APPENDICES

APPENDIX 1: Certificate of XRF Analysis of Zeolite Na-Y

Job No. PPP035/2001

UNIVERSITI KEBANGSAAN MALAYSIA
Fakulti Sains dan Teknologi

XRF RESULTS FOR ZEOLITE SAMPLES
(for Dr. Iskandar Idris Yaacob / Cik Yee Swee Li, Maxine, UM)

Sample Description

Two samples in powder form were received:

1. CBV-100 (zeolite ?, white).
2. MY-100 (treated zeolite ?, creamy yellow).

Sample Treatment and Sample Preparation

Pulverising

The samples were further ground to 20 - 30 microns for X-ray fluorescence analysis (XRF).

Drying

The samples were oven dried at 105°C for one hour prior to analysis.

Specimen for XRF Study

Glass beads were prepared by mixing 0.5 g of samples and 5 g of 110 Spectroflux (Johnson & Mathey), giving a dilution ratio of 1:10. The homogeneous mixtures, placed in Pt-Au crucibles, were burnt for 15 minutes at 1000°C, and the homogeneous melts were recasted into 4 mm thick, 32 mm diameter glass beads. Standards were also prepared by using the same procedure. The specimens were prepared using the Classie Bis 10! automatic bead preparation machine.

L.O.I. (Loss on ignition) Value

L.O.I. (Loss on ignition) value is the *percentage* of volatile components, mainly crystal-bound water and organic carbon (as CO_2), driven off from the samples when heated at 1000°C for an hour. 1 g of sample was used for the determination.

Techniques and Experimental Setting for XRF

A standard parameter for 10 major elements analysis was set-up on a fully automated Philips

PW 1480 spectrometer. A standard calibration method was used, using 10 concentration-intensity curves, one for each element, constructed from 18 certified reference materials (CRM) of rocks, minerals, ores, soils, sediments, bricks, etc. It is believed that the matrix of the unknown (the two samples) is reasonably similar to those CRM's, giving reasonably accurate result.

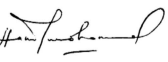
Results of XRF Analysis

Please refer to the attached certificates. The concentration for major elements are reported as the weight percentages of the oxides, recalculated to 100%.

Accuracy of XRF Analysis

The measure of accuracy used is the *relative error*, i.e. the difference between recommended value (given by the CRM's producer) and the observed value (given by UKM's XRF machine) of a certified reference material, stated as percentages. One CRM has been analysed along with the two samples to test the accuracy of major elements analysis. It is assumed that the relative error of the CRMs is *equivalent* to those of the analysed unknown (Refer to Appendix 1).

Certification:



[(Dr. Hamzah Mohamad, BSc (UKMalaysia), PhD (Strathclyde)]
Professor of Geology and Geochemistry
Geology Program
University Kebangsaan Malaysia
43600 BANGI, SELANGOR

Dates:

Sample received: 9th October 2001
Report submitted 2nd November 2001.

Job. No. PPP035/2001

Certificate of XRF Analysis

XRF RESULTS FOR ZEOLITE SAMPLES
(In weight percentages, recalculated to 100%)

	CBV-100	MY-100
SiO_2	49.26	68.65
TiO_2	0.03	0.04
Fe_2O_3(t)	0.09	5.48
Al_2O_3	16.58	2.35
Mn0	< 0.01	< 0.01
CaO	0.15	< 0.01
MgO	< 0.01	< 0.01
Na_2O	8.35	< 0.01
K_2O	0.03	< 0.01
P_2O_5	< 0.01	< 0.01
L.O.I.	25.51	23.48
Total	100.00	100.00

Appendix 1

THE RELATIVE ERROR OF MAJOR ELEMENT DETERMINATION BASED ON MEASUMENT ON A CERTIFIED REFERENCE MATERIAL (CRM)

CRM : **USGS GA**
Type : Granite

	Recommended Value	Observed Value	Absolute Difference	Relative Error
SiO_2	69.96	69.72	- 0.24	- 0.3
TiO_2	0.38	0.39	+ 0.01	+ 2.6
Fe_2O_3	2.77	2.67	- 0.10	- 3.6
Al_2O_3	14.51	14.77	+ 0.26	+ 1.8
Mn0	0.09	0.09	0	0
CaO	2.45	2.46	+ 0.01	+ 0.4
MgO	0.95	1.05	+ 0.10	+ 10.5
Na_2O	3.55	3.53	- 0.02	- 0.6
K_2O	4.03	4.04	+ 0.01	+ 0.2
P_2O_5	0.12	0.12	0	0

39-1346 Wavelength= 1.54184 *

Fe2O3

Iron Oxide

Maghemite-C, syn

Rad.: CuKa λ: 1.54178 Filter: Graph Mono d-sp: Diff.

Cut off: 15.0 Int.: Diffract. I/Icor.: 1.4

Ref: Schulz, D., McCarthy, G., North Dakota State University, Fargo, North Dakota, USA, ICDD Grant-In-Aid, (1987)

Sys.: Cubic S.G.: $P4_132$ (213)

a: 8.3515(22) b: c: A: C:

α: β: γ: Z: 10.66 mp:

Ref: Lindsley, D., Min. Soc. of America, Short Course Notes (Wash., D.C.), 3, L-18 (1976)

Dx: 4.856 Dm: 4.900 SS/FOM: F_{30} = 95(0.0090, 35)

εα: ηωβ: 2.74 εγ: Sign: 2V:

Ref: Deer, W., Howie, R., Zussman, J., Rock Forming Minerals, 5, 73 (1961)

Color: Light brown

Peak height intensity. Sample from Control Data as used in hard disks. Space group dependent upon preparation (Bernal et al.). Optical data on specimen from Iron Mountain, Shasta County, California, USA. Pattern reviewed by Syvinski, W., McCarthy, G., North Dakota State University, Fargo, North Dakota, USA, ICDD Grant-In-Aid (1990). Agrees well with experimental pattern. Additional weak reflections [indicated by brackets] were observed. σ(I obs)= ±0.067. Spinel group, related structures subgroup. Silicon used as an internal stand. Single-crystal data used. PSC: cP53.33. To replace 4-755 and 24-81. Mwt: 159.69. Volume[CD]: 582.50.

2θ	Int	h	k	l	2θ	Int	h	k	l
14.970	5	1	1	0	87.395	2	6	4	2
18.399	4	1	1	1	89.338	<1	[7	3	0]
23.791	5	2	1	0	90.321	7	7	3	1
26.125	5	2	1	1	95.208	3	[8	0	0]
30.266	35	2	2	0					
32.152	2	2	2	1					
33.911	2	3	1	0					
35.661	100	3	1	1					
37.281	3	2	2	2					
38.881	1	[3	2	0]					
40.412	1	[3	2	1]					
43.321	16	4	0	0					
44.743	1	4	1	0					
46.112	<1	[3	3	0]					
50.051	2	4	2	1					
53.781	10	4	2	2					
54.974	1	4	3	0					
56.156	1	[5	1	0]					
57.323	24	5	1	1					
59.622	1	5	2	0					
60.741	2	5	2	1					
62.983	34	4	4	0					
64.054	1	4	4	1					
65.133	1	5	3	0					
67.265	<1	[4	4	2]					
68.317	1	[6	1	0]					
69.371	1	6	1	1					
71.444	3	6	2	0					
72.471	1	5	4	0					
74.543	5	5	3	3					
75.516	2	6	2	2					
76.517	<1	[6	3	0]					
77.519	<1	[6	3	1]					
79.525	1	4	4	4					
80.504	<1	[6	3	2]					
81.501	1	7	1	0					
85.426	<1	[7	2	1]					

03-0800 Wavelength= 1.54184 O

α-Fe2O3

Iron Oxide

Hematite

Rad.: FeKa1 λ: 1.936 Filter: d-sp:

Cut off: Int.: Estimation I/Icor.:

Ref: Bohn, Ganter, Z. Kristallogr., Kristallgeom., Kristallphys., Kristallchem., 69, 19 (1928)

Sys.: Rhombohedral S.G.: $R\bar{3}c$ (167)

a: 5.035 b: c: 13.726 A: C: 2.7261

α: β: γ: Z: 2 mp: 1360

Ref: Ibid.

Dx: 1.760 Dm: 5.260 SS/FOM: $F_{16} = 2\ell(0.249, 33)$

εα: 2.94 ηωβ: 3.22 εγ: Sign:- 2V:

Ref: Ibid.

PSC: hR3.33, Delete: similar to 1-1053, Rinn, August 17, 1953, Mwt: 159.69, Volume[CD]: 301.35.

2θ	Int	h	k	l
✓24.052	50	0	1	2
✓33.055	100	1	0	4
✓35.482	70	1	1	0
38.301	10			
✓40.832	50	1	1	3
43.510	10	2	0	2
✓49.255	80	0	2	4
✓53.935	100	1	1	6
✓57.218	50	1	2	2
✓62.316	80	2	1	4
✓63.745	80	3	0	0
65.763	10			
69.062	30			
71.469	70			
74.749	70			
77.624	30	3	0	6
78.381	30			
80.757	30	3	1	2
83.301	30	0	2	10
85.102	70	1	3	4
87.978	70			
91.092	10			
93.318	80			
95.679	30	4	0	4
96.915	10	1	3	7
101.856	50			
102.141	50			

02-0127 Wavelength= 1.54184

γ-Fe2O3•H2O

Iron Oxide Hydrate

Lepidocrocite

Rad.: MoKa λ: 0.709 Filter: d-sp:

Cut off: Int.: I/Icor.:

Ref: Peacock, G., Trans. R. Soc. Can., Sect. 4, 36, 117 (1942)

Sys.: Orthorhombic S.G.: Amam (63)

a: 3.86 b: 12.50 c: 3.06 A: 0.3088 C: 0.2448

α: β: γ: Z: 4 mp:

Ref: Dana's System of Mineralogy, 7th Ed.

Dx: 7.995 Dm: 4.090 SS/FOM: $F_{22} = 9((0.051, 46)$

εα: 1.94 ηωβ: 2.20 ε: 2.51 Sign:- 2V: 8.°

Ref: Dana's System of Mineralogy, 7th Ed.

Color: Reddish brown
Specimen from Westphalia, Germany. PSC: oC32. Delete: see Berry comments August 31, 1956; see 8-98. Mwt: 177.71. Volume[CD]: 147.65.

2θ	Int	h	k	l
✓14.171	100	0	2	0
✓27.103	90	1	2	0
✓36.526	70	0	3	1
38.132	10	1	1	1
43.510	20	1	3	1
✓47.086	70	2	0	0
49.255	10	2	2	0
✓52.926	40	1	5	1
,54.280	5			
58.817	40	0	8	0
60.513	10	0	0	2
60.953	40	2	3	1
✓64.237	10b	1	8	0
65.245	20	1	7	1
66.289	20b	2	6	0
67.369	5b	1	2	2
68.488	40	2	5	1
75.446	10	3	2	0
78.381	30	2	8	0
79.947	10	2	0	2
80.757	30	3	4	0
88.988	20b	3	6	0
92.189	40b	3	5	1

APPENDIX 3 A: X-Ray Report and Diffractogram of Zeolite Na-Y

X'Pert Graphics & Identify **mss**
(searched) peak list: Zeolite **8/10/01 09:31**

Original scan: Zeolite Date: 8/9/01 13:23
Description of scan:

Used wavelength: K-Alpha1

K-Alpha1 wavelength (Å): 1.54056
K-Alpha2 wavelength (Å): 1.54439
K-Alpha2/K-Alpha1 intensity ratio : 0.50000
K-Alpha wavelength (Å): 1.54056
K-Beta wavelength (Å): 1.39222

Peak search parameter set: **As Measured Intensities**
Set created: 1/29/01 11:25
Peak positions defined by: Minimum of 2nd derivative
Minimum peak tip width (°2Theta): 0.00
Minimum peak tip width (°2Theta): 1.00
Peak base width (°2Theta): 2.00
Minimum significance: 0.60

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
14.00155	94.78	6.30731	958.49	49.30	0.12000	6.83
8.64081	23.69	10.22878	239.60	29.73	0.14000	4.73
7.38804	16.97	11.96911	171.64	25.71	0.12000	2.87
5.62602	63.95	15.73861	646.67	25.66	0.14000	7.57
5.00870	1.26	17.69308	12.78	25.05	0.24000	0.65
4.72759	35.25	18.75436	356.47	24.90	0.18000	7.81
4.34025	54.06	20.44527	546.65	24.68	0.16000	9.51
4.15740	3.17	21.35481	32.07	24.56	0.12000	1.07
3.88637	18.05	22.86347	182.55	24.35	0.18000	5.66
3.75171	98.70	23.69580	998.11	24.24	0.20000	17.76
3.70753	12.05	23.98233	121.82	24.20	0.06000	0.81
3.55116	8.49	25.05517	85.85	24.06	0.12000	1.32
3.44697	17.50	25.82537	176.93	23.96	0.14000	3.26
3.28499	70.95	27.12249	717.52	23.78	0.18000	11.58
3.20119	17.08	27.84660	172.75	23.69	0.14000	2.51
3.08095	3.53	28.95669	35.67	23.54	0.24000	0.69
3.00344	30.95	29.72093	312.94	23.43	0.12000	3.16
2.89991	47.72	30.80784	482.62	23.29	0.14000	5.07
2.84158	100.00	31.45644	1011.26	23.20	0.16000	10.47
2.75316	34.69	32.49420	350.79	23.06	0.12000	2.95
2.70205	12.16	33.12632	123.01	22.98	0.16000	1.51
2.62647	32.32	34.10829	326.83	22.85	0.14000	4.30
2.57969	17.53	34.74633	177.32	22.76	0.10000	1.44
2.51041	4.49	35.73710	45.42	22.63	0.08000	0.90
2.47133	2.74	36.32183	27.71	22.55	0.24000	1.02
2.41542	4.52	37.19289	45.70	22.43	0.12000	0.79
2.36972	22.46	37.93734	227.12	22.33	0.14000	3.23

Philips Analytical Page: 1

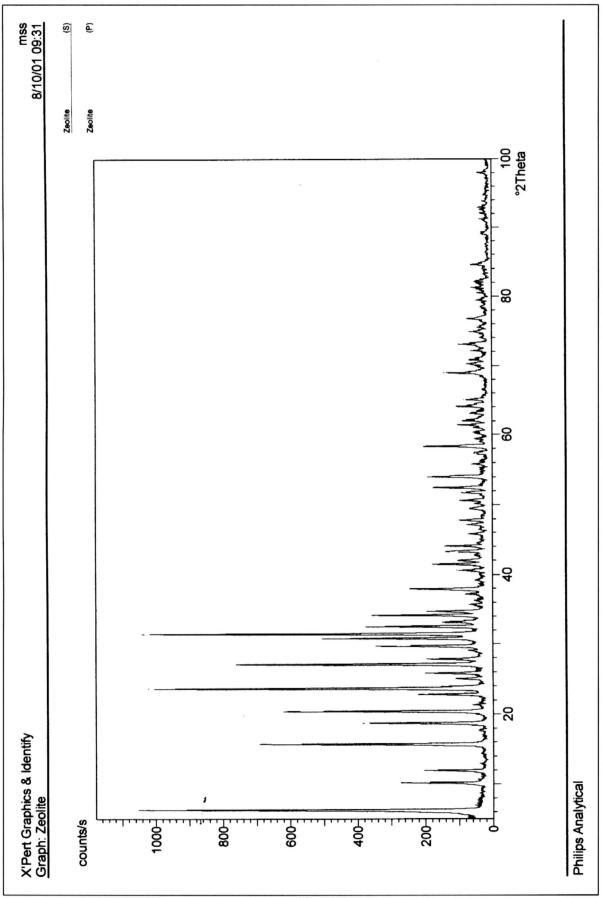
APPENDIX 3 A: X-Ray Report and Diffractogram of Zeolite Na-Y (cont.)

X'Pert Graphics & Identify **mss**
(searched) peak list: Zeolite **8/10/01 09:31**

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
2.29407	2.74	39.23874	27.69	22.16	0.24000	0.83
2.22020	8.17	40.60083	82.66	21.98	0.10000	1.13
2.17756	15.49	41.43187	156.69	21.86	0.14000	2.80
2.15187	8.09	41.94976	81.78	21.79	0.18000	2.31
2.09162	10.48	43.21781	105.96	21.62	0.14000	1.88
2.05399	11.09	44.05065	112.17	21.51	0.14000	2.35
1.97965	4.83	45.79694	48.81	21.28	0.16000	0.82
1.92357	5.64	47.21177	57.03	21.09	0.12000	0.71
1.90113	8.15	47.80359	82.38	21.01	0.20000	2.18
1.84168	4.49	49.44807	45.45	20.79	0.24000	1.40
1.81717	2.86	50.16075	28.89	20.69	0.16000	0.72
1.80339	7.47	50.57110	75.50	20.64	0.10000	0.81
1.76438	6.90	51.77080	69.80	20.48	0.14000	1.26
1.74153	16.20	52.50160	163.81	20.38	0.18000	4.14
1.69647	17.25	54.00766	174.40	20.18	0.12000	1.86
1.69150	9.00	54.17910	91.01	20.16	0.10000	0.73
1.64600	3.96	55.80514	40.08	19.94	0.12000	1.02
1.60530	3.12	57.34946	31.51	19.73	0.32000	1.53
1.58099	19.27	58.31530	194.82	19.60	0.10000	1.70
1.56469	1.87	58.98228	18.88	19.51	0.20000	0.71
1.55551	3.04	59.36509	30.72	19.46	0.16000	0.86
1.53089	2.97	60.41844	30.02	19.32	0.48000	2.19
1.50844	8.05	61.41374	81.41	19.19	0.08000	0.70
1.49449	7.20	62.05026	72.78	19.10	0.10000	0.96
1.47371	3.76	63.02428	37.97	18.97	0.16000	0.65
1.45266	9.27	64.04540	93.75	18.83	0.08000	0.81
1.43281	6.29	65.04082	63.62	18.70	0.12000	2.00
1.36034	12.02	68.97709	121.53	17.94	0.08000	0.70
1.33887	5.15	70.24447	52.05	17.38	0.20000	1.01
1.32903	5.53	70.84215	55.93	17.11	0.08000	0.64
1.30836	4.17	72.13467	42.20	16.54	0.12000	0.83
1.29393	7.98	73.06843	80.72	16.13	0.08000	0.63
1.29092	4.84	73.26642	48.91	16.04	0.10000	0.79
1.27991	1.74	74.00153	17.60	15.72	0.24000	0.75
1.26686	4.95	74.89314	50.07	15.33	0.16000	0.87
1.25719	1.89	75.56972	19.12	15.03	0.32000	0.62
1.24102	5.67	76.73203	57.33	14.51	0.16000	0.84
1.21803	1.47	78.45469	14.82	13.75	0.48000	0.86
1.20520	3.25	79.45368	32.87	13.31	0.12000	0.60
1.19227	2.92	80.49058	29.51	12.86	0.12000	0.82
1.18238	4.95	81.30416	50.09	12.50	0.10000	0.61
1.17134	2.88	82.23517	29.11	12.09	0.40000	1.38
1.14506	5.01	84.55157	50.64	11.06	0.12000	1.67
1.09909	1.75	88.98803	17.71	12.14	0.20000	0.82
1.07916	1.03	91.08592	10.41	12.93	0.32000	0.66
1.07044	1.49	92.04191	15.10	13.56	0.16000	0.66
1.06543	2.33	92.60174	23.52	13.92	0.16000	0.70
1.06251	2.85	92.93105	28.83	14.14	0.10000	0.80
1.02043	2.97	98.02545	30.07	12.23	0.16000	0.99

Philips Analytical Page: 2

APPENDIX 3 A: X-Ray Report and Diffractogram of Zeolite Na-Y (cont.)



APPENDIX 3 B: X-Ray Report and Diffractogram of ZIO-1

X'Pert Graphics & Identify **mss**
(searched) peak list: MY602 **7/28/03 15:00**

Original scan: MY602 Date: 7/28/03 12:46
Description of scan:

Used wavelength: K-Alpha1

K-Alpha1 wavelength (Å):	1.54056
K-Alpha2 wavelength (Å):	1.54439
K-Alpha2/K-Alpha1 intensity ratio :	0.50000
K-Alpha wavelength (Å):	1.54056
K-Beta wavelength (Å):	1.39222

Peak search parameter set:	**As Measured Intensities**
Set created:	1/29/01 11:25
Peak positions defined by:	Minimum of 2nd derivative
Minimum peak tip width (°2Theta):	0.00
Minimum peak tip width (°2Theta):	1.00
Peak base width (°2Theta):	2.00
Minimum significance:	0.60

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
13.90085	77.03	6.35305	537.43	49.38	0.10000	6.54
11.49135	0.74	7.68699	5.15	36.87	0.10000	0.72
8.59664	14.15	10.28147	98.74	27.25	0.16000	3.29
7.35491	12.08	12.03133	84.29	23.90	0.08000	1.07
5.60758	54.19	15.79070	378.10	22.11	0.12000	6.34
4.99722	1.46	17.73406	10.15	21.81	0.16000	0.69
4.71377	32.45	18.80985	226.37	21.63	0.10000	3.66
4.33470	48.53	20.47175	338.62	21.37	0.12000	5.78
4.15773	3.15	21.35309	22.01	21.23	0.16000	0.66
3.87923	20.56	22.90612	143.41	20.99	0.10000	2.39
3.74337	89.93	23.74938	627.44	20.85	0.12000	7.83
3.70226	8.54	24.01696	59.57	20.81	0.10000	0.66
3.51640	7.68	25.08931	53.61	20.64	0.08000	0.72
3.44025	14.32	25.87671	99.92	20.52	0.14000	3.75
3.28349	68.45	27.13512	477.56	20.32	0.10000	3.97
3.19884	20.59	27.86751	143.69	20.20	0.08000	1.08
3.00701	27.83	29.68485	194.17	19.92	0.12000	3.55
2.89737	46.33	30.83546	323.26	19.73	0.08000	1.69
2.83894	100.00	31.48641	697.70	19.63	0.10000	4.75
2.74884	32.29	32.54665	225.32	19.46	0.14000	4.89
2.70035	9.84	33.14780	68.63	19.37	0.08000	0.74
2.62163	26.37	34.17329	183.97	19.21	0.16000	5.54
2.57984	19.51	34.74420	136.10	19.12	0.12000	2.76
2.50586	3.89	35.80427	27.15	18.95	0.28000	1.52
2.41301	6.54	37.23143	45.64	18.72	0.10000	1.07
2.36674	21.00	37.98689	146.53	18.60	0.10000	1.55
2.21879	10.20	40.62761	71.18	18.19	0.08000	0.64

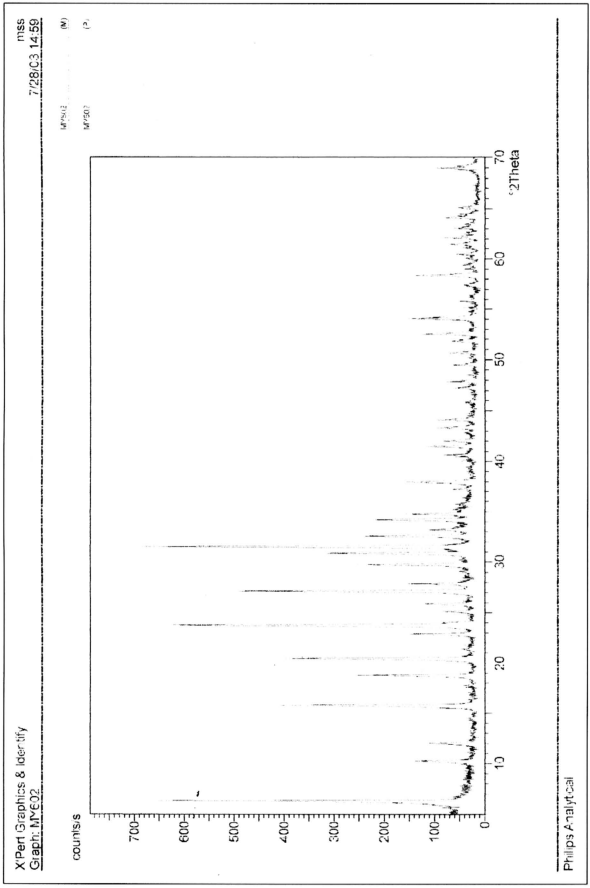
APPENDIX 3 B: X-Ray Report and Diffractogram of ZIO-1 (cont.)

X'Pert Graphics & Identify **mss**
(searched) peak list: MY002 **7/28/03 15:00**

d-spacing (A)	Relative intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
2.17580	14.84	41.46700	103.53	18.05	0.10000	1.91
2.15069	7.26	41.97376	50.67	17.97	0.08000	0.72
2.11022	7.89	42.81816	20.14	17.84	0.20000	0.64
2.08745	12.53	43.30860	87.40	17.76	0.08000	0.88
2.05118	10.61	44.10733	74.22	17.61	0.08000	0.68
1.97883	2.54	45.81705	17.74	17.37	0.16000	0.61
1.92223	6.33	47.24666	44.17	17.14	0.08000	0.77
1.89975	8.48	47.84038	59.15	17.05	0.06000	1.22
1.84050	6.91	49.48202	48.20	16.79	0.08000	0.81
1.80216	7.41	50.60792	51.72	16.61	0.10000	0.87
1.76413	6.08	51.76931	42.40	16.42	0.24000	2.37
1.74167	16.97	52.49689	118.43	16.31	0.08000	1.23
1.69524	15.23	54.04974	106.24	16.06	0.10000	1.39
1.61621	5.30	55.79752	36.97	15.79	0.08000	0.67
1.63177	1.62	56.33510	11.30	15.70	0.32000	0.76
1.60362	3.18	57.41480	22.16	15.53	0.16000	0.64
1.57971	14.86	58.36702	103.65	15.38	0.12000	2.90
1.57556	7.33	58.53555	51.17	15.36	0.08000	0.63
1.56445	2.46	58.99228	17.19	15.28	0.06000	0.61
1.55312	2.18	59.46565	15.21	15.21	0.24000	0.63
1.54009	2.90	60.02040	20.24	15.12	0.12000	1.12
1.53070	5.68	60.42660	39.60	15.06	0.12000	0.76
1.50787	7.05	61.43955	49.20	14.90	0.10000	0.83
1.49438	8.66	62.05519	60.42	14.80	0.08000	0.95
1.47362	6.74	63.02888	47.04	14.64	0.06000	0.97
1.45286	9.43	64.07508	65.77	14.48	0.12000	1.50
1.43275	4.57	65.04397	31.92	14.33	0.12000	0.65
1.42849	4.37	65.26229	30.51	14.29	0.08000	0.70
1.36061	11.26	68.96141	78.59	13.85	0.10000	1.49
1.35743	5.30	69.14598	36.99	13.85	0.10000	0.77

Philips Analytical Page: 2

APPENDIX 3 B: X-Ray Report and Diffractogram of ZIO-1 (cont.)



APPENDIX 3 C: X-Ray Report and Diffractogram of ZIO-2

X'Pert Graphics & Identify **mss**
(searched) peak list: Maxine MY605 **2/27/03 16:20**

Original scan: Maxine MY605 Date: 8/16/02 10:12
Description of scan:

Used wavelength: K-Alpha1

K-Alpha1 wavelength (Å): 1.54056
K-Alpha2 wavelength (Å): 1.54439
K-Alpha2/K-Alpha1 intensity ratio : 0.50000
K-Alpha wavelength (Å): 1.54056
K-Beta wavelength (Å): 1.39222

Peak search parameter set: **As Measured Intensities**
Set created: 6/11/99 16:01
Peak positions defined by: Minimum of 2nd derivative
Minimum peak tip width (°2Theta): 0.00
Minimum peak tip width (°2Theta): 1.00
Peak base width (°2Theta): 2.00
Minimum significance: 0.60

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
13.90735	97.55	6.35008	2570.14	368.32	0.15000	11.27
8.60518	20.60	10.27124	542.74	195.89	0.20000	10.17
7.35648	16.06	12.02066	423.24	160.38	0.20000	9.15
6.12215	1.07	14.45606	28.29	132.29	0.15000	1.37
5.61243	68.46	15.77696	1803.70	126.11	0.20000	23.40
4.99353	2.25	17.74724	59.41	119.10	0.20000	1.51
4.71513	33.27	18.80438	876.40	118.21	0.15000	6.95
4.33377	56.67	20.47618	1492.99	116.82	0.20000	21.07
4.14456	3.46	21.42179	91.17	116.04	0.20000	1.82
3.87930	17.63	22.90570	464.53	114.80	0.15000	4.41
3.74226	92.50	23.75653	2436.97	114.09	0.15000	11.71
3.54291	7.80	25.11444	205.44	112.96	0.20000	5.28
3.43797	14.18	25.89413	373.46	112.31	0.20000	7.53
3.28111	69.92	27.15516	1842.11	111.26	0.15000	10.30
3.19722	16.16	27.88192	425.62	110.65	0.20000	8.52
3.06894	4.59	29.07250	120.89	109.66	0.10000	1.07
3.00117	33.60	29.74396	885.29	109.10	0.20000	13.36
2.89538	46.05	30.85725	1213.10	108.18	0.15000	7.29
2.83738	100.00	31.50426	2634.57	107.64	0.20000	25.58
2.74801	34.91	32.55684	919.78	106.76	0.15000	6.39
2.69831	13.91	33.17360	366.51	106.25	0.20000	5.17
2.62068	33.11	34.18602	872.39	105.40	0.20000	12.62
2.57745	19.34	34.77748	509.47	104.91	0.20000	8.22
2.50837	6.77	35.76718	178.26	104.09	0.20000	2.06
2.41029	5.65	37.27495	148.77	102.83	0.20000	2.60
2.36624	21.50	37.99519	566.43	102.23	0.20000	8.65
2.28970	2.42	39.31664	63.65	101.13	0.20000	0.80

Philips Analytical Page: 1

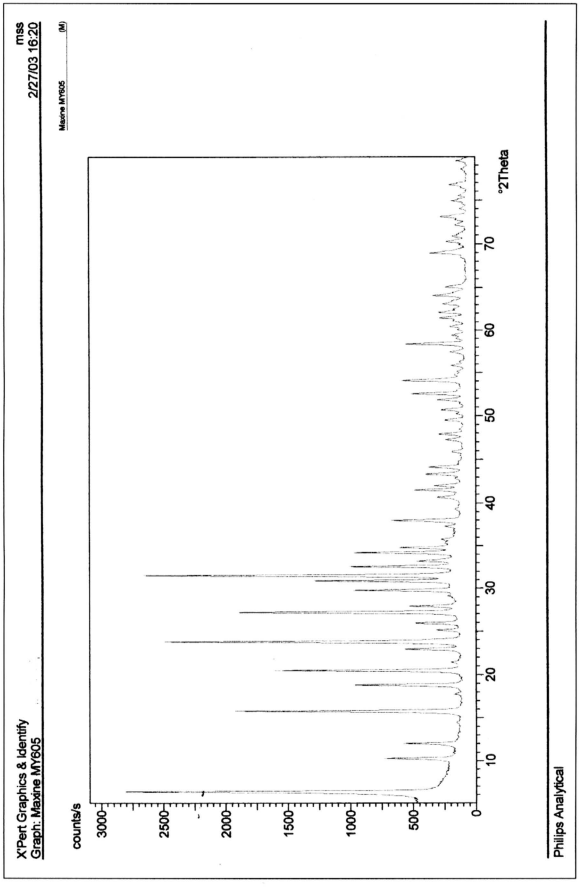
APPENDIX 3 C: X-Ray Report and Diffractogram of ZIO-2 (cont.)

X'Pert Graphics & Identify **mss**
(searched) peak list: Maxine MY605 **2/27/03 16:20**

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
2.21761	8.19	40.65035	215.82	100.02	0.20000	3.77
2.17434	15.11	41.49620	398.05	99.32	0.20000	7.28
2.14913	8.42	42.00568	221.72	98.89	0.20000	4.04
2.10916	2.66	42.84059	70.13	98.20	0.20000	1.12
2.08666	11.60	43.32587	305.61	97.79	0.20000	6.11
2.05044	10.62	44.13098	279.79	97.12	0.20000	6.00
1.97608	3.63	45.88429	95.62	95.66	0.20000	2.44
1.92222	5.79	47.24679	152.58	94.53	0.20000	2.96
1.89859	7.96	47.87149	209.59	94.01	0.20000	4.94
1.87806	1.89	48.42800	49.76	93.54	0.15000	1.08
1.83960	5.83	49.50792	153.61	92.64	0.25000	6.22
1.81540	2.46	50.21305	64.93	92.06	0.15000	0.70
1.80021	6.84	50.66665	180.23	91.68	0.20000	4.16
1.76328	8.20	51.80558	216.01	90.73	0.20000	4.64
1.74098	16.31	52.51937	429.69	90.14	0.20000	7.35
1.69531	19.26	54.04749	507.50	88.86	0.25000	13.72
1.67689	3.05	54.69042	80.27	88.33	0.20000	1.26
1.64502	4.18	55.84148	110.13	87.37	0.20000	2.56
1.63292	1.44	56.29193	38.04	86.99	0.15000	1.51
1.60339	4.60	57.42382	121.14	86.05	0.20000	2.75
1.58041	18.29	58.33870	481.81	85.29	0.25000	11.97
1.56473	2.88	58.98058	75.86	84.76	0.15000	2.95
1.55445	3.76	59.40969	99.10	84.40	0.20000	1.96
1.53999	2.32	60.02443	61.03	83.89	0.15000	2.31
1.53076	4.64	60.42422	122.25	83.55	0.25000	4.51
1.51648	3.68	61.05323	97.05	83.03	0.15000	0.79
1.50758	7.62	61.45247	200.86	82.70	0.20000	3.74
1.49415	8.23	62.06603	216.93	82.19	0.20000	4.24
1.47295	6.79	63.06085	178.87	81.36	0.20000	2.78
1.45220	9.99	64.06800	263.10	80.52	0.20000	4.76
1.43241	6.09	65.06148	160.54	79.69	0.25000	5.89
1.36991	1.47	68.42820	38.82	78.75	0.15000	1.19
1.36129	11.10	68.92212	292.44	78.50	0.25000	8.64
1.33915	5.99	70.22738	157.73	77.85	0.20000	3.40
1.32933	4.00	70.82347	105.50	77.55	0.15000	1.03
1.30884	3.24	72.10440	85.27	76.91	0.25000	3.53
1.29967	2.91	72.69375	76.67	76.61	0.15000	0.99
1.29417	7.80	73.05237	205.59	76.43	0.25000	5.69
1.28011	1.80	73.98743	47.51	75.96	0.15000	0.85
1.26681	4.24	74.89711	111.61	75.50	0.15000	1.46
1.25822	2.37	75.49754	62.37	75.20	0.15000	0.89
1.24060	5.25	76.76313	138.27	74.57	0.15000	1.49
1.21650	1.56	78.57234	41.03	73.99	0.20000	1.18
1.20490	3.10	79.47777	81.74	73.99	0.15000	1.24

Philips Analytical Page: 2

APPENDIX 3 C: X-Ray Report and Diffractogram of ZIO-2 (cont.)



APPENDIX 3 D: X-Ray Report and Diffractogram of ZIO-3

X'Pert Graphics & Identify **mss**
(searched) peak list: MY604 **2/27/03 16:28**

Original scan: MY604 Date: 8/12/02 14:58
Description of scan:

Used wavelength: K-Alpha1

K-Alpha1 wavelength (Å): 1.54056
K-Alpha2 wavelength (Å): 1.54439
K-Alpha2/K-Alpha1 intensity ratio : 0.50000
K-Alpha wavelength (Å): 1.54056
K-Beta wavelength (Å): 1.39222

Peak search parameter set: **As Measured Intensities**
Set created: 6/11/99 16:01
Peak positions defined by: Minimum of 2nd derivative
Minimum peak tip width (°2Theta): 0.00
Minimum peak tip width (°2Theta): 1.00
Peak base width (°2Theta): 2.00
Minimum significance: 0.60

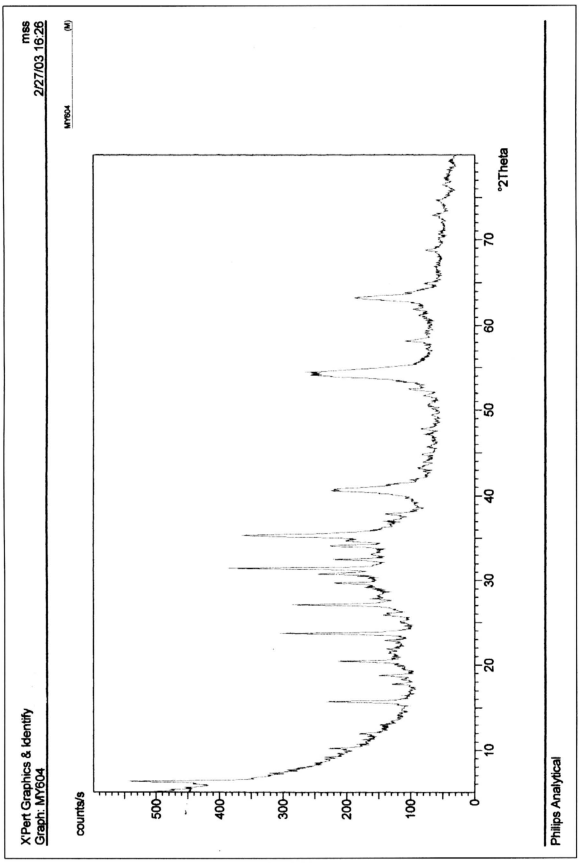
d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
13.98745	54.43	6.31368	167.98	378.99	0.15000	1.49
8.61577	11.73	10.25858	36.21	188.63	0.20000	1.20
7.38202	8.83	11.97891	27.24	151.75	0.15000	1.26
5.62972	41.34	15.72821	127.57	105.22	0.20000	3.67
4.98927	11.25	17.76252	34.72	96.41	0.20000	1.37
4.73021	18.05	18.74386	55.70	95.23	0.20000	1.62
4.34497	39.51	20.42282	121.95	93.20	0.15000	1.34
4.13421	12.47	21.47603	38.49	91.93	0.30000	0.79
3.89072	15.97	22.83761	49.28	90.29	0.15000	1.75
3.75340	71.03	23.68496	219.20	89.27	0.20000	5.07
3.55444	9.71	25.03165	29.98	87.65	0.25000	0.68
3.44765	18.18	25.82017	56.11	86.70	0.15000	0.84
3.29201	64.49	27.06359	199.02	85.20	0.20000	3.94
3.01018	45.12	29.65288	139.26	82.08	0.15000	1.11
2.90419	52.36	30.76135	161.58	80.75	0.15000	0.80
2.84479	100.00	31.41998	308.62	79.95	0.20000	5.29
2.75536	46.64	32.46750	143.95	78.69	0.15000	0.95
2.62844	48.59	34.08200	149.97	76.74	0.20000	2.32
2.58465	40.93	34.67752	126.33	76.03	0.25000	1.51
2.54118	90.30	35.29002	278.68	75.29	0.30000	5.53
2.37314	22.32	37.88054	68.88	72.17	0.20000	1.04
2.22422	48.85	40.52415	150.78	68.98	0.20000	0.84
2.21036	47.47	40.78942	146.51	68.66	0.15000	0.71
2.09131	6.37	43.22471	19.67	65.73	0.25000	0.95
2.02038	5.58	44.82298	17.23	63.80	0.15000	1.30
1.98118	2.76	45.75944	8.51	62.67	0.30000	0.90
1.92618	4.30	47.14390	13.26	61.01	0.30000	0.92

Philips Analytical Page: 1

X'Pert Graphics & Identify **mss**
(searched) peak list: MY604 **2/27/03 16:28**

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
1.90270	7.97	47.76173	24.59	60.26	0.20000	0.96
1.84372	2.57	49.38969	7.92	59.87	0.30000	1.07
1.80275	3.34	50.59010	10.30	62.07	0.30000	1.34
1.76780	5.09	51.66335	15.71	65.41	0.25000	0.91
1.74446	10.47	52.40670	32.32	68.41	0.20000	1.06
1.68430	61.13	54.42999	188.67	76.58	0.20000	0.71
1.58482	11.64	58.16064	35.93	70.96	0.15000	0.60
1.51405	5.79	61.16174	17.88	66.98	0.30000	0.76
1.49734	9.84	61.91891	30.36	65.26	0.15000	1.05
1.47134	37.70	63.13768	116.35	62.51	0.35000	3.77
1.43572	6.75	64.89281	20.83	58.54	0.20000	1.10
1.36466	7.74	68.72819	23.89	53.15	0.15000	1.37
1.29659	5.17	72.89454	15.96	45.14	0.40000	1.01
1.27048	6.20	74.64351	19.12	40.62	0.40000	0.98
1.24404	4.01	76.51174	12.37	38.82	0.30000	2.06

APPENDIX 3 D: X-Ray Report and Diffractogram of ZIO-3 (cont.)



APPENDIX 3 E: X-Ray Report and Diffractogram of ZIO-4

X'Pert Graphics & Identify **mss**
(searched) peak list: Maxine MY606 **2/27/03 16:29**

Original scan: Maxine MY606 Date: 8/16/02 12:29
Description of scan:

Used wavelength: K-Alpha1

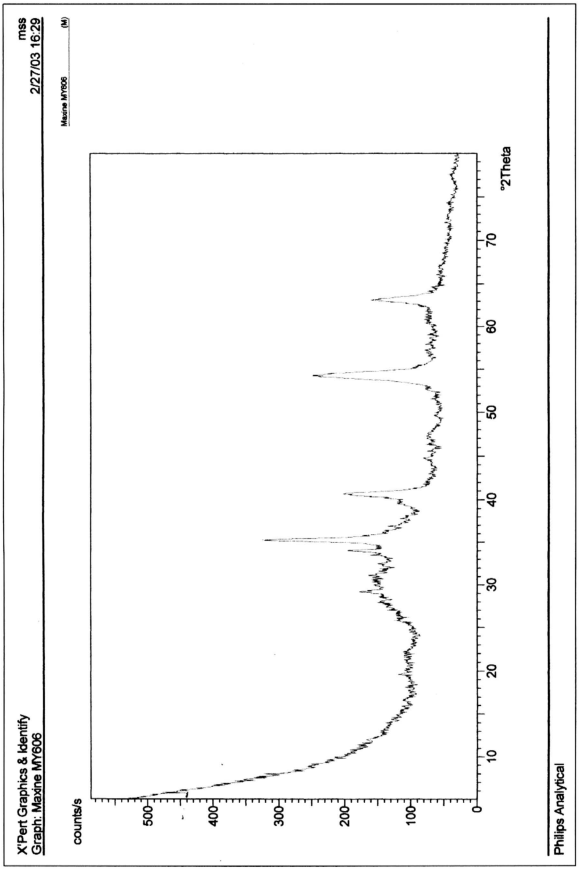
K-Alpha1 wavelength (Å): 1.54056
K-Alpha2 wavelength (Å): 1.54439
K-Alpha2/K-Alpha1 intensity ratio : 0.50000
K-Alpha wavelength (Å): 1.54056
K-Beta wavelength (Å): 1.39222

Peak search parameter set: **As Measured Intensities**
Set created: 6/11/99 16:01
Peak positions defined by: Minimum of 2nd derivative
Minimum peak tip width (°2Theta): 0.00
Minimum peak tip width (°2Theta): 1.00
Peak base width (°2Theta): 2.00
Minimum significance: 0.60

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
4.90208	4.19	18.08109	9.57	97.22	0.30000	0.80
4.50818	6.46	19.67599	14.76	96.75	0.80000	0.95
4.00839	5.01	22.15854	11.45	96.01	0.60000	0.60
3.44531	11.57	25.83802	26.44	94.66	0.30000	0.80
3.21545	18.45	27.72069	42.16	95.09	0.60000	0.72
3.05501	35.48	29.20797	81.07	95.44	0.30000	2.03
2.87027	28.10	31.13397	64.20	95.89	0.30000	0.79
2.76092	21.77	32.40037	49.74	96.18	0.30000	0.88
2.63400	44.05	34.00785	100.66	96.55	0.20000	1.53
2.54454	100.00	35.24199	228.49	96.84	0.35000	7.81
2.43770	14.22	36.84067	32.48	97.21	0.15000	0.64
2.21418	48.67	40.71599	111.20	87.71	0.20000	1.13
2.02504	7.55	44.71408	17.25	63.58	0.30000	0.88
1.91797	6.68	47.35806	15.27	58.84	0.80000	1.06
1.83169	2.50	49.73608	5.71	55.92	0.60000	0.77
1.69181	66.65	54.16832	152.29	80.22	0.30000	1.63
1.47242	38.60	63.08616	88.21	68.05	0.35000	3.28
1.27455	2.10	74.36498	4.79	37.41	0.60000	0.65

Philips Analytical Page: 1

APPENDIX 3 E: X-Ray Report and Diffractogram of ZIO-4 (cont.)



APPENDIX 3 F: X-Ray Report and Diffractogram of ZIO-5

X'Pert Graphics & Identify **mss**
(searched) peak list: Maxine-MY600 **2/27/03 16:31**

Original scan: Maxine-MY600 Date: 6/25/02 10:19
Description of scan:

Used wavelength: K-Alpha1

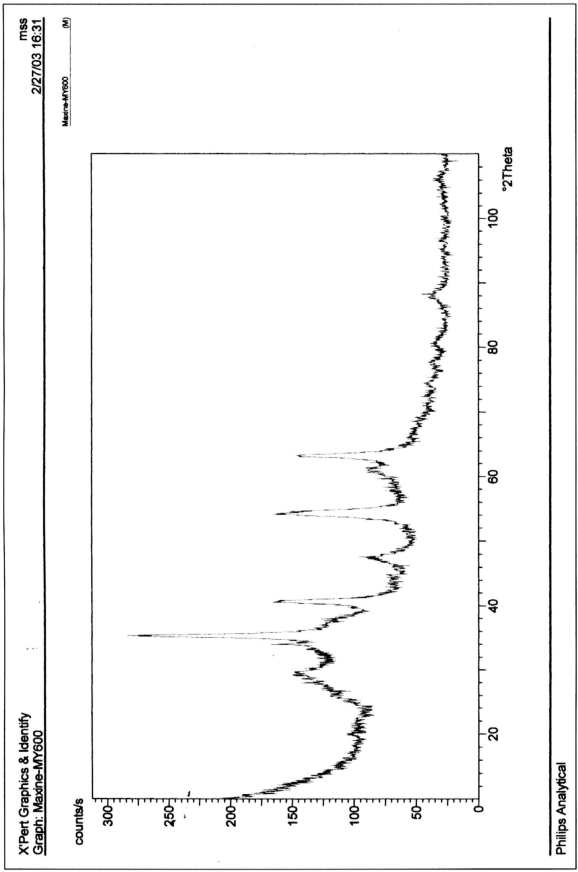
K-Alpha1 wavelength (Å): 1.54056
K-Alpha2 wavelength (Å): 1.54439
K-Alpha2/K-Alpha1 intensity ratio : 0.50000
K-Alpha wavelength (Å): 1.54056
K-Beta wavelength (Å): 1.39222

Peak search parameter set: **As Measured Intensities**
Set created: 6/11/99 16:01
Peak positions defined by: Minimum of 2nd derivative
Minimum peak tip width (°2Theta): 0.00
Minimum peak tip width (°2Theta): 1.00
Peak base width (°2Theta): 2.00
Minimum significance: 0.60

d-spacing (Å)	Relative Intensity (%)	Angle (°2Theta)	Peak Height (counts/s)	Background (counts/s)	Tip Width (°2Theta)	Significance
8.60788	26.51	10.26802	37.51	156.88	0.60000	1.17
2.63367	23.27	34.01230	32.93	124.34	0.20000	0.65
2.53494	100.00	35.37981	141.48	123.74	0.40000	6.74
2.21422	54.33	40.71524	76.86	83.83	0.60000	5.78
1.91203	18.09	47.51425	25.60	61.12	0.40000	0.81
1.69037	63.83	54.21817	90.30	70.09	0.25000	0.95
1.51498	13.72	61.12006	19.41	68.63	1.00000	3.03
1.47145	55.78	63.13263	78.91	65.82	0.15000	0.62
1.27385	4.04	74.41253	5.72	35.68	0.60000	1.06
1.22653	4.42	77.80810	6.25	31.04	0.50000	0.66
1.19268	4.19	80.45766	5.92	29.39	1.00000	1.05
1.10850	6.19	88.03605	8.76	28.66	1.00000	1.74

Philips Analytical Page: 1

APPENDIX 3 F: X-Ray Report and Diffractogram of ZIO-5 (cont.)



APPENDIX 4: Profile Fitting Report for ZIO-5

Profile Fit

Report

Experiment: ***MY600B.PRF***

User:

Experiment: A:\MY600B.PRF 31-mar-2003 12:12

Philips Analytical X-Ray **Experimental parameters** Profile Fit 1.0c

General

Pattern file:	A:\MY600.RD
Background file:	
Sample identification:	Maxine-MY600
Profile shape:	Pearson VII
Start angle:	10.025
End angle:	109.975

Search parameters:

FWHM:	0.62
Asymmetry parameter:	5
Intensity ratio:	0.5
Refine intensity ratio:	No
Peak detection threshold:	0

Refinement parameters:

Minimum calculated psf:	18.05
$\Delta\lambda / \lambda$:	0.002483
Number of refinements:	5

Assignment parameters:

Initial refinement flag:	1
Assignment threshold:	5

2

Experiment: A:\MY600B.PRF 31-mar-2003 12:12

Philips Analytical X-Ray **Peak Fit parameters** Profile Fit 1.0c

Num	Group	K	&	2θ		Intensity		FWHM		Asymm	μ & ξ	a2/a1	Integr.	Breadth
1	1	1		28.9513	Y	78	Y	3.2510	Y	5.00	1.60	0.50	6472.70	4.166
2	1	1		33.9707	Y	111	Y	0.1446	Y	5.00	1.60	0.50	412.60	0.185
3	1	1		35.3013	Y	490	Y	0.5723	Y	5.00	1.60	0.50	7190.90	0.733
4	1	1		40.6640	Y	281	Y	0.7597	Y	5.00	1.60	0.50	5467.10	0.974
5	1	1		47.4134	Y	94	Y	1.3165	Y	5.00	1.60	0.50	3180.60	1.687
6	1	1		54.2388	Y	345	Y	1.1511	Y	5.00	1.60	0.50	10180.30	1.475
7	1	1		60.9506	Y	61	Y	0.5741	Y	5.00	1.60	0.50	899.70	0.736
8	1	1		63.2299	Y	274	Y	0.7913	Y	5.00	1.60	0.50	5558.20	1.014
9	2	1		88.0632	Y	41	Y	1.5573	Y	5.00	1.60	0.50	1620.90	1.996

Num	Ratio	Total area	Overlap	Bg Res
1	0.780	8153.80	0.00	0.00
2	0.780	598.90	0.11	0.00
3	0.780	10598.50	0.00	0.00
4	0.780	7983.50	0.00	0.00
5	0.780	4492.40	0.01	0.00
6	0.780	14909.40	0.00	0.00
7	0.780	1249.90	0.05	0.00
8	0.780	8115.70	0.00	0.00
9	0.780	2174.60	0.00	0.00

Experiment: A:\MY600B.PRF 31-mar-2003 12:12

Philips Analytical X-Ray **Peak groups** Profile Fit 1.0c

Num	Fixed	Start angle	End angle	Offset of background	Slope of background	Rmin
1		26.5250	75.6250	0.000	0.000	0.0896
2		75.6750	91.9750	0.000	0.000	0.5820

4

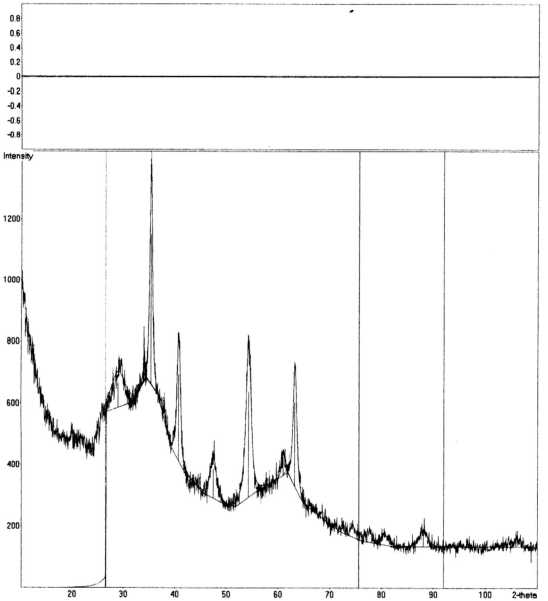
Experiment: A:\MY600B.PRF 31-mar-2003 12:12

Philips Analytical X-Ray **Background** Profile Fit 1.0c

Num	Angle	Intensity
0	26.6606	572
1	32.0307	605
2	34.3656	682
3	36.6420	627
4	39.0936	462
5	41.8954	374
6	45.5144	308
7	49.3084	275
8	51.7600	264
9	56.3129	319
10	59.6984	352
11	61.8581	374
12	64.9518	275
13	72.2481	182
14	75.9449	154
15	79.1553	144
16	82.3657	134
17	85.1480	134
18	90.4987	134
19	109.1189	134

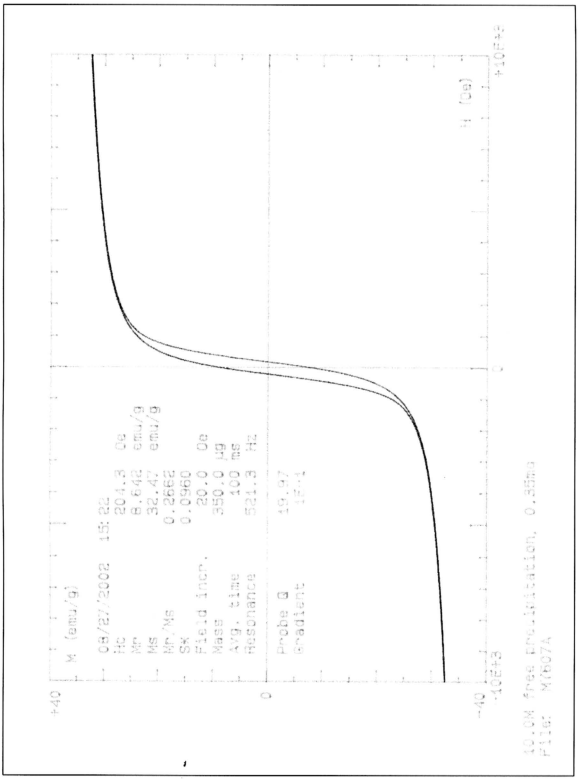
Experiment: A:\MY600B.PRF 31-mar-2003 12:12

Philips Analytical X-Ray **Plot** Profile Fit 1.0c

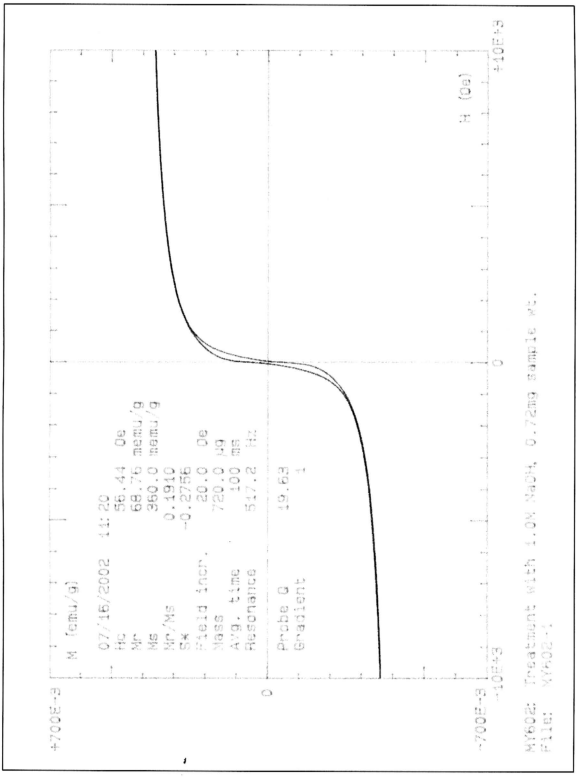


6

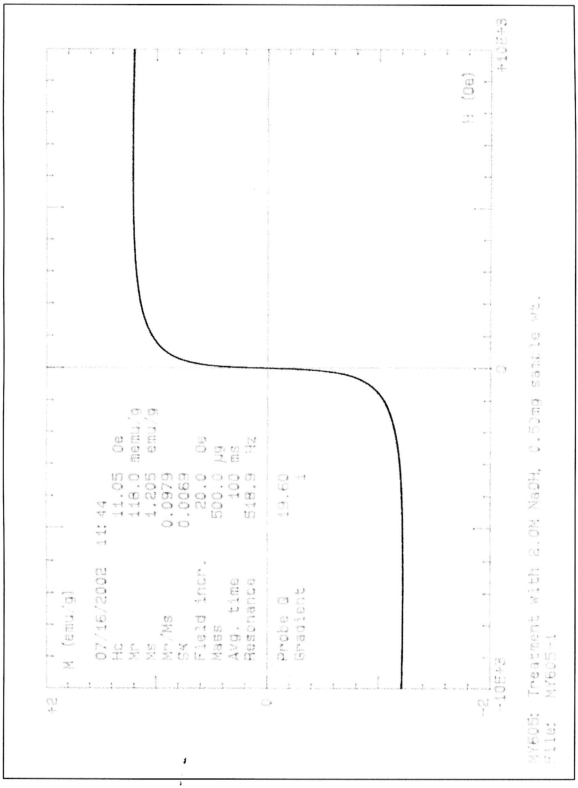
APPENDIX 5 A: Magnetization Curve of ZIO-0



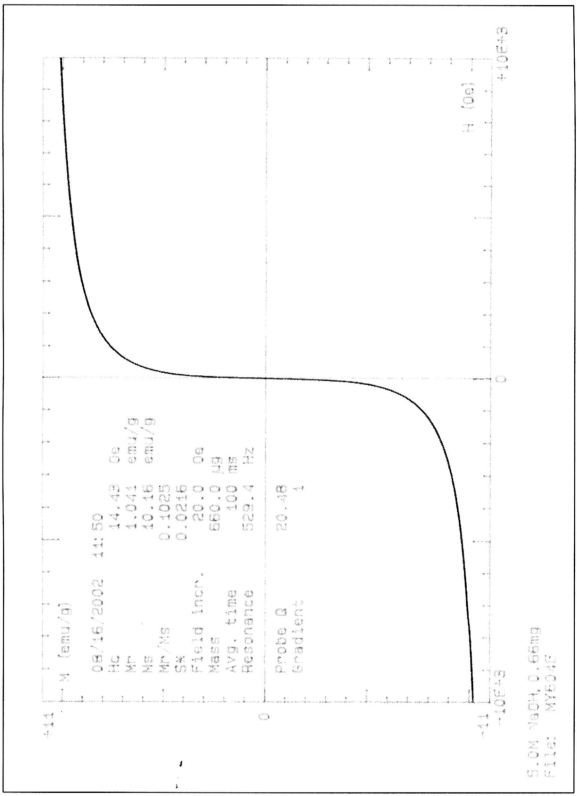
APPENDIX 5 B: Magnetization Curve of ZIO-1



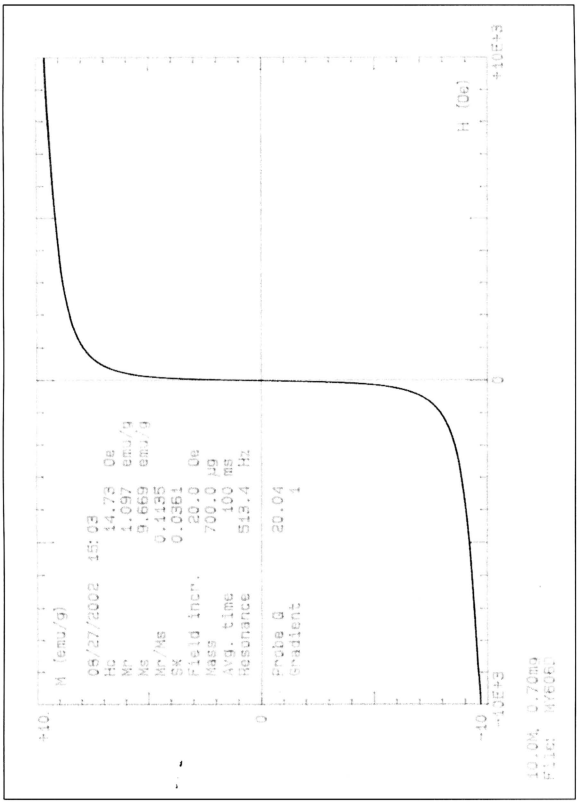
APPENDIX 5 C: Magnetization Curve of ZIO-2



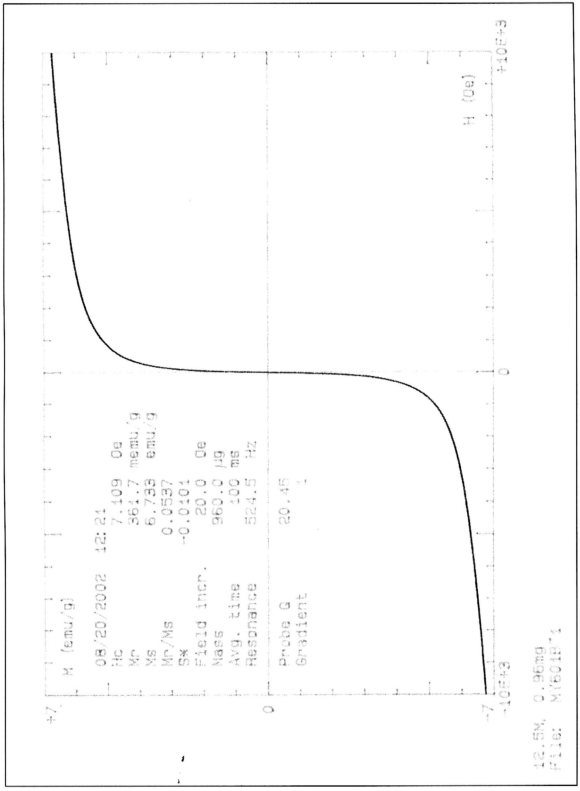
APPENDIX 5 D: Magnetization Curve of ZIO-3



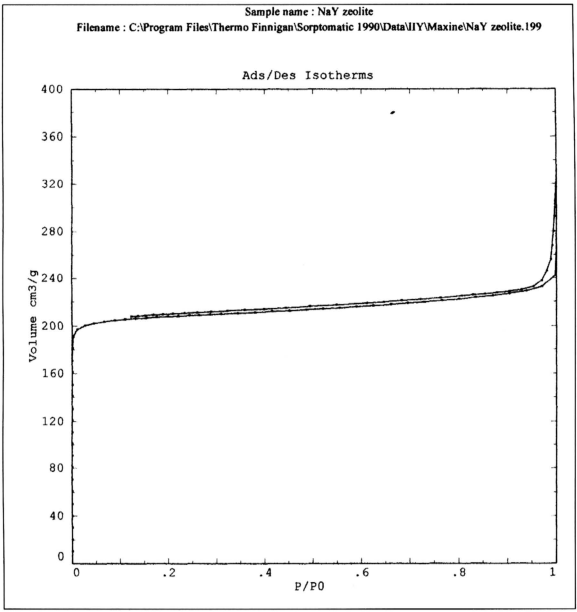
APPENDIX 5 E: Magnetization Curve of ZIO-4



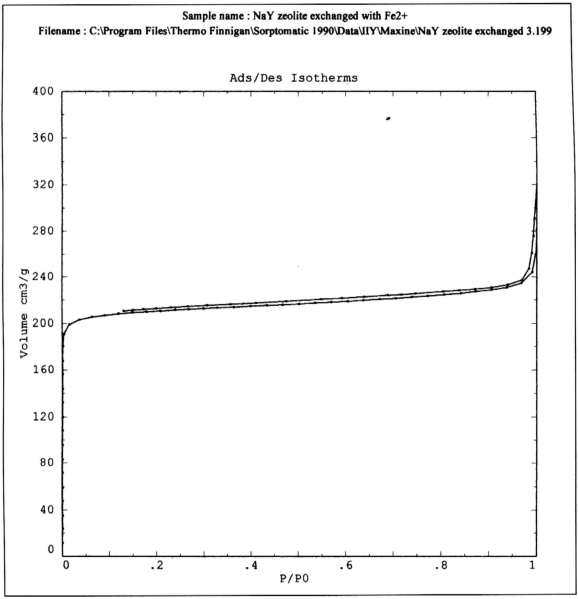
APPENDIX 5 F: Magnetization Curve of ZIO-5



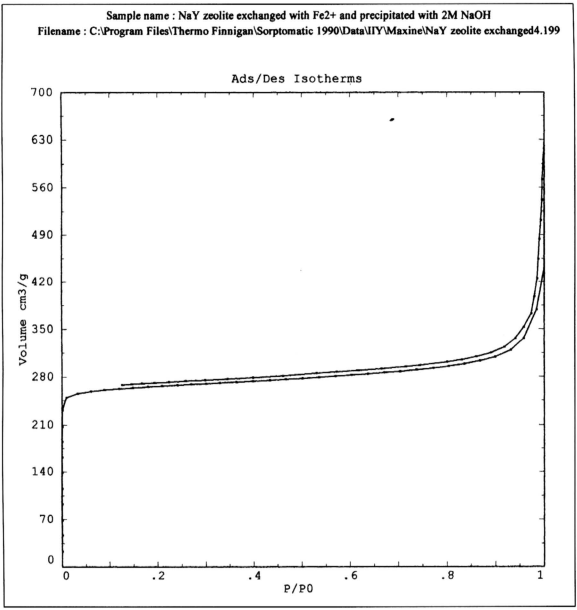
APPENDIX 6 A: Adsorption-Desorption Isotherm of Zeolite Na-Y



APPENDIX 6 B: Adsorption-Desorption Isotherm of Fe(II)-Exchanged Zeolite



APPENDIX 6 C: Adsorption-Desorption Isotherm of ZIO-2



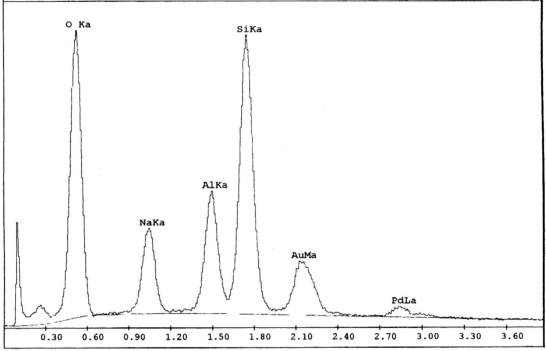
APPENDIX 7 A: EDS Results of Zeolite Na-Y

Untitled:1

Label:

kV:10.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 8027 Lsec : 102 1-Aug-2001 12:44:09



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
O K	39.84	61.71	0.2330	1.0912	0.5358	1.0003
NaK	7.21	7.77	0.0509	1.0218	0.6891	1.0020
AlK	8.47	7.78	0.0726	1.0092	0.8450	1.0055
SiK	22.08	19.48	0.1984	1.0324	0.8701	1.0003
AuM	18.33	2.31	0.1239	0.6848	0.9870	1.0000
PdL	4.07	0.95	0.0299	0.7738	0.9488	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
O K	542.94	19.61	0.43	27.69
NaK	178.82	31.29	0.80	5.71
AlK	241.03	28.21	0.67	8.54
SiK	586.35	29.56	0.42	19.84
AuM	132.77	29.12	0.95	4.56
PdL	23.45	23.15	2.88	1.01

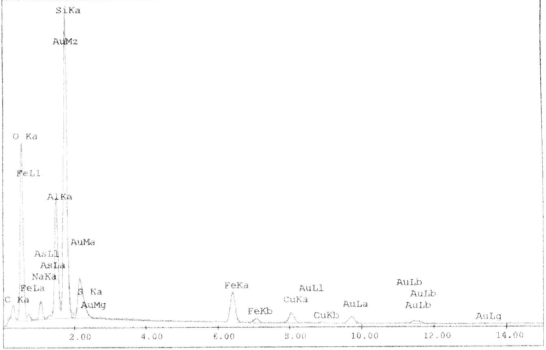
APPENDIX 7 B: EDS Results of Fe(II)-Exchanged Zeolite

Untitled:1

Label:specimen 1

kV:25.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 7278 Lsec : 100 29-May-2003 12:44:45



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	9.54	15.97	0.0157	1.0514	0.1562	1.0006
O K	47.57	59.79	0.1392	1.0353	0.2825	1.0005
NaK	2.47	2.16	0.0066	0.9709	0.2742	1.0028
AsL	0.59	0.16	0.0030	0.8413	0.6023	1.0052
AlK	7.77	5.79	0.0383	0.9672	0.5064	1.0065
SiK	17.95	12.85	0.1001	0.9960	0.5596	1.0002
S K	0.51	0.32	0.0029	0.9890	0.5700	1.0093
FeK	4.14	1.49	0.0372	0.8891	0.9954	1.0166
CuK	2.30	0.73	0.0204	0.8620	1.0002	1.0264
AuL	7.16	0.73	0.0522	0.6923	1.0538	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	22.34	15.74	2.76	1.42
O K	306.11	12.22	0.58	25.05
FeL	11.34	12.35	4.29	0.92
NaK	34.34	15.91	2.06	2.16
AsL	7.13	15.85	6.72	0.45
AlK	232.50	18.35	0.68	12.67
SiK	594.64	18.96	0.42	31.36
AuM	88.13	20.78	1.18	4.24
S K	14.08	20.60	4.18	0.68
FeK	85.56	10.60	1.15	8.07
CuK	30.86	9.18	2.05	3.36
AuL	22.99	6.24	2.35	3.68

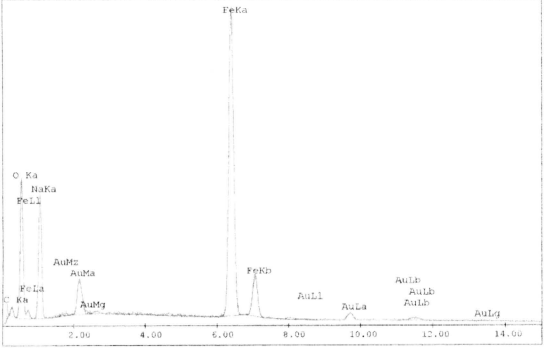
APPENDIX 7 C: EDS Results of ZIO-0

Untitled:1

Label:MY607 10.0M NaOH (Without Zeolite)

kV:30.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 5154 Lsec : 100 30-Aug-2002 11:25:48



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	6.04	11.92	0.0128	1.0794	0.1957	1.0006
O K	32.18	47.69	0.1180	1.0641	0.3442	1.0015
NaK	25.71	26.51	0.0453	0.9995	0.1764	1.0000
FeK	31.38	13.32	0.2931	0.9239	1.0063	1.0048
AuL	4.69	0.56	0.0366	0.7468	1.0443	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	10.21	10.99	4.51	0.93
O K	160.87	7.67	0.81	20.97
FeL	10.83	7.90	4.00	1.37
NaK	165.92	9.41	0.80	17.63
AuM	55.23	17.58	1.54	3.14
FeK	624.65	19.96	0.41	31.30
AuL	17.09	9.30	3.01	1.84

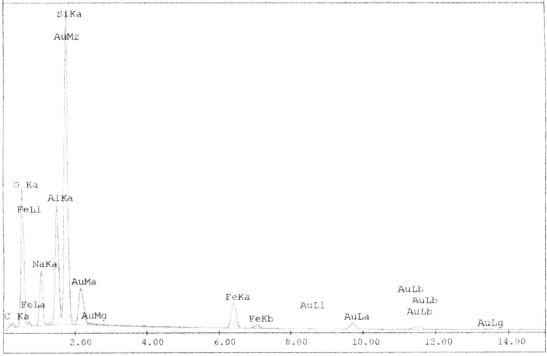
APPENDIX 7 D: EDS Results of ZIO-1

Untitled:1

Label:MY602 (1.0M NaOH)

kV:25.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 8822 Lsec : 100 8-Aug-2002 10:26:37



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	2.80	5.08	0.0040	1.0584	0.1340	1.0005
O K	42.92	58.41	0.1302	1.0422	0.2910	1.0006
NaK	8.29	7.85	0.0248	0.9774	0.3046	1.0034
AlK	9.21	7.43	0.0457	0.9736	0.5056	1.0084
SiK	23.99	18.60	0.1312	1.0025	0.5457	1.0001
FeK	4.36	1.70	0.0389	0.8956	0.9873	1.0093
AuL	8.43	0.93	0.0620	0.6978	1.0542	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	5.34	11.70	7.73	0.46
O K	269.60	10.00	0.62	26.96
FeL	8.57	12.63	5.37	0.68
NaK	121.19	17.01	0.97	7.12
AlK	261.00	17.40	0.64	15.00
SiK	733.85	19.53	0.37	37.58
AuM	99.69	20.99	1.10	4.75
FeK	84.08	12.13	1.17	6.93
AuL	25.70	6.45	2.21	3.98

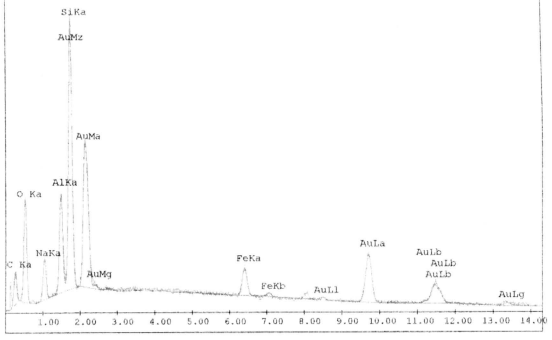
APPENDIX 7 E: EDS Results of ZIO-2

Untitled:1

Label:MY-605 (2.0M NaOH)

kV:25.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 3230 Lsec : 100 5-Aug-2002 16:06:28



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	14.14	30.68	0.0269	1.1071	0.1719	1.0002
O K	26.88	43.79	0.0583	1.0899	0.1990	1.0003
NaK	3.90	4.42	0.0112	1.0217	0.2809	1.0016
AlK	4.53	4.38	0.0225	1.0174	0.4865	1.0039
SiK	11.44	10.62	0.0680	1.0474	0.5671	1.0001
FeK	2.83	1.32	0.0258	0.9456	0.9398	1.0240
AuL	36.29	4.80	0.2829	0.7493	1.0404	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	22.73	5.58	2.34	4.07
O K	76.00	7.46	1.20	10.19
NaK	34.51	11.85	1.97	2.91
AlK	80.97	17.60	1.23	4.60
SiK	239.26	23.38	0.68	10.23
AuM	147.70	28.02	0.90	5.27
FeK	35.11	22.98	2.17	1.53
AuL	73.80	13.69	1.27	5.39

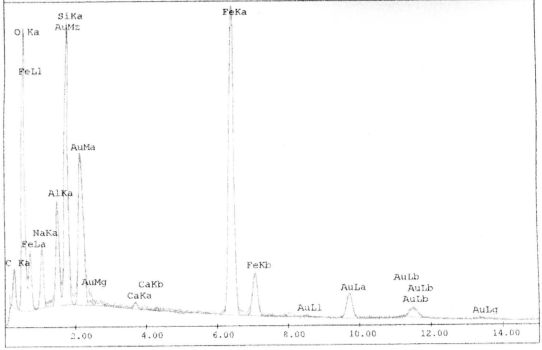
APPENDIX 7 F: EDS Results of ZIO-3

A:\MY604.spc

Label:MY-604 (5.0M NaOH)

kV:25.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 3016 Lsec : 100 6-Aug-2002 10:41:33



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	10.89	21.01	0.0215	1.0795	0.1832	1.0005
O K	36.17	52.41	0.1047	1.0629	0.2722	1.0008
NaK	5.07	5.12	0.0111	0.9966	0.2192	1.0011
AlK	3.88	3.34	0.0158	0.9926	0.4093	1.0030
SiK	9.03	7.46	0.0468	1.0220	0.5065	1.0005
CaK	0.23	0.13	0.0019	0.9994	0.8353	1.0107
FeK	21.70	9.01	0.1979	0.9161	0.9855	1.0104
AuL	13.03	1.53	0.0968	0.7170	1.0365	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	25.45	15.34	2.51	1.66
O K	190.94	11.88	0.75	16.07
FeL	43.38	13.53	1.74	3.21
NaK	47.83	17.82	1.69	2.68
AlK	79.58	18.51	1.24	4.30
SiK	230.50	20.93	0.69	11.01
AuM	142.43	22.78	0.90	6.25
CaK	6.62	20.30	7.84	0.33
FeK	377.10	13.56	0.52	27.81
AuL	35.34	8.67	1.88	4.08

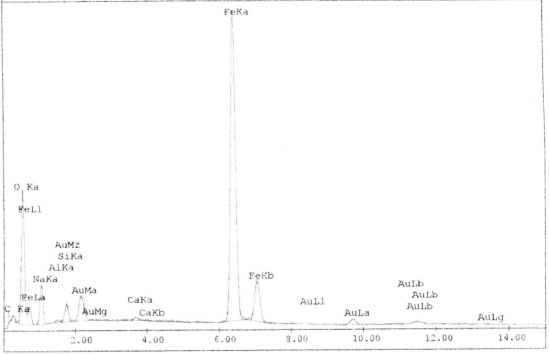
APPENDIX 7 G: EDS Results of ZIO-4

Untitled:1

Label:MY606 10.0M NaOH

kV:30.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 6942 Lsec : 100 30-Aug-2002 10:26:43



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	4.76	9.78	0.0104	1.0815	0.2014	1.0007
O K	37.39	57.61	0.1422	1.0661	0.3562	1.0015
NaK	11.95	12.81	0.0181	1.0013	0.1514	1.0002
AlK	0.32	0.30	0.0008	0.9983	0.2608	1.0010
SiK	1.75	1.54	0.0085	1.0283	0.3593	1.0011
CaK	0.19	0.12	0.0017	1.0057	0.8652	1.0287
FeK	39.19	17.30	0.3668	0.9262	1.0062	1.0041
AuL	4.44	0.56	0.0344	0.7492	1.0333	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	8.91	13.69	5.34	0.65
O K	207.96	9.07	0.71	22.93
FeL	29.89	8.94	2.08	3.34
NaK	71.14	10.51	1.27	6.77
AlK	4.10	12.96	10.07	0.32
SiK	31.51	15.87	2.16	1.99
AuM	52.54	19.30	1.61	2.72
CaK	6.54	23.54	8.39	0.28
FeK	838.88	23.07	0.35	36.36
AuL	17.23	9.32	2.99	1.85

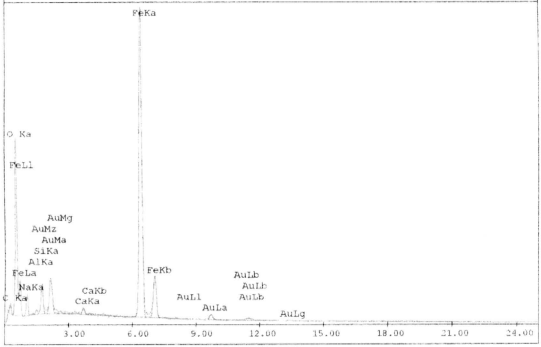
APPENDIX 7 H: EDS Results of ZIO-5

Untitled:2

Label:MY-601 (12.5M NaOH)

KV:25.0 Tilt:0.0 Take-off:35.0 Det Type:SUTW Res:145 Tc:40

FS : 6120 Lsec : 100 6-Aug-2002 11:22:54



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	4.99	10.80	0.0112	1.0936	0.2044	1.0007
O K	36.44	59.28	0.1417	1.0768	0.3606	1.0015
NaK	4.73	5.35	0.0079	1.0096	0.1650	1.0002
AlK	0.46	0.44	0.0015	1.0055	0.3236	1.0011
SiK	2.33	2.16	0.0106	1.0353	0.4393	1.0010
CaK	0.43	0.28	0.0040	1.0126	0.8896	1.0275
FeK	44.91	20.93	0.4188	0.9281	1.0008	1.0040
AuL	5.72	0.76	0.0422	0.7253	1.0188	1.0000
Total	100.00	100.00				

Element	Net Inte.	Bkgd Inte.	Inte. Error	P/B
C K	12.53	15.75	4.24	0.80
O K	245.66	12.18	0.65	20.17
FeL	53.68	13.87	1.53	3.87
NaK	32.29	14.61	2.12	2.21
AlK	7.13	15.72	6.70	0.45
SiK	49.60	18.15	1.66	2.73
AuM	68.89	20.40	1.37	3.38
CaK	13.11	21.52	4.49	0.61
FeK	758.74	15.92	0.37	47.66
AuL	14.66	10.20	3.40	1.44

PUBLICATIONS

1. M. Yee and I.I. Yaacob, "Synthesis and characterization of iron oxide nanostructured particles in Na-Y zeolite matrix", Journal of Materials Research, Vol. 19, pp. 930-936, 2004.

2. M. Yee and I.I. Yaacob, "Preparation and properties of iron oxide nanoparticles in a Na-Y zeolite matrix", Materials Science Forum, Vol. 437-438, pp. 177-180, 2003.

3. M. Yee and I.I. Yaacob, "Preparation and properties of iron oxide nanoparticles in a Na-Y zeolite matrix", Prosiding Seminar Penyelidikan Jangka Pendek Universiti Malaya, Paper 15, Project No.: F0175/2001D, 2003.

4. M. Yee and I.I. Yaacob, "Synthesis and characterization of iron oxide nanoparticles in a zeolite matrix", Prosiding Persidangan Kebangsaan Penyelidikan dan Pembangunan Institusi Pengajian Tinggi Awam, pp. 624-628, 2001.