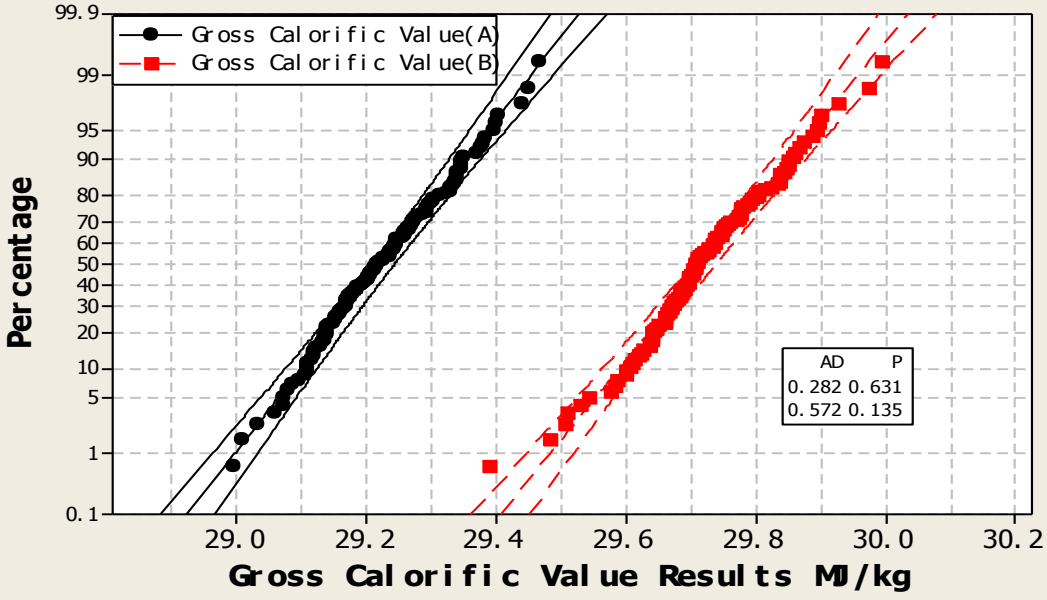
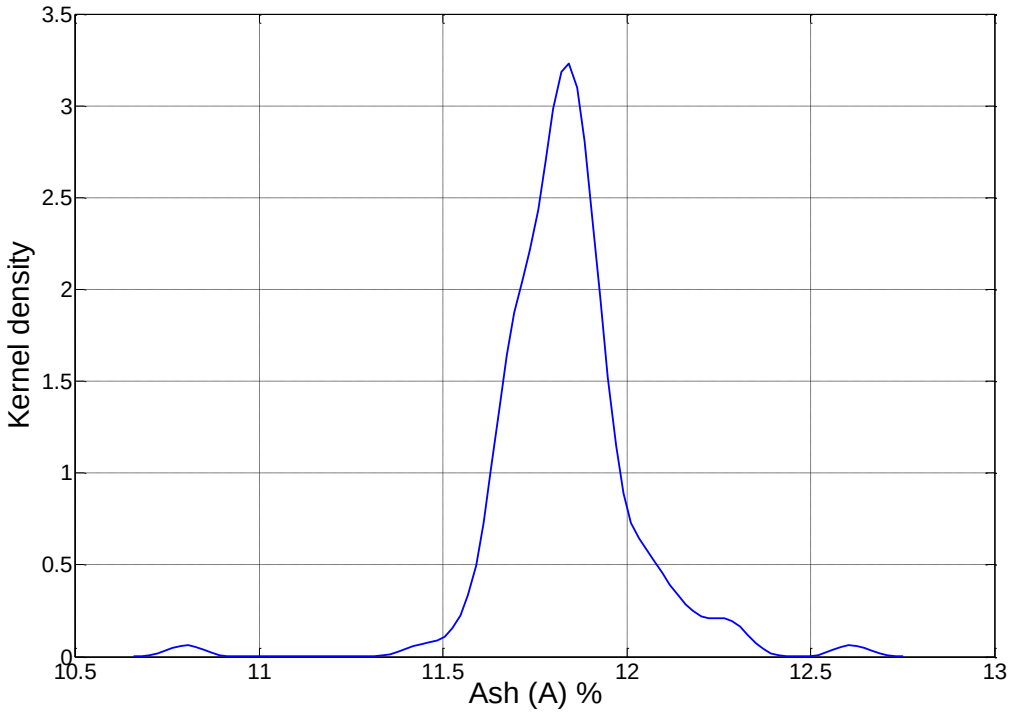


Figure 5 Graph of Probability Density for Ash



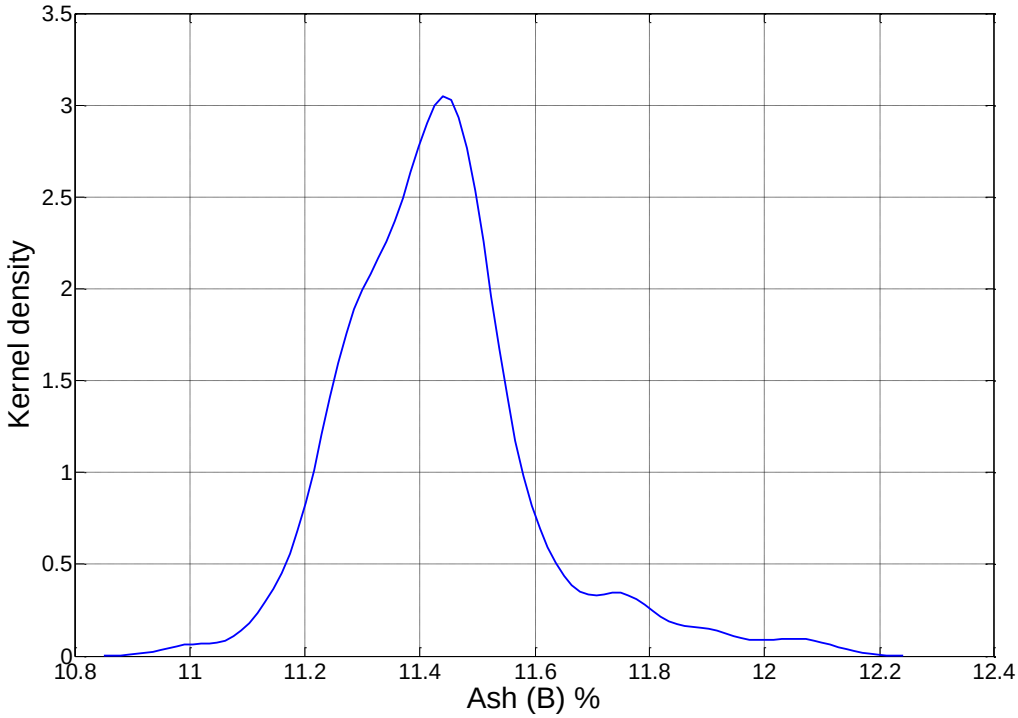
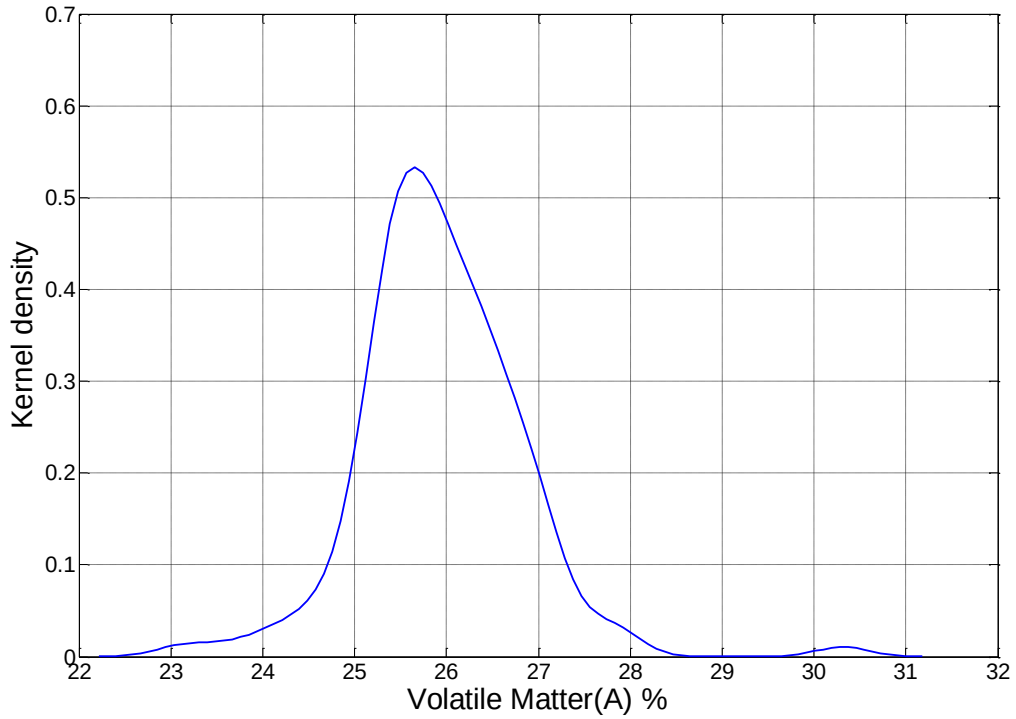
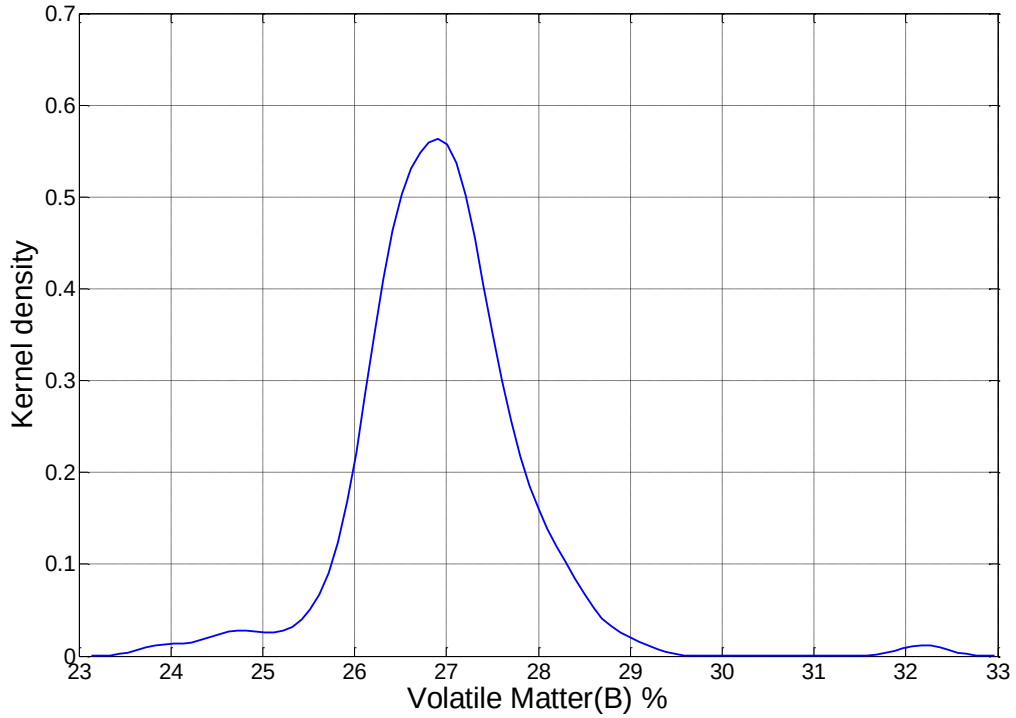
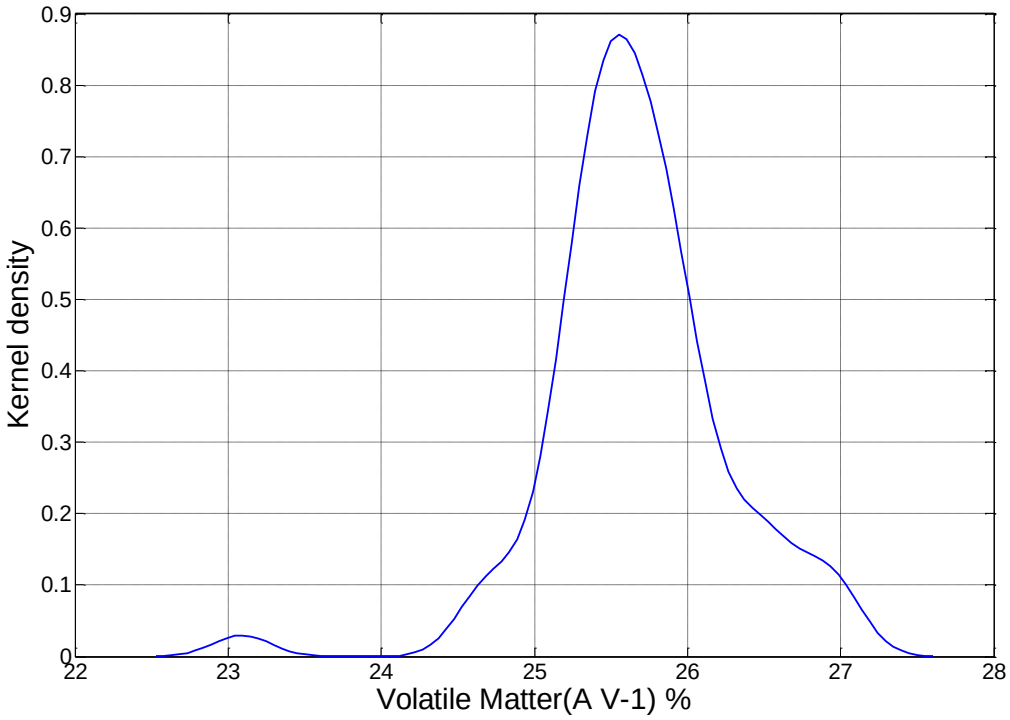
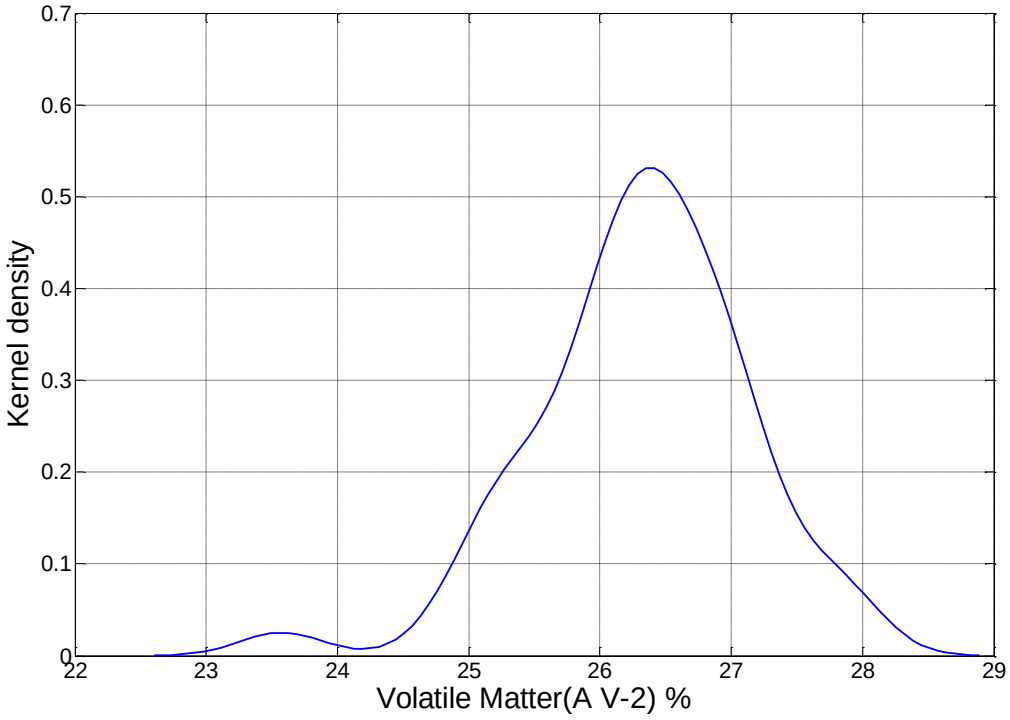


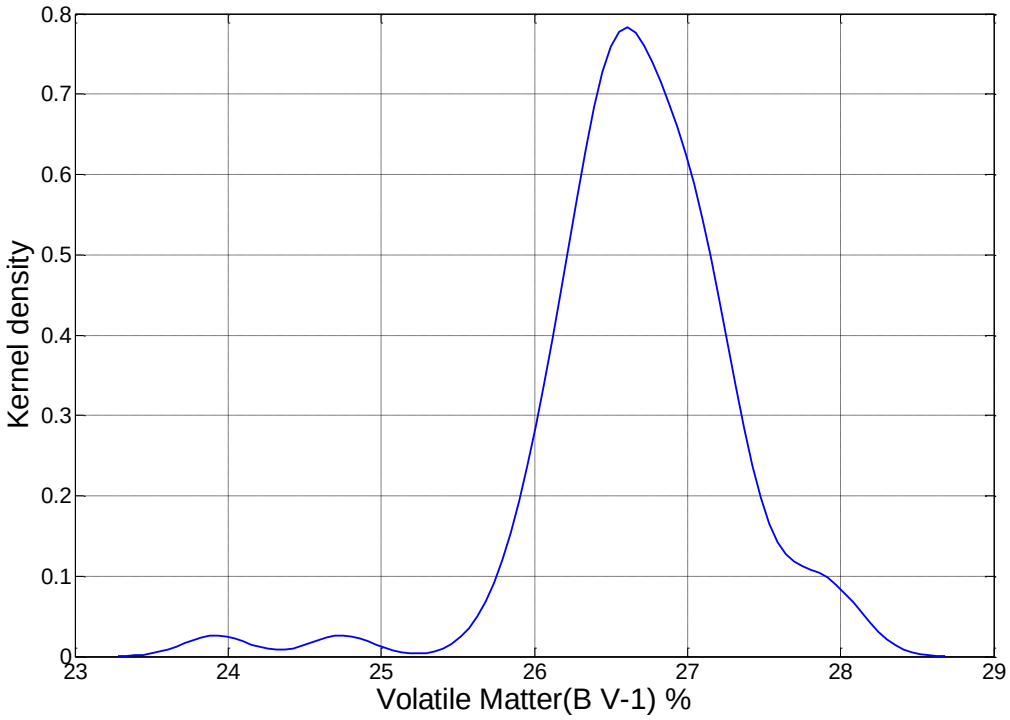
Figure 6 Graph of Probability Density for Volatile Matter

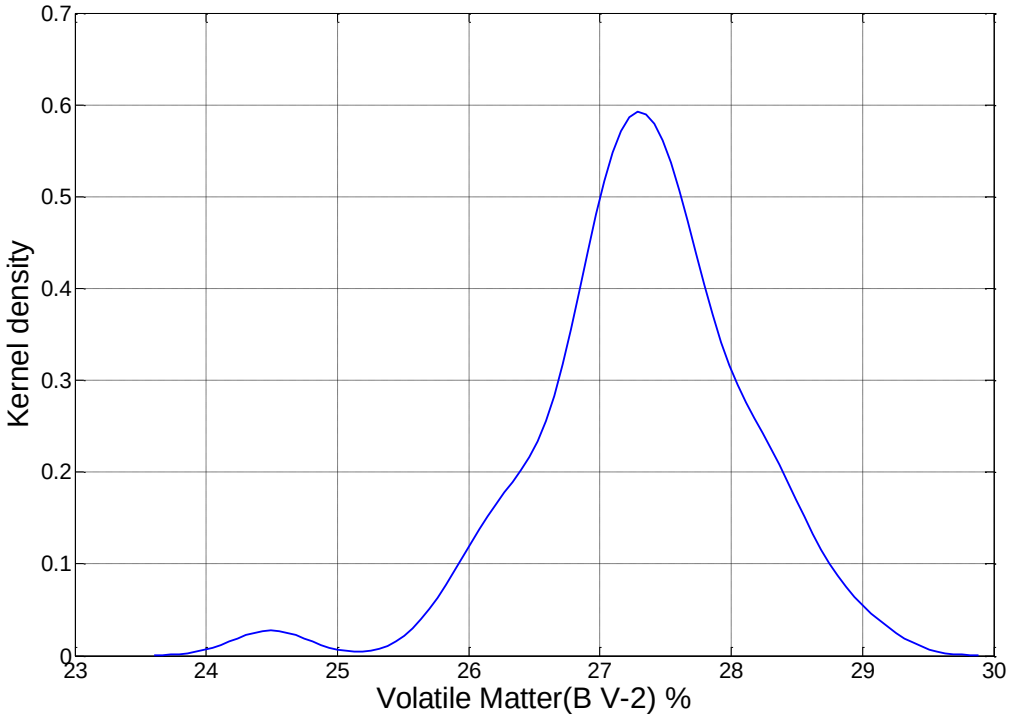





Kernel density
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
22
23
24
25
26
27
28
Volatile Matter(A V-1) %


Kernel density
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
22
23
24
25
26
27
28
29
Volatile Matter(A V-2) %


Kernel density
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
23
24
25
26
27
28
29
Volatile Matter(B V-1) %


Kernel density
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0.6
0.5
0.4
0.3
0.2
0.1
0
23
24
25
26
27
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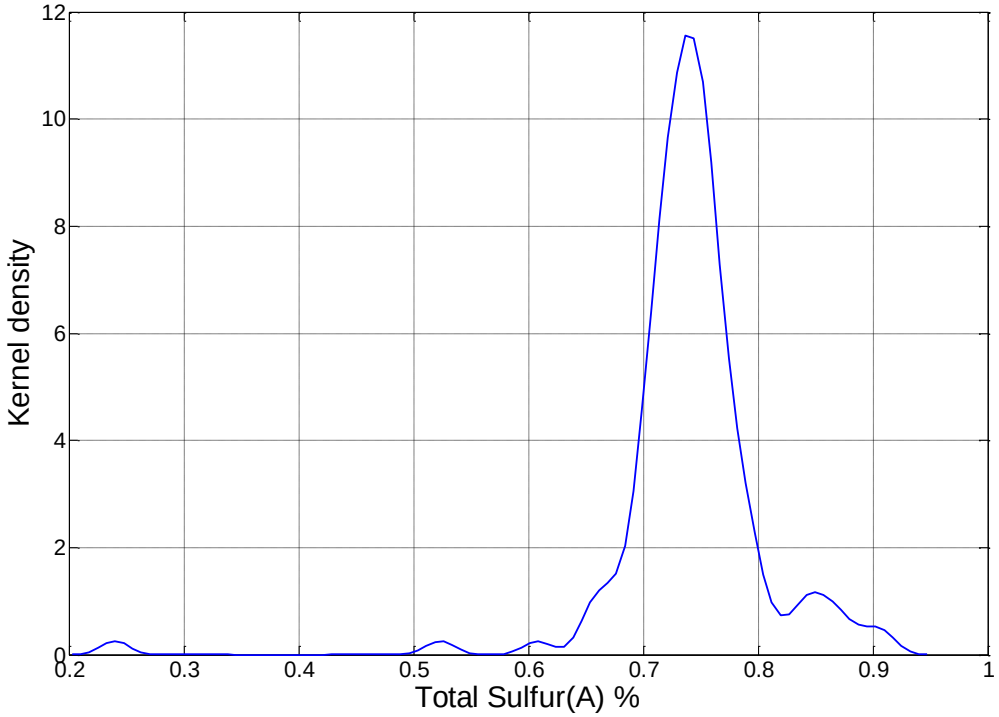
29
30
Volatile Matter(B V-2) %

Figure 7 Graph of Probability Density for Total Sulfur



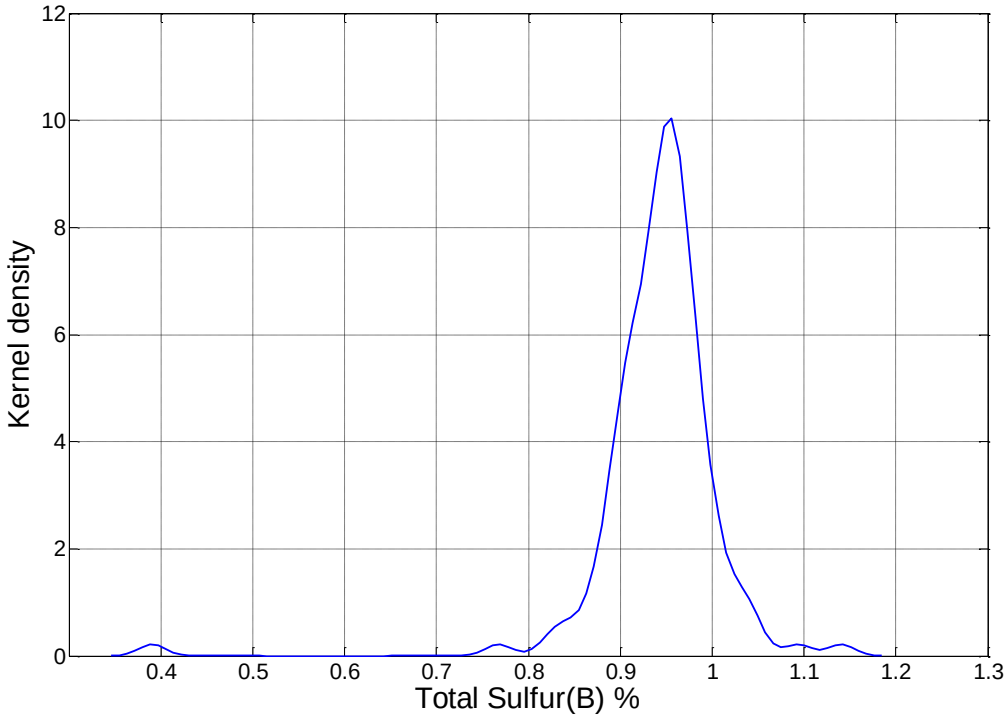
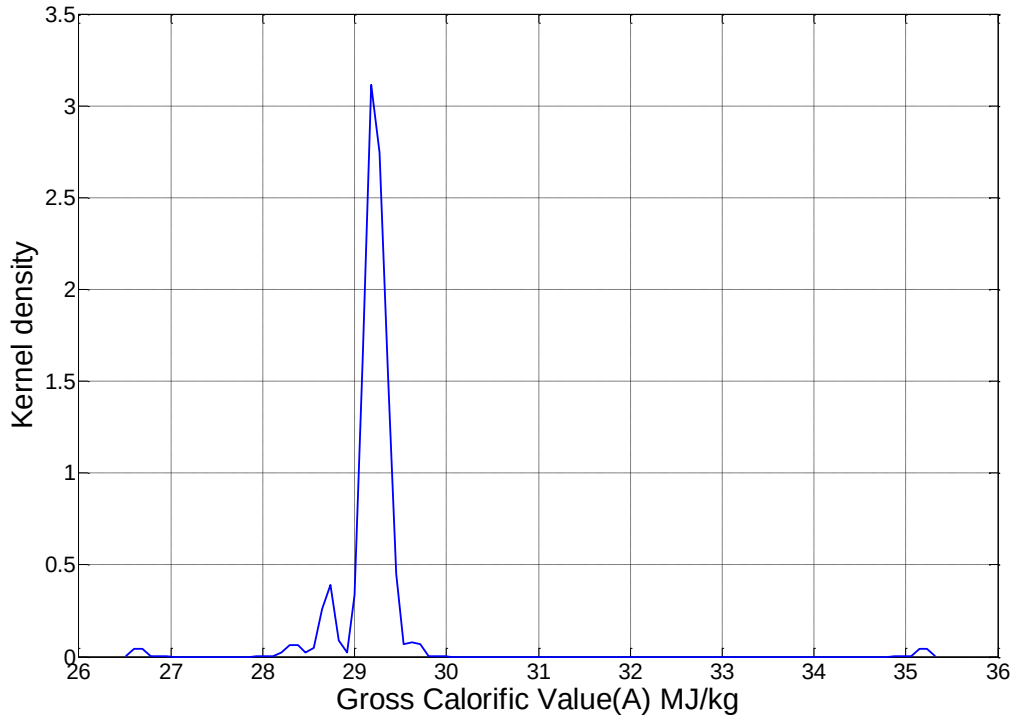


Figure 8 Graph of Probability Density for Gross Calorific Value



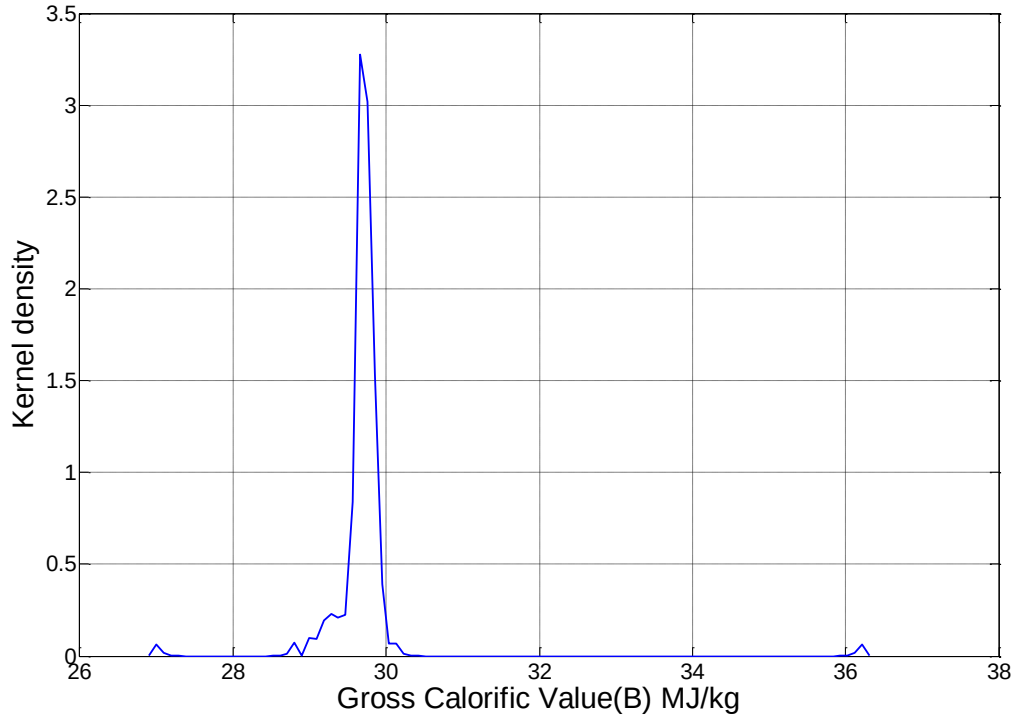


Figure 9 Difference of Frequency for Volatile Matter (A V-1 VS. V-2)

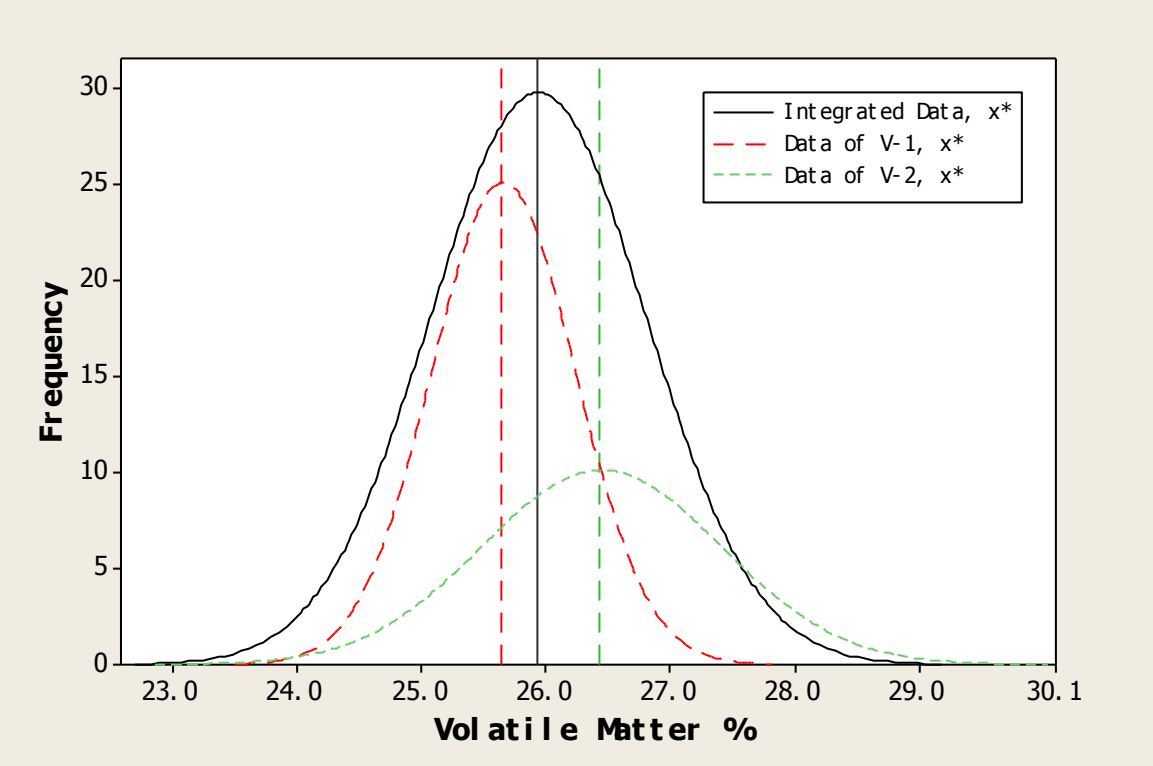


Figure 10 Difference of Frequency for Volatile Matter (B V-1 VS. V-2)

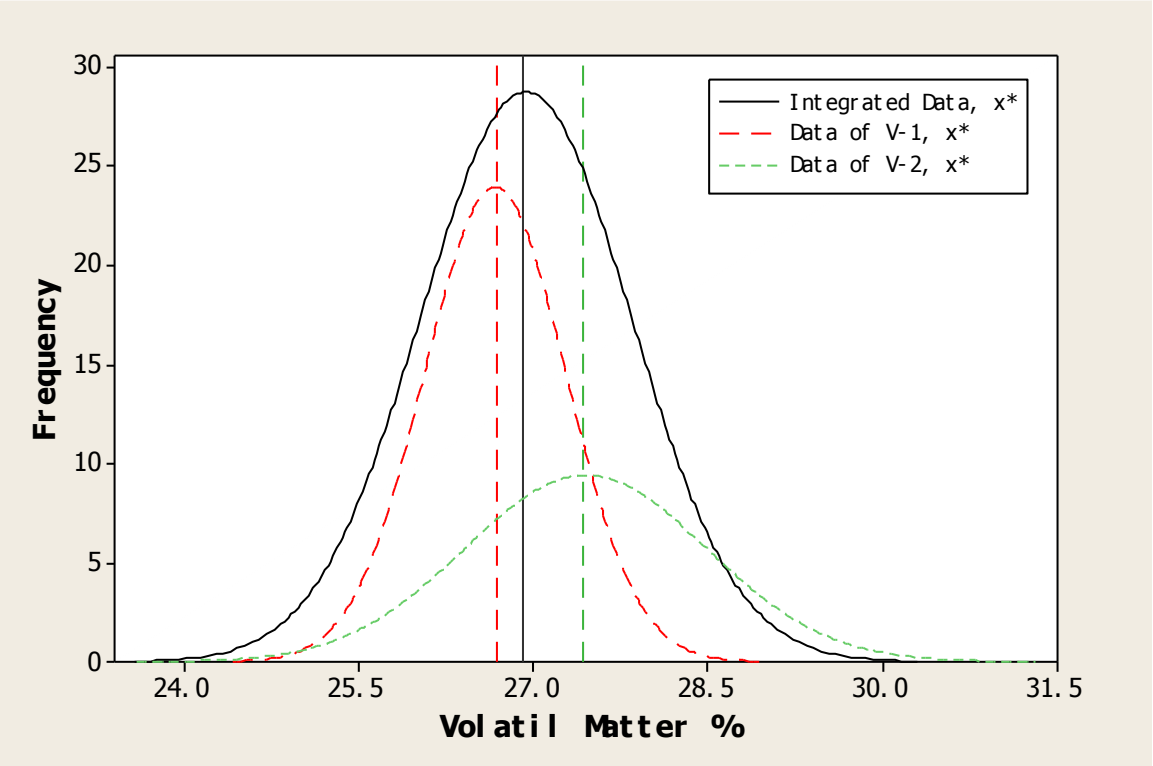


Figure 11 Scatter Diagram for Ash

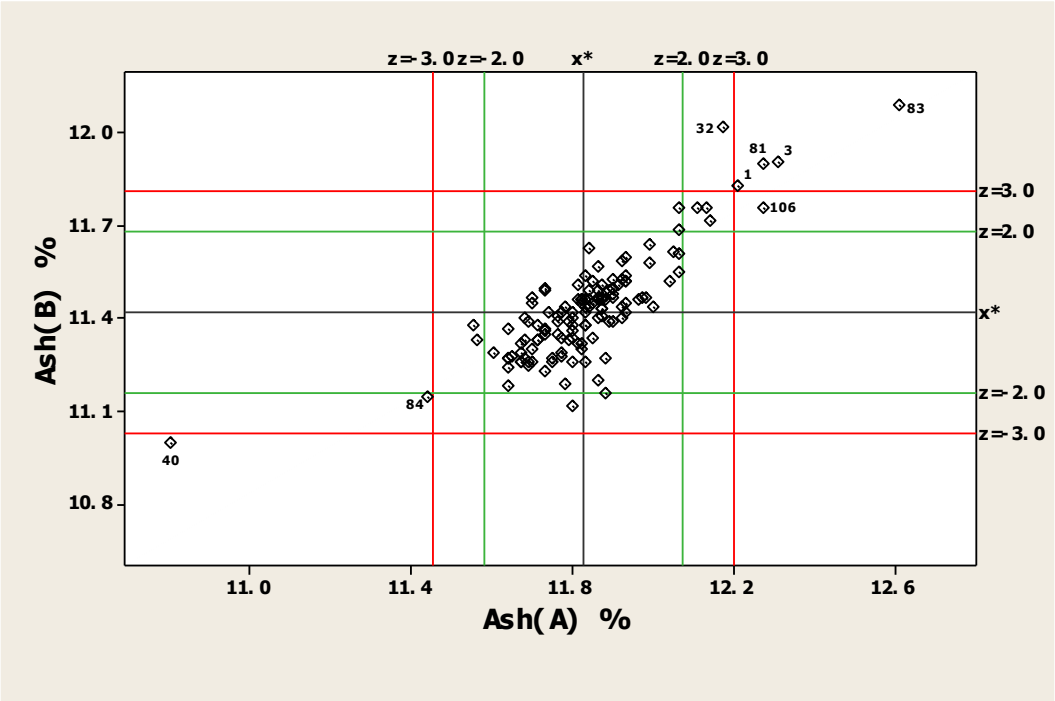


Figure 12 Scatter Diagram for Volatile Matter (V-1)

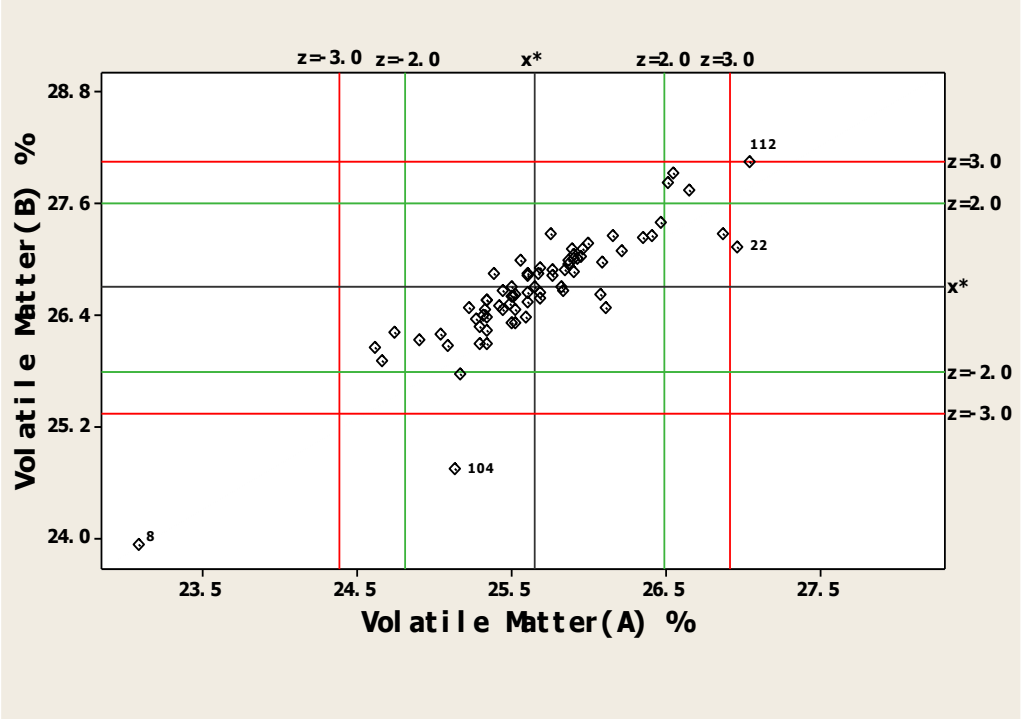


Figure 13 Scatter Diagram for Volatile Matter (V-2)

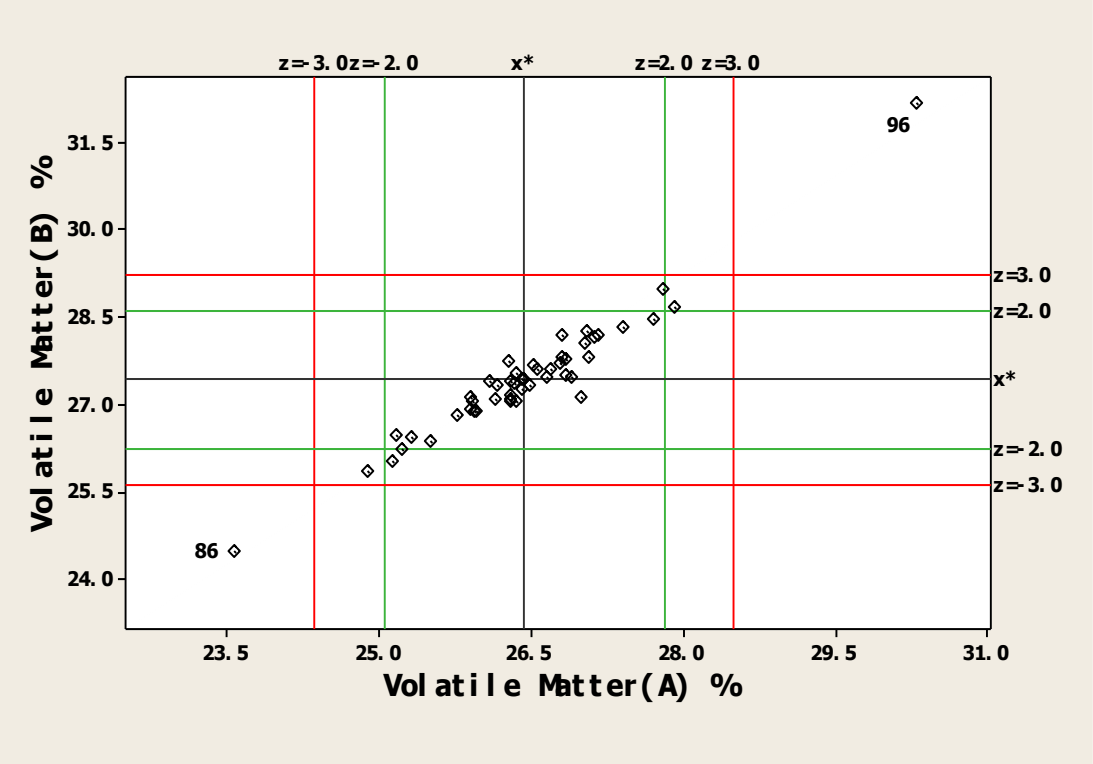


Figure 14 Scatter Diagram for Total Sulfur

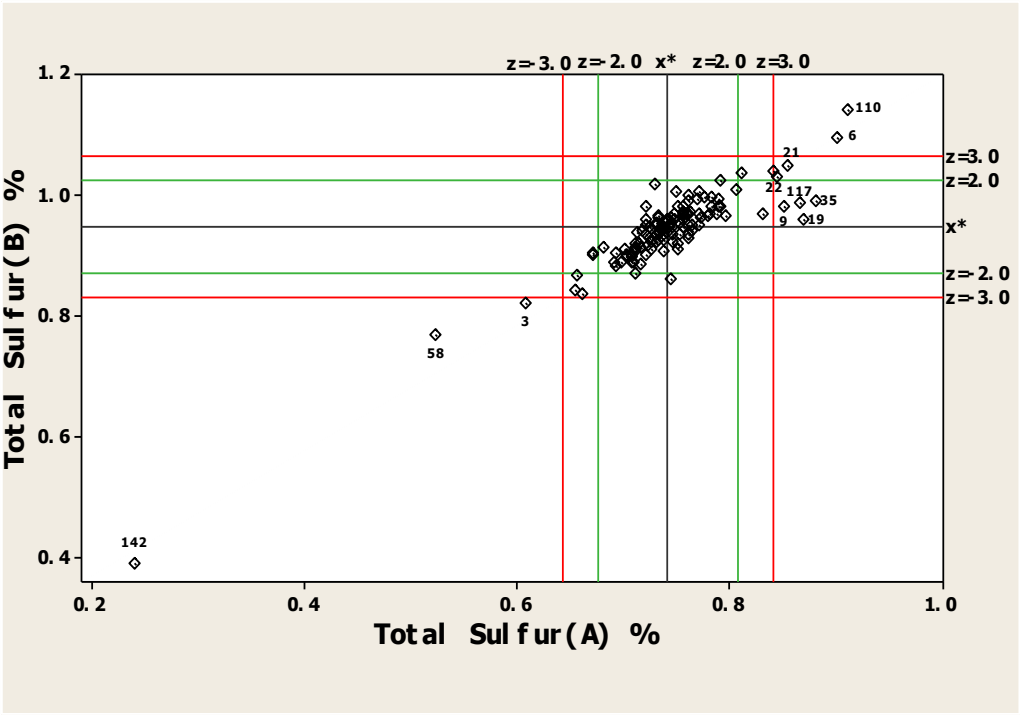
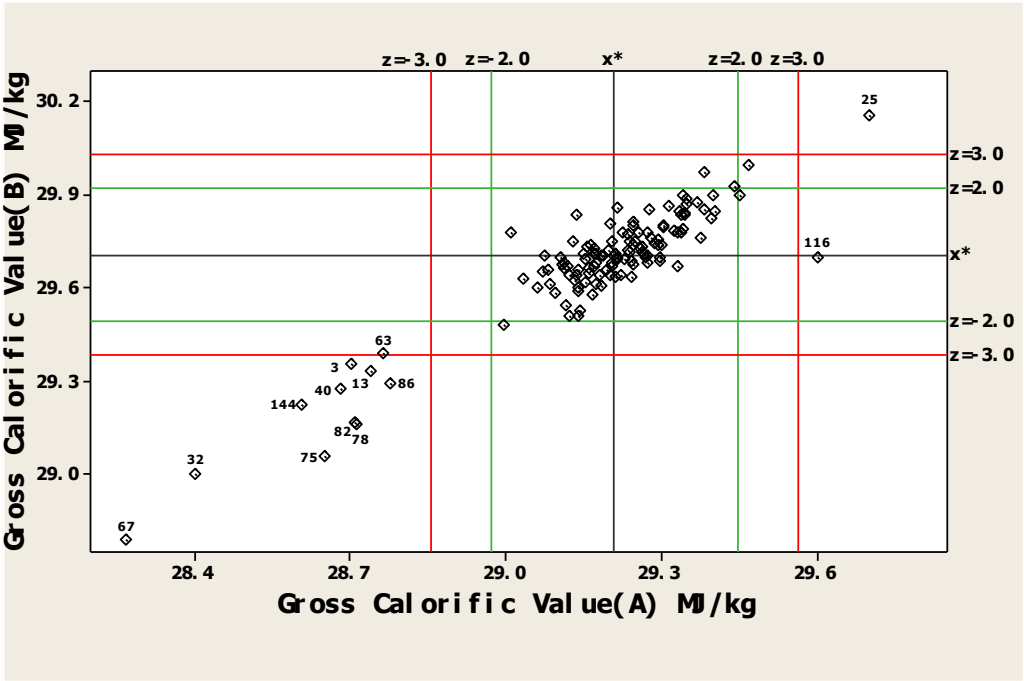


Figure 15 Scatter Diagram for Gross Calorific Value



Note: Lab code 35, 45 is not included.

Figure 16 Scatter Diagram for Ash (A) Results (z-score≥3) with Uncertainty

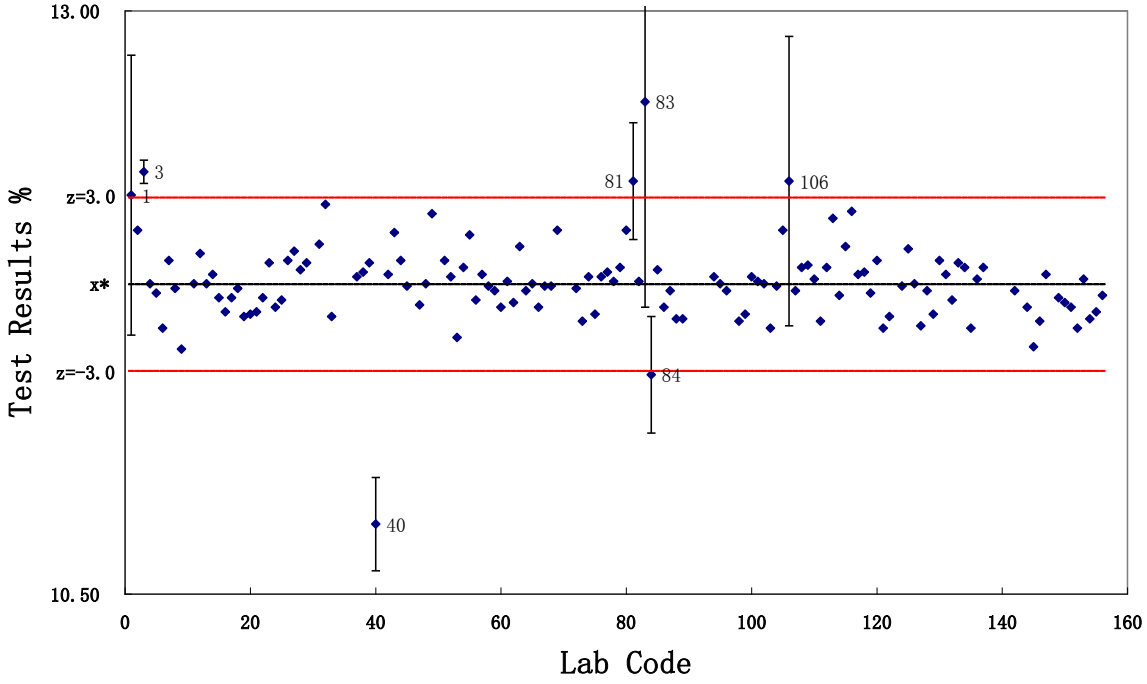


Figure 17 Scatter Diagram for Ash (B) Results (z-score⩾3) with Uncertainty

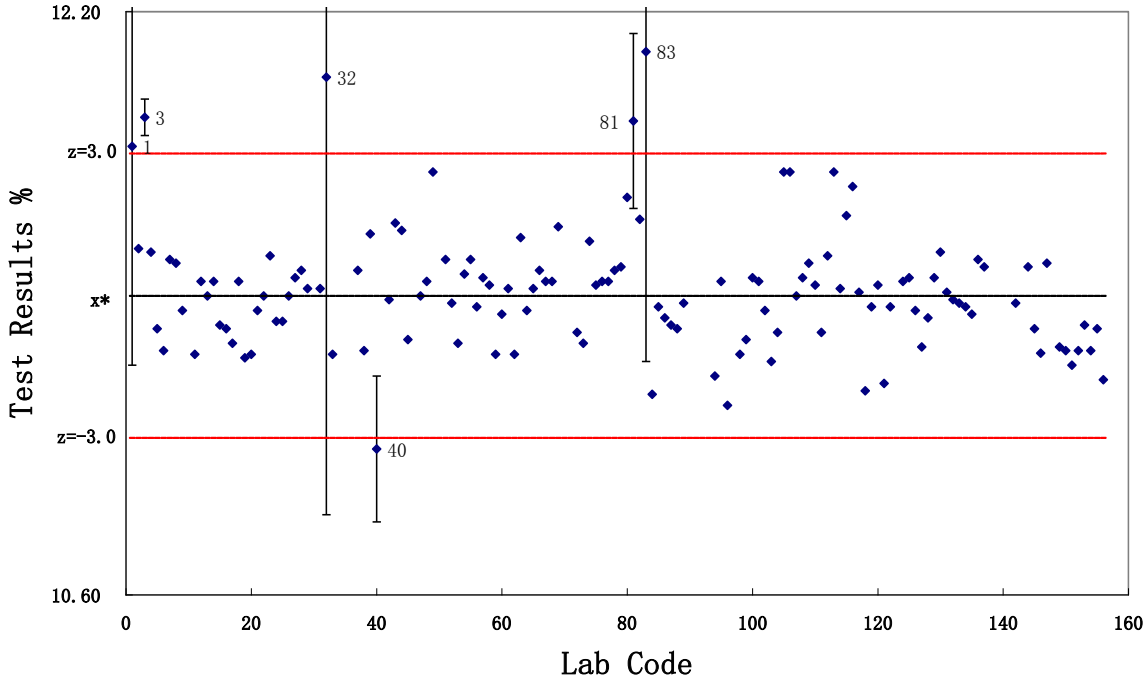


Figure 18 Scatter Diagram for Volatile Matter (A V-1) Results (z-score⩾3) with Uncertainty

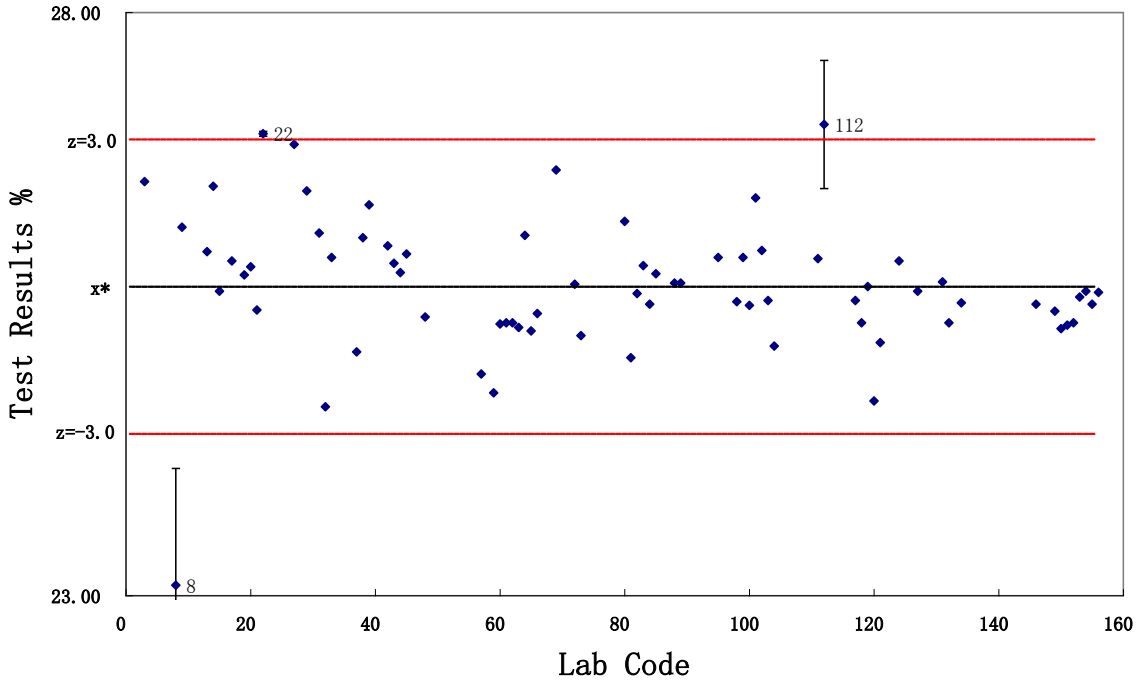
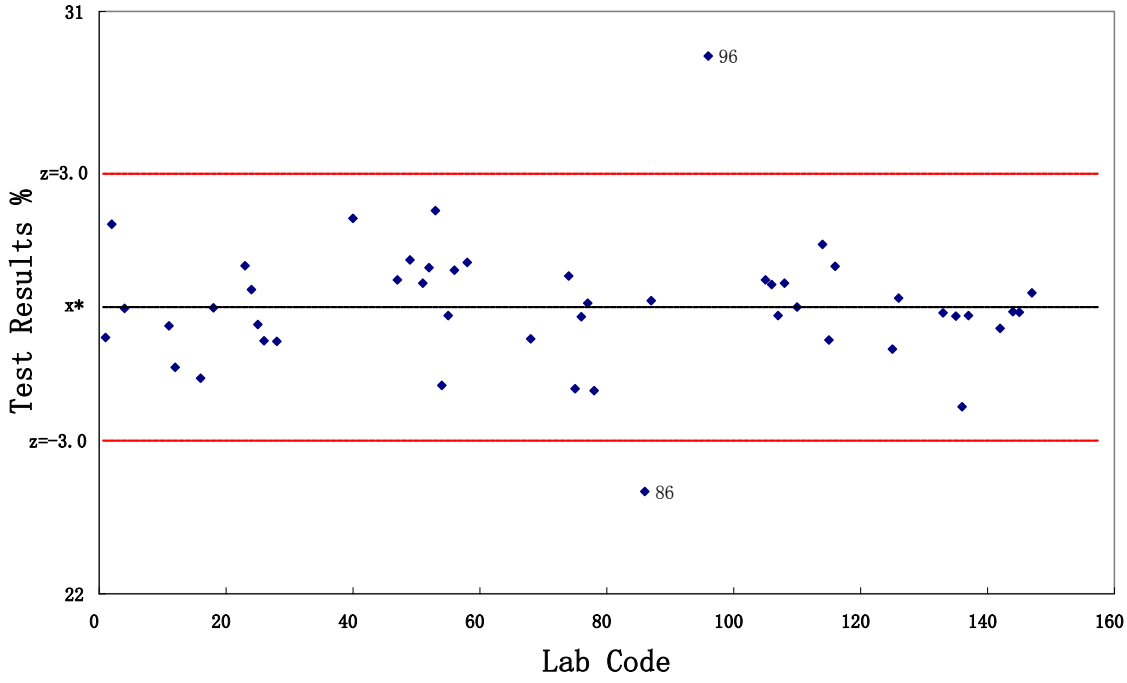


Figure 19 Scatter Diagram for Volatile Matter (A V-2) Results (z-score⩾3) with Uncertainty



Note: Lab code 86 & 96 didn't report uncertainty.

Figure 20 Scatter Diagram for Volatile Matter (B V-1) Results (z-score⩾3) with Uncertainty

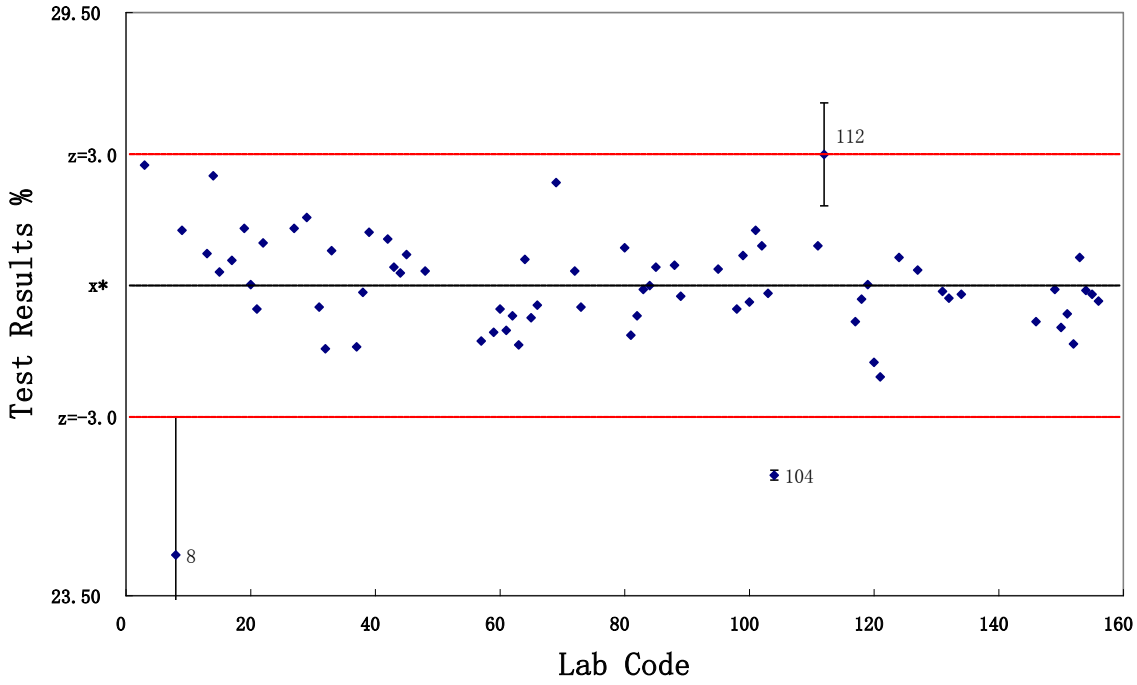
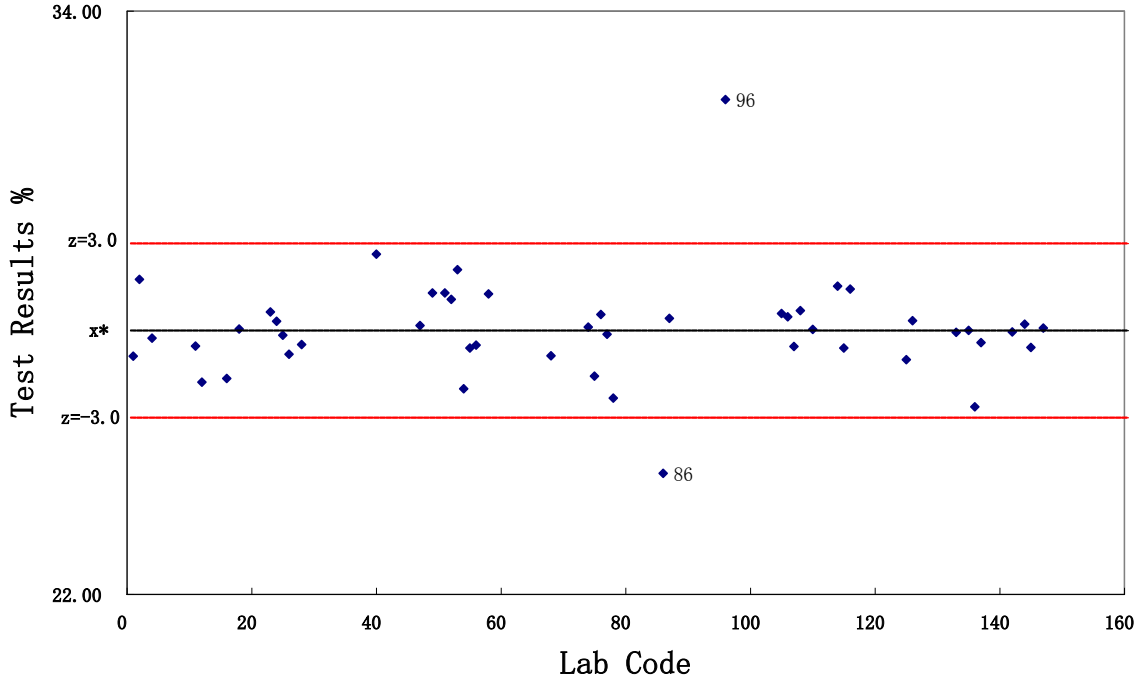
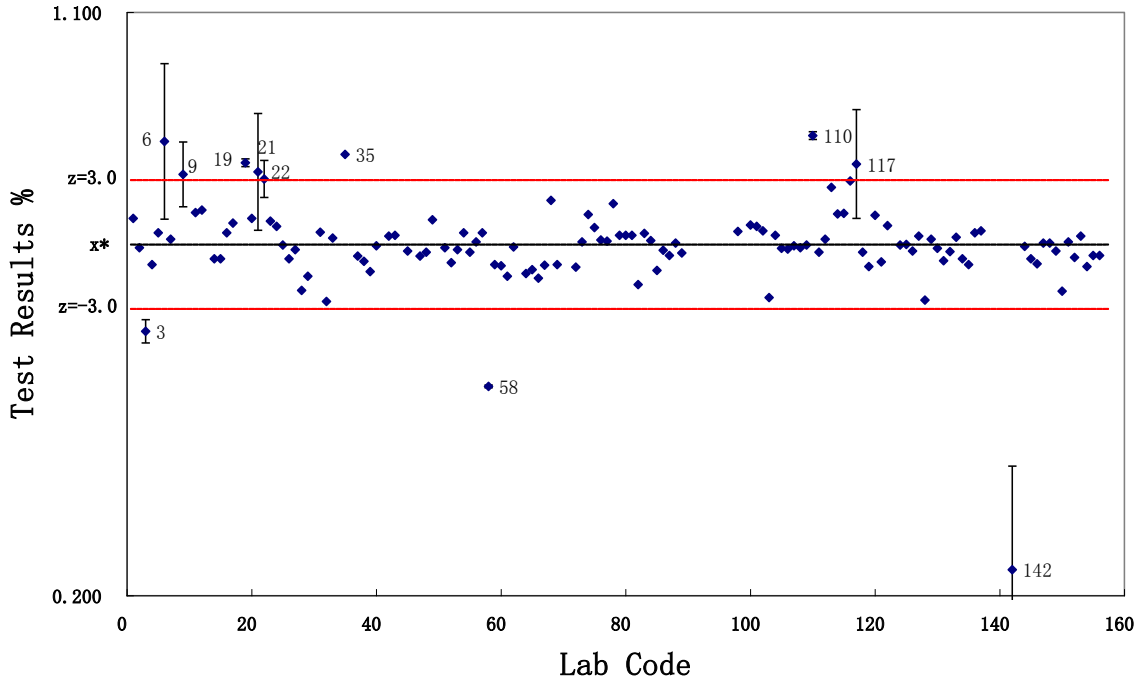


Figure 21 Scatter Diagram for Volatile Matter (B V-2) Results (z-score⩾3) with Uncertainty



Note: Lab code 86 & 96 didn't report uncertainty.

Figure 22 Scatter Diagram for Total Sulfur (A) Results (z-score≥3) with Uncertainty



Note: Lab code 35 didn't report uncertainty.

Figure 23 Scatter Diagram for Total Sulfur (B) Results (z-score≥3) with Uncertainty

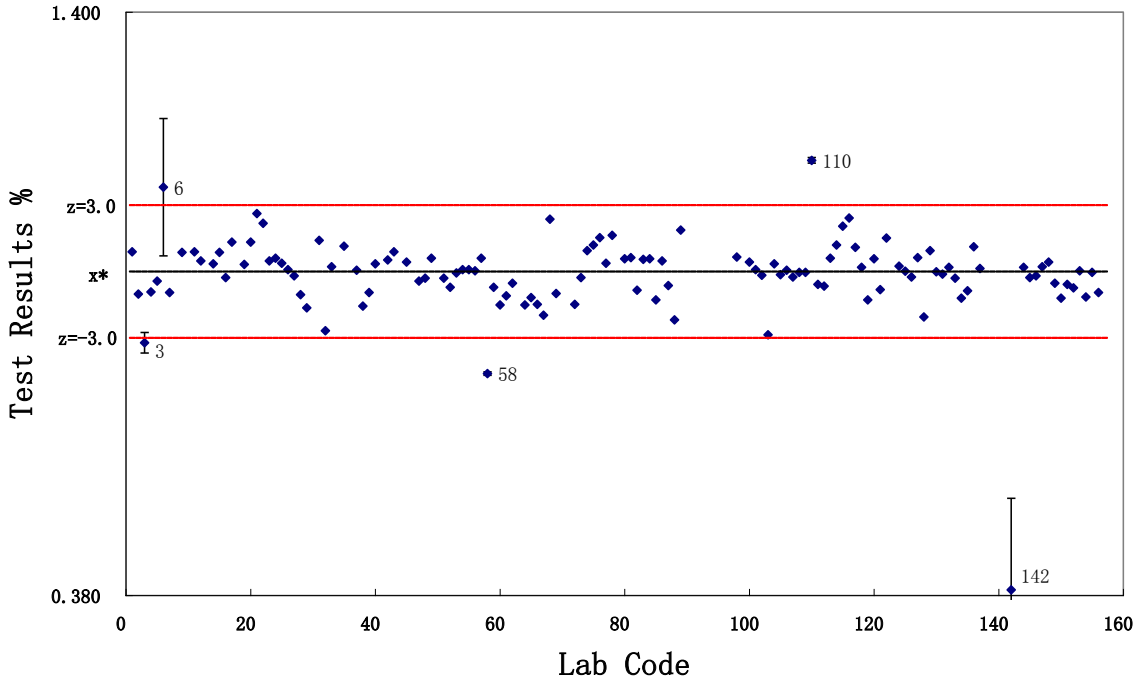
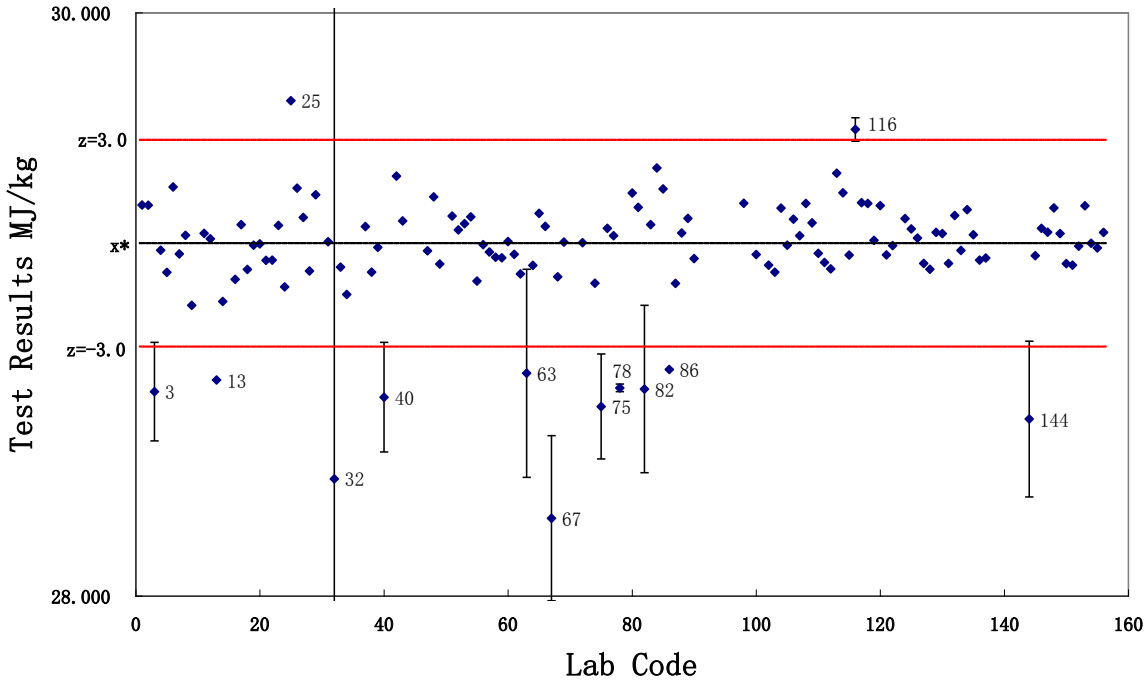
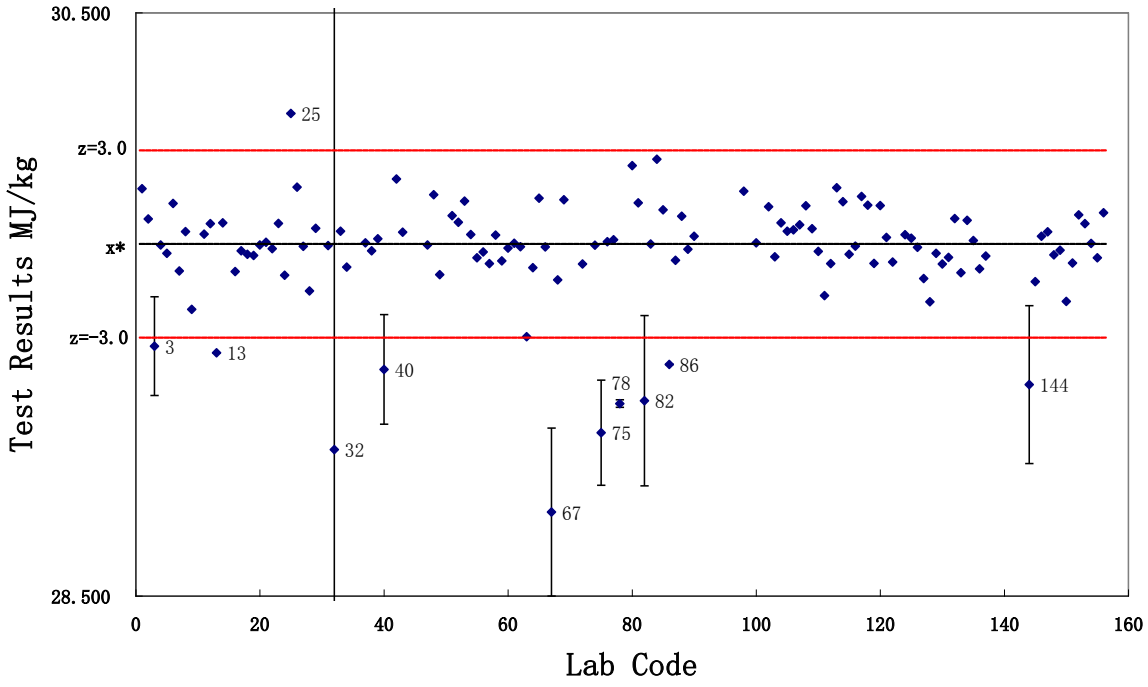


Figure 24 Scatter Diagram for Gross Calorific Value (A) Results (z-score≥3) with Uncertainty



Note: Lab code 35 & 45 are not included and lab code 13, 86 didn't report uncertainty.

Figure25 Scatter Diagram for Gross Calorific Value (B) Results (z-score⩾3) with Uncertainty



Note: Lab code 35 & 45 are not included and lab code 13, 86 didn't report uncertainty.

APPENDIX A Results and Statistical Analysis

Table A.1 Ash Results

Ash Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
1	12.21	0.60#	3.09	11.83	0.60#	3.15	ASTM D7582
2	12.06	0.08	1.88	11.55	0.08	1.00	ASTM D7582/12
3	12.31	0.05	3.89	11.91	0.05	3.76	ISO 1171
4	11.83	0.21	0.02	11.54	0.20	0.92	ASTM D7582
5	11.79	0.12	-0.30	11.33	0.124	-0.69	BAS ISO 1171 Gravimetry
6	11.64	0.13	-1.51	11.27	0.13	-1.15	ASTM D3174
7	11.93	0.44#	0.83	11.52	0.44#	0.77	BAS ISO 1171:2012
8	11.81	0.68#	-0.14	11.51	0.52#	0.69	BAS ISO 1171:2012
9	11.55	0.002	-2.24	11.38	0.002	-0.31	ISO 1171:2010
10	——	——	N/A	——	——	N/A	——
11	11.83	0.62#	0.02	11.26	0.60#	-1.23	ASTM D3174-2012
12	11.96	——	1.07	11.46	——	0.31	ASTM D3174-12
13	11.83	——	0.02	11.42	——	0.00	IS-1350 part Ⅰ-1984 RA-2002
14	11.87	0.026	0.34	11.46	0.044	0.31	IS-1350 part Ⅰ-1984 Reaffm-2002
15	11.77	0.055	-0.46	11.34	0.053	-0.61	IS-1350 Reaff-2010
16	11.71	0.24	-0.95	11.33	0.23	-0.69	ASTM D 3174-11
17	11.77	——	-0.46	11.29	——	-1.00	IS-1350 part Ⅰ-1984
18	11.81	0.56#	-0.14	11.46	0.52#	0.31	ASTM D7582/12
19	11.69	0.07	-1.11	11.25	0.07	-1.30	IS-1350 part Ⅰ-1984 Reaffirmed-2007
20	11.70	0.02	-1.03	11.26	0.04	-1.23	ISO 1171:2010
21	11.71	0.38#	-0.95	11.38	0.38	-0.31	SRPS B.H8 312
22	11.77	0.0392	-0.46	11.42	0.0158	0.00	SRPS B.H8 312
23	11.92	0.78#	0.75	11.53	0.78#	0.84	SRPS B.H8 312
24	11.73	——	-0.79	11.35	——	-0.54	
25	11.76	0.1109	-0.55	11.35	0.1109	-0.54	ASTM
26	11.93	0.13	0.83	11.42	0.13	0.00	ASTM D3174-2012
27	11.97	0.05	1.15	11.47	0.05	0.38	BS ISO 1171:2010
28	11.89	——	0.50	11.49	——	0.54	ASTM D3174-2012
29	11.92	0.24	0.75	11.44	0.23	0.15	ASTM D3174-2012
30	——	——	N/A	——	——	N/A	——
31	12.00	0.30	1.39	11.44	0.286	0.15	ISO 1171
32	12.17	1.22#	2.76	12.02	1.20#	4.61	NF EN 15403

Ash Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
33	11.69	0.50#	-1.11	11.26	0.50#	-1.23	ISO 1171:2010
34	——	——	N/A	——	——	N/A	——
35	67.73	——	Gross straggler	71.50	——	Gross straggler	——
36	——	——	N/A	——	——	N/A	——
37	11.86	0.879#	0.26	11.49	0.879#	0.54	UNE 32111-95
38	11.88	0.7#	0.42	11.27	0.7#	-1.15	PO/LECEM-EP/33 rev.5
39	11.92	0.35	0.75	11.59	0.36	1.31	UNE-32111:1995
40	10.8	0.2	-8.29	11.0	0.2	-3.22	ISO 1171
41	——	——	N/A	——	——	N/A	——
42	11.87	0.15	0.34	11.41	0.15	-0.08	Gravimetric
43	12.05	0.30	1.79	11.62	0.30	1.54	AS1038.3
44	11.93	0.30	0.83	11.60	0.30	1.38	AS1038.3
45	11.82	0.36	-0.06	11.30	0.34	-0.92	ISO 1171
46	——	——	N/A	——	——	N/A	——
47	11.74	0.47#	-0.71	11.42	0.46#	0.00	ASTM D7582/12
48	11.83	0.16	0.02	11.46	0.16	0.31	DIN 51719
49	12.13	0.14	2.44	11.76	0.13	2.61	ASTM D7582/12
50	——	——	N/A	——	——	N/A	——
51	11.93	0.19	0.83	11.52	0.19	0.77	ASTM D7582/10
52	11.86	——	0.26	11.40	——	-0.15	ASTM D3174
53	11.60	0.13	-1.84	11.29	0.13	-1.00	ASTM D3174
54	11.90	0.02	0.58	11.48	0.02	0.46	ASTM D7582/12
55	12.04	0.10	1.71	11.52	0.09	0.77	ASTM D7582/11
56	11.76	0.03	-0.55	11.39	0.03	-0.23	ASTM D3174
57	11.87	0.07	0.34	11.47	0.07	0.38	ASTM D3174
58	11.82	0.020	-0.06	11.45	0.011	0.23	ASTM D7582/12
59	11.80	0.05	-0.22	11.26	0.10	-1.23	BAC ISO 1171:2012
60	11.73	0.05	-0.79	11.37	0.08	-0.38	BDS ISO 1171:2012
61	11.84	0.07	0.10	11.44	0.02	0.15	BAC ISO 1171:2012
62	11.75	0.79#	-0.63	11.26	0.79#	-1.23	BDS ISO 1171:2012
63	11.99	0.683#	1.31	11.58	0.683#	1.23	BAC ISO 1171
64	11.80	0.04	-0.22	11.38	0.05	-0.31	DIN 51719/07-97
65	11.83	0.04	0.02	11.44	0.03	0.15	BAC ISO 1171
66	11.73	0.07	-0.79	11.49	0.15	0.54	DIN 51719
67	11.82	0.59#	-0.06	11.46	0.57#	0.31	OENORM EN 1074
68	11.82	0.07	-0.06	11.46	0.07	0.31	ASTM D7582/12
69	12.06	0.20	1.88	11.61	0.19	1.46	ISO 1171:2010
70	——	——	N/A	——	——	N/A	——

Ash Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
71	——	——	N/A	——	——	N/A	——
72	11.81	0.02	-0.14	11.32	0.18	-0.77	ISO 1171
73	11.67	0.23	-1.27	11.29	0.23	-1.00	ISO 1171
74	11.86	0.29	0.26	11.57	0.16	1.15	ASTM D7582/10
75	11.70	0.15	-1.03	11.45	0.14	0.23	ASTM D7582/10**e1**
76	11.86	0.66#	0.26	11.46	0.66#	0.31	ASTM D5142-09
77	11.88	0.27	0.42	11.46	0.26	0.31	ASTM D7582/12
78	11.84	0.06	0.10	11.49	0.06	0.54	ASTM D7582
79	11.90	0.03	0.58	11.50	0.04	0.61	ASTM D 6142
80	12.06	0.6#	1.88	11.69	0.58#	2.07	ISO 1171/ ASTM-D5142
81	12.27	0.25	3.57	11.90	0.24	3.68	mod. ISO 1171
82	11.84	0.71#	0.10	11.63	0.70#	1.61	SS187170
83	12.61	0.88#	6.31	12.09	0.85#	5.14	SS187157
84	11.44	0.25	-3.13	11.15	0.25	-2.07	ISO 1171
85	11.89	0.27	0.50	11.39	0.26	-0.23	ISO 1171
86	11.73	——	-0.79	11.36	——	-0.46	ASTM D3174
87	11.80	0.025	-0.22	11.34	0.023	-0.61	ASTM D3174-11
88	11.68	0.15	-1.19	11.33	0.15	-0.69	ISO 1171:1997
89	11.68	0.00560	-1.19	11.40	0.00560	-0.15	ISO 1171
90	——	——	N/A	——	——	N/A	——
91	——	——	N/A	——	——	N/A	——
92	——	——	N/A	——	——	N/A	——
93	——	——	N/A	——	——	N/A	——
94	11.86	0.28	0.26	11.20	0.12	-1.69	AFNOR 12902[1]
95	11.83	0.00378	0.02	11.46	0.00378	0.31	ISO 1171-2010
96	11.80	——	-0.22	11.12	——	-2.30	ASTM D3174
97	——	——	N/A	——	——	N/A	——
98	11.67	0.04	-1.27	11.26	0.04	-1.23	ISO 1171
99	11.7	——	-1.03	11.3	——	-0.92	ISO 1171:2010
100	11.86	——	0.26	11.47	——	0.38	ISO 1171
101	11.84	——	0.10	11.46	——	0.31	ISO 1171
102	11.83	——	0.02	11.38	——	-0.31	ISO 562
103	11.64	0.35	-1.51	11.24	0.34	-1.38	ISO 1171:2010
104	11.82	0.2	-0.06	11.32	0.2	-0.77	ISO 1171:2010
105	12.06	0.59#	1.88	11.76	0.52#	2.61	ASTM D7582
106	12.27	0.62#	3.57	11.76	0.57#	2.61	ASTM D7582-12
107	11.80	1.24#	-0.22	11.42	1.48#	0.00	ASTM D7582-12
108	11.90	0.18	0.58	11.47	0.18	0.38	ASTM D7582
109	11.91	0.06	0.67	11.51	0.04	0.69	ASTM D7582

Ash Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
110	11.85	0.02	0.18	11.45	0.02	0.23	ASTM D7582
111	11.67	0.16	-1.27	11.32	0.15	-0.77	KS E ISO1171
112	11.90	0.15	0.58	11.53	0.16	0.84	ISO 12746:2010
113	12.11	0.04	2.28	11.76	0.04	2.61	ASTM D7582-2010E
114	11.78	0.46#	-0.38	11.44	0.44#	0.15	ASTM D7582
115	11.99	0.11	1.31	11.64	0.10	1.69	ASTM D7582
116	12.14	0.30	2.52	11.72	0.29	2.30	ASTM D7582
117	11.87	0.15	0.34	11.43	0.15	0.08	ISO 1171:2010
118	11.88	0.15	0.42	11.16	0.06	-1.99	ISO 1171
119	11.79	——	-0.30	11.39	——	-0.23	ISO 1171:2010
120	11.93	0.24	0.83	11.45	0.23	0.23	ISO 1171
121	11.64	0.24	-1.51	11.18	0.23	-1.84	ASTM D7582
122	11.69	0.6#	-1.11	11.39	0.6#	-0.23	TGA
123	——	——	N/A	——	——	N/A	——
124	11.82	0.08	-0.06	11.46	0.07	0.31	ISO 1171
125	11.98	0.07	1.23	11.47	0.07	0.38	ASTM D7582
126	11.83	0.05	0.02	11.38	0.049	-0.31	ASTM D3174
127	11.65	0.20	-1.43	11.28	0.20	-1.07	Gravimetric method
128	11.80	0.45#	-0.22	11.36	0.43#	-0.46	PN ISO 1171:2002
129	11.70	0.21	-1.03	11.47	0.21	0.38	PN-G-04560:1998
130	11.93	0.36	0.83	11.54	0.36	0.92	PN-G-04560:1998
131	11.87	——	0.34	11.43	——	0.08	ISO 1171
132	11.76	0.02	-0.55	11.41	0.02	-0.08	DIN 51719
133	11.92	0.35	0.75	11.40	0.35	-0.15	ASTM D3174
134	11.90	0.49#	0.58	11.39	0.47#	-0.23	ISO 1171
135	11.64	——	-1.51	11.37	——	-0.38	ASTM D3174
136	11.85	0.02	0.18	11.52	0.02	0.77	ASTM D3174
137	11.90	0.39#	0.58	11.50	0.37	0.61	ASTM D7582
138	——	——	N/A	——	——	N/A	——
139	——	——	N/A	——	——	N/A	——
140	——	——	N/A	——	——	N/A	——
141	——	——	N/A	——	——	N/A	——
142	11.80	0.04	-0.22	11.40	0.04	-0.15	ASTM D4422
143	——	——	N/A	——	——	N/A	——
144	11.73	0.04	-0.78	11.50	0.03	0.61	NBR 8289
145	11.56	0.16	-2.15	11.33	0.16	-0.69	ASTM D7582-12
146	11.67	0.70#	-1.27	11.26	0.68#	-1.20	ISO 1171
147	11.87	0.48#	0.35	11.51	0.46#	0.69	ASTM D5142
148	——	——	N/A	——	——	N/A	——
149	11.77	——	-0.46	11.28	——	-1.07	GB/T212-2008 4.1

Ash Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
150	11.75	——	-0.62	11.27	——	-1.15	GB/T212-2008
151	11.73	0.14	-0.78	11.23	0.12	-1.46	GB/T212-2008
152	11.64	0.03	-1.51	11.27	0.03	-1.15	GB/T212-2008
153	11.85	0.08	0.19	11.34	0.08	-0.61	GB/T212-2008
154	11.68	0.15	-1.18	11.27	0.14	-1.15	GB/T212-2008
155	11.71	0.11	-0.94	11.33	0.11	-0.69	GB/T212-2008
156	11.78	0.14	-0.38	11.19	0.14	-1.76	GB/T212-2008
1078*	11.76	0.23	N/A	11.43	0.23	N/A	CSN ISO 1171
x*	11.828			11.420			
s*	0.124			0.130			
CV%	1.05			1.14			
Min	10.80			11.00			
Max	12.61			12.09			
Range	1.81			1.09			
Number	134			134			
Note: "——"Results or information were not provided. The results of lab code 35 & 1078 were not analyzed.							

* Lab123 reported the wrong code of Lab1078.

Uncertainty ＞ U_{max}.

Table A.2 Volatile Matter Results

Volatile Matter Results								
Lab code	Sample A%	Uncertainty	z-score (V-1)	z-score (V-2)	Sample B%	Uncertainty	z-score (V-1)	z-score (V-2)
1	25.96	0.40	N/A	-0.68	26.90	0.40	N/A	-0.88
2	27.71	0.15	N/A	1.87	28.48	0.16	N/A	1.76
3	26.55	0.17	2.14	N/A	27.93	0.17	2.75	N/A
4	26.41	1.17	N/A	-0.03	27.27	1.21	N/A	-0.26
5	——	——	N/A	N/A	——	——	N/A	N/A
6	26.15	0.24	N/A	N/A	27.06	0.24	N/A	N/A
7	——	——	N/A	N/A	——	——	N/A	N/A
8	23.09	1.00	-6.08	N/A	23.92	1.42#	-6.15	N/A
9	26.16	0.09	1.21	N/A	27.26	0.1	1.27	N/A
10	——	——	N/A	N/A	——	——	N/A	N/A
11	26.14	0.44	N/A	-0.42	27.11	0.48	N/A	-0.53
12	25.500	——	N/A	-1.35	26.367	——	N/A	-1.77
13	25.95	——	0.72	N/A	27.02	——	0.73	N/A
14	26.51	0.032	2.05	N/A	27.82	0.049	2.51	N/A
15	25.61	0.078	-0.09	N/A	26.83	0.096	0.31	N/A
16	25.33	0.33	N/A	-1.60	26.44	0.35	N/A	-1.65
17	25.87	——	0.53	N/A	26.95	——	0.58	N/A
18	26.42	0.41	N/A	-0.01	27.46	0.49	N/A	0.06
19	25.75	0.21	0.24	N/A	27.28	0.21	1.31	N/A
20	25.82	0.11	0.41	N/A	26.70	0.14	0.02	N/A
21	25.45	0.52	-0.47	N/A	26.45	0.52	-0.53	N/A
22	26.96	0.0214	3.12	N/A	27.13	0.0185	0.98	N/A
23	27.07	0.93	N/A	0.93	27.81	0.93	N/A	0.64
24	26.70	——	N/A	0.40	27.62	——	N/A	0.32
25	26.16	0.1619	N/A	-0.39	27.33	0.1619	N/A	-0.16
26	25.91	0.19	N/A	-0.75	26.94	0.19	N/A	-0.81
27	26.87	0.88	2.90	N/A	27.28	0.30	1.31	N/A
28	25.90	——	N/A	-0.77	27.14	——	N/A	-0.48
29	26.47	0.68	1.95	N/A	27.39	0.71	1.55	N/A
30	——	——	N/A	N/A	——	——	N/A	N/A
31	26.11	0.7833	1.10	N/A	26.47	0.7941	-0.49	N/A
32	24.62	——	-2.45	N/A	26.04	——	-1.44	N/A
33	25.90	0.80	0.60	N/A	27.05	0.80	0.80	N/A
34	——	——	N/A	N/A	——	——	N/A	N/A
35	——	——	N/A	N/A	——	——	N/A	N/A
36	——	——	N/A	N/A	——	——	N/A	N/A
37	25.09	0.611	-1.33	N/A	26.06	0.611	-1.40	N/A

Volatile Matter Results								
Lab code	Sample A%	Uncertainty	z-score (V-1)	z-score (V-2)	Sample B%	Uncertainty	z-score (V-1)	z-score (V-2)
38	26.07	1.2	1.00	N/A	26.62	1.2	-0.15	N/A
39	26.35	1.32#	1.67	N/A	27.24	1.36#	1.22	N/A
40	27.8	0.2	N/A	2.00	29.0	0.2	N/A	2.64
41	——	——	N/A	N/A	——	——	N/A	N/A
42	26.00	0.20	0.83	N/A	27.17	0.20	1.07	N/A
43	25.85	0.40	0.48	N/A	26.88	0.40	0.42	N/A
44	25.77	0.40	0.29	N/A	26.82	0.40	0.29	N/A
45	25.93	0.50	0.67	N/A	27.01	0.50	0.71	N/A
46	——	——	N/A	N/A	——	——	N/A	N/A
47	26.85	1.34	N/A	0.61	27.53	1.38	N/A	0.17
48	25.39	1.09	-0.62	N/A	26.84	1.15	0.33	N/A
49	27.16	0.41	N/A	1.07	28.20	0.42	N/A	1.30
50	——	——	N/A	N/A	——	——	N/A	N/A
51	26.80	0.50	N/A	0.54	28.20	0.50	N/A	1.30
52	27.04	——	N/A	0.89	28.07	——	N/A	1.08
53	27.92	0.71	N/A	2.17	28.68	0.71	N/A	2.10
54	25.22	0.03	N/A	-1.76	26.23	0.05	N/A	-2.00
55	26.30	0.13	N/A	-0.19	27.07	0.14	N/A	-0.60
56	27.00	0.07	N/A	0.83	27.13	0.07	N/A	-0.50
57	24.90	0.3	-1.78	N/A	26.12	0.3	-1.26	N/A
58	27.12	0.058	N/A	1.01	28.18	0.074	N/A	1.26
59	24.74	0.05	-2.16	N/A	26.21	0.08	-1.06	N/A
60	25.33	0.30	-0.76	N/A	26.45	0.30	-0.53	N/A
61	25.34	0.01	-0.73	N/A	26.23	0.01	-1.02	N/A
62	25.34	0.73	-0.73	N/A	26.38	0.71	-0.69	N/A
63	25.30	0.845	-0.83	N/A	26.08	0.845	-1.35	N/A
64	26.09	0.12	1.05	N/A	26.96	0.08	0.60	N/A
65	25.27	0.22	-0.90	N/A	26.36	0.12	-0.73	N/A
66	25.42	0.26	-0.54	N/A	26.49	0.35	-0.44	N/A
67	——	——	N/A	N/A	——	——	N/A	N/A
68	25.94	0.29	N/A	-0.71	26.91	0.30	N/A	-0.86
69	26.65	0.20	2.38	N/A	27.75	0.21	2.35	N/A
70	——	——	N/A	N/A	——	——	N/A	N/A
71	——	——	N/A	N/A	——	——	N/A	N/A
72	25.67	0.27	0.05	N/A	26.84	0.24	0.33	N/A
73	25.23	0.50	-1.00	N/A	26.47	0.50	-0.49	N/A
74	26.91	0.20	N/A	0.70	27.50	0.05	N/A	0.12
75	25.17	0.34	N/A	-1.83	26.49	0.36	N/A	-1.57
76	26.28	0.99	N/A	-0.22	27.76	1.03	N/A	0.56
77	26.49	0.67	N/A	0.09	27.35	0.69	N/A	-0.13

Volatile Matter Results								
Lab code	Sample A%	Uncertainty	z-score (V-1)	z-score (V-2)	Sample B%	Uncertainty	z-score (V-1)	z-score (V-2)
78	25.14	0.13	N/A	-1.87	26.04	0.13	N/A	-2.32
79	26.67	0.15	N/A	N/A	26.76	0.20	N/A	N/A
80	26.21	1.31#	1.33	N/A	27.08	1.35	0.87	N/A
81	25.04	1.00	-1.45	N/A	26.18	1.05	-1.13	N/A
82	25.59	1.02	-0.14	N/A	26.38	1.06	-0.69	N/A
83	25.83	1.29#	0.43	N/A	26.65	1.33	-0.09	N/A
84	25.50	0.50	-0.35	N/A	26.69	0.50	0.00	N/A
85	25.76	1.04	0.26	N/A	26.88	1.08	0.42	N/A
86	23.58	——	N/A	-4.14	24.49	——	N/A	-4.92
87	26.53	0.19	N/A	0.15	27.68	0.21	N/A	0.43
88	25.68	0.54	0.07	N/A	26.90	0.54	0.47	N/A
89	25.68	0.00921	0.07	N/A	26.58	0.00921	-0.24	N/A
90	——	——	N/A	N/A	——	——	N/A	N/A
91	——	——	N/A	N/A	——	——	N/A	N/A
92	——	——	N/A	N/A	——	——	N/A	N/A
93	——	——	N/A	N/A	——	——	N/A	N/A
94	——	——	N/A	N/A	——	——	N/A	N/A
95	25.90	0.0034	0.60	N/A	26.86	0.0034	0.38	N/A
96	30.31	——	N/A	5.65	32.18	——	N/A	7.96
97	——	——	N/A	N/A	——	——	N/A	N/A
98	25.52	0.13	-0.31	N/A	26.45	0.13	-0.53	N/A
99	25.9	——	0.60	N/A	27.0	——	0.69	N/A
100	25.49	——	-0.38	N/A	26.52	——	-0.38	N/A
101	26.41	——	1.81	N/A	27.26	——	1.27	N/A
102	25.96	——	0.74	N/A	27.10	——	0.91	N/A
103	25.53	1.02	-0.28	N/A	26.61	1.06	-0.18	N/A
104	25.14	0.5	-1.21	N/A	24.74	0.05	-4.33	N/A
105	26.85	1.10	N/A	0.61	27.78	0.94	N/A	0.59
106	26.78	1.73	N/A	0.51	27.71	1.74	N/A	0.48
107	26.30	2.82#	N/A	-0.19	27.10	3.39#	N/A	-0.55
108	26.80	0.51	N/A	0.54	27.84	0.53	N/A	0.69
109	26.47	0.18	N/A	N/A	27.54	0.19	N/A	N/A
110	26.43	0.09	N/A	0.00	27.45	0.29	N/A	0.04
111	25.89	0.15	0.57	N/A	27.10	0.14	0.91	N/A
112	27.04	0.55	3.31	N/A	28.04	0.53	3.00	N/A
113	25.49	0.05	N/A	N/A	26.31	0.05	N/A	N/A
114	27.40	0.83	N/A	1.41	28.34	0.86	N/A	1.53
115	25.92	0.30	N/A	-0.74	27.07	0.31	N/A	-0.60
116	27.06	0.05	N/A	0.92	28.28	0.06	N/A	1.43
117	25.53	0.23	-0.28	N/A	26.32	0.24	-0.82	N/A

Volatile Matter Results								
Lab code	Sample A%	Uncertainty	z-score (V-1)	z-score (V-2)	Sample B%	Uncertainty	z-score (V-1)	z-score (V-2)
118	25.34	0.1	-0.73	N/A	26.55	0.21	-0.31	N/A
119	25.65	——	0.00	N/A	26.70	——	0.02	N/A
120	24.67	1.00	-2.33	N/A	25.90	1.00	-1.75	N/A
121	25.17	1.01	-1.14	N/A	25.75	1.03	-2.08	N/A
122	25.54	——	N/A	N/A	26.53	——	N/A	N/A
123	——	——	N/A	N/A	——	——	N/A	N/A
124	25.87	0.22	0.53	N/A	26.98	0.2	0.64	N/A
125	25.78	0.85	N/A	-0.94	26.83	0.85	N/A	-1.00
126	26.57	0.06	N/A	0.21	27.63	0.05	N/A	0.34
127	25.61	0.17	-0.09	N/A	26.85	0.17	0.36	N/A
128	24.38	1.66	N/A	N/A	25.53	1.74	N/A	N/A
129	24.16	0.31	N/A	N/A	25.39	0.33	N/A	N/A
130	24.05	0.59	N/A	N/A	24.96	0.61	N/A	N/A
131	25.69	——	0.10	N/A	26.63	——	-0.13	N/A
132	25.34	0.4	-0.73	N/A	26.56	0.4	-0.29	N/A
133	26.34	0.99	N/A	-0.13	27.39	0.99	N/A	-0.06
134	25.51	0.43	-0.33	N/A	26.60	0.45	-0.20	N/A
135	26.29	——	N/A	-0.20	27.43	——	N/A	0.01
136	24.89	0.53	N/A	-2.24	25.86	0.55	N/A	-2.62
137	26.30	0.53	N/A	-0.19	27.18	0.54	N/A	-0.41
138	——	——	N/A	N/A	——	——	N/A	N/A
139	——	——	N/A	N/A	——	——	N/A	N/A
140	——	——	N/A	N/A	——	——	N/A	N/A
141	——	——	N/A	N/A	——	——	N/A	N/A
142	26.10	1.40	N/A	-0.48	27.40	1.40	N/A	-0.04
143	——	——	N/A	N/A	——	——	N/A	N/A
144	26.36	0.11	N/A	-0.10	27.56	0.13	N/A	0.22
145	26.35	0.26	N/A	-0.11	27.08	0.27	N/A	-0.58
146	25.50	0.76	-0.35	N/A	26.32	0.79	-0.82	N/A
147	26.65	1.87	N/A	0.32	27.48	1.92#	N/A	0.09
148	——	——	N/A	N/A	——	——	N/A	N/A
149	25.44	——	-0.50	N/A	26.65	——	-0.09	N/A
150	25.29	——	-0.85	N/A	26.26	——	-0.95	N/A
151	25.32	0.14	-0.78	N/A	26.40	0.15	-0.64	N/A
152	25.34	0.13	-0.73	N/A	26.09	0.16	-1.33	N/A
153	25.56	0.14	-0.21	N/A	26.98	0.14	0.64	N/A
154	25.61	0.26	-0.09	N/A	26.64	0.26	-0.11	N/A
155	25.50	0.35	-0.35	N/A	26.60	0.35	-0.20	N/A
156	25.60	0.35	-0.12	N/A	26.53	0.35	-0.35	N/A
1078*	24.78	0.74	N/A	N/A	25.55	0.77	N/A	N/A

Volatile Matter Results								
Lab code	Sample A%	Uncertainty	z-score (V-1)	z-score (V-2)	Sample B%	Uncertainty	z-score (V-1)	z-score (V-2)

Note: "——"Results or information were not provided. The results of lab code 1078 were not analyzed.

* Lab123 reported the wrong code of Lab1078.

Uncertainty ＞ U_{max}.

Table A.3 Total Sulfur Results

Total Sulfur Results							
Lab code	Sample A%	Uncert ainty	z-score	Sample B%	Uncert ainty	z-score	Method
1	0.782	0.021	1.21	0.981	0.022	0.89	ISO 15178
2	0.737	0.071	-0.15	0.907	0.087	-1.02	ASTM D4239/13e1
3	0.608	0.018	-4.04	0.822	0.018	-3.21	ISO 1928
4	0.711	0.055	-0.93	0.911	0.070	-0.91	ISO 19279-2006
5	0.76	——	0.55	0.93	——	-0.42	BAS ASTM D3177 Gravimetry
6	0.901	0.12#	4.81	1.094	0.12#	3.81	ASTM D3177
7	0.75	——	0.25	0.91	——	-0.94	BAS ASTM D3177 Esckha method
8	——	——	N/A	——	——	N/A	——
9	0.85	0.05	3.27	0.98	0.025	0.87	ISO 334:1998
10	——	——	N/A	——	——	N/A	——
11	0.791	0.045	1.49	0.981	0.070	0.89	ASTM D3177-02
12	0.795	——	1.61	0.965	——	0.48	ASTM D4239/14
13	——	——	N/A	——	——	N/A	——
14	0.72	——	-0.66	0.96	——	0.35	IS-1350（part 3-1969）
15	0.72	0.032	-0.66	0.98	0.031	0.87	IS-1350 Reaff-2010
16	0.760	0.050	0.55	0.936	0.060	-0.27	IS-1350（part 3-1969）
17	0.775	——	1.00	0.998	——	1.33	ASTM D4239
18	——	——	N/A	——	——	N/A	——
19	0.868	0.006	3.81	0.959	0.006	0.33	IS-1350 part 3-1969 Reaffirmed-2010
20	0.782	0.019	1.21	0.998	0.028	1.33	ISO 334（1999）
21	0.854	0.09	3.39	1.048	0.09	2.63	——
22	0.843	0.0286	3.06	1.031	0.0188	2.19	SRPS iso 334
23	0.778	0.06	1.09	0.965	0.06	0.48	ASTM D4239/13
24	0.77	——	0.85	0.97	——	0.61	——
25	0.741	0.0059	-0.02	0.961	0.0059	0.38	ASTM
26	0.720	0.06	-0.66	0.950	0.060	0.09	ASTM D4239/13
27	0.734	0.022	-0.24	0.939	0.033	-0.19	BS ISO 19579：2006
28	0.671	——	-2.14	0.906	——	-1.04	ASTM D4239/12
29	0.693	0.045	-1.47	0.883	0.058	-1.64	ASTM D4239/11
30	——	——	N/A	——	——	N/A	——
31	0.761	0.010	0.58	1.001	0.013	1.41	ISO/DIS 19579
32	0.654	——	-2.65	0.843	——	-2.67	NF EN 15408 and NF EN ISO 10304-1
33	0.752	0.080	0.31	0.955	0.080	0.22	ISO 334:2013
34	——	——	N/A	——	——	N/A	——
35	0.881	——	4.21	0.991	——	1.15	CNS(1)

Total Sulfur Results							
Lab code	Sample A%	Uncert ainty	z-score	Sample B%	Uncert ainty	z-score	Method
36	——	——	N/A	——	——	N/A	——
37	0.724	0.058	-0.54	0.949	0.058	0.07	ASTM D4239/13e1 Method A
38	0.716	0.06	-0.78	0.886	0.07	-1.56	ASTM D4239-13e1
39	0.70	0.11#	-1.26	0.91	0.14#	-0.94	ASTM D4239-08
40	0.74	0.05	-0.05	0.96	0.06	0.35	ASTM D4239
41	——	——	N/A	——	——	N/A	——
42	0.755	0.03	0.40	0.967	0.03	0.53	Infrared
43	0.756	0.060	0.43	0.981	0.060	0.89	AS1038.6.3.3
44	——	——	N/A	——	——	N/A	——
45	0.732	0.050	-0.30	0.963	0.050	0.43	AS1038.6.3.3
46	——	——	N/A	——	——	N/A	——
47	0.724	0.036	-0.54	0.930	0.047	-0.42	ASTM D4239-12
48	0.730	0.041	-0.36	0.935	0.052	-0.29	Eschka
49	0.78	0.02	1.15	0.97	0.02	0.61	ASTM D4239/13
50	——	——	N/A	——	——	N/A	——
51	0.737	0.421#	-0.15	0.935	0.481#	-0.29	ASTM D 4239-12
52	0.714	——	-0.84	0.919	——	-0.71	ASTM D4239
53	0.734	0.032	-0.24	0.944	0.032	-0.06	ASTM D4239
54	0.76	0.01	0.55	0.95	0.00	0.09	ASTM D 4239-12
55	0.73	0.031	-0.36	0.95	0.040	0.09	ASTM D 4239-12
56	0.746	0.064	0.13	0.948	0.064	0.04	ASTM D4239 method A
57	0.76	0.04	0.55	0.97	0.04	0.61	ASTM D4239 method A
58	0.523	0.002	-6.61	0.768	0.003	-4.61	XRF-Own method
59	0.711	0.034	-0.93	0.919	0.036	-0.71	BAC ISO 334:1999
60	0.709	0.050	-0.99	0.888	0.050	-1.51	BDS ISO 334:1999
61	0.693	0.006	-1.47	0.904	0.006	-1.10	ISO 334:2009
62	0.738	0.026	-0.11	0.926	0.034	-0.53	BAC ISO 334:1999
63	——	——	N/A	——	——	N/A	——
64	0.697	0.008	-1.35	0.888	0.012	-1.51	DIN 51724-3/07-12
65	0.703	0.025	-1.17	0.901	0.014	-1.17	Gravimetric
66	0.690	0.01	-1.56	0.889	0.01	-1.48	OENORM EN 15289
67	0.710	0.036	-0.96	0.870	0.044	-1.97	DIN 51724-3
68	0.810	0.024	2.06	1.038	0.030	2.37	ASTM D4239/14
69	0.711	0.014	-0.93	0.908	0.018	-0.99	ISO 334:2013
70	——	——	N/A	——	——	N/A	——
71	——	——	N/A	——	——	N/A	——
72	0.707	0.005	-1.05	0.889	0.007	-1.48	ASTM D4239 B

Total Sulfur Results							
Lab code	Sample A%	Uncert ainty	z-score	Sample B%	Uncert ainty	z-score	Method
73	0.746	0.045	0.13	0.936	0.056	-0.27	Internal method
74	0.788	0.038	1.40	0.983	0.043	0.95	ASTM D5016-08
75	0.768	0.18#	0.79	0.993	0.23#	1.20	ASTM D 4239-12
76	0.749	0.092	0.22	1.006	0.123#	1.54	——
77	0.747	0.025	0.16	0.961	0.030	0.38	ASTM D4239-14 method A
78	0.805	0.017	1.91	1.010	0.017	1.64	ASTM D4239
79	0.756	0.021	0.43	——	——	N/A	ASTM D5016-08
80	0.756	0.076	0.43	0.969	0.097	0.58	ASTM D4239:2013
81	0.756	0.076	0.43	0.971	0.097	0.64	ASTM D4239
82	0.68	0.05	-1.87	0.914	0.06	-0.84	SS-187177
83	0.759	0.061	0.52	0.968	0.077	0.56	SS-187177
84	0.748	0.087	0.19	0.969	0.107	0.58	ISO 19579
85	0.702	0.092	-1.20	0.897	0.117#	-1.28	ASTM D4239
86	0.733	——	-0.27	0.965	——	0.48	ASTM D4239 B
87	0.725	0.001	-0.51	0.922	0.001	-0.63	ASTM D3177-02/2007
88	0.744	0.010	0.07	0.862	0.010	-2.18	ISO 334:1992
89	0.729	0.0177	-0.39	1.019	0.0177	1.88	ISO 334
90	——	——	N/A	——	——	N/A	——
91	——	——	N/A	——	——	N/A	——
92	——	——	N/A	——	——	N/A	——
93	——	——	N/A	——	——	N/A	——
94	——	——	N/A	——	——	N/A	——
95	——	——	N/A	——	——	N/A	——
96	——	——	N/A	——	——	N/A	——
97	——	——	N/A	——	——	N/A	——
98	0.762	0.022	0.61	0.972	0.022	0.66	ASTM D4239
99	——	——	N/A	——	——	N/A	——
100	0.772	——	0.91	0.963	——	0.43	ASTM D4239
101	0.77	——	0.85	0.95	——	0.09	ASTM D4239
102	0.763	——	0.64	0.940	——	-0.17	ASTM D4239
103	0.660	0.10#	-2.47	0.836	0.10	-2.85	ASTM D3177B/IC analysis
104	0.756	0.06	0.43	0.960	0.06	0.35	ISO 19579:2006
105	0.736	0.056	-0.18	0.941	0.090	-0.14	ASTM D4239
106	0.735	0.101#	-0.21	0.949	0.130#	0.07	——
107	0.740	0.054	-0.05	0.937	0.070	-0.24	ASTM D4239-12
108	0.737	0.007	-0.15	0.945	0.008	-0.04	ASTM D4239
109	0.741	0.018	-0.02	0.945	0.020	-0.04	ASTM D 4239-12
110	0.910	0.006	5.08	1.141	0.005	5.03	ASTM D4239

Total Sulfur Results							
Lab code	Sample A%	Uncert ainty	z-score	Sample B%	Uncert ainty	z-score	Method
111	0.730	0.011	-0.36	0.924	0.008	-0.58	KS E ISO351:2003
112	0.750	0.034	0.25	0.921	0.031	-0.66	ASTM D 4239-12
113	0.83	0.11#	2.66	0.97	0.13#	0.61	ASTM D 4239-14
114	0.789	0.034	1.43	0.993	0.043	1.20	ASTM D4239
115	0.790	0.022	1.46	1.026	0.028	2.06	ASTM D4239
116	0.84	0.08	2.97	1.04	0.09	2.42	ASTM D4239
117	0.866	0.084	3.75	0.989	0.096	1.10	DIN 51724-1
118	0.730	0.02	-0.36	0.954	0.01	0.20	ASTM D4239
119	0.708	——	-1.02	0.897	——	-1.28	ASTM D 4239-14
120	0.787	0.050	1.37	0.969	0.050	0.58	ISO 19579
121	0.715	0.043	-0.81	0.915	0.055	-0.81	CSN 441379
122	0.771	0.2#	0.88	1.005	0.2#	1.51	NDIR
123	——	——	N/A	——	——	N/A	——
124	0.741	0.015	-0.02	0.956	0.010	0.25	ASTM D4239
125	0.742	0.024	0.01	0.947	0.024	0.02	ASTM D4239
126	0.732	0.008	-0.30	0.937	0.018	-0.24	ASTM D4239
127	0.755	0.040	0.40	0.971	0.040	0.64	IR spectrometry method
128	0.656	0.029	-2.59	0.867	0.038	-2.05	PN-G-04584:2001
129	0.750	0.030	0.25	0.983	0.039	0.95	PN-G-04584:2001
130	0.736	0.048	-0.18	0.946	0.061	-0.01	ISO 19579:2006
131	0.717	——	-0.75	0.942	——	-0.11	ISO 19579
132	0.731	0.02	-0.33	0.954	0.02	0.20	DIN 51724-3
133	0.753	0.06	0.34	0.935	0.06	-0.29	ASTM D4239
134	0.72	0.03	-0.66	0.90	0.04	-1.20	ASTM D4239
135	0.711	——	-0.93	0.913	——	-0.86	ASTM D4239
136	0.760	0.04	0.55	0.990	0.05	1.13	ASTM D4239-C
137	0.763	0.076	0.64	0.952	0.095	0.14	ASTM D4239
138	——	——	N/A	——	——	N/A	——
139	——	——	N/A	——	——	N/A	——
140	——	——	N/A	——	——	N/A	——
141	——	——	N/A	——	——	N/A	——
142	0.240	0.160#	-15.16	0.390	0.160#	-14.38	ASTM D6376 (fluorescencia RX)
143	——	——	N/A	——	——	N/A	——
144	0.739	0.005	-0.08	0.954	0.003	0.20	ASTM D4239
145	0.720	0.033	-0.66	0.936	0.034	-0.27	ASTM D4239-14
146	0.712	0.050	-0.90	0.939	0.066	-0.19	ASTM D4239
147	0.744	0.060	0.07	0.955	0.076	0.22	ASTM D4239
148	0.744	0.05	0.07	0.963	0.05	0.43	Inhouse

Total Sulfur Results							
Lab code	Sample A%	Uncert ainty	z-score	Sample B%	Uncert ainty	z-score	Method
149	0.732	——	-0.30	0.926	——	-0.53	GB/T214-2007 .4
150	0.67	——	-2.17	0.90	——	-1.20	GB/T214-2007
151	0.746	0.017	0.13	0.924	0.022	-0.58	GB/T 25214-2010
152	0.722	0.020	-0.60	0.918	0.009	-0.73	GB/T214-2007
153	0.755	0.025	0.40	0.948	0.025	0.04	GB/T 25214-2010
154	0.708	0.02	-1.02	0.902	0.02	-1.15	GB/T214-2007
155	0.725	0.053	-0.51	0.945	0.053	-0.04	GB/T 25214-2010
156	0.725	0.040	-0.51	0.910	0.040	-0.94	GB/T214-2007
*1078	0.799	0.08	N/A	0.904	0.09	N/A	CSN ISO 29541
x*	0.7418			0.9464			
s*	0.0331			0.0387			
CV%	4.46			4.09			
Min	0.240			0.390			
Max	0.910			1.141			
Range	0.670			0.751			
Number	127			126			
Note: "——"Results or information were not provided. The results of lab code 1078 were not analyzed.							

* Lab123 reported the wrong code of Lab1078.

Uncertainty ＞ U_{max}.

Table A.4 Gross Calorific Value Results

Gross Calorific Value Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
1	29.341	0.203	1.11	29.897	0.207	1.78	ISO 1928
2	29.340	0.060	1.10	29.793	0.060	0.80	ASTM D5865/13
3	28.701	0.169	-4.30	29.357	0.169	-3.27	ISO 1928
4	29.186	0.239	-0.20	29.704	0.264	-0.03	ISO 1928
5	29.110	0.148	-0.84	29.675	0.148	-0.30	BAS ISO 1928 Calorimetria
6	29.403	0.766#	1.63	29.846	0.766#	1.30	ASTM D5865
7	29.173	1.01#	-0.31	29.615	1.01#	-0.86	BAS ISO 1928:2010
8	29.237	0.099	0.23	29.750	0.121	0.40	BAS ISO 1928:2010
9	28.997	0.010	-1.80	29.483	0.015	-2.09	ISO 1928
10	——	——	N/A	——	——	N/A	——
11	29.244	0.275	0.29	29.741	0.282	0.32	ASTM D5865-11a
12	29.225	——	0.13	29.777	——	0.66	ASTM D5865/13
13	28.741	——	-3.97	29.334	——	-3.49	ASTM D5865/12
14	29.01	——	-1.69	29.78	——	0.68	IS-1350（part 2-1970）
15	6965.00	15.01	Gross straggler	7094.00	12.93	Gross straggler	ASTM D5865/10a
16	29.086	0.109	-1.05	29.613	0.113	-0.88	ASTM D5865-11a
17	29.274	——	0.54	29.684	——	-0.21	ASTM D5865
18	29.120	0.209	-0.76	29.672	0.400#	-0.33	ASTM D5865/12
19	29.203	0.077	-0.06	29.668	0.077	-0.36	IS-1350 part 2-1970 Reaffirmed-2005
20	29.208	0.116	-0.02	29.704	0.131	-0.03	ISO 1928（2009）
21	29.151	0.038	-0.50	29.713	0.038	0.06	——
22	29.152	0.119	-0.49	29.691	0.101	-0.15	SRPS B.H8 318
23	29.271	0.592#	0.52	29.778	0.520#	0.66	SRPS B.H8 318
24	29.06	——	-1.27	29.60	——	-1.00	——
25	29.699	0.000046	4.14	30.155	0.000046	4.19	ASTM
26	29.399	0.184	1.60	29.902	0.184	1.82	ASTM D5865/13
27	29.298	0.072	0.75	29.699	0.078	-0.07	BS ISO 1928:2009
28	29.115	——	-0.80	29.546	——	-1.50	ASTM D5865-11
29	29.376	0.303	1.41	29.761	0.307	0.51	ASTM D5865/12
30	——	——	N/A	——	——	N/A	——
31	29.215	0.876#	0.04	29.702	0.891#	-0.05	NF ISO 1928
32	28.402	2.840#	-6.83	29.002	2.900#	-6.59	NF EN 15400
33	29.128	0.230	-0.69	29.751	0.230	0.41	ISO 1928:2009
34	29.034	0.285	-1.49	29.628	0.291	-0.74	EN ISO 1716:2010
35	26.646	——	-21.69	27.024	——	-25.07	——

Gross Calorific Value Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
36	——	——	N/A	——	——	N/A	——
37	29.267	0.296	0.48	29.711	0.296	0.04	UNE 32006-95
38	29.111	0.251	-0.84	29.684	0.251	-0.21	UNE 32006:1995
39	29.196	0.292	-0.12	29.725	0.297	0.17	UNE 32006-95
40	28.682	0.188	-4.47	29.277	0.188	-4.02	ASTM D5865
41	——	——	N/A	——	——	N/A	——
42	29.440	0.13	1.95	29.930	0.13	2.09	Bomb calorimetcr
43	29.286	0.260	0.64	29.748	0.260	0.38	AS1038.5
44	——	——	N/A	——	——	N/A	——
45	35.187	0.300	50.57	36.191	0.300	60.60	NF ISO 1928
46	——	——	N/A	——	——	N/A	——
47	29.184	0.204	-0.22	29.704	0.208	-0.03	DIN 51900-05
48	29.369	0.253	1.35	29.876	0.269	1.58	DIN 51900
49	29.139	0.21	-0.60	29.602	0.21	-0.98	DIN 51900-1,3 2000-4
50	——	——	N/A	——	——	N/A	——
51	29.303	0.148864	0.79	29.804	0.148864	0.91	ASTM D5865-11a
52	29.256	——	0.39	29.782	——	0.70	ASTM D5865
53	29.277	0.192	0.57	29.854	0.192	1.37	ASTM D5865
54	29.30	0.03	0.76	29.74	0.02	0.31	ASTM D5865-12
55	29.08	0.010	-1.10	29.66	0.010	-0.44	ASTM D5865-11a
56	29.205	0.021	-0.04	29.680	0.021	-0.25	ASTM D5865
57	29.18	0.18	-0.25	29.64	0.18	-0.63	ASTM D5865
58	29.162	0.032	-0.40	29.738	0.031	0.29	ASTM D5865/13
59	29.160	0.054	-0.42	29.649	0.059	-0.54	BAC ISO 1928:2011
60	29.216	0.050	0.05	29.693	0.040	-0.13	BDS ISO 1928:2011
61	29.172	0.006	-0.32	29.710	0.006	0.03	ISO 1928:2011
62	29.105	0.096	-0.89	29.698	0.113	-0.08	BAC ISO 1928:2011
63	28.764	0.357#	-3.77	29.389	0.357#	-2.97	ISO 1928
64	29.134	0.066	-0.64	29.626	0.036	-0.76	DIN 51900-1/03-00 DIN 51900-3/01-05
65	29.312	0.028	0.86	29.864	0.043	1.47	ISO 1928
66	29.268	0.08	0.49	29.697	0.10	-0.09	DIN 51900-1
67	28.267	0.283	-7.98	28.788	0.288	-8.59	OENORM EN 14918
68	29.095	0.064	-0.97	29.584	0.065	-1.15	BAC ISO 1928:2009
69	29.214	1.200#	0.04	29.859	1.227#	1.42	ISO 1928:2009
70	——	——	N/A	——	——	N/A	——
71	——	——	N/A	——	——	N/A	——
72	29.212	0.088	0.02	29.639	0.119	-0.63	ISO 1928

Gross Calorific Value Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
73	——	——	N/A	——	——	N/A	——
74	29.073	1.042#	-1.16	29.703	1.061#	-0.04	ASTM D5865-11a
75	28.65	0.18	-4.74	29.06	0.18	-6.05	ASTM D5865-11a
76	29.261	0.334	0.43	29.715	0.339#	0.08	——
77	29.236	0.172	0.22	29.722	0.176	0.14	ASTM D5865/13
78	28.714	0.013	-4.19	29.160	0.013	-5.11	ASTM D5865
79	6890.000	15	Gross straggler	——	——	N/A	——
80	29.382	1.469#	1.46	29.976	1.499#	2.51	SS-EN14918/15400/ISO1928
81	29.333	0.18	1.04	29.848	0.18	1.32	ISO 1928
82	28.710	0.287	-4.23	29.170	0.292	-5.02	SS-187177
83	29.274	0.300	0.54	29.707	0.300	0.00	SS-ISO 1928
84	29.468	0.3	2.18	29.998	0.3	2.72	ISO 1928
85	29.396	0.16	1.58	29.824	0.17	1.09	ISO 1928
86	28.777	——	-3.66	29.294	——	-3.86	ASTM D5865
87	29.072	0.083	-1.17	29.651	0.085	-0.52	ASTM D5865-11a
88	29.245	0.289	0.30	29.802	0.289	0.89	ISO 1928:1995
89	29.295	0.00894	0.72	29.689	0.00894	-0.17	ISO 1928
90	29.157	0.01	-0.45	29.734	0.09	0.25	ASTM D5865-07a
91	——	——	N/A	——	——	N/A	——
92	——	——	N/A	——	——	N/A	——
93	——	——	N/A	——	——	N/A	——
94	——	——	N/A	——	——	N/A	——
95	——	——	N/A	——	——	N/A	——
96	——	——	N/A	——	——	N/A	——
97	——	——	N/A	——	——	N/A	——
98	29.347	0.071	1.16	29.888	0.071	1.69	ISO 1928
99	——	——	N/A	——	——	N/A	——
100	29.171	——	-0.33	29.711	——	0.04	ISO 1928
101	——	——	N/A	——	——	N/A	——
102	29.135	——	-0.63	29.835	——	1.20	ISO 1928
103	29.111	0.300	-0.84	29.663	0.300	-0.41	ISO 1928:2009
104	29.330	0.12	1.02	29.780	0.12	0.68	ISO 1928:2009
105	29.203	0.975#	-0.06	29.751	0.567#	0.41	ASTM D5865
106	29.292	0.738#	0.70	29.756	0.751#	0.46	——
107	29.236	0.161	0.22	29.773	0.088	0.62	ASTM D5865-12
108	29.346	0.059	1.15	29.838	0.024	1.23	ASTM D5865
109	29.280	0.126	0.59	29.760	0.061	0.50	ASTM D5865-12

Gross Calorific Value Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
110	29.175	0.009	-0.29	29.682	0.002	-0.23	KS E 3707
111	29.144	1.341#	-0.56	29.530	1.359#	-1.65	KS E 3707:2001
112	29.122	0.052	-0.74	29.640	0.059	-0.63	ASTM D5865-12
113	29.45	0.05	2.03	29.90	0.05	1.80	ASTM D5865-13
114	29.383	0.846#	1.47	29.852	0.858#	1.36	ISO 1928
115	29.169	0.0963	-0.35	29.672	0.0979	-0.33	ASTM D5865
116	29.60	0.04	3.30	29.70	0.04	-0.06	ASTM D5865
117	29.349	0.082	1.18	29.870	0.084	1.52	ISO 1928:2009
118	29.346	0.04	1.15	29.840	0.10	1.24	ISO 1928
119	29.220	——	0.09	29.641	——	-0.62	ISO 1928:2009
120	29.339	0.120	1.09	29.839	0.120	1.23	ISO 1928
121	29.17	0.146	-0.34	29.73	0.149	0.22	CSN ISO 1928
122	29.202	0.3	-0.07	29.645	0.3	-0.58	calorimetry
123	——	——	N/A	——	——	N/A	——
124	29.294	0	0.71	29.739	0	0.30	CNS 10835
125	29.259	0.020	0.42	29.727	0.020	0.19	ASTM D5865
126	29.228	0.018	0.15	29.696	0.019	-0.10	ASTM D5865
127	29.141	0.117	-0.58	29.589	0.118	-1.10	calorimetry method
128	29.121	0.285	-0.75	29.509	0.289	-1.85	PN-G-04513:1980
129	29.247	0.117	0.31	29.675	0.119	-0.30	PN-81-G-04513
130	29.243	245#	0.28	29.639	248#	-0.63	ISO 1928:2009
131	29.141	——	-0.58	29.661	——	-0.43	ISO 1928
132	29.305	0.120	0.81	29.794	0.120	0.81	DIN 51900 -1/3
133	29.185	0.181	-0.21	29.609	0.181	-0.91	ASTM D5865
134	29.325	0.234	0.97	29.788	0.238	0.76	ISO 1928
135	29.239	——	0.25	29.719	——	0.11	ASTM D5865
136	29.152	0.116	-0.49	29.622	0.116	-0.79	ASTM D5865
137	29.159	2.496#	-0.43	29.666	2.539#	-0.38	ASTM D5865
138	——	——	N/A	——	——	N/A	——
139	——	——	N/A	——	——	N/A	——
140	——	——	N/A	——	——	N/A	——
141	——	——	N/A	——	——	N/A	——
142	——	——	N/A	——	——	N/A	——
143	——	——	N/A	——	——	N/A	——
144	28.607	0.267	-5.10	29.225	0.271	-4.50	ASTM D5865
145	29.167	0.163	-0.36	29.578	0.163	-1.20	ASTM D5865-13
146	29.261	0.293	0.43	29.734	0.297	0.25	ISO 1928
147	29.248	0.380#	0.32	29.749	0.387#	0.39	ISO 1988
148	29.331	0.35	1.03	29.670	0.35#	-0.34	Inhouse

Gross Calorific Value Results							
Lab code	Sample A%	Uncertainty	z-score	Sample B%	Uncertainty	z-score	Method
149	29.243	——	0.28	29.686	——	-0.20	GB/T213-2008 8.2
150	29.14	——	-0.59	29.51	——	-1.84	GB/T213-2008
151	29.135	0.042	-0.63	29.642	0.034	-0.61	GB/T213-2008
152	29.200	0.057	-0.08	29.807	0.097	0.94	GB/T213-2008
153	29.338	0.167	1.08	29.777	0.167	0.66	GB/T213-2008
154	29.210	0.16	0.00	29.709	0.16	0.02	GB/T213-2008
155	29.194	0.11	-0.13	29.660	0.11	-0.44	GB/T213-2008
156	29.247	0.170	0.31	29.814	0.170	1.00	GB/T213-2008
1078*	29.051	0.12	N/A	29.553	0.12	N/A	CSN ISO 1928
x*	29.2098			29.7069			
s*	0.1182			0.1070			
CV%	0.40			0.36			
Min	26.646			27.024			
Max	35.187			36.191			
Range	8.541			9.167			
Number	128			128			
Note: "——"Results or information were not provided. The results of lab code 15, 79 & 1078 were not analyzed.							

* Lab123 reported the wrong code of Lab1078.

Uncertainty $>$ U_{max}.

Table A.5 Review of Test Methods

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
1	ASTM D7582	ASTM D7582	ISO 1928	ISO 15178
2	ASTM D7582/12	ASTM D7582/12	ASTM D5865/13	ASTM D4239/13e1
3	ISO 1171	ISO 562	ISO 1928	ISO 1928
4	ASTM D7582	ASTM D7582	ISO 1928	ISO 19279-2006
5	BAS ISO 1171 Gravimetry	——	BAS ISO 1928 Calorimetria	BAS ASTM D3177 Gravimetry
6	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D3177
7	BAS ISO 1171:2012	——	BAS ISO 1928:2010	BAS ASTM D3177 Esckha method
8	BAS ISO 1171:2012	BAS ISO 5071-1:2001	BAS ISO 1928:2010	——
9	ISO 1171:2010	ISO 562:2010	ISO 1928	ISO 334:1998
10	——	——	——	——
11	ASTM D3174-2012	ASTM D3175-11	ASTM D5865-11a	ASTM D3177-02
12	ASTM D3174-12	ASTM D3175-11	ASTM D5865/13	ASTM D4239/14
13	IS-1350 part Ⅰ -1984 RA-2002	IS-1350 part Ⅱ-1984 RA-2002	ASTM D5865/12	
14	IS-1350 part Ⅰ -1984 Reaffm-2002	IS-1350 part Ⅰ-1984 Reaffm-2002	IS-1350 (part 2-1970)	IS-1350 (part 3-1969)
15	IS-1350 Reaff-2010	IS-1350 Reaff-2010	ASTM D5865/10a	IS-1350 Reaff-2010
16	ASTM D3174-11	ASTM D3175-11	ASTM D5865-11a	IS-1350 (part 3-1969)
17	IS-1350 part Ⅰ -1984	IS-1350 part Ⅰ-1984	ASTM D5865	ASTM D4239
18	ASTM D7582/12	ASTM D7582/12	ASTM D5865/12	
19	IS-1350 part Ⅰ -1984 Reaffirmed-2007	IS-1350 part Ⅰ-1984 Reaffirmed-2007	IS-1350 part 2-1970 Reaffirmed-2005	IS-1350 part 3-1969 Reaffirmed-2010
20	ISO 1171:2010	ISO 5071:200:3	ISO 1928(2009)	ISO 334(1999)
21	SRPS B.H8 312	SRPS B.H8 317	SRPS B.H8 318	SRPS ISO 334
22	SRPS B.H8 312	SRPS B.H8 317	SRPS B.H8 318	SRPS ISO 334
23	SRPS B.H8 312	ASTM D7582	SRPS B.H8 318	ASTM D4239/13
24	——	——	——	——
25	ASTM	ASTM	ASTM	ASTM

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
26	ASTM D3174-2012	ASTM D3175-11	ASTM D5865/13	ASTM D4239/13
27	BS ISO 1171:2010	BS ISO 562:2010	BS ISO 1928:2009	BS ISO 19579:2006
28	ASTM D3174-2012	ASTM D3175-11	ASTM D5865-11	ASTM D4239/12
29	ASTM D3174-2012	ISO 562	ASTM D5865/12	ASTM D4239/11
30	——	——	——	——
31	ISO 1171	ISO 562	NF ISO 1928	ISO/DIS 19579
32	NF EN 15403	NF EN 15402	NF EN 15400	NF EN 15408 and NF EN ISO 10304-1
33	ISO 1171:2010	ISO 552:2010	ISO 1928:2009	ISO 334:2013
34	——	——	EN ISO 1716:2010	——
35	——	——	——	CNS(1)
36	——	——	——	——
37	UNE 32111-95	UNE 32019-84	UNE 32006-95	ASTM D4239/13e1 Method A
38	PO/LECEM-EP/33 rev.5	PO/LECEM-EP/34 rev.3	UNE 32006:1995	ASTM D4239-13e1
39	UNE-32111:1995	ISO 562:1998	UNE 32006-95	ASTM D4239-08
40	ISO 1171	ASTM D3175	ASTM D5865	ASTM D4239
41	——	——	——	——
42	Gravimetric	Gravimetric	Bomb calorimetcr	Infrared
43	AS1038.3	AS1038.3	AS1038.5	AS1038.6.3.3
44	AS1038.3	AS1038.3	——	——
45	ISO 1171	ISO 562	NF ISO 1928	AS1038.6.3.3
46	——	——	——	——
47	ASTM D7582/12	ASTM D7582/12	DIN 51900-05	ASTM D4239-12
48	DIN 51719	ISO 562	DIN 51900	Eschka
49	ASTM D7582/12	ASTM D7582/12	DIN 51900-1,3 2000-4	ASTM D4239/13
50	——	——	——	——
51	ASTM D7582/10	ASTM D3175-11	ASTM D5865-11a	ASTM D4239-12
52	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D4239
53	ASTM D3174	ASTM D7582	ASTM D5865	ASTM D4239

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
54	ASTM D7582/12	ASTM D3175-11	ASTM D5865-12	ASTM D4239-12
55	ASTM D7582/11	ASTM D3175-11	ASTM D5865-11a	ASTM D4239-12
56	ASTM D3174	ASTM D7582	ASTM D5865	ASTM D4239 method A
57	ASTM D3174	ISO 562	ASTM D5865	ASTM D4239 method A
58	ASTM D7582/12	ASTM D7582/12	ASTM D5865/13	XRF-Own method
59	BAC ISO 1171:2012	BAC ISO 562:2012	BAC ISO 1928:2011	BAC ISO 334:1999
60	BDS ISO 1171:2012	VLM 504-03:2012 / with TG/	BDS ISO 1928:2011	BDS ISO 334:1999
61	BACISO 1171:2012	BAC ISO 562:2012	ISO 1928:2011	ISO 334:2009
62	BAC ISO 1171:2012	BAC ISO 562:2012	BAC ISO 1928:2011	BAC ISO 334:1999
63	BAC ISO 1171	BAC ISO 562	ISO 1928	——
64	DIN 51719/07-97	DIN 51720/03-01	DIN 51900-1/03-00 DIN 51900-3/01-05	DIN 51724-3/07-12
65	BAC ISO 1171	BAC ISO 562	ISO 1928	Gravimetric
66	DIN 51719	DIN 51720	DIN 51900-1	OENORM EN 15289
67	OENORM EN 1074	——	OENORM EN 14918	DIN 51724-3
68	ASTM D7582/12	ASTM D7582/12	BAC ISO 1928:2009	ASTM D4239/14
69	ISO 1171:2010	ISO 562:2010	ISO 1928:2009	ISO 334:2013
70	——	——	——	——
71	——	——	——	——
72	ISO 1171	ISO 562	ISO 1928	ASTM D4239 B
73	ISO 1171	DIN 51720	——	Internal method
74	ASTM D7582/10	ASTM D7582/10	ASTM D5865-11a	ASTM D5016-08
75	ASTM D7582/10e1	ASTM D7582/10e1	ASTM D5865-11a	ASTM D4239-12
76	ASTM D5142-09	ASTM D5142-09	ASTM D5865-10a	ASTM D4239-10 method A
77	ASTM D7582/12	ASTM D7582/12	ASTM D5865/13	ASTM D4239-14 method A
78	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239
79	ASTM D6142	ASTM D5142	——	ASTM D5013-08
80	ISO 1171/ ASTM	ISO 562:2008 mod/	SS-EN14918/	ASTM D4239:2013

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
	D5142	ASTM D5142:2009 mod	15400/ISO1928	
81	mod. ISO 1171	mod. ISO 562	ISO 1928	ASTM D4239
82	SS187170	SS-ISO 56	SS-187177	SS-187177
83	SS187157	SS-ISO 562	SS-ISO 1928	SS-187177
84	ISO 1171	ISO 562	ISO 1928	ISO 19579
85	ISO 1171	ISO 562	ISO 1928	ASTM D4239
86	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D4239 B
87	ASTM D3174-11	ASTM D3175-11	ASTM D5865-11a	ASTM D3177-02/2007
88	ISO 1171:1997	ISO 562:1998	ISO 1928:1995	ISO 334:1992
89	ISO 1171	ISO 562	ISO 1928	ISO 334
90	——	——	ASTM D5865-07a	——
91	——	——	——	——
92	——	——	——	——
93	——	——	——	——
94	AFNOR 12902[1]		——	——
95	ISO 1171-2010	ISO 562-2010	——	——
96	ASTM D3174	ASTM D3175	——	——
97	——	——	——	——
98	ISO 1171	ISO 562	ISO 1928	ASTM D4239
99	ISO 1171:2010	ISO 562:2010		
100	ISO 1171	ISO 562	ISO 1928	ASTM D4239
101	ISO 1171	ISO 562		ASTM D4239
102	ISO 562	ISO 562	ISO 1928	ASTM D4239
103	ISO 1171:2010	ISO 562:2010	ISO 1928:2009	ASTM D3177B/IC analysis
104	ISO 1171:2010	ISO 562:2010	ISO 1928:2009	ISO 19579:2006
105	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239
106	ASTM D7582-12	ASTM D7582-12	ASTM D5865-12	ASTM D4239-12
107	ASTM D7582-12	ASTM D7582-12	ASTM D5865-12	ASTM D 4239-12
108	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
109	ASTM D7582	ASTM D7582	ASTM D5865-12	ASTM D4239-12
110	ASTM D7582	ASTM D7582	KS E 3707	ASTM D4239
111	KS E ISO1171	KS E ISO0562:2002	KS E 3707:2001	KS E ISO351:2003
112	ISO 12746:2010	ISO 12746:2010	ASTM D5865-12	ASTM D4239-12
113	ASTM D7582-2010E	ASTM D7582-2010E	ASTM D5865-13	ASTM D4239-14
114	ASTM D7582	ASTM D7582	ISO 1928	ASTM D4239
115	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239
116	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239
117	ISO 1171:2010	ISO 562:2010	ISO 1928:2009	DIN 51724-1
118	ISO 1171	ISO 562	ISO 1928	ASTM D4239
119	ISO 1171:2010	ISO 562:2010	ISO 1928:2009	ASTM D 4239-14
120	ISO 1171	ISO 562	ISO 1928	ISO 19579
121	ASTM D7582	CSN ISO 562	CSN ISO 1928	CSN 441379
122	TGA	TGA	calorimetry	NDIR
123	——	——	——	——
124	ISO 1171	ISO 562	CNS 10835	ASTM D4239
125	ASTM D7582	ASTM D3175	ASTM D5865	ASTM D4239
126	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D4239
127	Gravimetric method	Gravimetric method	calorimetry method	IR spectrometry method
128	PN ISO 1171:2002	PN-G-04516:1998	PN-G-04513:1980	PN-G-04584:2001
129	PN-G-04560:1998	PN-G-04516:1998	PN-81-G-04513	PN-G-04584:2001
130	PN-G-04560:1998	PN-G-04560:1998	ISO 1928:2009	ISO 19579:2006
131	ISO 1171	ISO 562	ISO 1928	ISO 19579
132	DIN 51719	DIN 51720	DIN 51900 -1/3	DIN 51724-3
133	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D4239
134	ISO 1171	ISO 562	ISO 1928	ASTM D4239
135	ASTM D3174	ASTM D3176	ASTM D5865	ASTM D4239
136	ASTM D3174	ASTM D3175	ASTM D5865	ASTM D4239-C
137	ASTM D7582	ASTM D7582	ASTM D5865	ASTM D4239

Lab Code	Test Methods			
	Ash	Volatile Matter	Gross Calorific Value	Total sulfur
138	——	——	——	——
139	——	——	——	——
140	——	——	——	——
141	——	——	——	——
142	ASTM D4422	ASTM D6374		ASTM D6376 (fluorescencia RX)
143	——	——	——	——
144	NBR 8289	NBR 8290	ASTM D5865	ASTM D4239
145	ASTM D7582-12	ASTM D7582-12	ASTM D5865-13	ASTM D4239-14
146	ISO 1171	ISO 562	ISO 1928	ASTM D4239
147	ASTM D5142	ASTM D5142	ISO 1988	ASTM D4239
148	——	——	Inhouse	Inhouse
149	GB/T212-2008 4.1	GB/T212-2008 5	GB/T213-2008 8.2	GB/T214-2007 4
150	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T214-2007
151	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T 25214-2010
152	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T214-2007
153	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T 25214-2010
154	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T214-2007
155	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T 25214-2010
156	GB/T212-2008	GB/T212-2008	GB/T213-2008	GB/T214-2007
1078	CSN ISO 1171	CSN ISO 1351	CSN ISO 1928	CSN ISO 29541

Figure A.1 Z-scores of Ash (A)

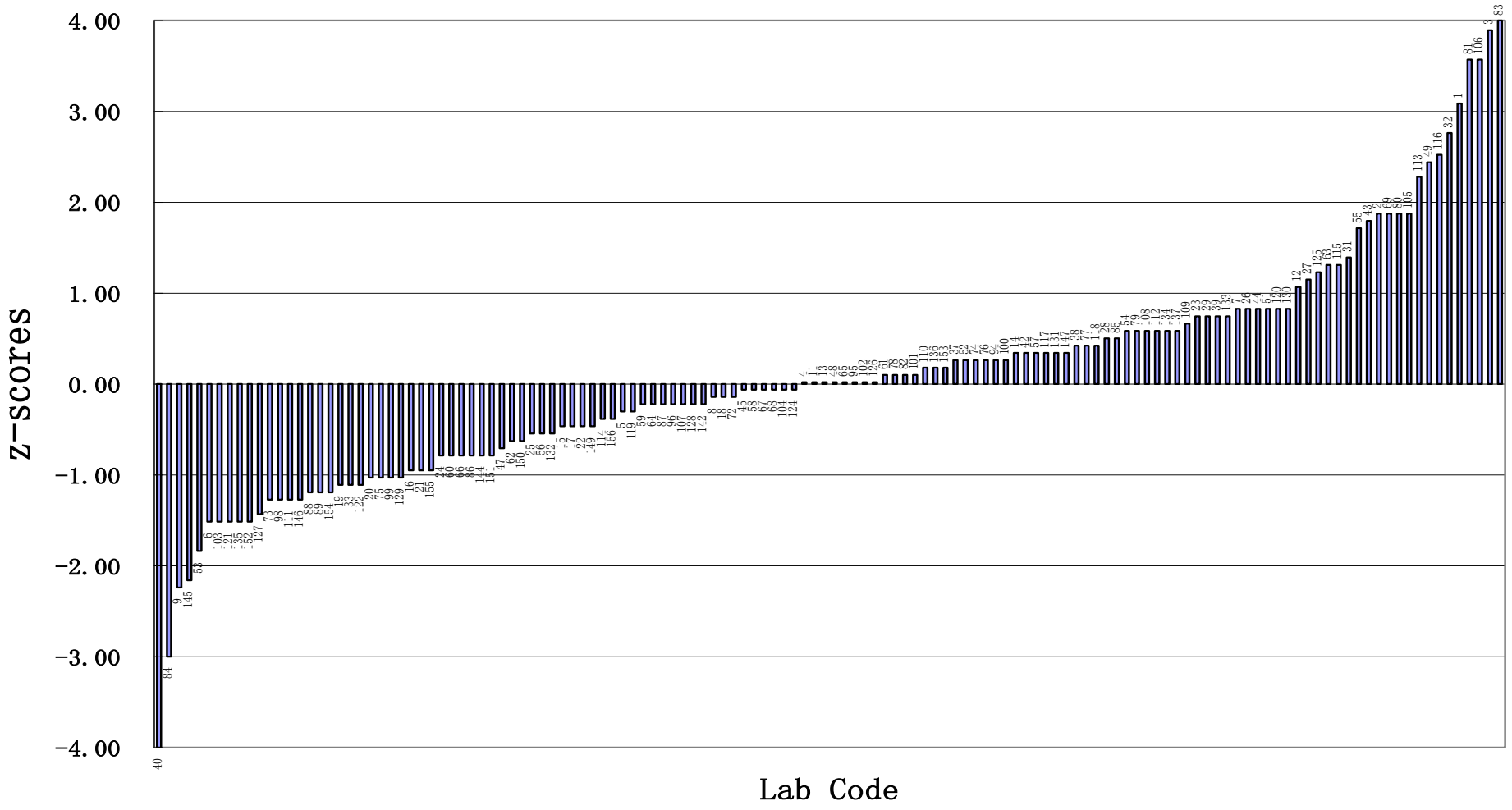


Figure A.2 Z-scores of Ash (B)

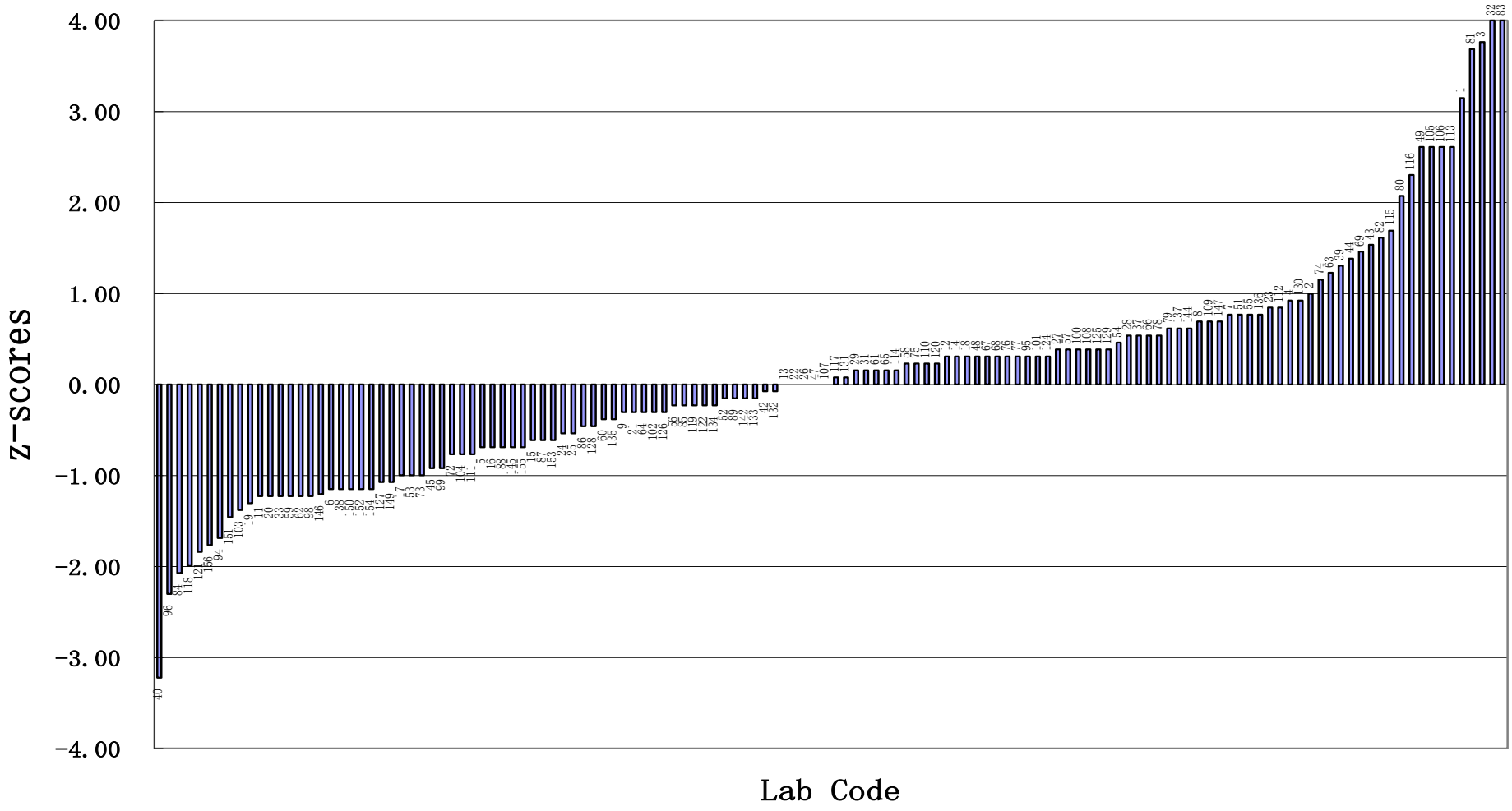


Figure A.3 Z-scores of Volatile Matter (A V-1)

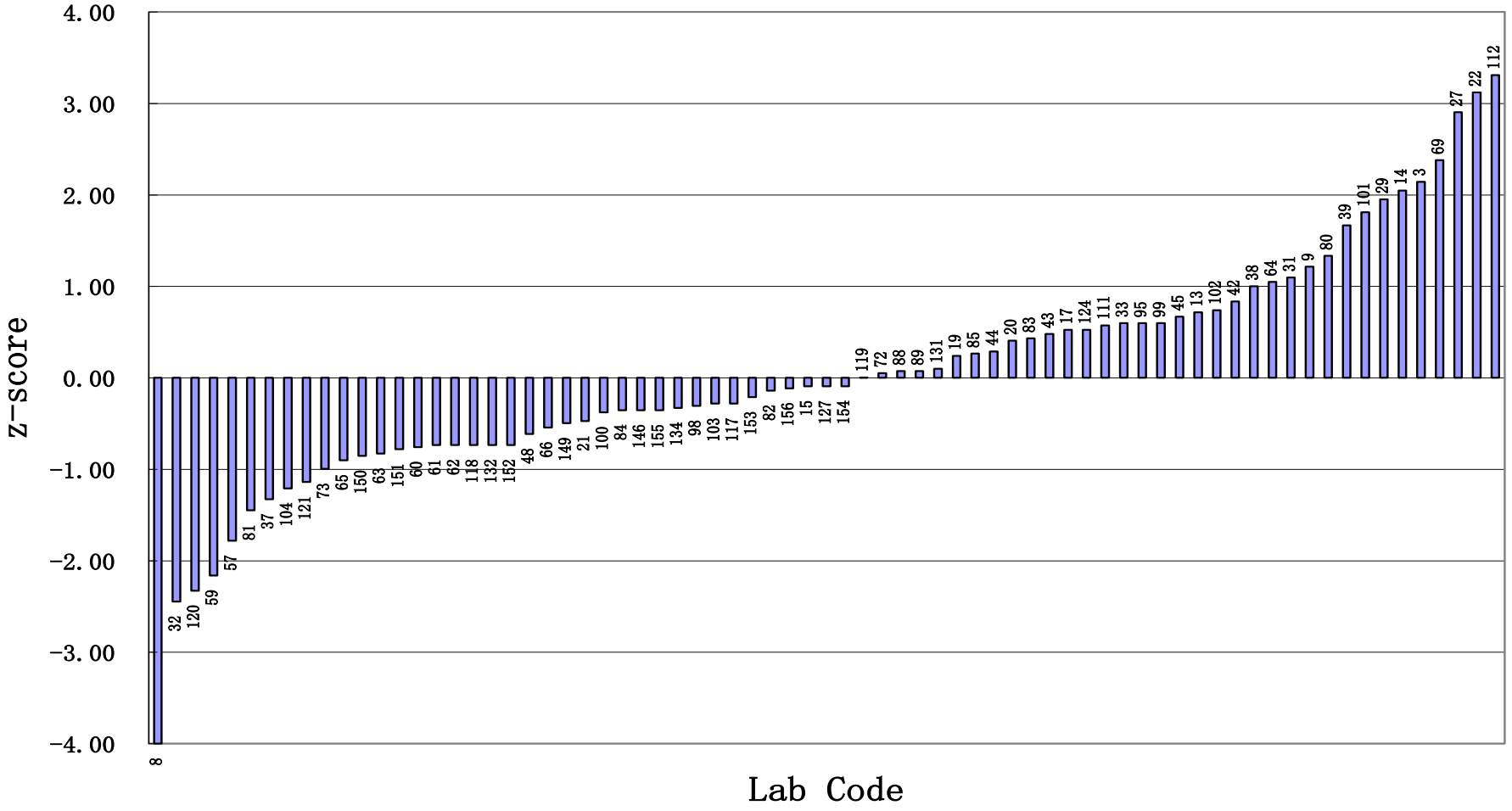


Figure A.4 Z-scores of Volatile Matter (A V-2)

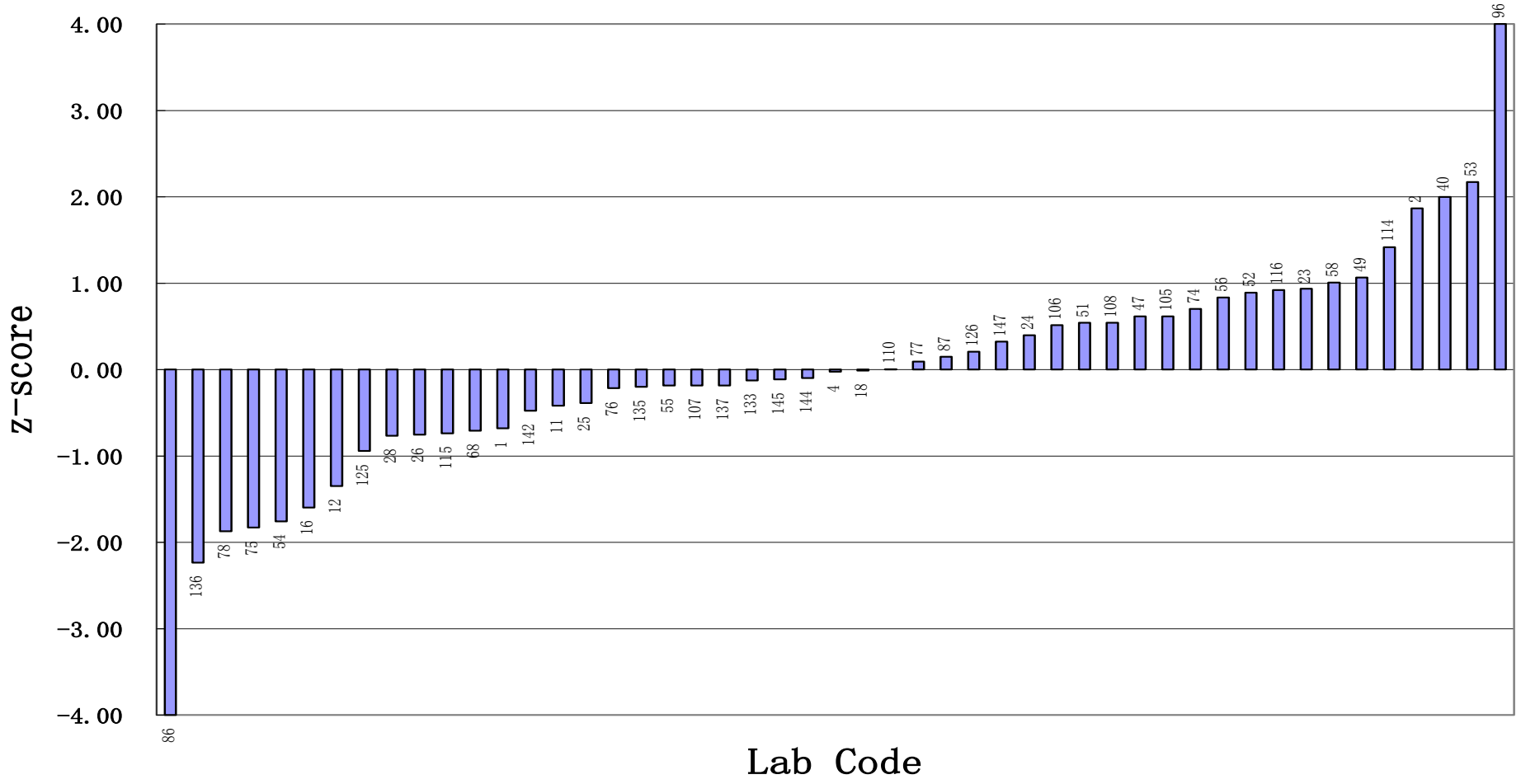


Figure A.5 Z-scores of Volatile Matter (B V-1)

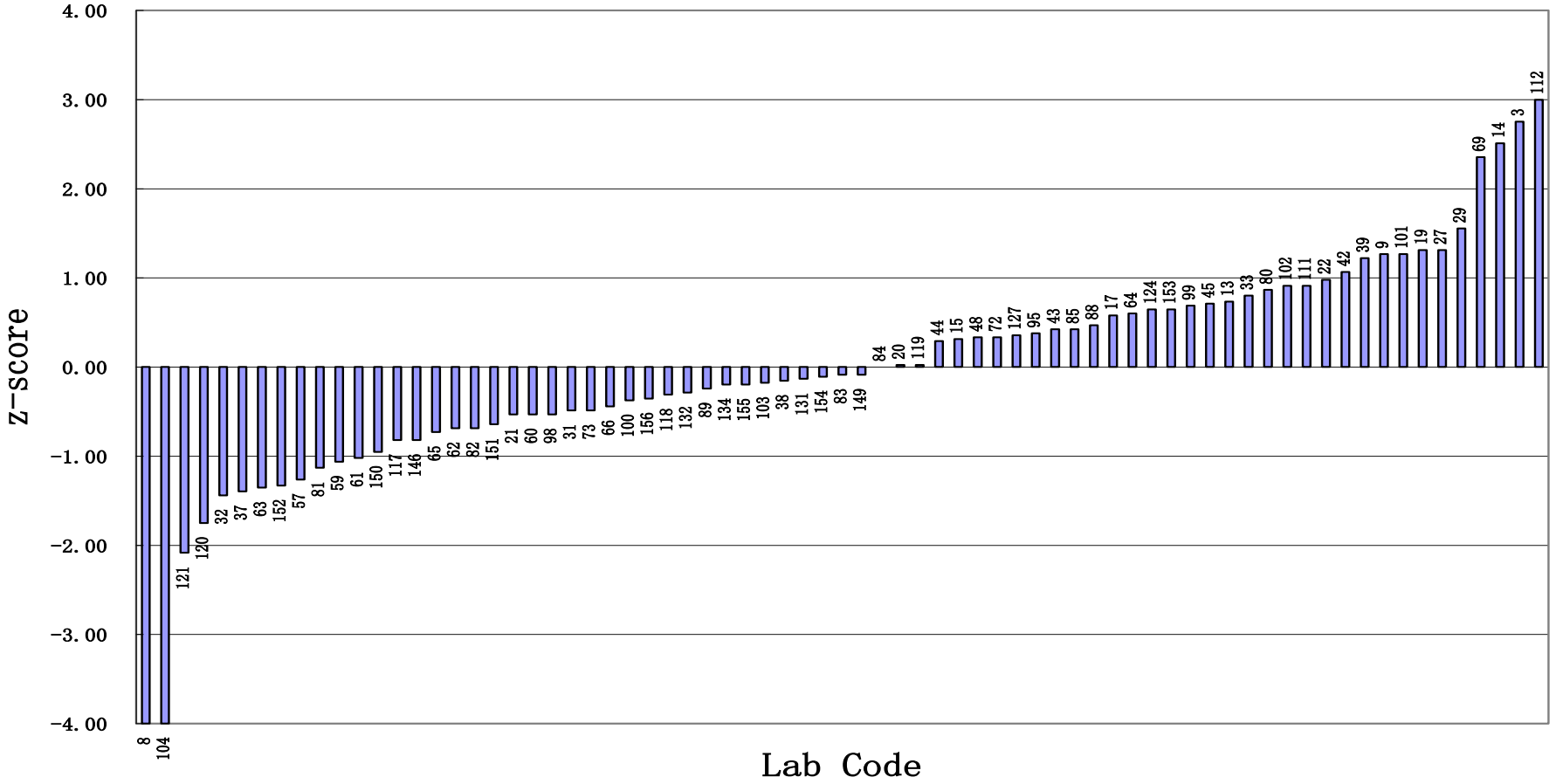


Figure A.6 Z-scores of Volatile Matter (B V-2)

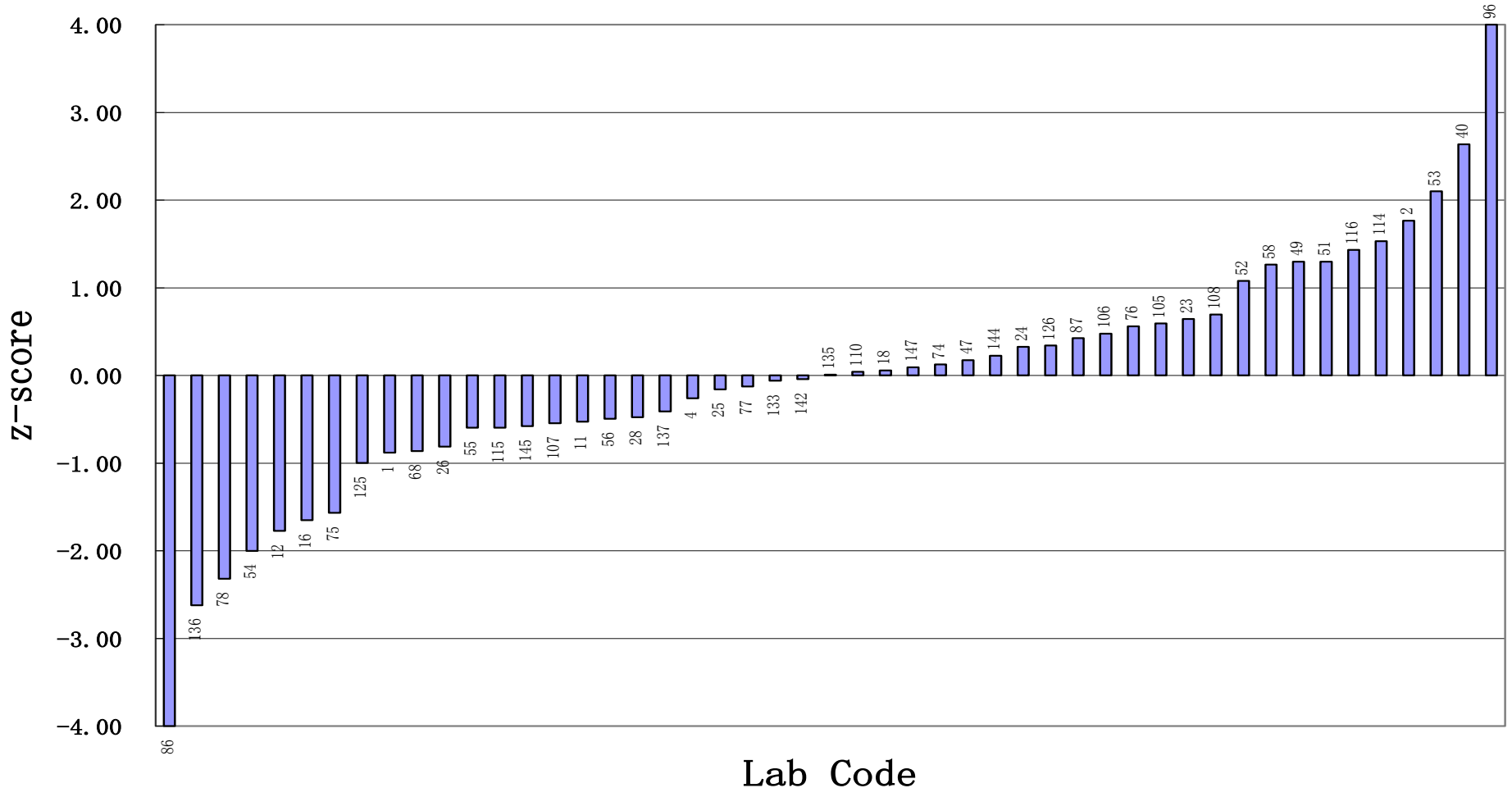


Figure A.7 Z-scores of Total Sulfur (A)

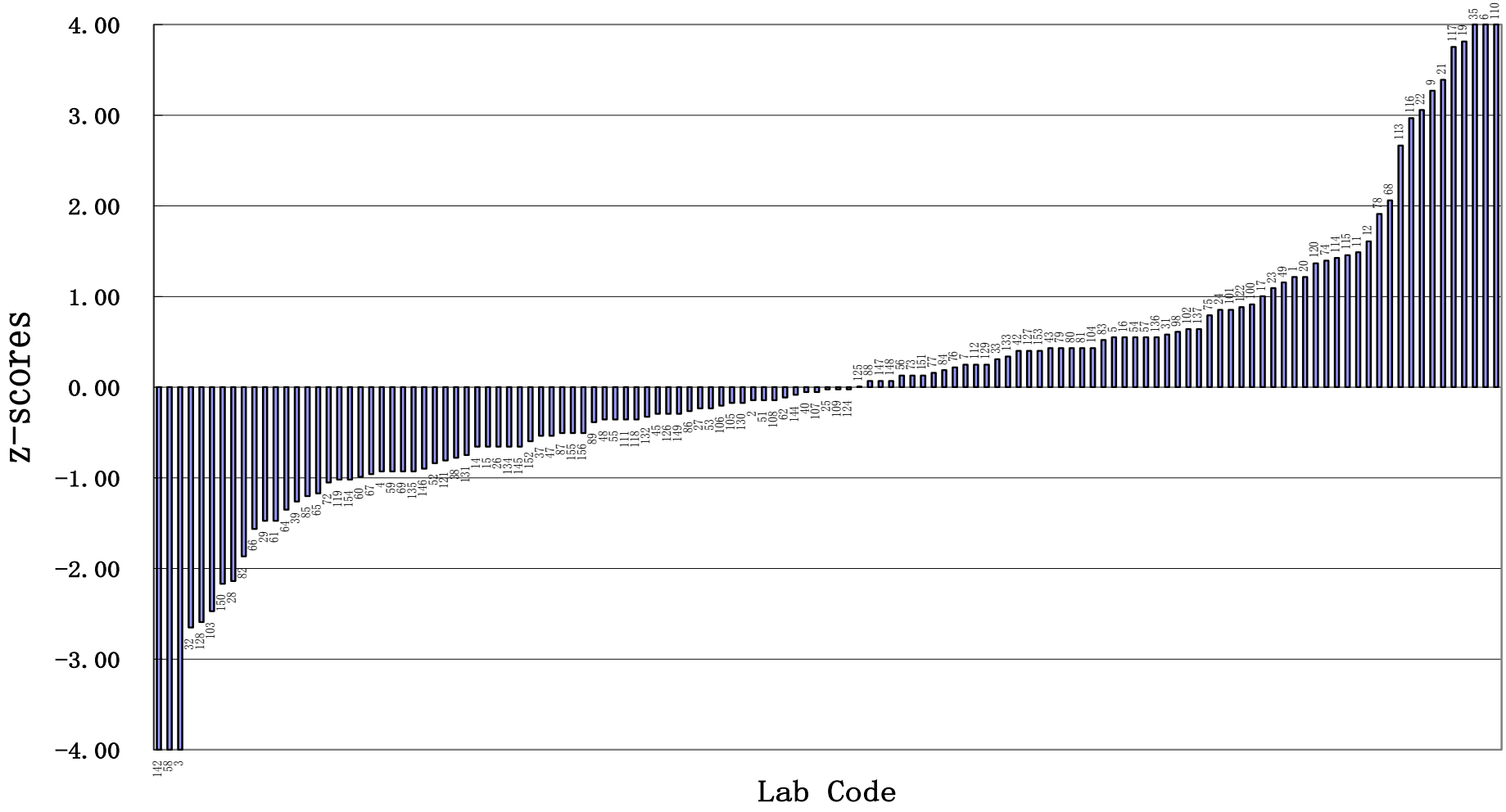


Figure A.8 Z-scores of Total Sulfur (B)

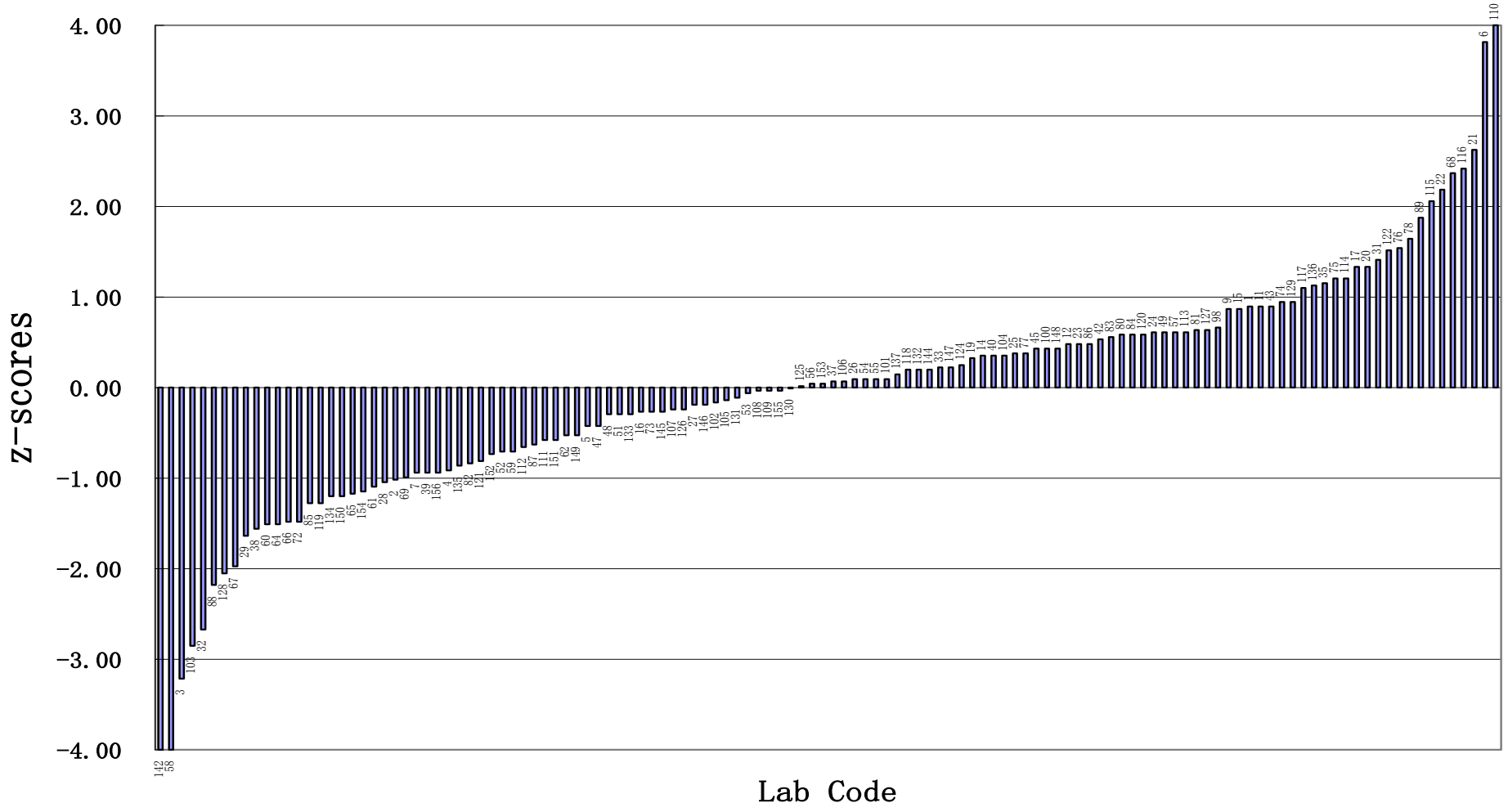


Figure A.9 Z-scores of Gross Calorific Value (A)

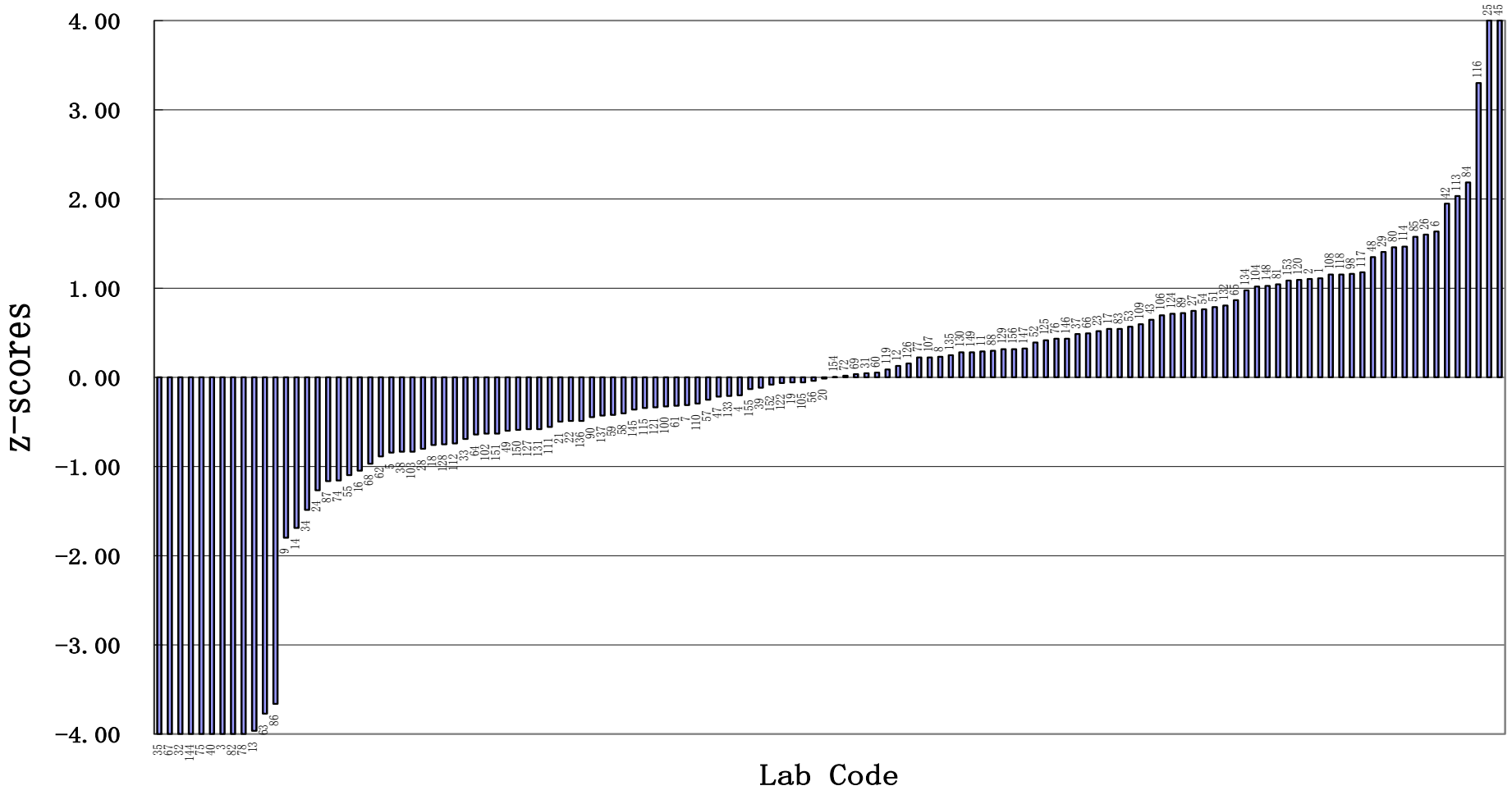
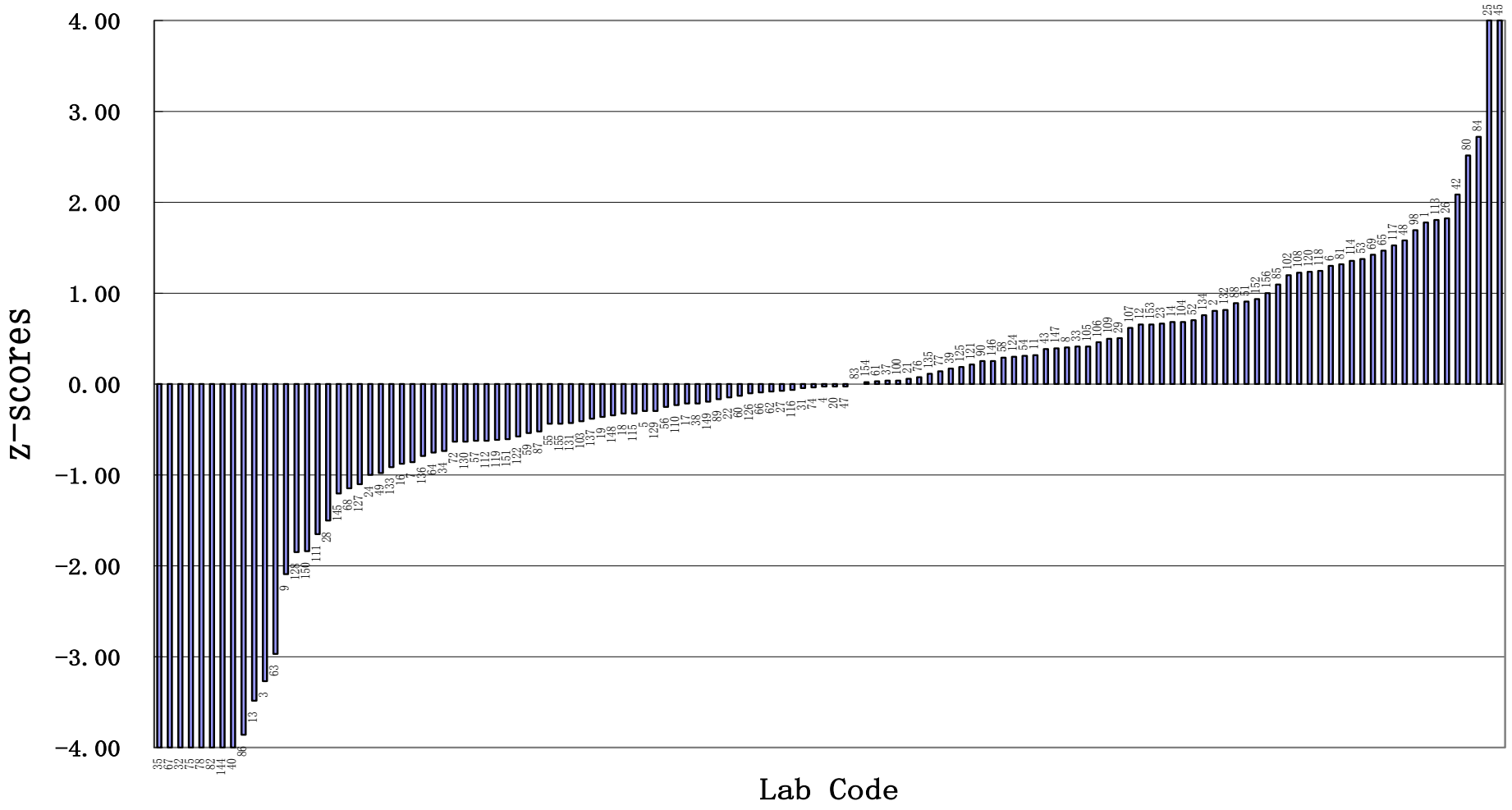


Figure A.10 Z-scores of Gross Calorific Value (B)



APPENDIX B Sample preparation and homogeneity study

1. Sample preparation

Two kinds of coal with size≤50mm were chosen as raw materials, each kind for 60kg. Firstly, the coal was crushed into 6mm, drying for 48h in air. Secondly, the crushed coal was grinded into 0.2mm, and treated on 80 mesh sieve. Then the undersized part was collected and dried for another 24 h in the air. Finally, the pulverized coal was mixed sufficiently and packaged for use. With respect to homogeneity test, the small packages of samples were putted in the area of 5×5 frames, marked in sequence as No.1 to No.25. Then 2×12 package of samples(each kind of sample for 12 bags) were chosen randomly from the specific frames which were obtained from a randomizer. Details are as follows:

Sampling graph of sample A

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Sampling graph of sample B

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

2. Homogeneity test

These samples were analysed in duplicate for Ash(dry) according to GB/T212-2008, weigh (1±0.1)g for each test, Total Sulfur(dry) according to ASTM D4239-12, weigh (100±10)mg for each test under repeatability conditions as short a time interval as possible. Test results are as follows:

	No.	Ash %		Total Sulfur %	
Sample A	01	11.60	11.51	0.802	0.810
	02	11.53	11.63	0.821	0.806

	03	11.61	11.53	0.792	0.793
	04	11.57	11.68	0.782	0.817
	05	11.57	11.58	0.787	0.793
	06	11.52	11.51	0.791	0.803
	07	11.59	11.53	0.797	0.791
	08	11.69	11.61	0.794	0.802
	09	11.65	11.64	0.814	0.818
	10	11.66	11.62	0.802	0.799
	11	11.68	11.63	0.783	0.791
	12	11.63	11.57	0.800	0.795
Sample B	01	11.32	11.35	1.038	1.029
	02	11.31	11.32	1.013	1.020
	03	11.29	11.36	1.054	1.012
	04	11.34	11.33	1.022	1.048
	05	11.39	11.38	1.017	1.027
	06	11.39	11.41	1.027	1.028
	07	11.30	11.32	1.022	1.012
	08	11.29	11.38	1.021	1.042
	09	11.36	11.40	1.031	1.050
	10	11.31	11.36	1.028	1.043
	11	11.30	11.31	1.058	1.058
	12	11.31	11.30	1.046	1.052

3. Evaluation of homogeneity

3.1 Results of One-Way ANOVA

	SS	df	MS	F		SS	df	MS	F
Sample A		Ash			Sample A		Total sulfur		
Between groups	0.043044	11	0.003913	1.73	Between groups	0.00172	12	0.000156	1.93
Within group	0.02712	12	0.00226		Within group	0.000973	11	8.11E-05	
Total	0.070164	23			Total	0.002693	23		
Sample B		Ash			Sample B		Total sulfur		
Between groups	0.020246	11	0.001841	2.24	Between groups	0.003188	11	0.00029	1.84
Within group	0.009872	12	0.000823		Within group	0.001892	12	0.000158	
Total	0.030118	23			Total	0.00508	23		
Critical Value of F =2.72									

3.2 Results of 0.3σ

	Ash		Total Sulfur	
	A	B	A	B
Ss	0.0288	0.0226	0.0061	0.0081
0.3σ	0.0372	0.0399	0.0098	0.0118

3.3 The statistical analysis (ANOVA and 0.3σ) of results obtained indicated that no significant sample variability existed. Therefore it was concluded that any outlier results subsequently identified could not be attributed to sample variability.

APPENDIX C Relevant documents

Sample Receipt Form

(Participants)

Institute/ Laboratory: _____

Postal address: _____

Contact person: _____ _____ _____

Title Given name Surname

E-mail: _____

Print name / Signature: _____

Date: _____

Confirmation of Package Contents

I hereby acknowledge the receipt of the sealed shipping box for the APLAC proficiency testing programme (APLAC T090). The box contains:

☐ The sample is *Intact & Sealed / Broken / Missing** and should be *Suitable / Not Suitable** for analysis (* Please delete as appropriate).

Other comments: _____

Upon receipt of the sample(s), please complete this form and return it to the organizer of the proficiency testing program (E-mail: ptesting@163.com).

Sample Receipt Form

(Accreditation Bodies)

Accreditation Body: _____

Postal address: _____

Contact person: _____

Title Given name Surname

E-mail: _____

Print name/ Signature: _____

Date:

Confirmation of Package Contents

I hereby acknowledge the receipt of _____ sealed shipping box(es) containing the proficiency testing sample(s) for the APLAC proficiency testing program (APLAC T090).

The sealed shipping box(es) is/are Intact & Sealed / Broken / Missing* and should be Suitable / Not Suitable* for analysis. (* Please delete as appropriate)

Other comments:

Upon receipt of the sample(s), please complete this form and return it to the organizer of the proficiency testing program (E-mail: ptesting@163.com).

Instructions to Accreditation Bodies

1. Samples Distribution

- Required samples will be distributed as a whole to the nominating accreditation body (NAB) according to the nomination.
- Once the package received, NAB is required to check the package carefully and send the " Sample Receipt Form (for accreditation bodies)" electronically to the organizer. New samples will be replaced for any damaged claims.
- LAB CODE of each participant has been labeled on the packet，please post the packets according to the LAB CODE FORM on the Packing List.
- Each packet containing two sample bottles，"Instructions to Participants" and "Results Sheet". Pay attention to that the LAB CODES have also been marked respectively on the "Results Sheets".

2. Documents to be Submitted

Please assure the results from your nominated lab(s) be submitted to both ptesting@163.com and heping@cnas.org.cn before April 30 2014. All related documents will be sent to your emails.

3. General Information

Additional information may be obtained from:

Technical center, Shanxi Entry-exit Inspection and Quarantine Bureau (SXCIQTC)

Name: Chen Yong

Email: ptesting@163.com

Tel: +86-351-6162536

Fax: +86-351-6162536

Instructions to Participants

1. Samples

Participants will be given two sample bottles labeled APLAC T090 Sample A and APLAC T090 Sample B from your respective accreditation bodies (AB). Each bottle contains about 80 g of Coal. Upon receipt of the samples, participants should carefully inspect the sample for any physical damages and defects, send the "Receipt Form (for Participants)" electronically to the organizer. New samples will be replaced for any damaged claims.

2. Testing Period and Storage Instruction

Testing should be commenced as soon as possible after receiving the samples. Store your samples in the original packaging at room temperature until testing commences.

3. Measurement requirement

- Participants are strongly recommended to use routine test method which would normally be used in testing customer supplied samples and record the method on results sheet.
- For each sample the following determinations are required:

  Ash

  Volatile Matter

  Gross Calorific Value

  Total Sulfur
- Report the significant graphs referring to the attached "RESULTS SHEET".
- Besides, please provide detailed information of the test methods applied in this scheme in the Result Sheet .
- The reporting basis is dry for all tests.
- Also it is encouraged to report the measurement uncertainty for each result.

4. Documents to be returned

- Please fill out the Results Sheet and return it electronically to ptesting@163.com , heping@cnas.org.cn as well as your AB before April 30 2014.
- Unless with special reasons, results submitted after the deadline will not be accepted by the organizers.

- Participants should make a copy of all documents and worksheets for your own records and keep these on file for an adequate period of time (at least until a final report has been issued).
- Related electronical documents will be sent to your emails.

5. General Information

Chen Yong

Technical center, Shanxi Entry-exit Inspection and Quarantine Bureau (SXCIQTC)

Email: ptesting@163.com

Tel: +86-351-6162536

Fax: +86-351-6162536

RESULTS SHEET

LAB CODE: _____

Test (Report to)	SAMPLE A		SAMPLE B		Method
	Result	Measurement Uncertainty ($k \approx 2$)	Result	Measurement Uncertainty ($k \approx 2$)	
Ash (A_d , 0.01%)					
Volatile Matter (V_d , 0.01%)					
Gross Calorific Value ($Q_{gr.d}$, 0.001 MJ/kg)					
Total Sulfur ($S_{t,d}$, 0.001%)					
Detailed information on the testing	Ash	burned temperature(℃): burned time(min):			
	Volatile Matter	burned temperature(℃): burned time(min):			
	Total Sulfur	□1, High temperature combustion method; □2, Eschka method; □3, IR spectrometry method			

Note: The reporting basis for all tests is dry.

Signature _____ **Date** _____

End of Report