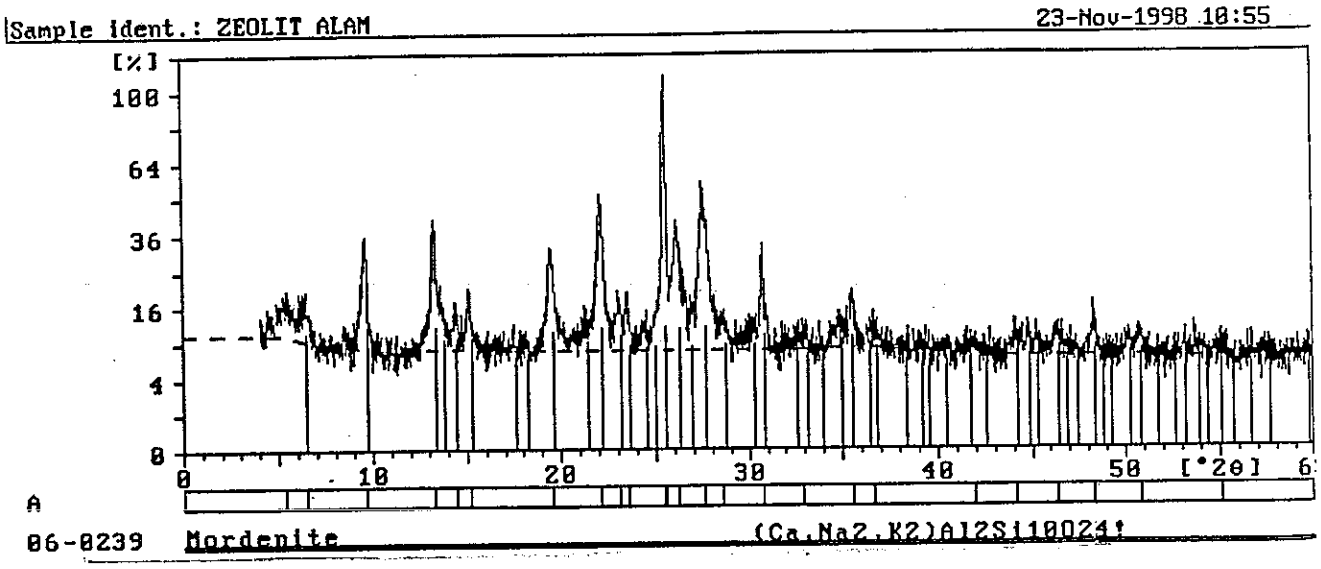
LAMPIRAN A

1. Hasil Analisa Difraksi Sinar-X Zeolit Alam



Sample identification: ZEOLIT ALAM
Data measured at: 23-Nov-1998 10:18:00

Diffractometer type: PW3710 BASED
Tube anode: Cu
Generator tension [kV]: 40
Generator current [mA]: 30
Wavelength Alpha1 [Å]: 1.54056
Wavelength Alpha2 [Å]: 1.54439
Intensity ratio (alpha2/alpha1): 0.500
Divergence slit: 1°
Receiving slit: 0.2
Monochromator used: NO

Start angle [°2θ]: 4.010
End angle [°2θ]: 59.950
Step size [°2θ]: 0.020
Maximum intensity: 453.6900
Time per step [s]: 0.100
Type of scan: CONTINUOUS

Minimum peak tip width: 0.00
Maximum peak tip width: 1.00
Peak base width: 2.00
Minimum significance: 0.75
Number of peaks: 25

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
5.355	16.4892	16.5302	0.480	26	48	5.7	1.01
6.415	13.7668	13.8010	0.200	35	42	7.7	0.90
9.625	9.1815	9.2043	0.100	123	36	27.2	0.84
13.285	6.6591	6.6756	0.060	130	36	28.6	0.77
14.485	6.1100	6.1252	0.160	35	36	7.7	1.34
15.180	5.8318	5.8463	0.160	42	36	9.3	1.18
19.480	4.5531	4.5644	0.200	106	35	23.4	2.18
22.095	4.0198	4.0298	0.120	180	35	39.6	1.35
23.055	3.8545	3.8641	0.200	45	35	9.9	0.96
23.500	3.7825	3.7919	0.160	45	35	9.9	0.89
25.445	3.4976	3.5063	0.080	331	35	73.0	0.97
25.540	3.4848	3.4935	0.080	454	35	100.0	1.66
26.195	3.3992	3.4076	0.240	128	35	28.1	3.30
27.565	3.2333	3.2413	0.100	193	35	42.6	0.90
28.605	3.1180	3.1258	0.320	26	35	5.7	0.80
30.770	2.9034	2.9106	0.160	94	35	20.7	1.97
32.845	2.7246	2.7313	0.480	12	35	2.7	1.80
35.525	2.5249	2.5312	0.200	44	36	9.6	1.54
36.615	2.4522	2.4583	0.480	14	36	3.0	1.54
41.940	2.1523	2.1577	0.960	6	31	1.4	0.97
44.115	2.0511	2.0562	0.640	15	30	3.4	1.12
46.330	1.9581	1.9630	0.240	19	30	4.3	1.19

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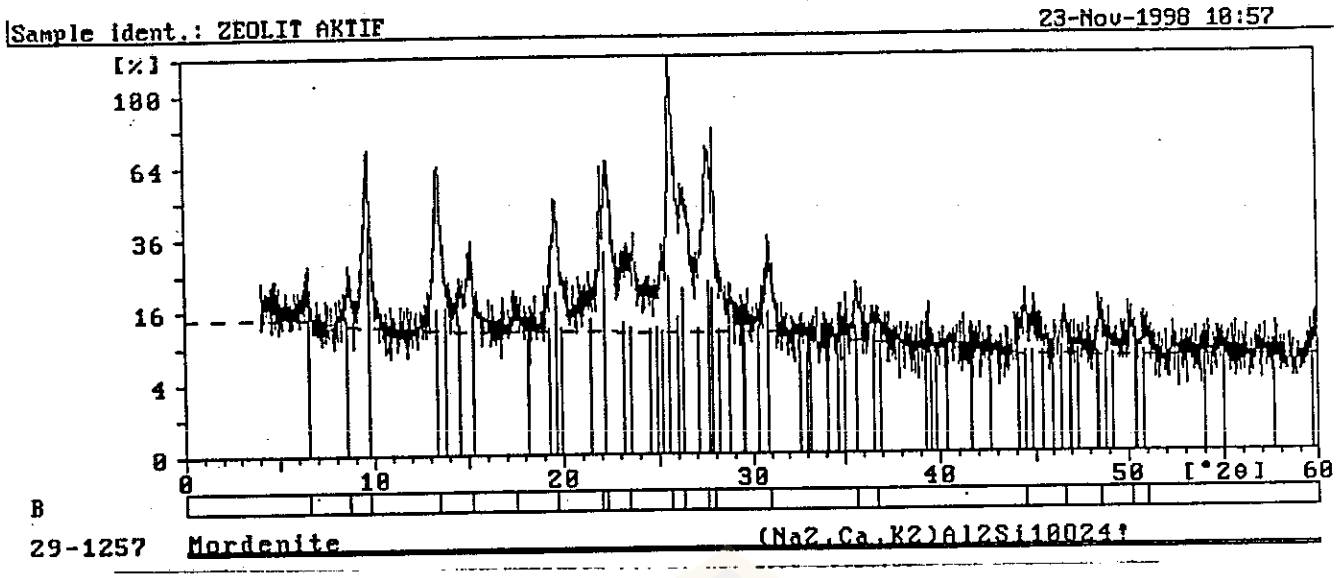
2. Hasil Analisa Difraksi Sinar-X Zeolit Aktif



Diffractometer type: PW3710 BASED
Tube anode: Cu
Generator tension [kV]: 40
Generator current [mA]: 30
Wavelength Alpha1 [Å]: 1.54056
Wavelength Alpha2 [Å]: 1.54439
Intensity ratio (alpha2/alpha1): 0.500
Divergence slit: 1°
Receiving slit: 0.2
Monochromator used: NO

Start angle [°2θ]: 4.010
End angle [°2θ]: 59.950
Step size [°2θ]: 0.020
Maximum intensity: 259.2100
Time per step [s]: 0.100
Type of scan: CONTINUOUS

Minimum peak tip width: 0.00
Maximum peak tip width: 1.00
Peak base width: 2.00
Minimum significance: 0.75
Number of peaks: 22

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
6.490	13.6078	13.6417	0.120	27	37	10.4	1.28
8.665	10.1964	10.2217	0.240	27	34	10.4	1.41
9.725	9.0873	9.1099	0.100	154	32	59.3	1.22
13.515	6.5463	6.5625	0.240	130	31	50.1	4.48
15.245	5.8071	5.8215	0.280	48	30	18.4	2.09
17.525	5.0564	5.0689	0.400	10	30	4.0	0.77
19.630	4.5186	4.5299	0.240	86	30	33.4	2.90
22.000	4.0369	4.0470	0.060	132	30	51.0	3.26
22.265	3.9895	3.9994	0.240	128	30	49.3	1.88
23.475	3.7865	3.7959	0.480	42	29	16.3	0.84
25.670	3.4675	3.4761	0.140	259	29	100.0	3.26
26.270	3.3896	3.3981	0.280	104	29	40.1	1.55
27.580	3.2315	3.2396	0.160	142	29	54.6	0.86
27.930	3.1918	3.1998	0.060	174	29	67.2	3.07
30.930	2.8887	2.8959	0.200	52	29	20.0	1.25
35.655	2.5160	2.5223	0.120	28	25	10.8	0.83
36.715	2.4458	2.4518	0.480	9	24	3.5	0.90
44.470	2.0356	2.0407	0.240	23	18	8.9	1.08
46.560	1.9490	1.9538	0.240	14	18	5.6	0.87
48.520	1.8747	1.8794	0.240	19	18	7.5	1.64
50.155	1.8174	1.8219	0.320	14	18	5.6	0.84
51.025	1.7884	1.7929	0.320	10	18	4.0	1.18

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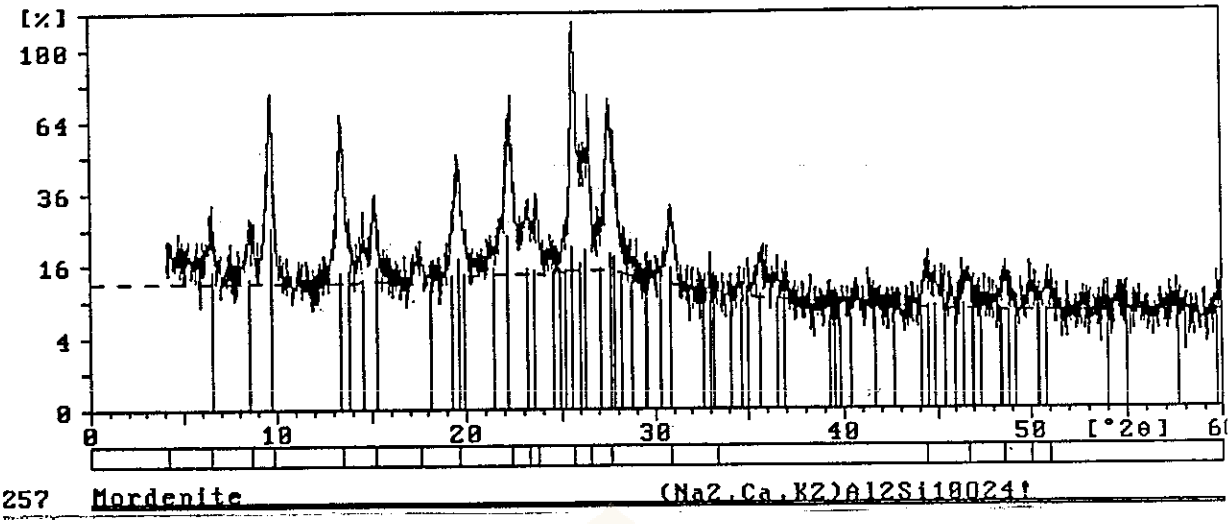
3. Hasil Analisa Difraksi Sinar-X Ni-Zeolit Kalsinasi

Sample ident.: Ni-ZEOLIT KALSINASI 23-Nov-1998 10:58



Diffractometer type: PW3710 BASED
Tube anode: Cu
Generator tension [kV]: 40
Generator current [mA]: 30
Wavelength Alpha1 [Å]: 1.54056
Wavelength Alpha2 [Å]: 1.54439
Intensity ratio (alpha2/alpha1): 0.500
Divergence slit: 1°
Receiving slit: 0.2
Monochromator used: NO

Start angle [°2θ]: 4.010
End angle [°2θ]: 59.950
Step size [°2θ]: 0.020
Maximum intensity: 272.2500
Time per step [s]: 0.100
Type of scan: CONTINUOUS

Minimum peak tip width: 0.00
Maximum peak tip width: 1.00
Peak base width: 2.00
Minimum significance: 0.75
Number of peaks: 21

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
4.175	21.1466	21.1992	0.320	20	34	7.4	0.91
6.475	13.6393	13.6732	0.240	38	34	14.1	3.12
8.630	10.2377	10.2631	0.320	29	34	10.7	1.07
9.780	9.0363	9.0587	0.100	156	34	57.4	1.16
13.460	6.5729	6.5892	0.320	139	34	51.1	7.68
15.180	5.8318	5.8463	0.160	56	35	20.7	0.93
17.585	5.0392	5.0518	0.320	11	36	4.0	0.77
19.635	4.5175	4.5287	0.240	81	37	29.8	2.70
22.320	3.9798	3.9897	0.280	139	38	51.1	4.47
23.240	3.8243	3.8338	0.240	40	38	14.6	1.25
23.755	3.7425	3.7518	0.160	41	38	15.0	0.92
25.635	3.4721	3.4808	0.080	272	40	100.0	0.91
26.530	3.3570	3.3653	0.120	154	40	56.5	1.17
27.620	3.2269	3.2350	0.280	149	40	54.7	4.41
30.870	2.8942	2.9014	0.360	42	32	15.5	4.08
33.295	2.6888	2.6954	0.560	3	27	1.2	0.96
44.380	2.0395	2.0446	0.320	18	21	6.5	0.87
46.660	1.9450	1.9499	0.400	16	20	5.9	1.33
48.520	1.8747	1.8794	0.400	11	19	4.0	1.07
49.980	1.8233	1.8279	0.320	17	19	6.2	0.97
51.030	1.7882	1.7927	0.480	11	19	4.0	1.47

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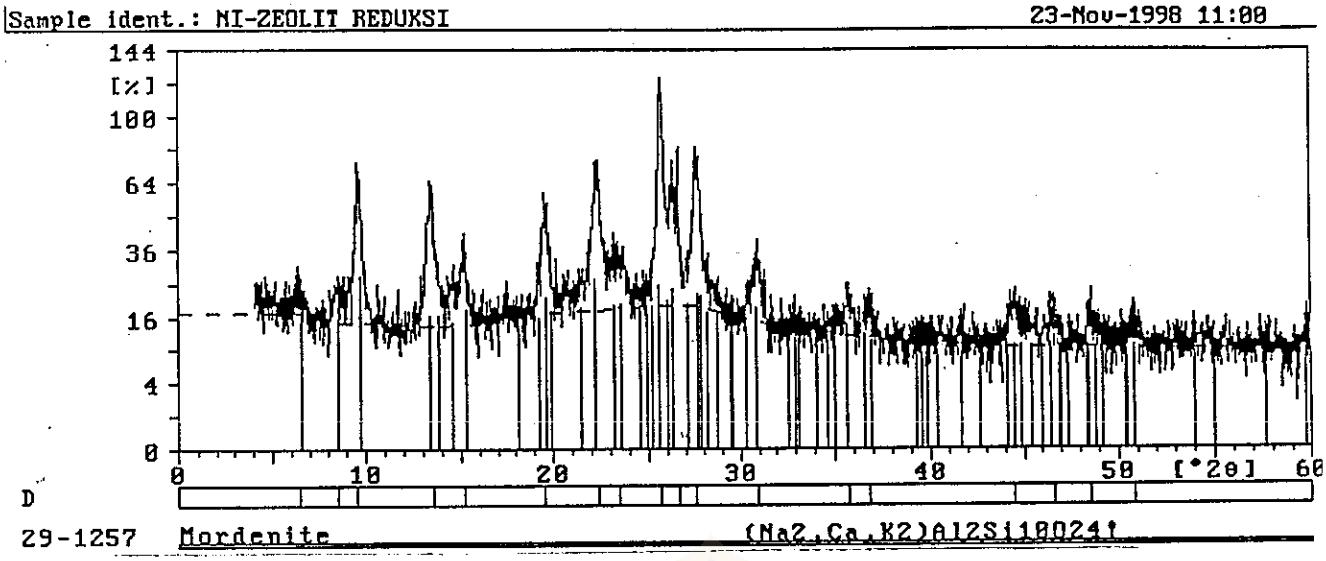
4. Hasil Analisa Difraksi Sinar-X Ni-Zeolit Reduksi-450 °C



Diffractometer type:	PW3710 BASED
Tube anode:	Cu
Generator tension [kV]:	40
Generator current [mA]:	30
Wavelength Alpha1 [Å]:	1.54056
Wavelength Alpha2 [Å]:	1.54439
Intensity ratio (alpha2/alpha1):	0.500
Divergence slit:	1°
Receiving slit:	0.2
Monochromator used:	NO
Start angle [°2θ]:	4.010
End angle [°2θ]:	59.950
Step size [°2θ]:	0.020
Maximum intensity:	204.4900
Time per step [s]:	0.100
Type of scan:	CONTINUOUS
Minimum peak tip width:	0.00
Maximum peak tip width:	1.00
Peak base width:	2.00
Minimum significance:	0.75
Number of peaks:	18

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif.
6.465	13.6604	13.6944	0.480	14	35	6.7	0.88
8.490	10.4062	10.4320	0.560	18	30	9.0	2.09
9.580	9.2245	9.2474	0.280	100	30	48.9	4.62
13.530	6.5390	6.5553	0.200	96	28	47.0	1.84
15.215	5.8184	5.8329	0.160	40	29	19.4	0.83
19.520	4.5439	4.5551	0.280	72	35	35.3	2.98
22.380	3.9692	3.9791	0.320	100	36	48.9	5.01
23.485	3.7849	3.7943	0.480	30	37	14.8	2.06
25.660	3.4688	3.4774	0.240	204	38	100.0	5.45
26.615	3.3465	3.3548	0.120	128	38	62.4	2.59
27.550	3.2350	3.2430	0.160	104	38	50.9	0.92
30.975	2.8846	2.8918	0.320	40	30	19.4	1.38
35.750	2.5095	2.5158	0.240	17	24	8.2	0.80
36.790	2.4409	2.4470	0.480	12	23	5.7	1.30
44.460	2.0360	2.0411	0.400	18	19	9.0	1.38
46.600	1.9474	1.9522	0.320	12	19	6.0	0.77
48.505	1.8753	1.8799	0.240	17	19	8.2	1.31
50.845	1.7943	1.7988	0.640	10	18	4.7	0.98

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5. Data Pola Difraksi Mineral Mordenit Standar ASTM

Name : Calcium Aluminum Silicate Hydrate
Name : Mordenite
Formula : (Ca,Na2,K2)Al2Si10O24!7H2O
Elements : H, O, Na, Al, Si, K, Ca
Groups : H2O
Subfiles : Inorganic, Minerals, Common phases, Forensics, Zeolites, Corrosion products
Pattern deleted: NO

Radiation : Cu Kα
Wavelength : 1.54184

d value	Angle	Rel.Int.	d value	Angle	Rel.Int.	d value	Angle	Rel.Int.
13.7000	6.452	50	13.6000	6.499	18	2.4590	36.542	4
9.1000	9.719	90	10.3000	8.585	5	2.4360	36.899	2
6.6100	13.395	90	9.0600	9.762	100	2.2940	39.274	1
6.3800	13.880	40	6.5900	13.436	14	2.2790	39.543	1
6.1000	14.521	50	6.4000	13.837	17	2.2630	39.834	1
5.7900	15.303	50	6.0700	14.593	4	2.2320	40.412	2
5.0300	17.632	10	5.8000	15.276	18	2.1660	41.699	2
4.8700	18.216	20	4.8800	18.179	3	2.1170	42.711	1
4.5300	19.597	80	4.6000	19.296	2	2.0520	44.134	7
4.1400	21.464	30	4.5300	19.597	30	2.0350	44.522	2
4.0000	22.224	90	4.4600	19.907	2	2.0190	44.894	2
3.8400	23.163	60	4.1500	21.411	8	1.9970	45.416	2
3.7600	23.663	20	4.0000	22.224	70	1.9740	45.976	1
3.6200	24.592	10	3.8400	23.163	7	1.9540	46.474	5
3.5600	25.013	10	3.7700	23.599	4	1.9350	46.957	3
3.4800	25.598	100	3.6300	24.523	3	1.9320	47.035	3
3.3900	26.289	90	3.5700	24.942	4	1.9200	47.347	2
3.3100	26.936	10	3.5300	25.229	2	1.8820	48.363	4
3.2200	27.704	100	3.4800	25.598	45	1.8780	48.472	2
3.1000	28.799	20	3.4200	26.055	11	1.8640	48.860	1
2.9460	30.340	20	3.3900	26.289	35	1.8510	49.226	1
2.8960	30.877	60	3.2900	27.103	3	1.8110	50.388	10
2.7430	32.646	10	3.2200	27.704	40	1.8070	50.508	6
2.7000	33.181	30	3.2000	27.881	35	1.7950	50.869	3
2.6390	33.970	10	3.1600	28.241	2	1.6970	54.038	2
2.5600	35.052	40	3.1000	28.799	4	1.6670	55.092	2
2.5220	35.598	50	3.0300	29.479	1	1.5980	57.688	2
2.4650	36.450	20	3.0200	29.579	2	1.5470	59.779	2
2.4370	36.883	20	2.9420	30.382	5			
2.3430	38.420	20	2.8950	30.888	13			
2.2990	39.185	10	2.7410	32.670	2			
2.2750	39.616	10	2.7150	32.992	2			
2.2280	40.487	20	2.7010	33.168	5			
2.1620	41.780	20	2.6330	34.050	3			
2.1230	42.585	10	2.5880	34.661	1			
2.0470	44.248	40	2.5650	34.982	10			
2.0190	44.894	40	2.5210	35.612	7			
1.9980	45.392	40						
1.9530	46.499	40						
1.9360	46.932	10						
1.9170	47.425	20						
1.8830	48.336	40						
1.8650	48.832	10						
1.8500	49.254	10						
1.8130	50.329	30						
1.7950	50.869	30						
1.7650	51.797	10						
1.7380	52.663	10						
1.7200	53.258	20						
1.6980	54.003	10						
1.6860	54.419	20						
1.6650	55.164	20						
1.6470	55.819	10						
1.6220	56.756	20						
1.5970	57.728	30						
1.5460	59.822	20						

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LAMPIRAN B

Penetuan Kristalinitas

Untuk menentukan kristalinitas zeolit pada beberapa perlakuan dilakukan dengan langkah sebagai berikut :

1. Menentukan luas puncak masing-masing sudut karakteristik

- Memperbesar gambar 4.1 dua kali gambar semula.
- Dari gambar tersebut diukur tinggi puncak.

Sudut karakteristik Mordenit	Tinggi Puncak (mm)			
	ZA	Z	Ni-ZK	Ni-ZR
9,719	40	71	81	69
25,598	122	121	121	120
27,704	63	71	77,5	77

- Lebar puncak diperoleh dari lampiran A dan diubah kedalam satuan milimeter, dimana 1° = 7,4 mm.

Sudut karakteristik Mordenit	Lebar Puncak (mm)			
	ZA	Z	Ni-ZK	Ni-ZR
9,719	0,74	0,74	0,74	2,012
25,598	0,592	1,036	0,59	1,776
27,704	0,74	1,184	2,072	1,184

- Untuk menentukan luas puncak digunakan persamaan :

$$\text{Luas Puncak} = \frac{(\text{TinggiPuncak}).(\text{Lebar Puncak})}{2} (\text{mm}^2)$$

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➢ Dengan mengunakan persamaan diatas diperoleh luas puncak sebagai berikut :

Sudut karakteristik Mordenit	Luas puncak (mm^2)			
	ZA	Z	Ni-ZK	Ni-ZR
9,719	14,8	16,17	29,27	71,484
25,598	36,112	62,678	35,818	106,56
27,704	23,31	42,032	80,296	45,58

2. Penentuan Kristalinitas relatif

Untuk menentukankristalinitas digunakan persamaan :

$$\text{Kristalinitas} = \frac{\text{Luas puncak pada sudut tertentu}}{\text{Luas puncak terbesar}} * 100\%$$

Hasil penentuan kristalinitas zeolit

Sudut karakteristik Mordenit	Kristalinitas (%)			
	ZA	Z	Ni-ZK	Ni-ZR
9,719	13,89	24,65	28,13	67,08
25,598	33,98	58,82	33,61	100
27,704	21,87	39,44	75,34	42,77

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LAMPIRAN C

Penentuan Keasaman Total Padatan

➢ Hasil Penimbangan Gelas Arloji

No	Tempat Sampel	I	II	III	rata-rata
1	Zeolit Alam	40,2512	40,4508	40,2504	40,2508
2	Zeolit Aktif	26,6222	26,6211	26,6227	26.6220
3	Ni-Zeolit Kalsinasi	31,3313	31,3313	31,3312	31,33126
4	Ni-Zeolit R-300	14,7777	14.7778	14,7776	14,7777
5	Ni-Zeolit R-350	13,9327	13,9321	13,9327	13,9325
6	Ni-Zeolit R-400	15,4716	15,4715	15,4715	15,4714
7	Ni-Zeolit R-450	14,9882	14,9977	14,9876	14,98783

➢ Hasil Penimbangan Sampel Sebelum Asorbsi Dengan Gelas Arloji

No	Tempat Sampel	I	II	III	rata-rata
1	Zeolit Alam	40,7292	40,7377	40,7360	40,73.763
2	Zeolit Aktif	27,1357	27,1378	27,1325	27,13533
3	Ni-Zeolit Kalsinasi	31,8482	31,8445	31.8502	31,86096
4	Ni-Zeolit R-300	15,2474	15,2495	15,2527	15,24986
5	Ni-Zeolit R-350	14,4162	14,4125	14,4101	14,41283
6	Ni-Zeolit R-400	15,9563	15,9584	15,9605	15,9584
7	Ni-Zeolit R-450	15,5349	15,5356	15,5365	15,5357

➢ Hasil Penimbangan Sampel Sesudah dengan Gelas Arloji

No	Tempat Sampel	I	II	III	rata-rata
1	Zeolit Alam	40,7583	40,7581	40,7584	40,75826
2	Zeolit Aktif	27,1773	27,1572	27,1575	27,15733
3	Ni-Zeolit Kalsinasi	31,8867	31,8865	31,8869	31,8867
4	Ni-Zeolit R-300	15,2800	15,2803	15,1801	115,28013
5	Ni-Zeolit R-350	14,4425	14,4425	14,4425	14,44246
6	Ni-Zeolit R-400	15,9982	15,9984	15,9987	15,99843
7	Ni-Zeolit R-450	15,5652	15,5623	15,5624	15,56236

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2.4. Penentuan Keasaman Total

Penentuan dengan mengunakan persamaan :

$$\text{Keasaman Total} = \frac{\frac{B - A}{BM\ NH_3}}{A} (\text{mmol.g}^{-1})$$

Diimana :

A Berat Sampel Sebelum
B Berat Sampal Sesudah

No	Sampel	A (gram)	B (gram)	A-B (gram)	(A-B) BM NH_3 (mmol)	Keasaman total (mmol/gram)
1	**Zeolit Alam**	0,48683	0,50746	0,02063	1,21353	2,490
2	**Zeolit Aktif**	0,51330	0,53533	0,02203	1,29000	2,520
3	**Ni-Zeolit Kalsinasi**	0,52990	0,55544	0,02574	1,54100	2,858
4	**Ni-Zeolit R-300**	0,47220	0,50243	0,03030	1,78400	3,779
5	**Ni-Zeolit R-350**	0,48043	0,50996	0,02953	1,73000	3,616
6	**Ni-Zeolit R-400**	0,48700	0,52703	0,04000	2,25470	4,835
7	**Ni-Zeolit R-450**	0,54770	0,57453	0,02667	1,56820	2,862

Contoh Perhitungan :

Zeolit Alam (ZA) :

A = (berat gelas arloji + berat sampel Sebelum adsorbsi) – berat gelas arloji

= 40,73763 g – 40,25089 g

= 0,48638 g

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B = (berat gelas arloji + berat sampel sesudah adsorbsi) - berat gelas arloji

= 40, 75826 g – 40,2508 g

= 0,50746 g

$$\text{Keasaman Total} = \frac{\frac{B - A}{BM\ NH_3}}{A} = \frac{\frac{0{,}5746g - 0{,}48638g}{17g.mol^{-1}}}{0{,}48638g} = 2{,}49mmol.g^{-1}$$

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