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Lampiran 1. Analisis XRD tembaga sulfida

Match! Phase Analysis Report

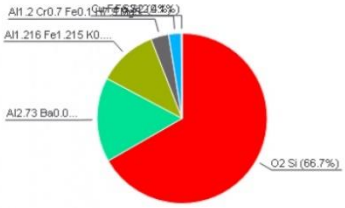
Sample: SU-01

Sample Data

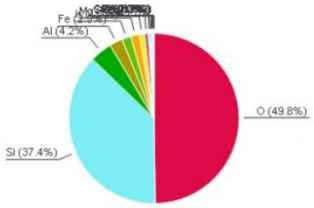
File name	SU-01 Revisi 03.mtd
File path	D:/SATRIAWAN UTOMO BUANA PUTRA/SEMESTER 7/TUGAS AKHIR/DATA XRD/SU-01/Revisi 4
Data collected	Aug 7, 2024 13:50:45
Data range	5.000° - 70.020°
Original data range	5.000° - 70.020°
Number of points	3252
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.541874 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	66.7	Quartz	O2 Si
B	16.1	Muscovite	Al2.73 Ba0.01 H2.86 K0.465 N0.36 Na0.03 O11.236 Si3.128
C	11.3	Biotite	Al1.216 Fe1.215 K0.946 Mg1.545 Mn0.018 Na0.032 O12 Si2.784 Ti0.225
D	3.4	Chlorite	Al1.2 Cr0.7 Fe0.1 H7.9 Mg5 O18 Si3
E	2.4	Copper iron sulfide Chalcopyrite	Cu Fe S2
F	0.1	Pyrite	Fe S2
	8.3	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Element	*Amount (weight %)*
O	*49.8%(*)*
Si	37.4%
Al	4.2%
Fe	2.5%
K	1.7%
Mg	1.6%
S	0.9%
Cu	0.8%
Ti	0.3%
N	*0.2%(*)*
Cr	0.2%
H	*0.2%(*)*
Ba	0.1%
Na	0.0%
Mn	0.0%
**LE (sum)*	*50.2%*

Details of identified phases

A: Quartz (66.7 %)*

Formula sum	O2 Si
Entry number	96-901-1494
Figure-of-Merit (FoM)	0.808543*
Total number of peaks	140
Peaks in range	36
Peaks matched	32
Intensity scale factor	0.62
2theta correction	-0.054°
Space group	P 31 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9210 Å c= 5.4163 Å
I/Ic	2.99 (Source: Unknown)
Calc. density	2.635 g/cm³
Reference	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 GeO2 at elevated pressure P = room pressure", Zeitschrift fur Kristallographie **198**, 177-212 (1992)

B: Muscovite (16.1 %)*

Formula sum	Al2.73 Ba0.01 H2.86 K0.465 N0.36 Na0.03 O11.236 Si3.128
Entry number	96-901-5971
Figure-of-Merit (FoM)	0.511933*
Total number of peaks	600
Peaks in range	386
Peaks matched	161
Intensity scale factor	0.03
2theta correction	-0.035°
Space group	C 1 2/c 1
Crystal system	monoclinic

Unit cell	a= 9.0270 Å b= 5.1999 Å c= 20.6160 Å β= 100.113 °
I/Ic	0.57 (Source: Unknown)
Calc. density	2.576 g/cm³
Reference	Mesto E., Scordari F., Lacalamita M., Schingaro E., "Tobelite and NH4+ -rich muscovite single crystals from Ordovician Armoricansandstones (Brittany, France): Structure and crystal chemistryNote: sample musc_4", American Mineralogist **97**, 1460-1468 (2012)

C: Biotite (11.3 %)

Formula sum	Al1.216 Fe1.215 K0.946 Mg1.545 Mn0.018 Na0.032 O12 Si2.784 Ti0.225
Entry number	96-900-1584
Figure-of-Merit (FoM)	0.000000
Total number of peaks	598
Peaks in range	392
Peaks matched	150
Intensity scale factor	0.07
Space group	C 1 2/c 1
Crystal system	monoclinic
Unit cell	a= 5.3390 Å b= 9.2490 Å c= 20.1960 Å β= 95.060 °
I/Ic	1.86
Calc. density	3.062 g/cm³
Reference	Bigi S., Brigatti M. F., "Crystal chemistry and microstructures of plutonic biotiteSample 2M1 from Valle del Cervo syenitic complex", American Mineralogist **79**, 63-72 (1994)

D: Chlorite (3.4 %)*

Formula sum	Al1.2 Cr0.7 Fe0.1 H7.9 Mg5 O18 Si3
Entry number	96-900-4189
Figure-of-Merit (FoM)	0.478777*
Total number of peaks	284
Peaks in range	284
Peaks matched	108
Intensity scale factor	0.01
2theta correction	-0.137°
Space group	C -1
Crystal system	triclinic (anorthic)
Unit cell	a= 5.3290 Å b= 9.2460 Å c= 14.4420 Å α= 90.000° β= 97.100 ° γ= 90.000 °
I/Ic	0.73 (Source: Unknown)
Calc. density	2.709 g/cm³
Reference	Bailey S. W., "Re-evaluation of ordering and local charge-balance in la chlorite", The Canadian Mineralogist **24**, 649-654 (1986)

E: Copper iron sulfide Chalcopyrite (2.4 %)

Formula sum	Cu Fe S2
Entry number	96-101-0930
Figure-of-Merit (FoM)	0.000000
Total number of peaks	32
Peaks in range	10
Peaks matched	2
Intensity scale factor	0.06
Space group	F -4 3 m
Crystal system	cubic
Unit cell	a= 5.2280 Å
I/Ic	8.46
Meas. density	4.190 g/cm³
Calc. density	4.265 g/cm³
Reference	Burdick C L, Ellis J H, "The Crystal Structure of Chalcopyrite Determined by X-Rays", Journal of the American Chemical Society **39**, 2519-2525 (1917)

F: Pyrite (0.1 %)

Formula sum	Fe S2
Entry number	96-156-4891
Figure-of-Merit (FoM)	0.000000
Total number of peaks	78
Peaks in range	20
Peaks matched	10
Intensity scale factor	0.00
Space group	P a -3
Crystal system	cubic
Unit cell	a= 5.4103 Å
I/Ic	3.54
Calc. density	5.032 g/cm³
Color	black
Reference	Ma KeYuan, Lef?vre Robin, Li Qingtian, Lago Jorge, Blacque Olivier, Yang Wanli, von Rohr Fabian O., "Synthetic control over polymorph formation in the d-band semiconductorsystem FeS2", Chemical Science (2021)

(*)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*
Potassium iron dimagnesium phyllo-alumotrisilicate dihydroxide (Biotite)	Al Fe H2 K Mg2 O12 Si3	96-100-0039	0.0000
Potassium trialuminium dihydroxide trisilicate (Muscovite 2M1)	Al3 H2 K O12 Si3	96-100-0043	0.0000
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
Potassium aluminium silicate hydroxide * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-101-1050	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.873 F0.256 H1.744 K0.894 O11.744 Si2.829	96-110-0008	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.905 F0.256 H1.744 K0.86 O11.744 Si2.895	96-110-0009	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.91 F0.256 H1.744 K0.94 O11.744 Si2.85	96-110-0010	0.0000
Potassium alumosilicate hydrate * (Muscovite 2M1)	Al2.88 Fe0.12 H2 K O12 Si3	96-110-0011	0.0000
Potassium aluminium silicate hydrate * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-110-0012	0.0000
Potassium alumosilicate hydrate * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-110-0013	0.0000
Potassium aluminium silicate hydroxide * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-110-0014	0.0000
Potassium alumosilicate hydroxide * (Muscovite 3T)	Al3 H2 K O12 Si3	96-110-0015	0.0000
Potassium aluminium silicate hydroxide * (Muscovite 3T)	Al2.91 Fe0.09 H2 K O12 Si3	96-110-0016	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.873 F0.256 H1.744 K0.894 O11.744 Si2.829	96-110-1026	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.905 F0.256 H1.744 K0.86 O11.744 Si2.895	96-110-1027	0.0000
Potassium aluminium phyllo-alumosilicate hydroxide fluoride * (Muscovite 2M1)	Al2.91 F0.256 H1.744 K0.94 O11.744 Si2.85	96-110-1028	0.0000
Potassium alumosilicate hydrate * (Muscovite 2M1)	Al2.88 Fe0.12 H2 K O12 Si3	96-110-1029	0.0000
Potassium aluminium silicate hydrate * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-110-1030	0.0000

Potassium alumosilicate hydrate * (Muscovite 2M1)	Al3 H2 K O12 Si3	96-110-1031	0.0000
Potassium alumosilicate hydroxide * (Muscovite 3T)	Al3 H2 K O12 Si3	96-110-1032	0.0000
Potassium aluminium silicate hydroxide * (Muscovite 3T)	Al2.91 Fe0.09 H2 K O12 Si3	96-110-1033	0.0000
K2 (Fe2.786 Mg2.321 Ti0.550) (Al2.413 Si5.587 O20) (O H)4 (Biotite)	Al2.413 Fe2.786 H4 K2 Mg2.321 O24 Si5.587 Ti0.55	96-152-4088	0.0000
FeS2 (pyrite at 1 atm)	Fe S2	96-154-4892	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
Pyrite	Fe S2	96-156-4891	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
Kaolinite K-III	Al2 H4 O9 Si2	96-156-6360	0.0000
lithium chlorite	Cl Li O2	96-201-4618	0.0000
potassium chlorite	Cl K O2	96-201-4619	0.0000
barium chlorite hydrate	Ba Cl2 H7 O7.5	96-201-4931	0.0000
Arsenopyrite	As Fe S	96-210-4742	0.0000
Chalcopyrite	Cu Fe S2	96-210-4743	0.0000
Arsenopyrite	As Fe S	96-210-4753	0.0000
Chalcopyrite	Cu Fe S2	96-210-4754	0.0000
ammonium chlorite	Cl H4 N O2	96-220-5377	0.0000
calcium chlorite	Ca Cl2 O4	96-220-7380	0.0000
strontium chlorite	Cl2 O4 Sr	96-220-7381	0.0000
Iron persulfide (Pyrite)	Fe S2	96-500-0116	0.0000
chalcopyrite (?Chalkopyrit?)	Cu0.5 Fe0.5 S	96-724-2111	0.0000
Biotite	Al F H K Mg3 O11 Si3	96-900-0026	0.0000
Arsenopyrite	As Fe S	96-900-0110	0.0000
Chlorite	H4 Mg3 O9 Si2	96-900-0159	0.0000
Biotite	Al1.999 H2 K Mg2.001 O12 Si3	96-900-0468	0.0000
Biotite	Al1.999 K0.5 Mg2.001 O12 Si3	96-900-0469	0.0000
Pyrite	Fe S2	96-900-0595	0.0000
Pyrite	Fe S2	96-900-0596	0.0000
and 113 others...			

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
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: 96-100-0043;96-101-1050;96-110-0008;96-110-0009;96-110-0010;96-110-0011;96-110-0012;96-110-0013;96-110-0014;96-110-0015;96-110-0016;96-110-1026;96-110-1027;96-110-1028;96-110-1029;96-110-1030;96-110-1031;96-110-1032;96-110-1033;96-900-0838;96-900-1055;96-900-1056;96-900-1057;96-900-1058;96-900-1059;96-900-1953;96-900-1954;96-900-1955;96-900-1956;96-900-1957;96-900-1958;96-900-1959;96-900-1960;96-900-1961;96-900-1962;96-900-1963;96-900-4372;96-900-4373;96-900-4410;96-900-4411;96-900-4412;96-900-4476;96-900-4477;96-900-4641;96-900-4642;96-900-4643;96-900-4644;96-900-4645;96-900-5014;96-900-5015;96-900-5188;96-900-5189;96-900-5201;96-900-5202;96-900-5472;96-900-5473;96-900-5474;96-900-6327;96-900-6328;96-900-6329;96-900-6330;96-900-8133;96-900-9274;96-900-9462;96-901-2887;96-901-2888;96-901-4605;96-901-4749;96-901-4938;96-901-4961;96-901-5387;96-901-5624;96-901-5971;96-901-6013;96-901-6413;96-901-6478;96-901-7157;96-100-0039;96-152-4088;96-900-0026;96-900-0468;96-900-0469;96-900-0744;96-900-0843;96-900-0844;96-900-0845;96-900-1265;96-900-1266;96-900-1267;96-900-1268;96-900-1269;96-900-1347;96-900-1348;96-900-1349;96-900-1350;96-900-1351;96-900-1352;96-900-1353;96-900-1354;96-900-1583;96-900-1584;96-900-2302;96-900-2303;96-900-2304;96-900-2305;96-900-2306;96-900-2307;96-900-2308;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;96-201-4618;96-201-4619;96-201-4931;96-220-5377;96-220-7380;96-220-7381;96-900-0159;96-900-4189;96-901-0164;96-901-0165;96-901-0166;96-901-0167;96-901-0168;96-901-0169;96-901-0170;96-101-0930;96-101-0941;96-210-4743;96-210-4754;96-724-2111;96-900-7573;96-901-5006;96-901-5235;96-901-5637;96-101-0914;96-154-4892;96-154-4893;96-154-4894;96-156-4891;96-210-4742;96-210-4753;96-500-0116;96-900-0110;96-900-0595;96-900-0596;96-900-6171;96-900-6172;96-901-0012;96-901-3070;96-901-3071;96-901-3072;96-901-3409;96-901-3698;96-901-5843;96-901-6640

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	8.80	10.0488	26.97	26.88	0.5949	B,C
2	12.50	7.0815	24.42	17.21	0.4207	D
3	13.76	6.4357	5.87	4.08	0.4149	
4	16.06	5.5189	3.93	1.70	0.2590	
5	17.78	4.9887	19.66	13.52	0.4105	B,C
6	18.82	4.7153	6.14	3.83	0.3721	D
7	19.82	4.4796	37.60	30.50	0.4843	B,C,D
8	20.86	4.2585	180.81	106.84	0.3528	A,B,C,D
9	22.28	3.9902	20.69	17.45	0.5036	B,C
10	23.62	3.7668	38.68	26.11	0.4030	C
11	24.42	3.6452	11.85	10.66	0.5369	B,C,D
12	25.12	3.5452	23.65	37.19	0.9390	B,C,D
13	25.66	3.4718	33.11	15.38	0.2773	D
14	26.66	3.3438	1000.00	515.76	0.3079	A,B,C,D
15	27.60	3.2320	52.28	32.67	0.3731	B
16	29.88	2.9904	36.16	25.60	0.4227	D,E
17	30.84	2.8994	21.48	17.90	0.4975	B,C
18	32.26	2.7750	7.33	5.03	0.4098	
19	34.90	2.5709	84.22	73.92	0.5240	B,C,D
20	35.92	2.5002	5.45	8.07	0.8847	B,C
21	36.58	2.4566	83.23	42.98	0.3083	A,B,C,D
22	37.72	2.3849	25.46	22.18	0.5200	B,C,D
23	39.52	2.2803	39.18	19.34	0.2947	A,B,C,D
24	40.34	2.2359	34.18	18.40	0.3213	A,B,C,D
25	41.72	2.1650	16.33	10.43	0.3814	B,C,D
26	42.50	2.1271	64.01	40.09	0.3739	A,B,C,D
27	45.36	1.9994	19.86	40.79	1.2266	B,C,D
28	45.90	1.9771	25.56	14.32	0.3345	A,B,C,D

29	47.36	1.9195	8.52	3.77	0.2646	B,C,F
30	50.18	1.8181	96.63	49.83	0.3079	A,B
31	50.80	1.7973	23.60	9.37	0.2371	A,B,C,D,F
32	54.94	1.6713	29.15	14.03	0.2873	A,B,C,D
33	55.42	1.6579	22.86	35.03	0.9149	A,B,C,D
34	56.56	1.6272	6.81	6.95	0.6089	B,C,D,F
35	57.84	1.5942	0.00	0.00	1.0513	B,C,D
36	58.90	1.5680	6.09	10.73	1.0513	B,C,D,E,F
37	60.02	1.5414	86.81	47.90	0.3295	A,B,C,D
38	61.94	1.4982	30.11	25.97	0.5148	B,C,D,F
39	64.12	1.4524	16.75	9.34	0.3330	A,B,C,D,F
40	67.80	1.3822	38.29	21.54	0.3358	A,B,C
41	68.28	1.3737	67.33	52.17	0.4625	A,C

Integrated Profile Areas

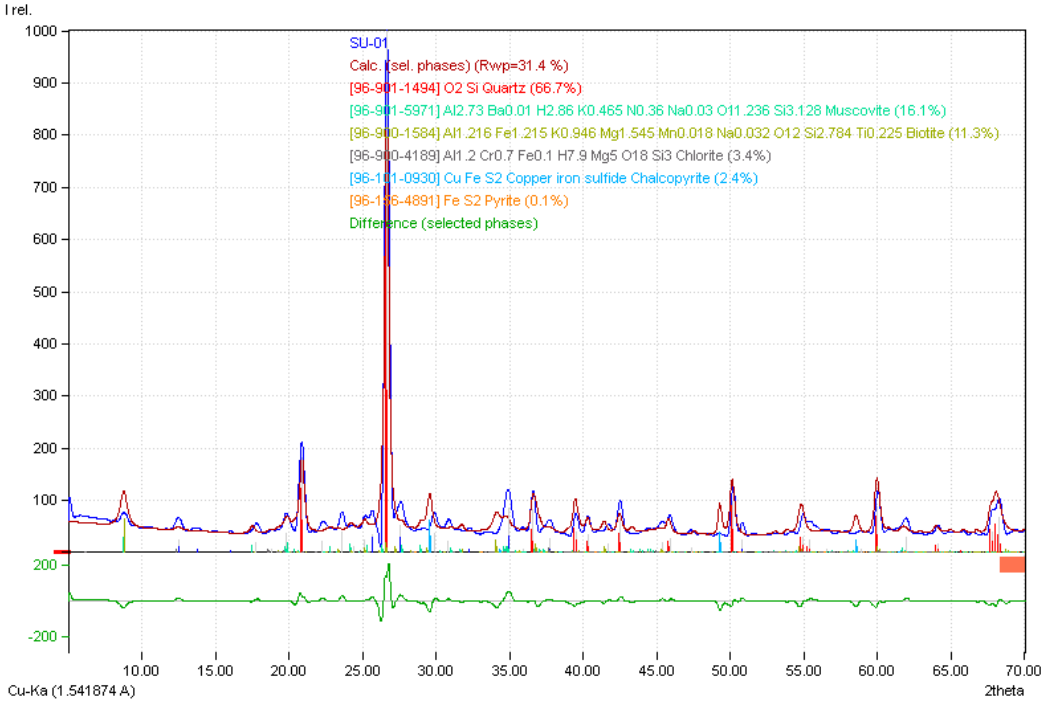
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	230650	100.00%
Background radiation	158143	68.56%
Diffraction peaks	72507	31.44%
Peak area belonging to selected phases	53353	23.13%
Peak area of phase A (Quartz)	*35177*	*15.25%*
Peak area of phase B (Muscovite)	*8470*	*3.67%*
Peak area of phase C (Biotite)	*6527*	*2.83%*
Peak area of phase D (Chlorite)	*1827*	*0.79%*
Peak area of phase E (Copper iron sulfide Chalcopyrite)	*1232*	*0.53%*
Peak area of phase F (Pyrite)	*121*	*0.05%*
Unidentified peak area	19155	8.30%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	1485	100.00%
Peak intensity belonging to selected phases	1451	97.71%
Unidentified peak intensity	34	2.29%

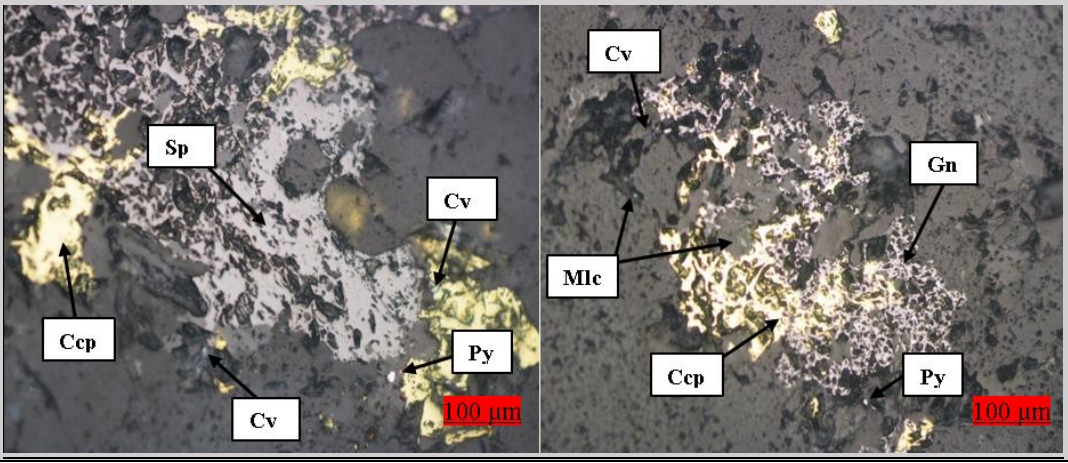
Diffraction Pattern Graphics



Lampiran 2. Analisis mikroskop tembaga sulfida

Kode. Sampel : **Cu_2S**

Foto



Tipe Endapan	**: Porfiri**
Jenis Mineralisasi	**: kalkopirit – Sfalerit – Galena – Malasit – Kovelit – Pirit**
Referensi	: Ore Mineral Atlas (Marshall, 2004)
Mikroskopis	:

Kenampakan pada sayatan poles memperlihatkan mineral yang terdiri dari kalkopirit, sfalerit, dan galena dengan tekstur intergrowth serta mineral Malasit dan kovelit dengan tekstur replacement. Mineral-mineral tersebut hadir dengan menyebar (*disaminated*). Mineral kovelit menggantikan mineral kalkopirit, mineral oksida Malasit menggantikan mineral sulfida tembaga yaitu pirit.

Deskripsi Mineralogi

Komposisi Mineral	Keterangan Optik Mineral
Kalkopirit (Ccp) **($CuFeS_2$)**	Berwarna kuning, bentuk anhedral, ukuran 0,1 mm-0,2 mm, memiliki tekstur *intergrowth* terhadap *sphalerite* dan *galena*, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Sfalerit (Sp) **(ZnS)**	Berwarna abu-abu, bentuk anhedral, ukuran 0,5 mm, memiliki tekstur intergrowth terhadap kalkopirit dan galena, bersifat isotropik
Galena (Gn) **(PbS)**	Berwarna putrih, Bentuk anhedral-subhedral, ukuran mineral <0,2mm-0,4 mm, tekstur replacment intergrowth terhadap sfalerit dan kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Malasit (Mlc) **($Cu_2(OH)_2CO_3$)**	Berwarna hijau, bentuk anhedral-subhedral, ukuran mineral 0,1 mm-0,2 mm dengan tekstur replacement terhadap mineral kalkopirit.
Kovelit (Cv) **(CuS)**	Berwarna Biru, Bentuk anhedral-subhedral, ukuran mineral <0,01 mm, tekstur replacement terhadap kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Pirit (Py) **(FeS_2)**	Berwarna kekuningan, bentuk anhedral-subhedral, ukuran mineral 0,01 mm, tekstur intergrowth terhadap kalkopirit dan sfalerite dan bersifat isotropik.

Lampiran 3. Perhitungan *recovery*

Hasil *recovery* Cu berdasarkan variasi ukuran partikel dengan waktu flotasi

$$R = \frac{C \times c}{F \times f} \times 100\ \%$$

Keterangan:

R = *Recovery* (%)

F = Massa Umpan (gr)

f = Kadar Umpan (%)

C = Massa Konsentrat (gr)

C = Kadar Konsentrat (gr)

1. *Recovery* Cu pada waktu flotasi 5 menit

$$\text{Recovery Cu-150-5} = \frac{1{,}64 \times 0{,}16}{50 \times 0{,}08} \times 100\ \%$$

$$= 6{,}56\%$$

$$\text{Recovery Cu-89-5} = \frac{2{,}69 \times 0{,}11}{50 \times 0{,}14} \times 100\ \%$$

$$= 4{,}22\%$$

$$\text{Recovery Cu-75-5} = \frac{4{,}18 \times 0{,}13}{50 \times 0{,}15} \times 100\ \%$$

$$= 7{,}24\%$$

2. *Recovery* Cu pada waktu flotasi 10 menit

$$\text{Recovery Cu-150-10} = \frac{1{,}94 \times 0{,}09}{50 \times 0{,}08} \times 100\%$$

$$= 4{,}38\%$$

$$\text{Recovery Cu-89-10} = \frac{4{,}21 \times 0{,}04}{50 \times 0{,}14} \times 100\%$$

$$= 2{,}41\%$$

$$\text{Recovery Cu-75-10} = \frac{6{,}55 \times 0{,}12}{50 \times 0{,}15} \times 100\%$$

$$= 9{,}73\%$$

3. *Recovery* Cu pada waktu flotasi 15 menit

$$\text{Recovery Cu-150-15} = \frac{1{,}70 \times 0{,}08}{F \times 0{,}08} \times 100\%$$

$$= 5{,}41\%$$

$$\text{Recovery Cu-89-15} = \frac{9{,}73 \times 0{,}07}{50 \times 0{,}14} \times 100\%$$

$$= 9{,}73\%$$

$$\text{Recovery Cu-75-15} = \frac{11 \times 0{,}1}{50 \times 0{,}15} \times 100\%$$

$$= 14{,}66\%$$

Lampiran 4. Analisis AAS tembaga sulfida

Hasil Analisis AAS

No.	Nama Sampel (Micron)	Nama Sampel (Mesh)	Konsentrasi Logam Cu	
			ppm	%
1	Cu – 150	Cu -100 +150	762,47	0,08
2	Cu – 104	Cu -150 +200	1.410,98	0,14
3	Cu – 75	Cu -200	1.483,72	0,15
4	Cu – 150 – 5	Cu -100 +150 – 5	1.631,95	0,16
5	Cu – 104 – 5	Cu -150 +200 – 5	1.075,20	0,11
6	Cu – 75 – 5	Cu -200 – 5	1.317,43	0,13
7	Cu – 150 – 10	Cu -100 +150 – 10	941,94	0,09
8	Cu – 104 – 10	Cu -150 +200 – 10	428,46	0,04
9	Cu – 75 – 10	Cu -200 – 10	1.233,32	0,12
10	Cu – 150 – 15	Cu -100 +150 – 15	797,24	0,08
11	Cu – 104 – 15	Cu -150 +200 – 15	716,50	0,07
12	Cu – 75 – 15	Cu -200 – 15	1.034,38	0,10

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Telp. 0411-586016 • Fax. 0411-588551 • Email : lpps.fmipa.unhas@gmail.com

LAPORAN HASIL PENGUJIAN
CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : LPPS.AJ-2408-4/12

I. Pelanggan / *Principal*

1.1 Nama / *Name*	: Satriawan Utomo Buana Putra
1.2 Alamat / *Address*	: Fakultas Teknik, Universitas Hasanuddin
1.3 Telepon / *Phone*	: 081238673567
1.4 Personil Penghubung / *Contact Person*	: -
1.5 Email / *Email*	: saputrairfan497@gmail.com

II. Contoh Uji / *Sample*

2.1 Kode Sampel / *Sampel Code*	: LPPS.A-2408-4/12a-l
2.2 Kemasan / *Packaging*	: Plastik Sampel
2.3 Nama Sampel / *Sample Name*	: Padatan
2.4 Jumlah Sampel / *Number of Sample*	: 12
2.5 Tanggal Sampling / *Date of Sampling*	: -
2.6 Diterima / *Date of Received*	: 07 Agustus 2024
2.7 Tanggal Uji / *Date of Analysis*	: 19 – 27 Agustus 2024
2.8 Jenis Uji / *Type of Analysis*	: Logam Cu AAS

III. Hasil Uji / *Result*

Kode Sampel	Nama Sampel	Konsentrasi Logam Cu	
		ppm	%
LPPS.A-2408-4/12a	Cu - 150	762,47	0,08
LPPS.A-2408-4/12b	Cu - 89	1410,98	0,14
LPPS.A-2408-4/12c	Cu - 75	1483,72	0,15
LPPS.A-2408-4/12d	Cu – 150 - 5	1631,95	0,16
LPPS.A-2408-4/12e	Cu – 89 - 5	1075,2	0,11
LPPS.A-2408-4/12f	Cu – 75 - 5	1317,43	0,13
LPPS.A-2408-4/12g	Cu – 150 - 10	941,94	0,09
LPPS.A-2408-4/12h	Cu – 89 - 10	428,46	0,04
LPPS.A-2408-4/12i	Cu – 75 - 10	1233,32	0,12
LPPS.A-2408-4/12j	Cu – 150 - 15	797,24	0,08
LPPS.A-2408-4/12k	Cu – 89 - 15	716,5	0,07
LPPS.A-2408-4/12l	Cu – 75 - 15	1034,38	0,10

Makassar, 4 September 2024
Penanggung Jawab Mutu

Prof. Dr. Nunuk Hariani Soekamto, MS
NIP. 19601215 198702 2 001

Catatan:
- Hasil Uji hanya berlaku untuk contoh tersebut di atas
- Dilarang mengutip/menyalin sebagian isi hasil uji ini
- Laboratorium tidak bertanggungjawab dalam pengambilan contoh uji

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Telp. 0411-586016 • Fax. 0411-588551 • Email : lpps.fmipa.unhas@gmail.com

LAPORAN HASIL PENGUJIAN

CERTIFICATE OF ANALYSIS

Nomor Pekerjaan : **LPPS.AJ-2408-4/12**
Job Number

Dipersembahkan Kepada
Presented To

Kepada Yth *Attention*	: **Satriawan Utomo Buana Putra**	**Jabatan** *Job Title*	: **Peneliti**
Nama Pelanggan *Customer Name*	: **Satriawan Utomo Buana Putra**	**Tujuan Pengujian** *Purpose of analysis*	: **Analisis Logam**
Alamat/Universitas *Address/University*	: **Fakultas Teknik, Universitas Hasanuddin**	**No. Faks/** *Fax No.*	: -
		No. Telp./ *Phone No.*	: **081238673567**
Tanggal Sampel Diterima *Date of Sample Receipt*	: **07 Agustus 2024**	**Tanggal Sampel Dianalisis** *Date of Sample Analysed*	: **19 – 27 Agustus 2024**
Email *Email*	: **saputrairfan497@gmail.com**	**Total Halaman**	: **2**
Nama Pengujian *Name of analysis*	: **Analisis Kadar Tembaga (Cu) pada Padatan menggunakan AAS**		

Hasil hanya berhubungan dengan contoh yang diuji dan laporan ini tidak boleh digandakan kecuali seluruhnya.
The result relate only to the samples tested and this report shall not be reproduced except in full

LABORATORIUM PENELITIAN DAN PENGEMBANGAN SAINS
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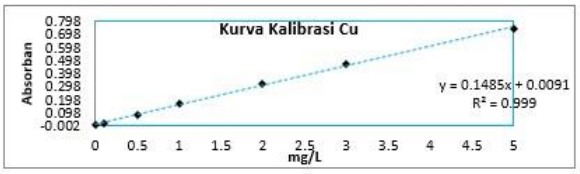
Telp. 0411-586016 • Fax. 0411-588551 • Email : lpps.fmipa.unhas@gmail.com

Nomor Sampel : LPPS.A.2408-4/12A-L
Tgl Terima Sampel : 07 Agustus 2024 — Suhu Ruangan: 20.5 °C
Tgl Preparasi : 19-26 Agustus 2024 — Kelembaban Ruangan: 60% RH
Tanggal Analisis : 27 Agustus 2024
Sampel : Serbuk — Parameter: Cu

Optimasi Analisa Tembaga (Cu)

Type Alat: AA 7000 Shimadzu		Slit width	: 0.7 nm	Fuel Gas Flow Rate (0.8-4.0)	: 1.8 L/min
: ASC-7000		Flame type	: Air-C_2H_2	Support gas flow rate (13.5-17.50)	: 15 L/min
HCL Cu Hamamatsu		Burner Height	: 7,0 nm		
P. gelombang	: 324,8 nm	Burner angle	: 0 degree	P. Gelombang Max	: 324,62 nm
Lamp Current Low (Peak) (mA)	: 8	Lamp Mode	: BGC-D2		

Cu (mg/L)	Absorban
0	0.0020
0.1	0.0170
0.5	0.0825
1	0.1627
2	0.3172
3	0.4639
5	0.7406



Persyaratan		Hasil	Keterangan
Linearitas	r > 0,995	R^2 = 0.9999 r = 0.9996	DITERIMA
MDL (mg/L)	MDL < Spike < 10 MDL < Baku Mutu*	0.01 < 0.1	DITERIMA
LoD (mg/L)	< Nilai Min. rentang ukur	0.0130 mg/L	DITERIMA
LoQ (mg/L)	< Nilai Min. rentang ukur	0.1303 mg/L	DITERIMA
$\%R_{CCS}$	75% - 120%	98.94 %	DITERIMA
%RSD	≤ 11.92	1.42 %	DITERIMA

R^2= 0.9999
r= 0.9996

y = ax + b	x = (y - b)/a
a	0.148
b	0.0091

Target			0.5 mg/L
Kontrol sampel	Absorban	[Cu]mg/L	$\%R_{CCS}$
Cu 0.5 mg/L	0.0836	0.50	100.74
	0.0837	0.50	
Rata-rata	0.0837	0.50	

Kode Sampel	Berat sampel peleburan (G)	B. Cawan Kosong (G)	B. Cawan+sampel **sebelum** dilebur (G)	B. Sampel (B. kering) (G)	Berat Pelebur ($NaHCO_3$) (G)	B.cawan+sampel +pelebur **sblm** (G)	B.cawan+sampel +pelebur **setelah** (G)	Berat sampel **setelah** dilebur (G)
Kontrol peleburan		29.8738			1.5015	31.3753		
LPPS.A.2408-4/12A		26.6206	27.1225	0.5019	1.5009	28.6234	27.1147	0.4941
LPPS.A.2408-4/12B		29.4482	29.9488	0.5006	1.5016	31.4504	29.9454	0.4972
LPPS.A.2408-4/12C		30.0212	30.5231	0.5019	1.5019	32.0250	30.4956	0.4744
LPPS.A.2408-4/12D		28.8977	29.3979	0.5002	1.5014	30.8993	29.3806	0.4829
LPPS.A.2408-4/12E		31.1753	31.6756	0.5003	1.5002	33.1758	31.6527	0.4774
LPPS.A.2408-4/12F		28.9233	29.4247	0.5014	1.5007	30.9254	29.4189	0.4956
LPPS.A.2408-4/12G		20.2215	20.7221	0.5006	1.5001	22.2222	20.7183	0.4968
LPPS.A.2408-4/12H		30.4648	30.9653	0.5005	1.5024	32.4677	30.9412	0.4764
LPPS.A.2408-4/12I		28.6696	29.1715	0.5019	1.5027	30.6742	29.1593	0.4897
LPPS.A.2408-4/12J		30.7197	31.2209	0.5012	1.5018	32.7227	31.2156	0.4959
LPPS.A.2408-4/12K		33.2347	33.7358	0.5011	1.5011	35.2369	33.7220	0.4873
LPPS.A.2408-4/12L		28.9255	29.4266	0.5011	1.5013	30.9279	29.4089	0.4834

Kode Sampel	Absorban	[Cu] (mg/L)	fp (kali)	[Cu] x fp (mg/L)	B. Sampel (G)	V. Sampel (mL)	[Cu] (mg/kg= ppm) BK	Hasil [Cu] yang dilaporka
Kontrol	0.0476	0.26						
	0.0481	0.26	1	0.26	1.5015	50	8.72	8.72
Rata-Rata =	**0.0479**	**0.2618**						

Kode Sampel	Absorban	[Cu] (mg/L)	fp (kali)	[Cu] x fp (mg/L)	([Cu] x fp) - [Blanko]	B. Sampel sblm peleburan	V. Sampel (L)	Kadar Cu (mg/kg= ppm)	Kadar Cu (%)
LPPS.A.2408-4/12A	0.1263	0.79	10	7.92	7.6537	0.5019	0.05	762.47	0.08
	0.1262	0.79							
Rata-Rata =	**0.1263**	**0.7916**							
LPPS.A.2408-4/12B	0.2211	1.43	10	14.39	14.1267	0.5006	0.05	1410.98	0.14
	0.2230	1.45							
Rata-Rata =	**0.2221**	**1.4389**							
LPPS.A.2408-4/12C	0.2335	1.52	10	15.16	14.8936	0.5019	0.05	1483.72	0.15
	0.2333	1.51							
Rata-Rata =	**0.2334**	**1.5155**							
LPPS.A.2408-4/12D	0.2547	1.66	10	16.59	16.3260	0.5002	0.05	1631.95	0.16
	0.2545	1.66							
Rata-Rata =	**0.2546**	**1.6588**							
LPPS.A.2408-4/12E	0.1723	1.10	10	11.02	10.7584	0.5003	0.05	1075.20	0.11
	0.1721	1.10							
Rata-Rata =	**0.1722**	**1.1020**							
LPPS.A.2408-4/12F	0.2084	1.35	10	13.47	13.2111	0.5014	0.05	1317.43	0.13
	0.2086	1.35							
Rata-Rata =	**0.2085**	**1.3473**							
LPPS.A.2408-4/12G	0.1531	0.97	10	9.69	9.4307	0.5006	0.05	941.94	0.09
	0.1520	0.97							
Rata-Rata =	**0.1526**	**0.9693**							
LPPS.A.2408-4/12H	0.0762	0.45	10	4.55	4.2889	0.5005	0.05	428.46	0.04
	0.0767	0.46							
Rata-Rata =	**0.0765**	**0.4551**							
LPPS.A.2408-4/12I	0.1962	1.26	10	12.64	12.3801	0.5019	0.05	1233.32	0.12
	0.1962	1.26							
Rata-Rata =	**0.1962**	**1.2642**							
LPPS.A.2408-4/12J	0.1318	0.83	10	8.25	7.9916	0.5012	0.05	797.24	0.08
	0.1307	0.82							
Rata-Rata =	**0.1313**	**0.8253**							
LPPS.A.2408-4/12K	0.1189	0.74	10	7.44	7.1807	0.5011	0.05	716.50	0.07
	0.1196	0.75							
Rata-Rata =	**0.1193**	**0.7443**							
LPPS.A.2408-4/12L	0.1667	1.06	10	10.63	10.3666	0.5011	0.05	1034.38	0.10
	0.1661	1.06							
Rata-Rata =	**0.1664**	**1.0628**							

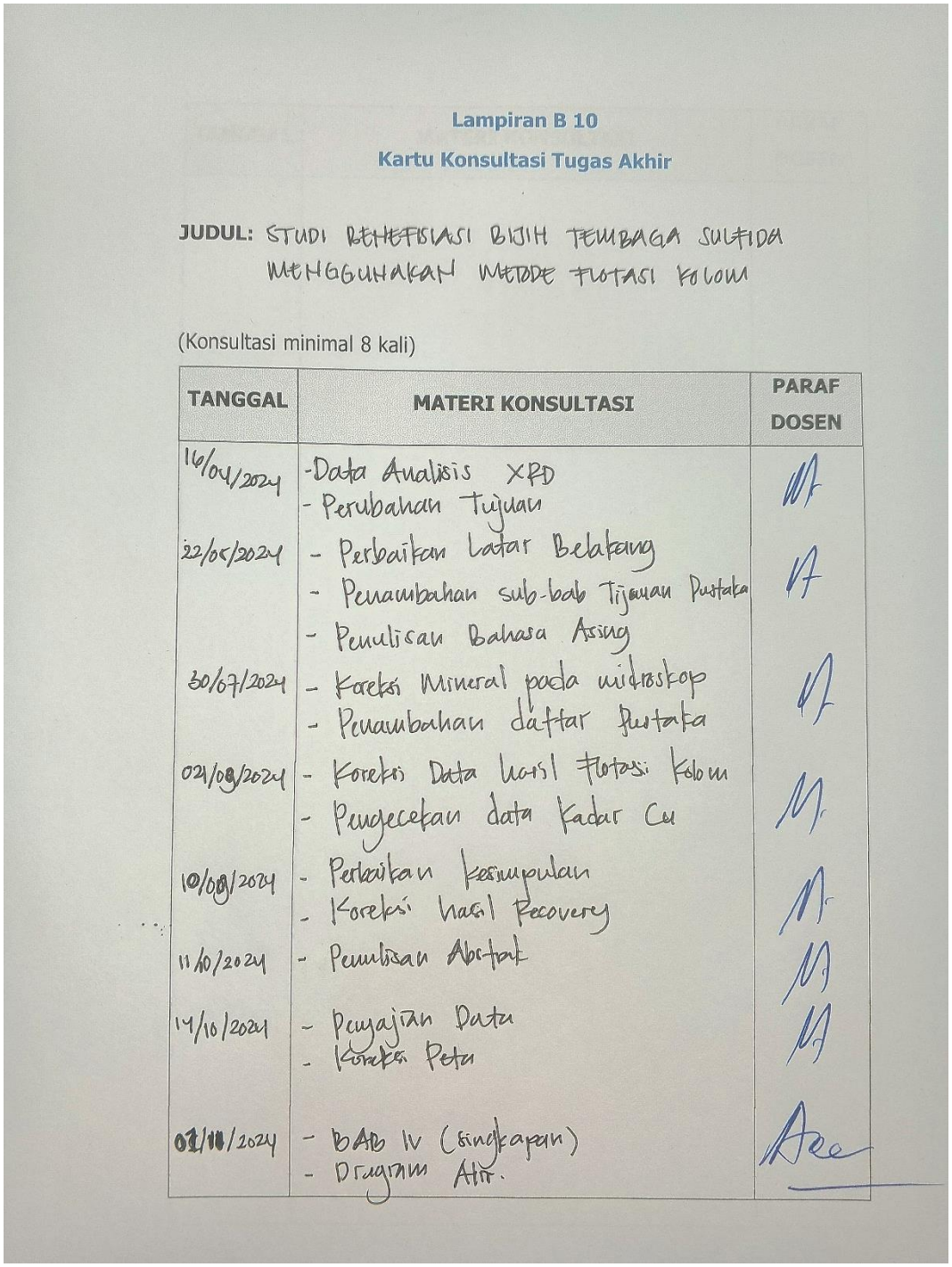
Perhitungan

$$mg/kg = \frac{\text{konsentrasi (mg/L) x Volume (L)}}{\text{berat sampel (kg)}}$$

$$\% = \frac{\text{konsentrasi (mg/L) x Volume (L)}}{\text{berat sampel (mg)}} \times 100\%$$

$$\text{Kadar Air} = \frac{\text{(berat cawan kosong + sampel setelah pemanasan - berat cawan kosong + sampel sebelum pemanasan)}}{\text{berat sampel (g)}} \times 100\%$$

Lampiran 5. Kartu Konsultasi Tugas Akhir



Lampiran B 10

Kartu Konsultasi Tugas Akhir

JUDUL: STUDI BENEFISIASI BIJIH TEMBAGA SULFIDA MENGGUNAKAN METODE FLOTASI KOLOM

(Konsultasi minimal 8 kali)

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
16/04/2024	-Data Analisis XRD - Perubahan Tujuan	
22/05/2024	- Perbaikan Latar Belakang - Penambahan sub-bab Tinjauan Pustaka - Penulisan Bahasa Asing	
30/07/2024	- Koreksi Mineral pada mikroskop - Penambahan daftar pustaka	
02/08/2024	- Koreksi Data hasil flotasi kolom - Pengecekan data kadar Cu	
10/08/2024	- Perbaikan kesimpulan - Koreksi hasil Recovery	
11/10/2024	- Penulisan Abstrak	
14/10/2024	- Penyajian Data - Koreksi Peta	
01/11/2024	- BAB IV (singkapan) - Diagram Alir.	