DAFTAR PUSTAKA

Aladin, A. (2009). Penentuan Rasio Optimum Campuran CPO: Batubara dalam Desulfuridasi dan Deasing Secara Flotasi Sistem Kontinyu. *Jurnal Rekayasa Proses*, 3(2), 50-56.

Annisa, A. (2016). Pengaruh Mineral Sekunder Sulfat Hasil Oksidasi Pirit Terhadap Nilai Total Sulfur Pada Batubara Formasi Haloq dan Serpih Karbonan Formasi Batuayau Cekungan Kutai Atas. *PROMINE*, 4(2).

ASTM D4239-18. (2018). *Standard Test Method for Sulfur in the Analysis Sample of Coal and Coke Using High-Temperature Tube Furnace Combustion. ASTM Book of Standards*. USA: ASTM International, p. 1-6.

ASTM D388-05. (2019). *Standard classification of coals by rank*. *ASTM Book of Standards*. USA; ASTM International, p. 1-6.

Ehsani, M. R. (2006). Desulfurization of tabas coals using chemical reagents. *Journal of Chemical Engineering Department*. Isfahan University of Technology, Isfahan, I.R. Iran.

Febriaty, I. R., & Harlia, A. H. A. (2016). Perbandingan Metode Hidrolisis Asam Dan Basa Tandan Kosong Kelapa Sawit Sebagai Bahan Baku Pembuatan Asam Oksalat. *Jurnal Kimia Khatulistiwa*, 5(4).

Hidayat, A. (2012). Variabel Penelitian Adalah: Pengertian, Jenis, Contoh. *Statistikian. com. https://www. statistikian. com/2012/10/variabel-penelitian. html (December 8, 2021).*

Hidayat, A. (2017). Metode Penelitian Adalah: Pengertian, Tujuan, Jenis, Manfaat, Contoh. *Last modified*.

Hu, P., Zhang, Y., Liu, T., Huang, J., Yuan, Y., & Zheng, Q. (2017). Highly selective separation of vanadium over iron from stone coal by oxalic acid leaching. *Journal of Industrial and Engineering Chemistry*, 45, 241-247.

Irwandy, A. (2014). Batubara Indonesia. *Jakarta: Gramedia Pustaka Utama*.

Kasim, R. W. (2023). *Analisis Benefisiasi Batubara dengan Metode Flotasi Kolom Menggunakan Air Laut* (Doctoral dissertation, Universitas Hasanuddin).

Katoh, K. (2011). *Thermal Coal and Sub-Bituminous Coal.* Jakarta: Indonesian Coal Mining Association, p. 126.

, V. H. (2018). *Metodologi Penelitian Pedoman Penulisan Karya Tulis miah:(KTI)*. Deepublish.

Kusumaningrum, R., Fitroturokhmah, A., Sinaga, G. S. T., Wismogroho, A. S., Widayatno, W. B., Diguna, L. J., & Amal, M. I. (2019). Study: leaching of zinc dust from electric arc furnace waste using oxalic acid. In IOP Conference Series: *Materials Science and Engineering* (Vol. 478, No. 1, p. 012015). IOP Publishing.

Laskowski, J. (2001). *Coal flotation and fine coal utilization*. Elsevier.

Liu, J., Jiang, J., Jiang, C., Wang, Z., & Chen, P. (2022). Desulfurization mechanism of high-sulfur coal by heating reduced iron powder and magnetic separation. *Journal of Cleaner Production*, 370, 133254.

Maidi, S., & Yunasril, Y. (2020). Desulfurisasi Batubara dengan Metode Leaching Menggunakan Pelarut Asam Klorida (HCl). *Bina Tambang*, 5(2), 218-227.

Muchjidin, M. (2006). Pengendalian Mutu Dalam Industri Batubara. *Penerbit ITB Bandung.*

Mulyana, H. (2005). Kualitas batubara dan stockpile management. *PT Geoservices, LTD.*

Nur, Z., Oktavia, M., & Desmawita, D. (2020). Analisis Kualitas Batubara Di Pit Dan Stockpile Dengan Metoda Analisis Proksimat Di PT. Surya Anugrah Sejahtera Kecamatan Rantau Pandan Kabupaten Bungo Provinsi Jambi. *Jurnal Mine Magazine, 1(2)*.

Orem, W. H., & Finkelman, R. B. (2003). Coal formation and geochemistry (Vol. 7, p. 407).

Osborne, D. (2013). *The Coal Handbook*: *Towards Cleaner Production: Volume 2: Coal Utilisation. Elsevier.*

Palit, C. (2018). Studi Benefisasi Bauksit Jenis Gibsit Berkadar Silika Tinggi Asal Tayan-Kalimantan Barat dengan Menggunakan Metode Flotasi Kebalikan Kationik. Institut Teknologi Bandung: Bandung.

Riley, J. T. (2007). *Routine coal and coke analysis: collection, interpretation, and use of analytical data* (pp. 84-92). Pennsylvania: ASTM International.

Sachsenhofer, R. F., Privalov, V. A., Izart, A., Elie, M., Kortensky, J., Panova, E. A., & Zhykalyak, M. V. (2003). Petrography and geochemistry of Carboniferous coal seams in the Donets Basin (Ukraine): implications for paleoecology. *International Journal of Coal Geology*, 55(2-4), 225-259.

Satiman, N. (2020). Pengertian Metode Penelitian dan Jenis-jenis Metode Penelitian. *Retrieved June, 1*, 2021.

Secretariat General of the National Energy Council. (2019). *Indonesia Energy Outlook (IEO)* 2019, 4, 5.

Sepfitrah, S. (2016). Analisis Proximate Kualitas Batubara Hasil Tambang Di Riau (Studi Kasus Logas, Selensen dan Pangkalan Lesung). *JURNAL SAINSTEK*, *4*(1), 17.

Sitompul, M. R., & Suryaa, F. (2018). Ekstraksi asam oksalat pada umbi porang (Amorphophallus oncophyllus) dengan Metode Microwave Solvent Extraction dan Mechanical Separation. *Naskah Skripsi S*, 1.

Speight, J. G. (2015). *Handbook of coal analysis*. John Wiley & Sons.

Sudarsono, A. S. (2003). Pengantar preparasi dan pencucian batubara. *Bandung: Institut Teknologi Bandung.*

Tang, Y., Xue, L., Gou, M., Wang, L., Ma, P., & Yu, X. (2022). Study on influencing factors of Coal Microbial Flotation Desulfurization. *Fuel*, 358, 130115.

Taylor, G. H., Teichmueller, M., Davis, A., Diessel, C. K., Littje, R., and Robert. (1998). *Organic Petrologi*. Gebrueder Borntraeger, Berlin, Stutgart, 704 p.

Thomas, L. (2013). Coal Geology, Second Edi. ed, Coal Geology. *A John Wiley & Sons, Ltd.,. doi*, *10*, 9781118385685.

Ward, C. R. (2002). Analysis and significance of mineral matter in coal seams. *International Journal of Coal Geology*, *50*(1-4), 135-168.

Widodo, S., Oschmann, W., Bechtel, A., Sachsenhofer, R. F., Anggayana, K., & Puettmann, W. (2010). Distribution of sulfur and pyrite in coal seams from Kutai Basin (East Kalimantan, Indonesia): Implications for paleoenvironmental conditions. *International Journal of Coal Geology*, *81*(3), 151-162.

Xiuyi, T. (2009). Mineral matter in coal. *Coal, Oil Shale, Natural Bitumen, Heavy Oil and Peat-Volume I*, 165.

Zhang, Z., Yang, J., Ding, L., & Zhao, Y. (2012). Estimation of coal particle size distribution by image segmentation. *International Journal of Mining Science and Technology*, 22(5), 739-744.

LAMPIRAN

LAMPIRAN 1

HASIL PERHITUNGAN ANALISIS PROKSIMAT SAMPEL AWAL

1. **Analisis Kandungan Air (*Moisture Content*)**

   Analisis kadar air dapat dihitung dengan menggunakan rumus:

   $$\text{MC (\%)} = \frac{W2 - W3}{W2 - W1} \text{ x } 100\%$$

   Keterangan:

   W1 = Berat cawan (gram)

   W2 = Berat cawan + sampel (gram)

   W3 = Berat cawan + sampel setelah dipanaskan (gram)

   Maka,

   $$\text{MC (\%)} = \frac{W2 - W3}{W2 - W1} \text{ x } 100\%$$

   $$\text{MC (\%)} = \frac{13{,}7036 - 13{,}6898}{13{,}7036 - 12{,}7036} \text{ x } 100\%$$

   $$\text{MC (\%)} = 0{,}0138 \text{ x } 100\%$$

   $$= 1{,}38\%$$

2. **Analisis Kandungan Abu (*Ash Content*)**

   Analisis kandungan abu dapat dihitung dengan menggunakan rumus:

   $$\text{AC (\%)} = \frac{W3 - W1}{W2 - W1} \text{ x } 100\%$$

   Keterangan:

   W1 = Berat cawan (gram)

   W2 = Berat cawan + sampel (gram)

   W3 = Berat cawan + sampel setelah dipanaskan (gram)

   Maka,

   $$\text{AC (\%)} = \frac{W3 - W1}{W2 - W1} \text{ x } 100\%$$

   $$\text{AC (\%)} = \frac{12{,}0848 - 12{,}0149}{13{,}0149 - 12{,}0149} \text{ x } 100\%$$

   $$\text{AC (\%)} = 0{,}0699 \text{ x } 100\%$$

   $$= 6{,}99\%$$

3. **Analisis Kandungan Zat Terbang (*Volatille Matter*)**

   Analisis kandungan zat terbang dapat dihitung dengan menggunakan rumus:

   $$\text{VM (\%)} = \frac{W2 - W3}{W2 - W1} \text{ x } 100\%$$

   Keterangan:

   W1 = Berat cawan + tutup (gram)

   Berat cawan + tutup + sampel (gram)

   Berat cawan + tutup + sampel setelah dipanaskan (gram)

   ,

$$VM\ (\%) = \frac{W2-W3}{W2-W1} \text{ x } 100\%$$

$$VM\ (\%) = \frac{20{,}2407-19{,}7996}{20{,}2407-19{,}2407} \text{ x } 100\%$$

VM (%) = 0,4411 x 100%

= 44,11%

4. Analisis Kandungan Karbon Tertambat (*Fixed Carbon*)

Analisis kandungan karbon tertambat dapat dihitung dengan menggunakan rumus:

FC = 100% - (MC + VM + AC)

Keterangan:

FC = *Fixed Carbon* (%)

MC = *Moisture Content* (%)

VM = *Volatille Matter* (%)

AC = *Ash Content* (%)

Maka,

FC = 100% - (MC + VM + AC)

FC = 100% - (1,38 + 44,11 + 6,99)

FC = 47,52%

LAMPIRAN 2

HASIL PERHITUNGAN REDUKSI KADAR SULFUR (DESULFURISASI) BATUBARA SETELAH PENCUCIAN BATUBARA

Hasil Perhitungan Reduksi Sulfur (Desulfurisasi) Setelah Pencucian Batubara

1. **Percobaan 1 M 4 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 1{,}99}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 16{,}73\%$$

2. **Percobaan 2 M 4 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 1{,}98}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 17{,}15\%$$

3. **Percobaan 3 M 4 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 2{,}00}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 16{,}31\%$$

4. **Percobaan 4 M 4 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 1{,}95}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 18{,}41\%$$

5. **Percobaan 4 M 2 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 1{,}99}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 16{,}73\%$$

6. **Percobaan 4 M 6 Jam**

$$\text{Desulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{Desulfurisasi (\%)} = \frac{2{,}39 - 2{,}04}{2{,}39} \times 100\%$$

$$\text{Desulfurisasi (\%)} = 14{,}64\%$$

7. **baan 4 M 8 Jam**

$$\text{esulfurisasi (\%)} = \frac{\text{Kadar sulfur awal (\%)} - \text{Kadar sulfur akhir (\%)}}{\text{Kadar sulfur awal (\%)}} \times 100\%$$

$$\text{esulfurisasi (\%)} = \frac{2{,}39 - 1{,}97}{2{,}39} \times 100\%$$

$$\text{esulfurisasi (\%)} = 17{,}57\%$$

LAMPIRAN 3
HASIL ANALISIS XRD

Match! Phase Analysis Report

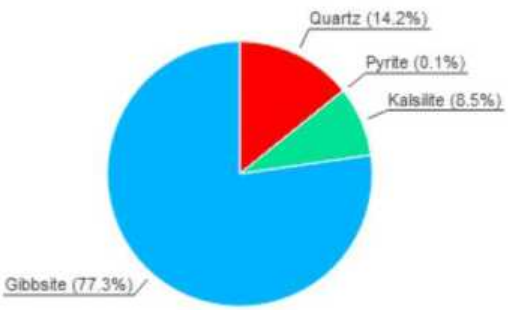
Sample: BB-EGI

Sample Data

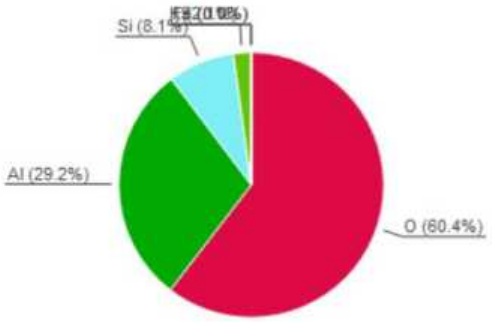
File name	BB-EGI.txt
File path	E:/PROPOSAL KP DAN TA/ANALISIS XRD/EGI
Data collected	Mar 13, 2024 11:41:41
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.541874 Å

Analysis Results

Phase composition (Weight %)



Elemental composition (Weight %)



Index	*Amount (%)*	*Name*	*Formula sum*
A	14.2	Quartz	O2 Si
B	0.1	Pyrite	Fe S2
C	8.5	Kalsilite	Al K O4 Si
D	77.3	Gibbsite	Al O3
	16.5	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Element	*Amount (weight %)*
O	*60.4%(*)*
Al	29.2%
Si	8.1%
K	2.1%
S	0.0%
Fe	0.0%
**LE (sum)*	*60.4%*

Details of identified phases

A: Quartz (14.2 %)*

Formula sum	O2 Si
Entry number	96-901-1494
Figure-of-Merit (FoM)	0.584139*
Total number of peaks	140
Peaks in range	140
Peaks matched	14
Intensity scale factor	0.09*
	P 31 2 1 S
m	trigonal (hexagonal axes)
	a= 4.9210 Å c= 5.4163 Å
	2.99
	2.635 g/cm³

Glinnemann J., King H. E., Schulz H., Hahn T., La Placa S. J., Dacol F., "Crystal structures of the low-temperature quartz-type phases of SiO2 and GeO2at elevated pressure P = room pressure", Zeitschrift fur Kristallographie **198**, 177-212 (1992)

B: Pyrite (0.1 %)*

Formula sum	Fe S2
Entry number	96-900-0596
Figure-of-Merit (FoM)	0.579169*
Total number of peaks	66
Peaks in range	66
Peaks matched	16
Intensity scale factor	0.00*
Space group	P 1
Crystal system	triclinic (anorthic)
Unit cell	a= 5.4166 Å b= 5.4166 Å c= 5.4166 Å α= 90.000° β= 90.000 ° γ= 90.000 °
I/Ic	0.99
Calc. density	5.015 g/cm³
Reference	Bayliss P., "Crystal structure refinement of a weakly anisotropic pyrite", American Mineralogist **62**, 1168-1172 (1977)

C: Kalsilite (8.5 %)*

Formula sum	Al K O4 Si
Entry number	96-901-7540
Figure-of-Merit (FoM)	0.634494*
Total number of peaks	244
Peaks in range	244
Peaks matched	23
Intensity scale factor	0.04*
Space group	P 63
Crystal system	hexagonal
Unit cell	a= 5.1510 Å c= 8.6900 Å
I/Ic	2.16
Calc. density	2.631 g/cm³
Reference	Andou Y., Kawahara A., "The refinement of the structure of synthetic kalsilite", Mineralogical Journal **12**, 153-161 (1984)

D: Gibbsite (77.3 %)*

Formula sum	Al O3
Entry number	96-901-5977
Figure-of-Merit (FoM)	0.663729*
Total number of peaks	996
Peaks in range	996
Peaks matched	76
Intensity scale factor	0.28*
Space group	P 1 21/n 1
Crystal system	monoclinic
Unit cell	a= 8.6410 Å b= 5.0700 Å c= 9.7200 Å β= 85.430 °
I/Ic	1.79
Calc. density	2.347 g/cm³
Reference	Megaw H., "The crystal structure of Hydrargillite Al (O H)3_cod_database_code 1011081", Zeitschrift fur Kristallographie **87**, 185-204 (1934)

(*)2theta values have been shifted internally for the calculation of the amounts, the intensity scaling factors as well as the figure-of-merit (FoM), due to the active search-match option 'Automatic zero point adaption'.

Candidates

Name	*Formula*	*Entry No.*	*FoM*
Iodargyrite	Ag I	96-901-1695	0.6224
Molybdenum(III) catena-phosphate	Mo O9 P3	96-100-1603	0.6073
Caesium rhenate(VII)	Cs O4 Re	96-101-0427	0.6062
Caesium rhenate	Cs O4 Re	96-101-0066	0.6053
	F3 Ga	96-810-0894	0.6041
Silicon oxide - $-alpha (Quartz low)	O2 Si	96-101-1177	0.5645
Quartz	O2 Si	96-901-1494	0.5622
Quartz	O2 Si	96-900-9667	0.5619
Quartz	O2 Si	96-901-0145	0.5606
Quartz	O2 Si	96-901-0147	0.5597
Silicon oxide $-alpha (Quartz low)	O2 Si	96-101-1173	0.5589
Silicon oxide (Quartz)	O2 Si	96-500-0036	0.5589
Quartz	O2 Si	96-900-5019	0.5583
Silicon oxide $-alpha (Quartz low)	O2 Si	96-101-1098	0.5564
Quartz	O2 Si	96-901-0146	0.5564
Quartz	O2 Si	96-901-2601	0.5563
(Quartz low)	O2 Si	96-101-1160	0.5561
	O2 Si	96-900-0776	0.5560
	O2 Si	96-901-3322	0.5558
	O2 Si	96-900-5018	0.5555
	O2 Si	96-900-5020	0.5546
	O2 Si	96-900-5021	0.5494
	O2 Si	96-901-5023	0.5480
	O2 Si	96-900-5022	0.5478

Quartz	O2 Si	96-900-5023	0.5478
Quartz	O2 Si	96-900-5024	0.5218
Quartz	O2 Si	96-900-5025	0.4961
Quartz	O2 Si	96-900-7379	0.4740
Pyrite	Fe S2	96-900-0596	0.3991
Pyrite	Fe S2	96-156-4891	0.3846
Pyrite	Fe S2	96-901-5843	0.3822
Pyrite	Fe S2	96-900-0595	0.3791
FeS2 (pyrite at 1 atm)	Fe S2	96-154-4892	0.3789
Pyrite	Fe S2	96-901-3070	0.3758
Iron persulfide (Pyrite)	Fe S2	96-500-0116	0.3754
Pyrite	As0.54 Fe S1.46	96-901-3072	0.3724
Pyrite	As0.026 Fe S1.974	96-901-3071	0.3677
Pyrrhotite	Fe4.509 S5	96-901-6892	0.3021
Arsenopyrite	As Fe S	96-901-6640	0.2628
Iron arsenide sulfide (1/1/1) (Arsenopyrite)	As Fe S	96-101-0914	0.0000
Copper iron sulfide (Chalcopyrite)	Cu Fe S2	96-101-0930	0.0000
Copper iron sulfide (Chalcopyrite)	Cu Fe S2	96-101-0941	0.0000
Aluminium silicate hydroxide * (Kaolinite 2M)	Al2 H4 O9 Si2	96-101-1046	0.0000
Iron sulfide (.95/1.05) (Pyrrhotite 1T subcell)	Fe0.95 S1.05	96-101-1179	0.0000
Iron sulfide (1.05/.95) (Pyrrhotite)	Fe1.05 S0.95	96-101-1180	0.0000
Silicon oxide - \b (Quartz high)	O2 Si	96-101-1201	0.0000
Silicon oxide (Quartz high)	O2 Si	96-110-0020	0.0000
FeS2 (pyrite at 3.1 GPa)	Fe S2	96-154-4893	0.0000
FeS2 (pyrite at 4.2 GPa)	Fe S2	96-154-4894	0.0000
Kaolinite	Al2 H4 O9 Si2	96-155-0599	0.0000
Kaolinite K-I	Al2 H4 O9 Si2	96-156-6358	0.0000
Kaolinite K-II	Al2 H4 O9 Si2	96-156-6359	0.0000

and 62 others...

Search-Match

Settings

Reference database used	COD-Inorg 2023.06.06
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	0
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Criteria for entries added by user

Reference:

Entry number:

96-101-1098;96-101-1160;96-101-1173;96-101-1177;96-101-1201;96-110-0020;96-500-0036;96-900-0776;96-900-0777;96-900-0778;96-900-0779;96-900-0780;96-900-0781;96-900-5018;96-900-5019;96-900-5020;96-900-5021;96-900-5022;96-900-5023;96-900-5024;96-900-5025;96-900-5026;96-900-5027;96-900-5028;96-900-5029;96-900-5030;96-900-5031;96-900-5032;96-900-5033;96-900-5034;96-900-7379;96-900-8093;96-900-8094;96-900-9667;96-901-0145;96-901-0146;96-901-0147;96-901-1494;96-901-1495;96-901-1496;96-901-1497;96-901-2601;96-901-2602;96-901-2603;96-901-2604;96-901-2605;96-901-2606;96-901-3322;96-901-5023;96-101-1046;96-155-0599;96-156-6358;96-156-6359;96-156-6360;96-900-9231;96-900-9235;96-901-5000;96-901-7767;96-901-7768;96-101-0914;96-101-0930;96-101-0941;96-154-4892;96-154-4893;96-154-4894;96-156-4891;96-210-4742;96-210-4743;96-210-4753;96-210-4754;96-500-0116;96-724-2111;96-900-0110;96-900-0595;96-900-0596;96-900-6171;96-900-6172;96-900-7573;96-901-0012;96-901-3070;96-901-3071;96-901-3072;96-901-3409;96-901-3698;96-901-5006;96-901-5235;96-901-5637;96-901-5843;96-901-6640;96-101-1179;96-101-1180;96-210-4735;96-210-4736;96-210-4739;96-210-4740;96-210-4741;96-210-4750;96-210-4751;96-210-4752;96-500-0092;96-901-3689;96-901-3705;96-901-6892;96-901-6893;96-901-6894;96-901-7804;96-901-7805

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	16.30	5.4336	361.54	134.92	1.4400	B
2	17.54	5.0522	358.16	48.26	0.5200	
3	18.06	4.9079	331.41	371.02	4.3200	D
4	19.74	4.4938	519.78	75.43	0.5600	C,D
5	20.30	4.3711	364.37	392.82	4.1600	C,D
6	20.70	4.2911	365.63	69.84	0.4000	A,D
7	22.30	3.9834	395.61	643.84	6.2800	C,D
	24.86	3.5787	466.41	285.25	2.3600	
	25.30	3.5203	407.82	77.90	0.4000	D
	26.60	3.3484	1000.00	72.56	0.2800	A,D
	28.48	3.1341	233.28	77.38	1.2800	B,C,D
	32.94	2.7192	157.62	19.13	0.4683	B,D
	34.70	2.5852	94.53	6.86	0.2800	C
	37.02	2.4284	131.86	20.06	0.5869	B,C,D
	38.00	2.3680	113.06	21.06	0.7189	D

16	39.32	2.2915	96.32	14.25	0.5711	A,D
17	40.70	2.2169	122.07	38.93	1.2305	B,C,D
18	42.52	2.1261	105.04	31.86	1.1705	A,D
19	44.12	2.0527	250.76	44.93	0.6914	D
20	45.66	1.9870	122.53	37.54	1.1823	A,C,D
21	47.36	1.9195	110.17	26.02	0.9115	B,C,D
22	50.00	1.8242	101.86	16.92	0.6408	A
23	56.22	1.6362	124.60	18.25	0.5653	B,D
24	59.96	1.5428	77.78	8.12	0.4029	A,D
25	64.58	1.4420	403.52	20.91	0.2000	B,C,D

Integrated Profile Areas

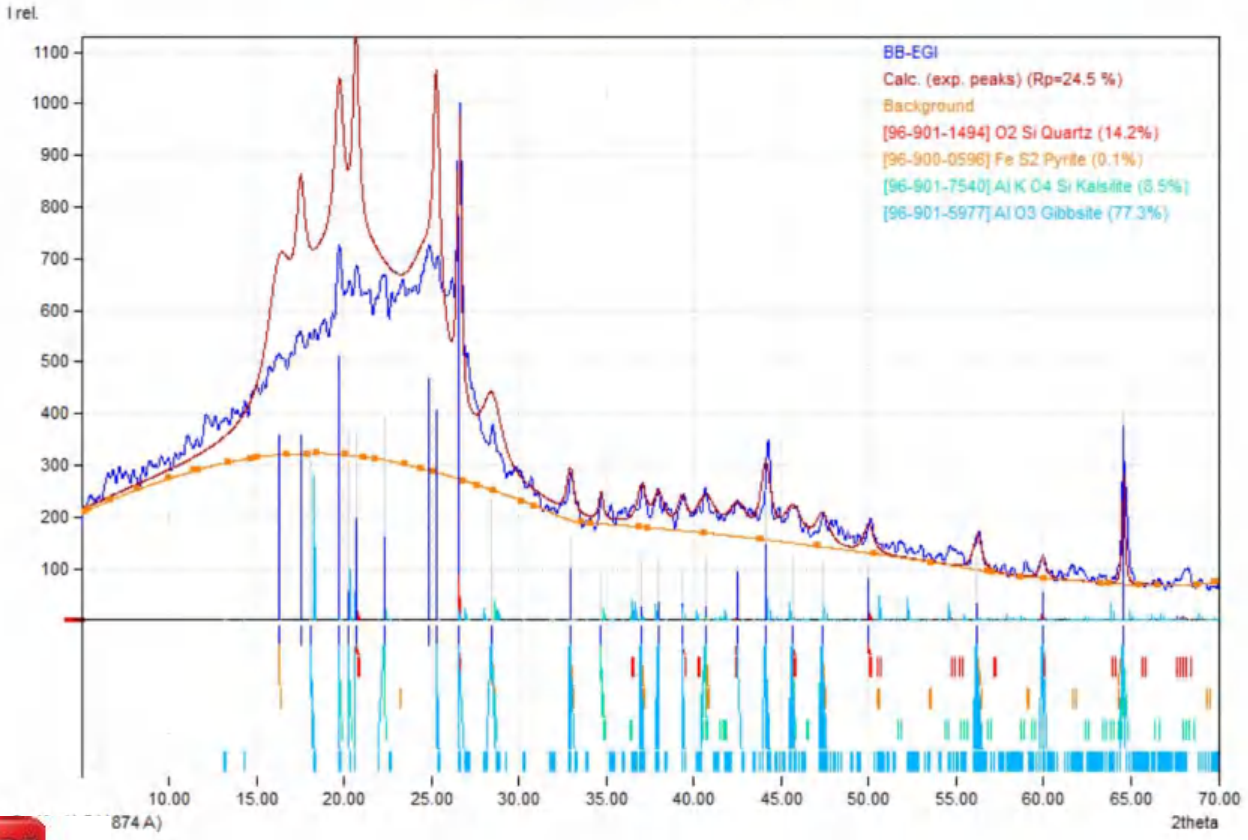
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	328468	100.00%
Background radiation	226209	68.87%
Diffraction peaks	102259	31.13%
Peak area belonging to selected phases	47930	14.59%
Peak area of phase A (Quartz)	*6571*	*2.00%*
Peak area of phase B (Pyrite)	*18*	*0.01%*
Peak area of phase C (Kalsilite)	*4424*	*1.35%*
Peak area of phase D (Gibbsite)	*36917*	*11.24%*
Unidentified peak area	54329	16.54%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	2574	100.00%
Peak intensity belonging to selected phases	718	27.90%
Unidentified peak intensity	1856	72.10%

Diffraction Pattern Graphics



LAMPIRAN 4
HASIL ANALISIS TOTAL SULFUR

LECO
EMPOWERING RESULTS

Overview

- Name: SAMPEL AWAL
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 13:36:31
- Method: BB_ADB
- Description:
- Sulfur Average: 2,39 %
- Set ID: 0000000000002C7D

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2001 g		2,35 %	07/12/2023 13:33:26
0,2005 g		2,42 %	07/12/2023 13:36:31

Overview

- Name: 1M - 4 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 13:53:49
- Method: BB_ADB
- Description:
- Sulfur Average: 1,99 %
- Set ID: 0000000000002C80

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2003 g		1,97 %	07/12/2023 13:51:02
0,2000 g		2,00 %	07/12/2023 13:53:49

Overview

- Name: 2M - 4 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:05:02
- Method: BB_ADB
- Description:
- Sulfur Average: 1,98 %
- Set ID: 0000000000002C89

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2001 g		1,98 %	07/12/2023 14:01:46
0,2002 g		1,98 %	07/12/2023 14:05:02

Overview

- Name: 3M - 4 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:11:16
- Method: BB_ADB
- Description:
- Sulfur Average: 2,00 %
- Set ID: 0000000000002C8C

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2000 g		2,00 %	07/12/2023 14:08:03
0,2003 g		2,00 %	07/12/2023 14:11:16

Overview

- Name: 4M - 4 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:22:25
- Method: BB_ADB
- Description:
- Sulfur Average: 1,95 %
- Set ID: 0000000000002C92

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2000 g		1,94 %	07/12/2023 14:19:45
0,2000 g		1,96 %	07/12/2023 14:22:25

Overview

- Name: 4M - 2 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:27:32
- Method: BB_ADB
- Description:
- Sulfur Average: 1,99 %
- Set ID: 0000000000002C96

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2000 g		1,99 %	07/12/2023 14:25:01
0,2001 g		2,00 %	07/12/2023 14:27:32

LECO
EMPOWERING RESULTS

Overview

- Name: 4M - 6 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:33:13
- Method: BB_ADB
- Description:
- Sulfur Average: 2,04 %
- Set ID: 0000000000002C9C

Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2002 g		2,02 %	07/12/2023 14:30:34
0,2003 g		2,05 %	07/12/2023 14:33:13

Overview

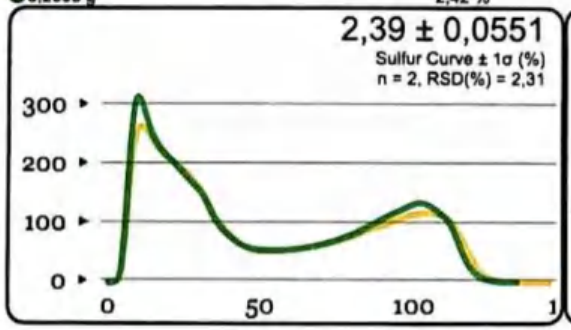
- Name: 4M - 8 JAM
- Number of Included Replicates: 2
- Analysis Date: 07/12/2023 14:39:08
- Method: BB_ADB
- Description:
- Sulfur Average: 1,97 %
- Set ID: 0000000000002C9D

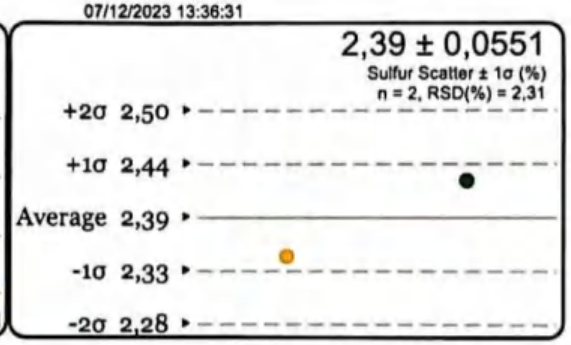
Replicates

Sample Mass	Comments	Sulfur	Analysis Date
0,2003 g		1,97 %	07/12/2023 14:35:51
0,2003 g		1,97 %	07/12/2023 14:39:08

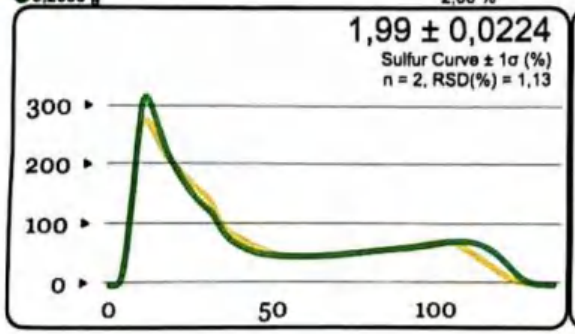
LECO
EMPOWERING RESULTS

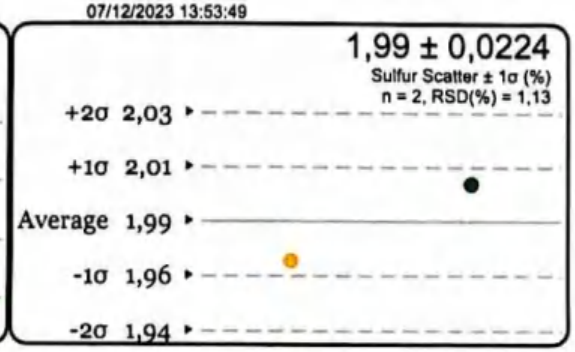
Name	Method	Sulfur Average	Number of Replicates	Included
SAMPEL AWAL	BB_ADB	2,39 %	2	
Description		Sulfur Std. Dev. 0,0551 %	Sulfur %RSD 2,31	
Sample Mass	Comments	Sulfur	Analysis Date	
0,2001 g		2,35 %	07/12/2023 13:33:26	
0,2005 g		2,42 %	07/12/2023 13:36:31	



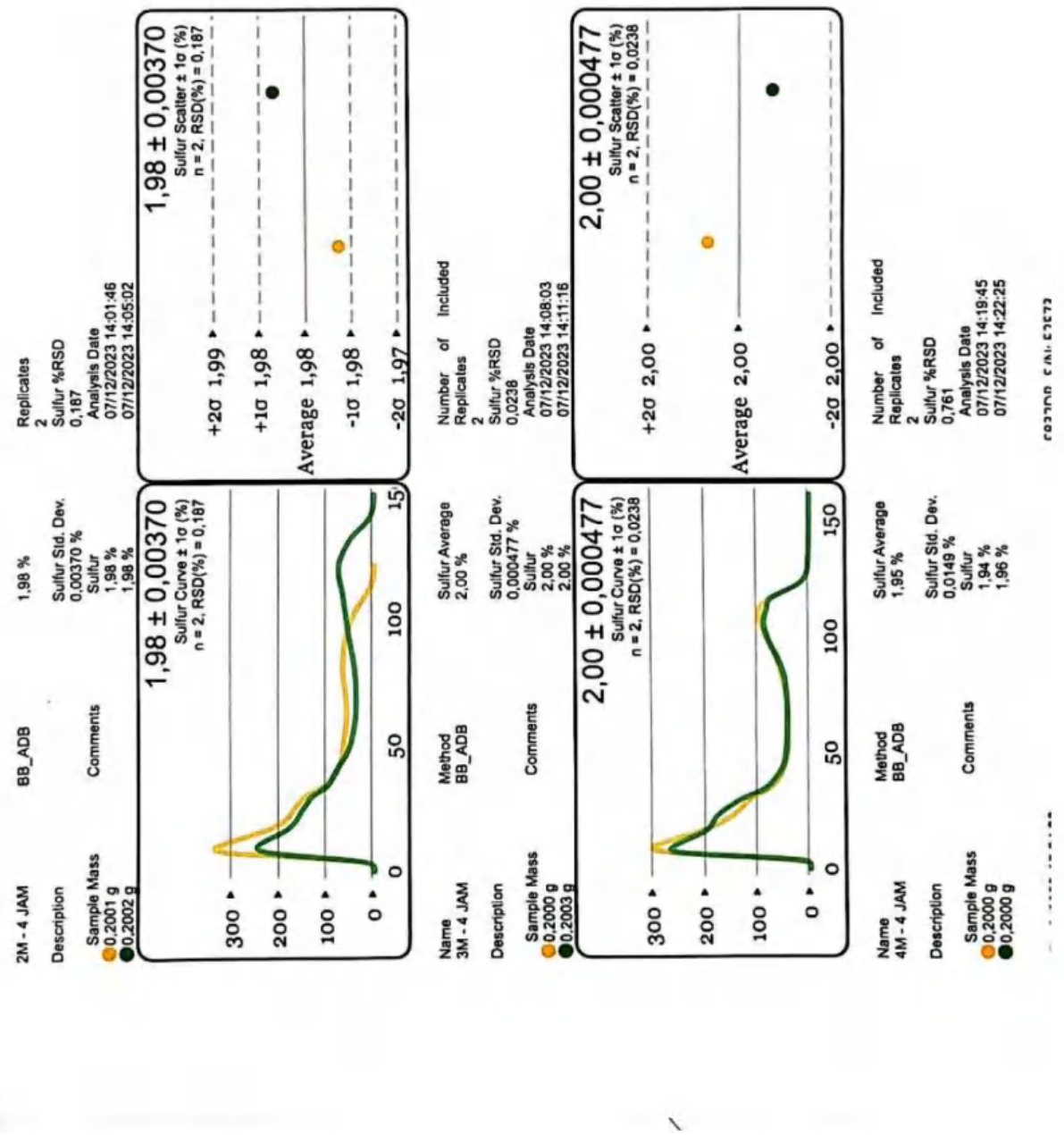


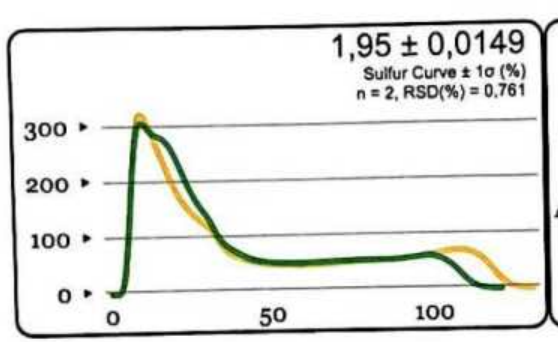
Name	Method	Sulfur Average	Number of Replicates	Included
1M - 4 JAM	BB_ADB	1,99 %	2	
Description		Sulfur Std. Dev. 0,0224 %	Sulfur %RSD 1,13	
Sample Mass	Comments	Sulfur	Analysis Date	
0,2003 g		1,97 %	07/12/2023 13:51:02	
0,2000 g		2,00 %	07/12/2023 13:53:49	

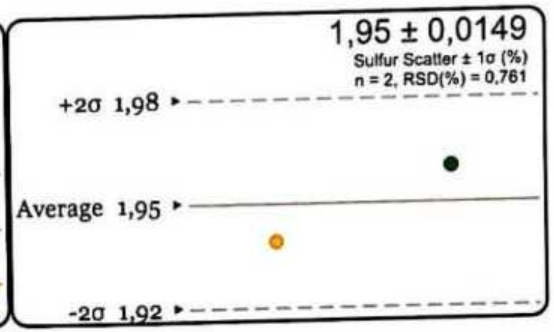




Name	Method	Sulfur Average	Number of	Included
07/12/2023 15:54:20			S832DR S/N: 52573	







Name
4M - 2 JAM

Method
BB_ADB

Sulfur Average
1,99 %

Number of Included Replicates
2

Description

Sulfur Std. Dev.
0,00123 %

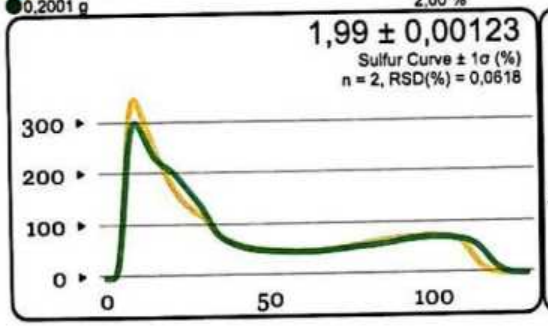
Sulfur %RSD
0,0618

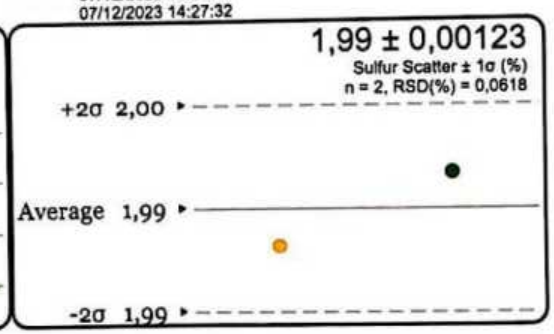
Sample Mass
0,2000 g
0,2001 g

Comments

Sulfur
1,99 %
2,00 %

Analysis Date
07/12/2023 14:25:01
07/12/2023 14:27:32





Name
4M - 6 JAM

Method
BB_ADB

Sulfur Average
2,04 %

Number of Included Replicates
2

Description

Sulfur Std. Dev.
0,0199 %

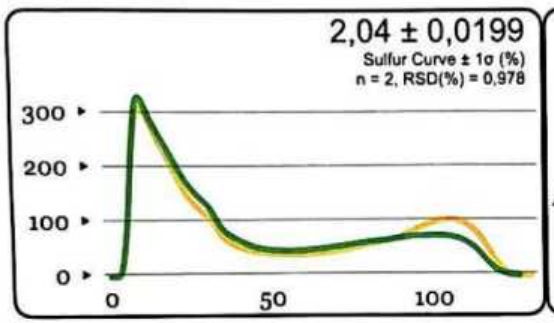
Sulfur %RSD
0,978

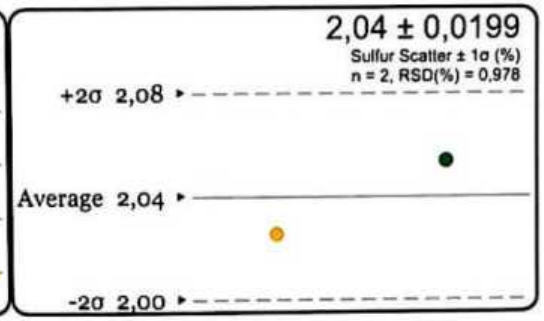
Sample Mass
0,2002 g
0,2003 g

Comments

Sulfur
2,02 %
2,05 %

Analysis Date
07/12/2023 14:30:34
07/12/2023 14:33:13





Name
4M - 8 JAM

Method
BB_ADB

Sulfur Average
1,97 %

Number of Included Replicates
2

Description

Sulfur Std. Dev.
0,00261 %

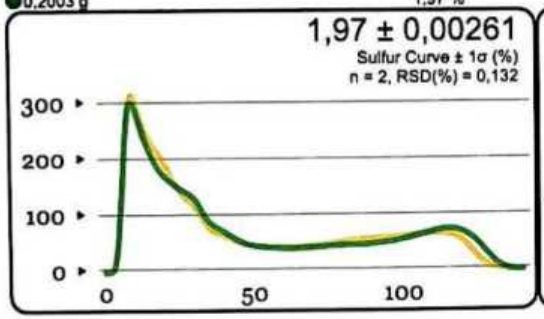
Sulfur %RSD
0,132

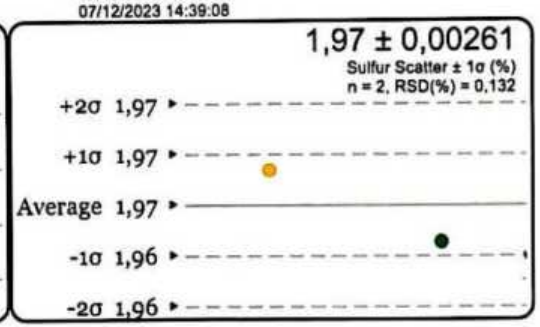
Sample Mass
0,2003 g
0,2003 g

Comments

Sulfur
1,97 %
1,97 %

Analysis Date
07/12/2023 14:35:51
07/12/2023 14:39:08





LAMPIRAN 5
HASIL ANALISIS NILAI KALORI

LABORATORIUM MOTOR BAKAR
DEPARTEMEN TEKNIK MESIN
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
Jalan Poros Malino Km.6 Bontomarannu (92171) Gowa Sulawesi Selatan
Telp. (0411) 586015, 586162 Fax (0411) 586015

SURAT KETERANGAN HASIL ANALISIS SAMPEL

Nomor : 12/LMB-FT/UH/2023

Yang bertanda tangan dibawah ini kepala laboratorium motor bakar menerangkan bahwa:

Nama	: Regina Frensya
NIM	: D111201034
Parameter Uji	: Nilai Kalor
Peralatan	: Bomcalorimeter
Jenis Sampel	: Batubara
Tanggal Uji	: 24 November 2023

No.	Kode Sampel	Nilai Kalor (Kalori/Gram)
1.	Batubara	6.043 (25.286 kJ/kg)

Gowa, 5 Desember 2023
Kepala Laboratorium Motor Bakar,

Prof.Dr.Eng. A. Erwin Eka Putra,S.T., M.T.
NIP. 19711221 199802 1 001

LABORATORIUM MOTOR BAKAR
DEPARTEMEN TEKNIK MESIN
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
Jalan Poros Malino Km.6 Bontomarannu (92171) Gowa Sulawesi Selatan
Telp. (0411) 586015, 586162 Fax (0411) 586015

Lampiran

FOTO CAWAN HASIL PENGUJIAN

LAMPIRAN 6
KARTU KONSULTASI

Lampiran B 10

Kartu Konsultasi Tugas Akhir

JUDUL: STUDI DESULFURISASI BATUBARA DAERAH PALUDA, KABUPATEN BARRU DENGAN MENGGUNAKAN LARUTAN ASAM OKSALAT

(Konsultasi minimal 8 kali)

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
25/04/2024	- Tambahkan peta darrah pengambilan sampel - Tambahkan mengapa penurunan kadar sulfur rendah	
02/05/2024	- Tujuan penelitian - Abstrak - Kesimpulan - Skala dan arah mata angin di peta	
07/05/2024	- Penempatan sub-bab analisis - Tambahkan kesimpulan.	
08/05/2024	- Poster	
13/05/2024	- Abstrak jurnal ilmiah	
14/05/2024	- Metode penelitian	

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
16/05/2024	ACC untuk seminar hasil	
24/06/2024	konsultasi bagan alir	
24/06/2024		