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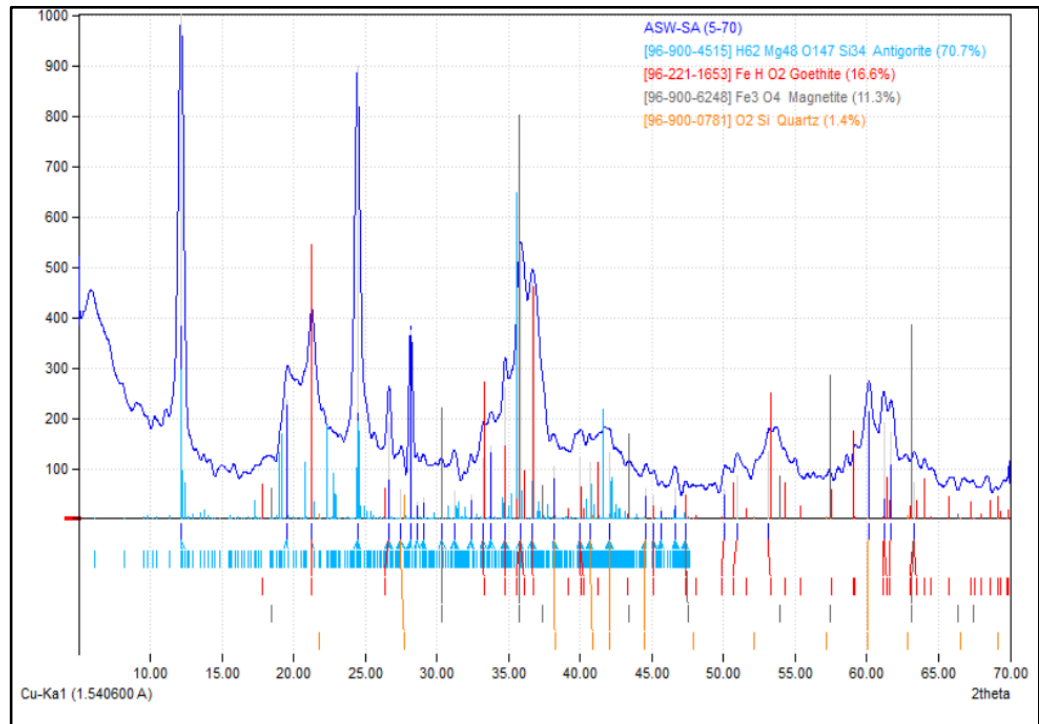
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## **LAMPIRAN**

**LAMPIRAN A**  
**HASIL ANALISIS XRD**

## 1. Sampel Awal

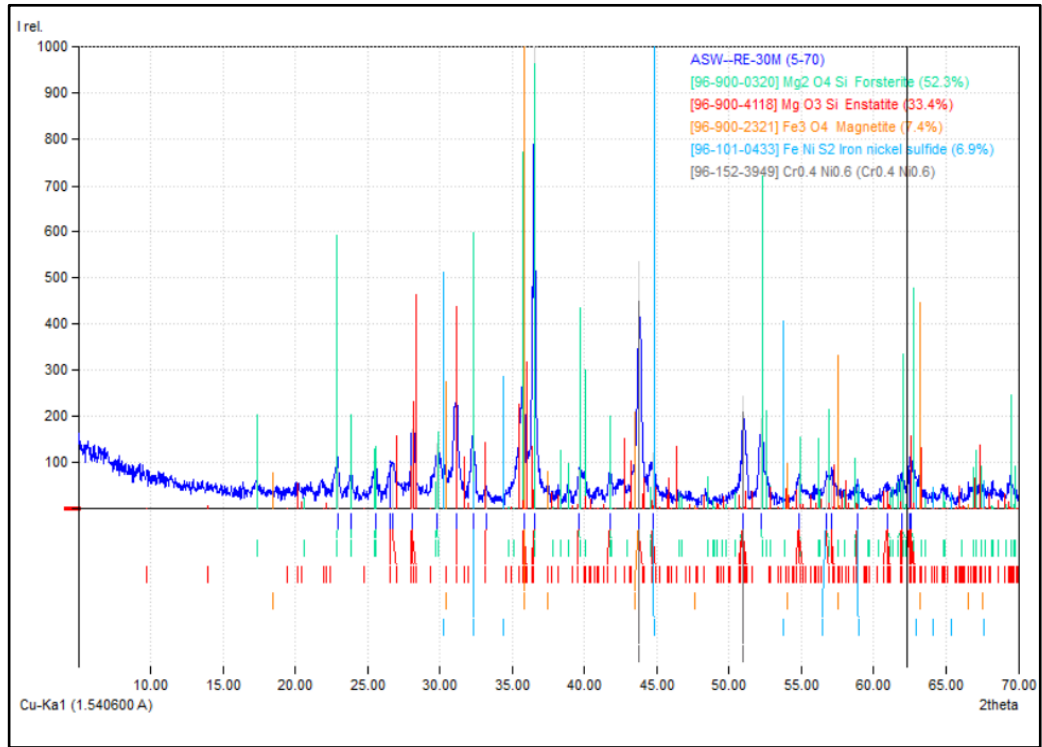


### Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	12.16	7.2727	1000.00	82.27	0.4290	A
2	19.58	4.5302	237.16	30.72	0.6755	A
3	21.28	4.1720	353.43	62.49	0.9219	A,B
4	24.46	3.6363	899.08	80.88	0.4691	A
5	26.66	3.3410	190.10	15.10	0.4141	A,B
6	27.50	3.2408	57.99	3.64	0.3271	A,D
7	28.18	3.1642	373.41	17.19	0.2400	A
8	28.62	3.1165	32.85	1.51	0.2400	A
9	29.06	3.0703	42.47	2.56	0.3138	A
10	30.34	2.9436	36.39	2.48	0.3553	A,C
11	31.20	2.8644	56.40	4.29	0.3968	A
12	32.38	2.7627	46.58	5.20	0.5824	A
13	33.26	2.6916	120.17	15.56	0.6752	A,B
14	33.74	2.6544	143.64	19.88	0.7216	A
15	34.78	2.5773	261.63	38.53	0.7680	A,B
16	35.82	2.5049	528.40	77.82	0.7680	A,B,C
17	36.66	2.4494	469.64	69.16	0.7680	A,B
18	38.16	2.3565	104.71	15.42	0.7680	A,D
19	40.02	2.2511	119.10	17.54	0.7680	A,B
20	40.66	2.2172	111.94	16.49	0.7680	A,D
21	42.02	2.1485	130.28	19.19	0.7680	A,D
22	44.60	2.0300	60.25	8.87	0.7680	A,D
23	45.12	2.0078	46.47	6.84	0.7680	A,B
24	45.68	1.9845	23.95	3.53	0.7680	A
25	46.62	1.9466	60.79	8.95	0.7680	A
26	47.36	1.9179	28.52	4.20	0.7680	A,B,C
27	50.10	1.8193	58.57	8.63	0.7680	B
28	50.96	1.7906	85.85	12.64	0.7680	B
29	53.14	1.7221	134.22	19.77	0.7680	B
30	60.14	1.5373	216.20	48.85	1.1784	D
31	61.18	1.5137	189.86	48.46	1.1784	B
32	61.70	1.5022	172.09	43.92	1.1784	B
33	63.28	1.4684	70.55	18.01	1.1784	B,C



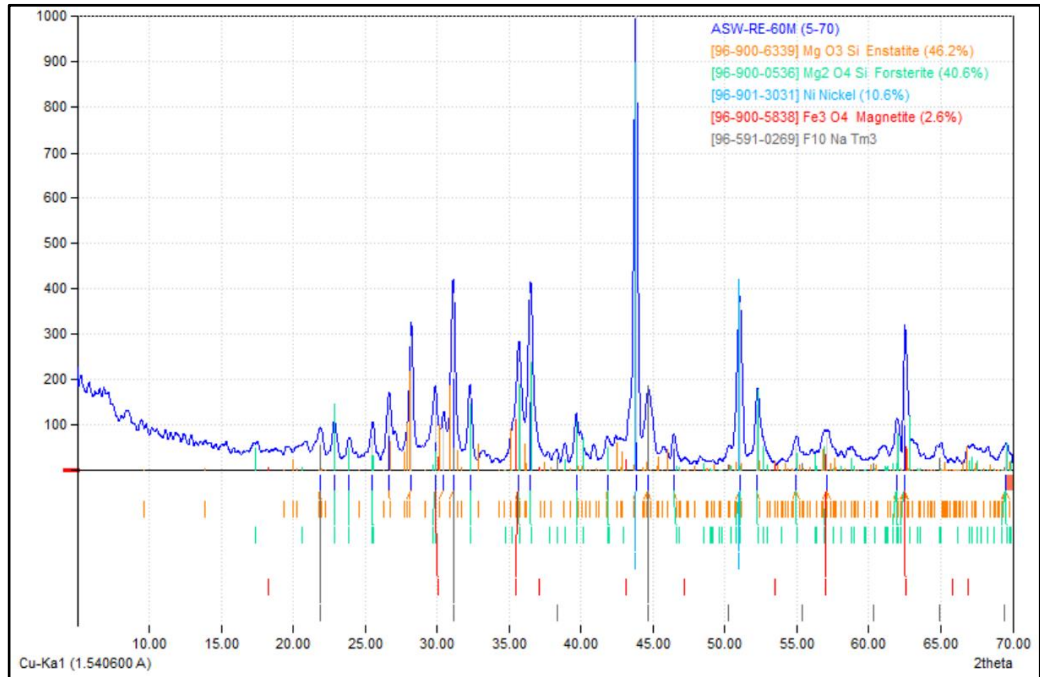
2. Hasil kalsinasi menggunakan reduktor batubara dengan waktu 30 menit



Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	22.92	3.8770	87.94	12.05	0.3283	A
2	23.82	3.7325	55.15	8.23	0.3575	A
3	25.58	3.4796	72.40	11.30	0.3738	A
4	26.58	3.3509	99.33	15.86	0.3826	B
5	26.78	3.3263	97.00	15.67	0.3870	B
6	28.12	3.1708	172.10	28.12	0.3914	B
7	29.82	2.9938	140.36	22.79	0.3890	A
8	31.16	2.8680	283.87	45.82	0.3866	B
9	32.30	2.7693	197.62	31.90	0.3866	A,D
10	33.24	2.6931	39.62	5.84	0.3533	B
11	35.80	2.5062	322.82	43.12	0.3200	A,B,C
12	36.54	2.4571	1000.00	98.75	0.2366	A,B
13	39.66	2.2707	85.43	19.93	0.5589	A,B
14	41.74	2.1623	70.46	13.27	0.4511	A,B
15	43.78	2.0661	534.33	81.36	0.3647	B,C
16	44.76	2.0231	122.38	19.12	0.3743	A,B,D
17	51.00	1.7893	243.46	39.02	0.3839	A,B
18	52.24	1.7497	196.20	36.50	0.4456	A
19	54.82	1.6733	65.23	12.98	0.4768	A,B
20	56.74	1.6211	61.26	16.01	0.4768	A,B,D
21	57.12	1.6112	71.29	18.63	0.4768	B
22	58.88	1.5672	45.95	12.01	0.4768	A,B,D
23	60.98	1.5182	39.14	10.23	0.4768	A,B
24	61.92	1.4974	59.43	15.53	0.4768	A,B
25	62.46	1.4857	91.03	23.78	0.4768	B
26	62.60	1.4827	96.15	25.12	0.4768	A,B

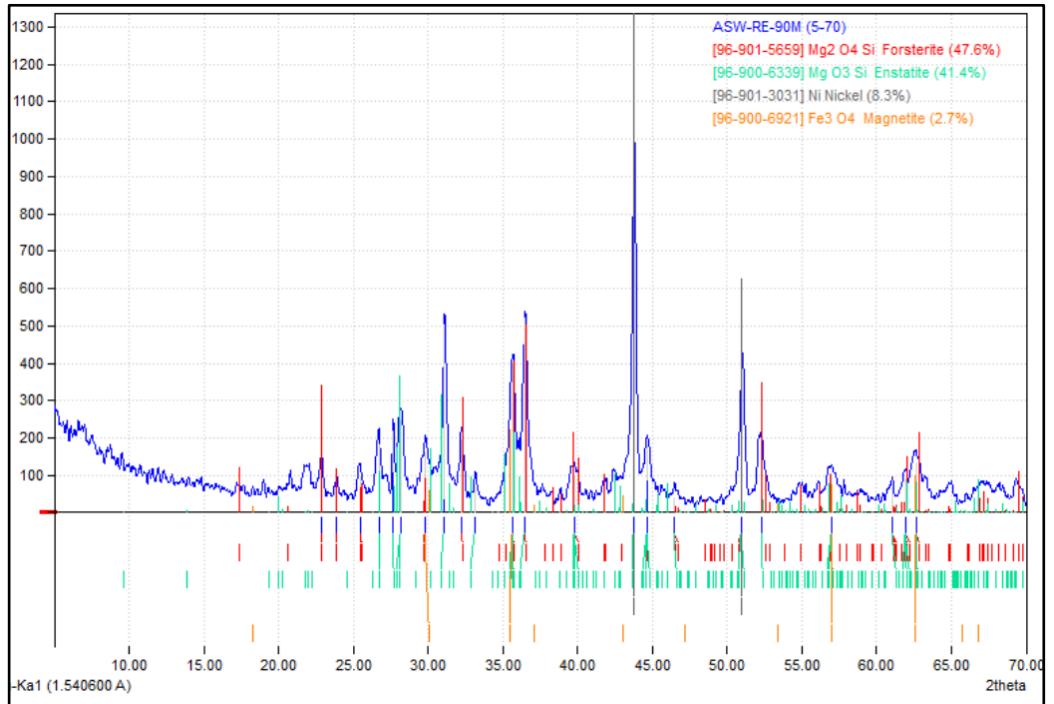
3. Hasil kalsinasi menggunakan reduktor batubara dengan waktu 60 menit



Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	21.86	4.0626	61.02	11.38	0.4924	A
2	22.84	3.8904	75.68	14.12	0.4924	B
3	23.90	3.7202	42.29	7.89	0.4924	B
4	25.50	3.4903	76.12	9.31	0.3229	B
5	26.66	3.3410	142.98	20.88	0.3855	A
6	28.22	3.1598	296.21	32.92	0.2934	A
7	29.86	2.9898	151.84	27.37	0.4759	B,D
8	30.46	2.9323	100.63	18.14	0.4759	A
9	31.12	2.8716	390.83	53.29	0.3600	A
10	32.28	2.7710	168.13	19.16	0.3009	B
11	35.68	2.5144	245.79	51.36	0.5517	A,B,D
12	36.50	2.4597	388.67	58.89	0.4000	B
13	39.68	2.2696	94.58	16.53	0.4613	A,B
14	41.84	2.1573	51.79	10.82	0.5516	A,B
15	43.82	2.0643	1000.00	110.85	0.2927	A,C
16	44.66	2.0274	154.80	17.16	0.2927	A,B
17	46.42	1.9546	58.10	7.11	0.3230	A,B
18	51.02	1.7886	370.39	53.01	0.3779	A,B,C
19	52.20	1.7509	142.96	25.39	0.4688	A,B
20	54.96	1.6693	56.88	11.12	0.5161	A,B
21	57.06	1.6128	71.98	23.45	0.8601	A,B,D
22	61.98	1.4961	93.24	14.75	0.4175	A,B
23	62.44	1.4861	226.80	31.46	0.3663	A,B,D
24	69.48	1.3518	40.30	9.92	0.6501	A,B

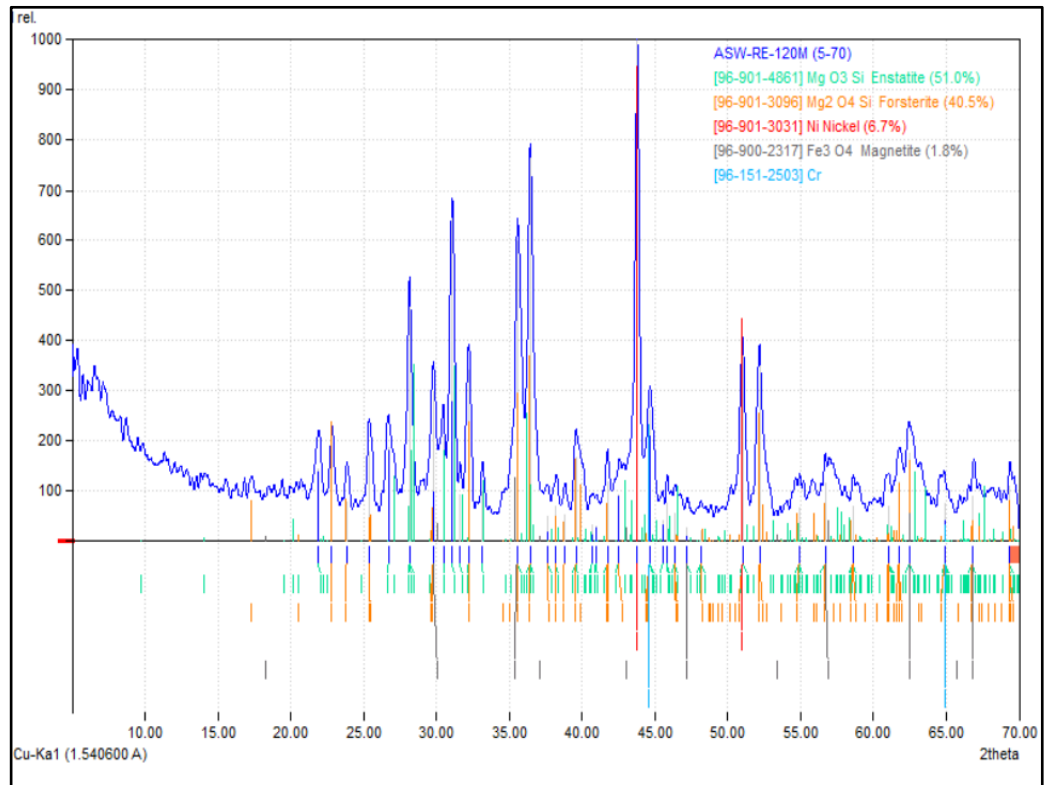
4. Hasil kalsinasi menggunakan reduktor batubara dengan waktu 90 menit



Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	22.88	3.8837	113.81	9.73	0.3046	A
2	23.88	3.7233	56.26	3.53	0.2233	A
3	25.44	3.4984	94.13	9.48	0.3588	A
4	26.70	3.3361	182.83	20.13	0.3922	B
5	27.66	3.2224	217.68	23.97	0.3922	B
6	28.20	3.1620	248.29	27.34	0.3922	B
7	29.80	2.9957	158.81	27.59	0.6188	A,D
8	31.10	2.8734	504.48	42.88	0.3028	B
9	32.24	2.7744	192.21	18.24	0.3381	A
10	33.14	2.7010	72.93	6.92	0.3381	B
11	35.66	2.5157	398.32	56.89	0.5087	A,B,D
12	36.48	2.4610	521.35	58.55	0.4000	A,B
13	39.80	2.2631	97.81	19.97	0.7271	A,B
14	43.78	2.0661	1000.00	84.82	0.3021	B,C
15	44.64	2.0283	177.06	15.02	0.3021	A,B
16	46.48	1.9522	38.57	4.09	0.3779	A,B
17	51.00	1.7893	408.83	41.86	0.3647	A,B,C
18	52.28	1.7484	191.67	28.61	0.5317	A,B
19	56.96	1.6154	100.97	22.40	0.7900	A,B,D
20	61.04	1.5168	67.42	20.50	1.0312	A,B
21	61.94	1.4969	87.21	29.62	1.1517	A,B
22	62.62	1.4823	131.71	47.05	1.2723	A,B,D

5. Hasil kalsinasi menggunakan reduktor batubara dengan waktu 120 menit

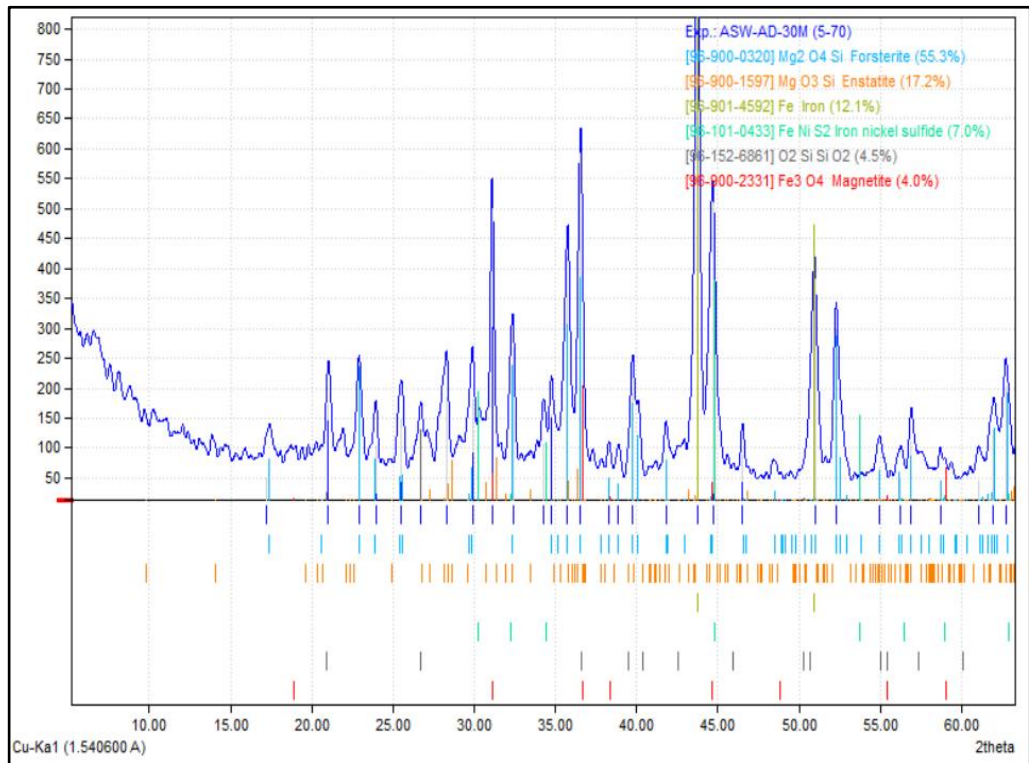


Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	21.90	4.0552	144.45	14.42	0.4675	A
2	22.82	3.8938	150.70	15.04	0.4675	B
3	23.84	3.7294	78.74	7.86	0.4675	B
4	25.40	3.5038	179.82	12.88	0.3355	B
5	26.70	3.3361	185.99	19.27	0.4852	A
6	28.16	3.1664	468.41	36.48	0.3648	A
7	29.80	2.9957	298.18	29.54	0.4641	B,D
8	30.48	2.9304	210.59	20.86	0.4641	A
9	31.08	2.8752	645.32	55.10	0.4000	A
10	31.62	2.8273	92.67	7.91	0.4000	A
11	32.24	2.7744	341.95	29.20	0.4000	A,B
12	33.16	2.6995	97.97	8.37	0.4000	A
13	35.58	2.5212	599.83	63.63	0.4970	A,B,D
14	36.44	2.4636	764.41	65.27	0.4000	A,B
15	37.60	2.3903	50.29	4.29	0.4000	A,B
16	38.22	2.3529	69.34	5.92	0.4000	A,B
17	38.84	2.3168	53.48	4.57	0.4000	B
18	39.58	2.2751	166.01	14.18	0.4000	A,B
19	40.70	2.2151	33.17	2.80	0.3956	A
20	41.00	2.1996	29.43	2.47	0.3934	A
21	41.74	2.1623	117.50	9.81	0.3911	A,B
22	42.48	2.1263	93.09	7.77	0.3911	A,B
23	43.80	2.0652	1000.00	69.81	0.3270	C
24	44.66	2.0274	260.35	18.18	0.3270	A,B
25	45.54	1.9903	41.24	2.88	0.3270	A
26	45.84	1.9779	75.23	5.25	0.3270	A
27	46.38	1.9562	54.56	3.81	0.3270	A,B
28	47.20	1.9241	27.53	1.92	0.3270	A,D
29	48.16	1.8879	22.85	1.60	0.3270	A,B
30	51.02	1.7886	371.31	32.52	0.4103	A,B,C
31	52.18	1.7515	350.42	30.69	0.4103	B
32	54.94	1.6699	68.01	17.69	1.2184	A,B
33	56.68	1.6227	115.25	31.51	1.2184	A,B,D
34	58.60	1.5740	69.00	18.87	1.2184	A,B
35	61.08	1.5159	70.63	19.31	1.2184	A,B
36	61.72	1.5017	119.71	32.73	1.2184	B
37	62.44	1.4861	174.71	47.77	1.2184	A,B,D
38	64.88	1.4360	74.38	20.34	1.2184	A,B
39	66.84	1.3986	89.26	24.41	1.2184	A,B,D
40	69.36	1.3538	109.51	29.94	1.2184	A,B



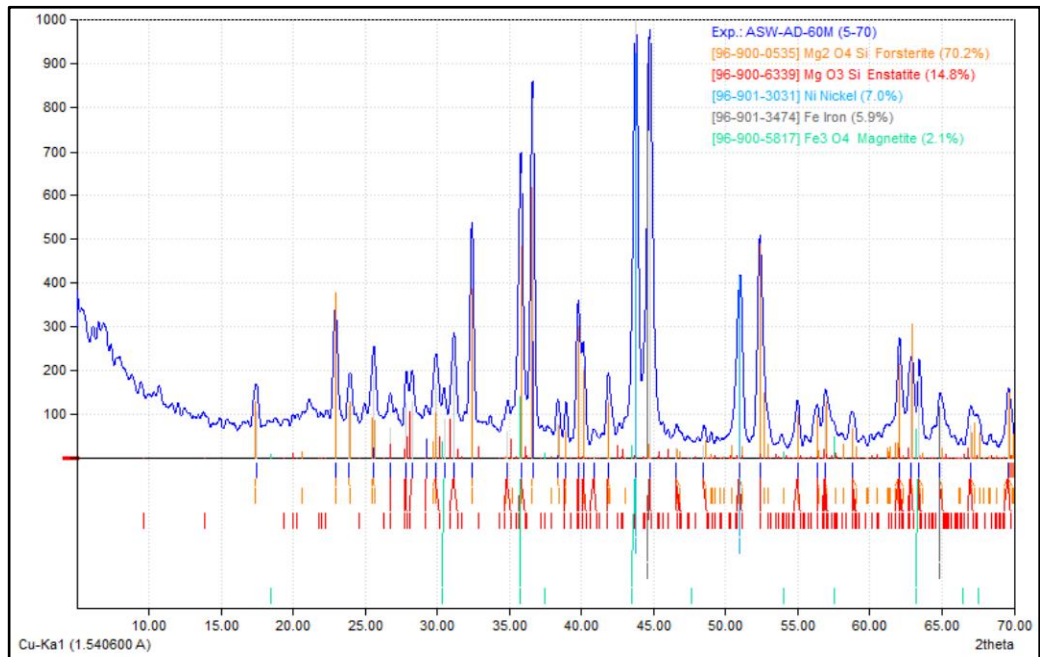
6. Hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 30 menit



Peak List

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
1	17.22	5.1454	50.02	0.7746	A
2	21.02	4.2230	171.97	0.3663	E
3	22.90	3.8804	186.28	0.3470	A,B
4	23.94	3.7141	103.02	0.3470	A
5	25.52	3.4876	147.55	0.3503	A
6	26.72	3.3336	97.69	0.4761	B,E
7	28.30	3.1510	183.57	0.4712	B
8	29.88	2.9879	181.59	0.5454	A,B
9	31.10	2.8734	499.04	0.2650	B,F
10	32.38	2.7627	266.95	0.3479	A,B,D
11	34.26	2.6153	106.06	0.4771	D
12	34.76	2.5788	156.14	0.4771	A,B
13	35.74	2.5103	419.29	0.4000	A,B
14	36.54	2.4571	591.52	0.3600	A,B,E,F
15	38.30	2.3482	49.29	0.2110	A,B,F
16	38.88	2.3145	40.95	0.3275	A
17	39.74	2.2663	190.46	0.4440	A,B,E
18	41.80	2.1593	82.61	0.3414	A,B
19	43.72	2.0688	1000.00	0.3654	B,C
20	44.70	2.0257	509.38	0.4400	A,B,D,F
21	46.52	1.9506	89.31	0.2377	A,B
22	50.96	1.7906	382.66	0.4618	A,B,C,E
23	52.28	1.7484	298.34	0.3960	A,B
24	54.98	1.6688	67.27	0.4486	A,B,E
25	56.26	1.6338	48.79	0.4179	A,B,D
26	56.90	1.6169	112.18	0.3871	A,B
27	58.70	1.5716	38.98	0.4480	A,B,D
28	61.04	1.5168	45.66	0.4650	A,B
29	61.98	1.4961	131.59	0.4650	A,B
30	62.72	1.4802	200.54	0.4650	A,B,D
31	63.40	1.4659	69.86	0.4650	A,B
32	64.98	1.4340	61.22	0.6214	A,B,F
33	67.18	1.3923	49.77	0.6383	A,B

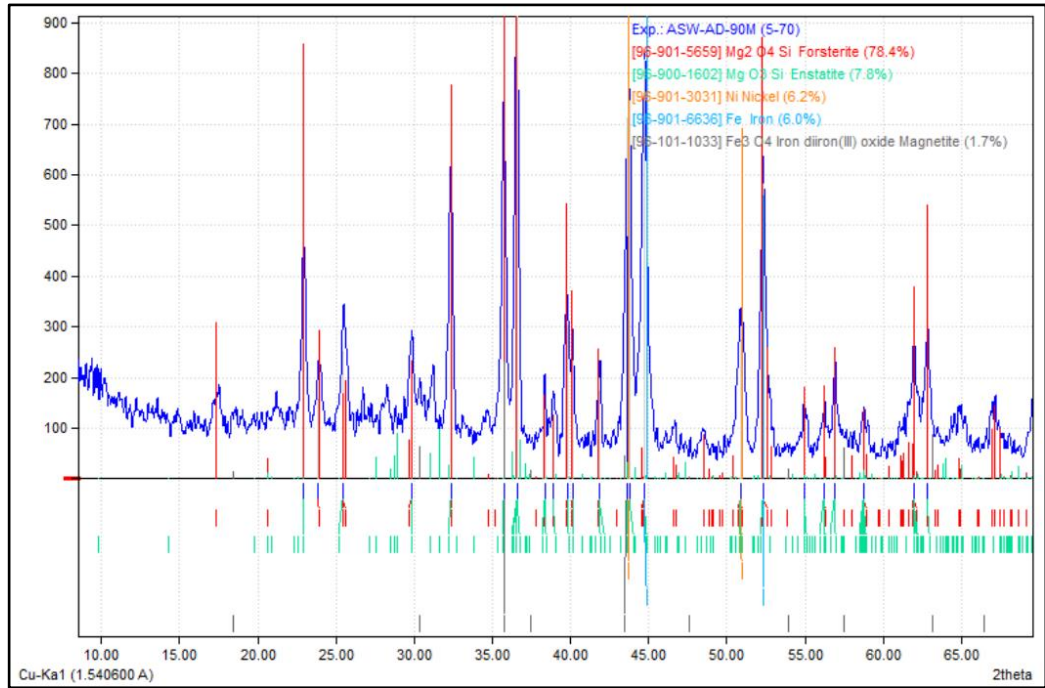
7. Hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 60 menit



Peak List

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
1	17.46	5.0752	106.83	0.3440	A
2	22.94	3.8737	288.82	0.3307	A
3	23.90	3.7202	119.81	0.3307	A
4	25.60	3.4769	186.74	0.3787	A
5	26.74	3.3312	69.95	0.4692	B
6	27.84	3.2020	125.93	0.4692	B
7	28.26	3.1554	129.21	0.4692	B
8	29.22	3.0539	46.83	0.4692	B
9	29.90	2.9859	169.00	0.4692	A,B
10	30.48	2.9304	89.64	0.4692	E
11	31.16	2.8680	218.87	0.4692	B
12	32.40	2.7610	502.70	0.2792	A
13	34.88	2.5702	61.26	0.3697	A,B
14	35.80	2.5062	649.39	0.3600	A,B,E
15	36.60	2.4532	820.78	0.3200	A
16	38.38	2.3435	77.53	0.1964	A
17	38.94	2.3110	62.95	0.2000	A,B
18	39.80	2.2631	327.45	0.2849	A,B
19	40.14	2.2447	208.89	0.2849	A,B
20	40.88	2.2057	4.18	0.2849	B
21	41.88	2.1553	142.81	0.2982	A,B
22	43.78	2.0661	1000.00	0.3804	B,C,E
23	44.76	2.0231	954.93	0.4400	A,B,D
24	46.58	1.9482	24.85	0.2250	A,B
25	48.48	1.8762	29.28	0.1382	A,B
26	51.00	1.7893	401.06	0.4198	A,B,C
27	52.38	1.7453	490.73	0.3990	A,B
28	54.98	1.6688	104.21	0.2849	A,B
29	56.34	1.6317	86.95	0.5087	A,B
30	56.90	1.6169	121.65	0.5087	A,B
31	58.78	1.5696	76.37	0.3633	A,B
32	62.06	1.4943	236.56	0.4022	A,B
33	62.84	1.4776	194.30	0.4022	A,B
34	63.42	1.4655	188.53	0.4022	A,B,E
35	64.84	1.4368	100.42	0.5618	A,B,D
36	66.98	1.3960	74.73	0.5841	A,B
37	69.60	1.3497	110.16	0.3022	A,B

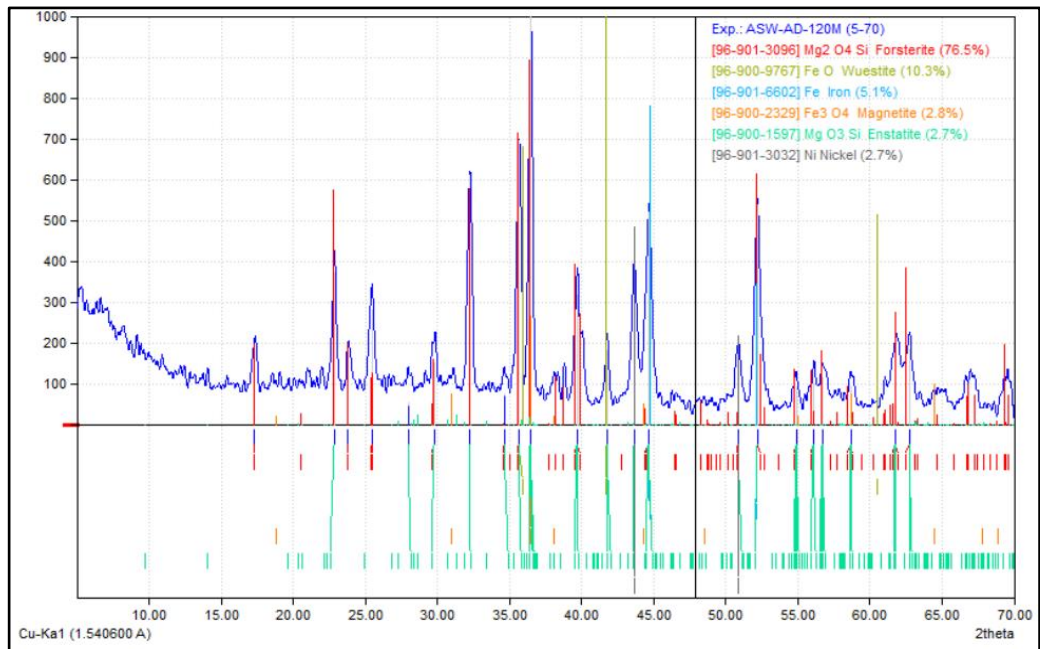
8. Hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 90 menit



Peak List

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
1	22.92	3.8770	401.31	0.3342	A,B
2	23.88	3.7233	156.65	0.3342	A
3	25.48	3.4930	251.50	0.4421	A,B
4	29.86	2.9898	203.38	0.4499	A,B
5	32.34	2.7660	591.41	0.3051	A,B
6	35.72	2.5116	724.69	0.3098	A,B,E
7	36.58	2.4545	1000.00	0.2812	A,B
8	38.36	2.3446	135.65	0.1369	A,B
9	38.90	2.3133	99.94	0.2340	A,B
10	39.78	2.2642	302.35	0.4204	A,B
11	40.14	2.2447	232.29	0.4204	A,B
12	41.88	2.1553	173.76	0.2053	A,B
13	43.66	2.0715	713.04	0.4701	B,E
14	43.78	2.0661	746.52	0.3200	B,C
15	44.76	2.0231	827.28	0.3600	A,B,D
16	50.86	1.7939	273.89	0.5637	A,B,C
17	52.32	1.7472	580.97	0.3711	A,B,D
18	54.92	1.6705	76.84	0.3700	A,B
19	56.24	1.6343	88.86	0.3354	A,B
20	56.92	1.6164	207.19	0.3354	A,B
21	58.78	1.5696	76.86	0.3671	A,B
22	61.98	1.4961	194.83	0.5202	A,B
23	62.84	1.4776	240.87	0.5202	A,B

9. Hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 120 menit



Peak List

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
1	17.28	5.1276	130.03	0.4873	A
2	22.86	3.8871	373.84	0.3084	A,E
3	23.78	3.7387	126.22	0.3084	A
4	25.46	3.4957	284.15	0.3911	A
5	27.98	3.1863	56.15	0.5299	E
6	29.84	2.9918	151.66	0.4518	A,E
7	32.24	2.7744	612.40	0.3505	A,E
8	34.64	2.5874	78.59	0.3558	A,E
9	35.64	2.5171	699.02	0.3610	A,B,E
10	36.48	2.4610	1000.00	0.3200	A,D,E
11	39.72	2.2674	318.46	0.5106	A,E
12	41.78	2.1603	182.16	0.2491	A,B,E
13	43.64	2.0724	365.22	0.4442	E,F
14	44.68	2.0266	523.20	0.4800	A,C,E
15	50.88	1.7932	172.64	0.4499	A,E,F
16	52.22	1.7503	540.55	0.4659	A,C,E
17	54.88	1.6716	94.90	0.4096	A,D,E
18	56.12	1.6376	101.93	0.6704	A,E
19	56.70	1.6222	116.77	0.6704	A,E
20	58.66	1.5726	95.61	0.6704	A,D,E
21	61.80	1.5000	177.32	1.0404	A,E
22	62.74	1.4797	185.47	1.0404	A,E



**LAMPIRAN B**  
**HASIL ANALISIS XRF**

Analisis XRF Sampel Hasil Kalsinasi



**PT. IFISHDECO Tbk.**  
**Mineral Laboratory Analysis**  
 SITE TINANGGEEA, KONAWA SELATAN

**REPORT OF ANALYSIS**

Date of Report : 11-October-2022  
 Subject : Analysis Sample Nickel Laterit  
 Sample Description : Dry Sample  
 Sample Quantity : -  
 Tested For : Element Analysis  
 Date Received : 09-October-2022  
 Date Analysis : 10-October-2022  
 Type of Sample Analysis : Press Pellet Samples

No	Sample ID	MC	Fe (%)	Ni (%)		Co (%)	MgO (%)	SiO2 (%)	CaO (%)	Al2O3 (%)	P (%)	Cr2O3 (%)	MnO (%)	TiO2 (%)	SiO2/MgO Ratio
				Results	certificate										
1	STD OREAS 187	NA	13.60	1.38	1.37	0.0636	17.99	46.66	0.341	2.80	0.0000	0.9869	0.4118	0.033	2.59
2	STD OREAS 190	NA	24.82	1.64	1.64	0.0890	6.91	38.22	0.133	6.00	0.0001	1.7260	0.7071	0.064	5.53
3	STD OREAS 192	NA	12.66	1.78	1.77	0.0404	21.32	43.58	0.313	2.76	0.0001	0.9129	0.3395	0.036	2.04
4	STD OREAS 193	NA	13.65	1.94	1.93	0.0495	20.25	42.72	0.362	3.08	0.0000	0.9623	0.3885	0.053	2.11
5	STD OREAS 194	NA	11.52	2.12	2.13	0.0428	22.83	43.02	0.311	2.74	0.0001	0.8191	0.3199	0.035	1.88
1	A01-01	NA	16.81	1.70		0.0603	15.12	27.74	0.38	3.14	0.0025	0.9889	0.3469	0.1095	1.83
2	A01-02	NA	16.70	1.62		0.0575	14.01	27.09	0.42	3.17	0.0026	1.0079	0.3483	0.1022	1.93
3	A01-03	NA	16.44	1.56		0.0600	14.61	28.21	0.40	3.14	0.0007	0.9972	0.3590	0.1111	1.93
4	A01-04	NA	16.85	1.54		0.0596	13.65	26.90	0.43	3.24	0.0027	1.0136	0.3410	0.1104	1.97
5	B01-01	NA	18.06	1.88		0.0668	15.46	28.46	0.41	3.32	0.0018	1.0205	0.3589	0.1190	1.84
6	B01-02	NA	17.97	1.87		0.0666	15.83	27.56	0.37	3.31	0.0022	1.0221	0.3680	0.1272	1.74
7	B01-03	NA	17.74	1.82		0.0647	16.26	29.07	0.40	3.29	0.0040	1.0108	0.3611	0.1232	1.79
8	B01-04	NA	17.82	1.86		0.0627	17.13	29.76	0.40	3.25	0.0019	1.0310	0.3791	0.1029	1.74
<b>TOTAL AVERAGE</b>			<b>NA</b>	<b>16.51</b>	<b>1.73</b>	<b>0.0603</b>	<b>16.26</b>	<b>33.77</b>	<b>0.36</b>	<b>3.33</b>	<b>0.0014</b>	<b>1.0384</b>	<b>0.3869</b>	<b>0.0867</b>	<b>2.08</b>

**Analytical Methods:**

Chemical Analysis: X-Ray Fluorescence (XRF) analysis. All results reported on percentage of dry basis except stated as ratio (no unit).  
 Moisture Content (MC): Percentage loss of mass of original sample at 105 oC until constant weight.  
 NA: Not Available.

Laboratory Analyst

Muh. Nur Alif

Tinanggea, 11 Oktober, 2022  
 QAQC Department

Diana Sutistna

**LAMPIRAN C**  
**PERHITUNGAN RECOVERY**

## A. Nikel

No	Waktu Kalsinasi (menit)	Kadar awal (%)	Berat Awal (gr)		Berat setelah Kalsinasi (gr)		Kadar Akhir (%)		Recovery (%)	
			Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif
1	30	1,48	16,5	18	12,61	13,08	1,88	1,7	97,07	83,44
2	60	1,48	16,5	18	12,40	12,92	1,87	1,62	94,96	78,59
3	90	1,48	16,5	18	12,23	12,83	1,82	1,56	91,17	75,12
4	120	1,48	16,5	18	12,20	12,85	1,86	1,54	92,95	74,12

*Recovery* Ni dihitung menggunakan rumus sebagai berikut:

$$\text{Recovery (\%)} = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

1. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dengan waktu 30 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,61(\text{gr}) \times 1,88(\%))}{16,5(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 97,07 \%$$

2. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dengan waktu 60 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,40(\text{gr}) \times 1,87(\%))}{16,5(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 94,96 \%$$

3. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dengan waktu 90 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,23(\text{gr}) \times 1,82(\%))}{16,5(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 91,17 \%$$

4. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dengan waktu 120 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,20(\text{gr}) \times 1,86(\%))}{16,5(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 92,95 \%$$

5. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 30 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(13,08(\text{gr}) \times 1,7(\%))}{18(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 83,44 \%$$

6. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 60 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,92(\text{gr}) \times 1,62(\%))}{18(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 78,59 \%$$

7. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dan aditif Na<sub>2</sub>CO<sub>3</sub> dengan waktu 90 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,83(\text{gr}) \times 1,56(\%))}{18(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 75,12 \%$$

8. Recovery Ni hasil kalsinasi menggunakan reduktor batubara dan aditif Na<sub>2</sub>CO<sub>3</sub> dengan waktu 120 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Ni} \times \text{Kadar Produk Ni})}{(\text{M Awal Ni} \times \text{Kadar Awal Ni})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,85(\text{gr}) \times 1,54(\%))}{18(\text{gr}) \times 1,48(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 74,12 \%$$

## B. Iron

No	Waktu Kalsinasi (menit)	Kadar awal (%)	Berat Awal (gr)		Berat setelah Kalsinasi (gr)		Kadar Akhir (%)		Recovery (%)	
			Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif	Reduktor	Reduktor dan Aditif
1	30	22.44	16,5	18	12,61	13,08	18.06	16.81	61.51	54.43
2	60	22.44	16,5	18	12,40	12,92	17.97	16.7	60.19	53.44
3	90	22.44	16,5	18	12,23	12,83	17.74	16.44	58.62	52.22
4	120	22.44	16,5	18	12,20	12,85	17.82	16.85	58.74	53.62

*Recovery Fe* dihitung menggunakan rumus sebagai berikut:

$$\text{Recovery (\%)} = \frac{(\text{M produk Fe} \times \text{Kadar Produk FE})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

1. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dengan waktu 30 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,61(\text{gr}) \times 18,06(\%))}{16,5(\text{gr}) \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 61,51 \%$$

2. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dengan waktu 60 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,23(\text{gr}) \times 17,74(\%))}{16,5(\text{gr}) \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 60,19 \%$$

$$\text{Recovery (\%)} = 61,51 \%$$

3. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dengan waktu 90 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,40(\text{gr}) \times 17,97(\%))}{16,5(\text{gr}) \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 58,62 \%$$

4. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dengan waktu 120 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,20 \text{ (gr)} \times 17,82(\%))}{16,5(\text{gr}) \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 58,74 \%$$

5. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 30 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(13,08 \text{ (gr)} \times 16,81(\%))}{18 \text{ (gr)} \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 54,43 \%$$

6. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 60 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,92 \text{ (gr)} \times 16,7(\%))}{18 \text{ (gr)} \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 53,44 \%$$

7. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 90 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,83 \text{ (gr)} \times 16,44(\%))}{18 \text{ (gr)} \times 22,44(\%)} \times 100\%$$



$$\text{Recovery (\%)} = 52,22 \%$$

8. Recovery Fe hasil kalsinasi menggunakan reduktor batubara dan aditif  $\text{Na}_2\text{CO}_3$  dengan waktu 120 menit

$$\text{Recovery (\%)} : = \frac{(\text{M produk Fe} \times \text{Kadar Produk Fe})}{(\text{M Awal Fe} \times \text{Kadar Awal Fe})} \times 100\%$$

$$\text{Recovery (\%)} = \frac{(12,85 \text{ (gr)} \times 16,85(\%))}{18 \text{ (gr)} \times 22,44(\%)} \times 100\%$$

$$\text{Recovery (\%)} = 53,62 \%$$

**LAMPIRAN D**  
**KARTU KONSULTASI TUGAS AKHIR**

Kartu Kontrol Tugas Akhir

Lampiran B 10  
Kartu Konsultasi Tugas Akhir

**JUDUL:** Pengaruh waktu kalsinasi terhadap peningkatan kadar nikel bijih saprolit menggunakan reduktor bitumena dan aditif  $\text{Na}_2\text{CO}_3$   
(Konsultasi minimal 8 kali)

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
03/11/2022	Format laporan skripsi	A
04/11/2022	Bab I	A
05/11/2022	Bab II, III	A
06/11/2022	Perbaikan Tujuan penelitian	A
14/11/2022	Hasil dan Pembahasan	A
17/11/2022	Hasil dan Pembahasan	A
23/11/2022	Abstrak	A
02/12/2022	Abstrak	A
09/12/2022	Kesimpulan dan saran	A

Aae