

## REFERENCE

- Abella, S.R. & Zimmer, B.W. 2007. Estimating organic carbon from loss-on-ignition in northern Arizona forest soils. *Soil Science Society of America Journal*, 71, 545–550.
- Anand RR, Paine M. 2002. Regolith geology of the Yilgarn Craton, Western Australia: implications for exploration. *Australian Journal of Earth Sciences*. 49: 3-162.
- Belis, C. A., A. Lami, P. Guilizzoni, D. Ariztegui & W. Geiger. 1999. The late Pleistocene ostracod record of the crater sediments from Lake Albano (Central Italy): changes in trophic status, water level and climate. *Journal Paleolim*. 21: 151–169
- Bengtsson, L. & M. Enell, 1986. *Chemical analysis*. In *Berglund, B. E. (ed.), Handbook of Holocene Palaeoecology and Palaeohydrology*. John Wiley & Sons Ltd., Chichester.
- Brand NW, Butt CRM, Elias M. 1998. Nickel laterites: classification and features. *AGSO Journal of Australian Geology and Geophysics*, 17, 81-88.
- Butt CRM, Zeegers H. 1992. *Regolith Exploration Geochemistry in Tropical and Subtropical Terrains*. Handbook of Exploration Geochemistry 4, Elsevier, Amsterdam, 607 pp.
- Butt CRM, Cluzel D. 2013. *Nickel Laterite Ore Deposits: Weathered Serpentinites*. *Elements*. 9:123–128.
- Cluzel D, Vigier B. 2008. Syntectonic mobility of supergene nickel ores of New Caledonia (Southwest Pacific): Evidence from garnierite veins and faulted regolith. *Resource Geology*. 58: 161-170.
- Costa, U.R., Barnett, R.L. and Kerrich, R. 1983. The Mattagami Lake Mine Archean Zn-Cu sulfide deposit, Quebec: Hydrothermal coprecipitation of talc and sulfides in a sea-floor brine pool-evidence from geochemistry, oxygen 18/oxygen 16, and mineral chemistry. *Econ Geol*. 78:1144-1203.
- Crouse K.K, Hardy D.H, Heckendorn S, Huluka G, Joines D.K, Kissel D.E, Miller R, Mitchell C.C, Moore K.P, Mylavarapu R, Oldham J.L, Provin T, Savoy H.J, Sikora F.J, Sonon L, Wang J.J, Warncke D.D, Zhang H. 2014. *Soil Test Methods From the Southeastern United States*. Division of Regulatory Services University of Kentucky, Lexington. p 155-158.
- Dean, W. E. Jr., 1974. *Determination of carbonate and organic matter in calcareous sediments and sedimentary rocks by loss on ignition*. Comparison with other methods. *J. Sed. Petrol*.

- Eggleton, RA. 2001. *The Regolith Glossary*. Cooperative Research Centre for Landscape Evolution and Mineral Exploration, Perth.
- Elias, M., 2002. Nickel Laterite Deposits-Eological Overview, Resources And Exploitation, In Giant Ore Deposit: Characteristics, Genesis And Exploration. *Centre Ore Deposit Res.*, Univ. Tasmania, Spec. Pub 4, 205-220.
- Farrokhpay S, Cathelineau M, Blancher SB, Laugier O, Filippov L. 2019. *Characterization of Weda Bay nickel laterite ore from Indonesia*. *J Geochem Explor.* 196:270–281.
- Freyssinet, P., Butt C. R. M., Morris R. C., and P Piantone, 2005. *Ore-Forming Processes Related to Lateritic Weathering, Economic Geology 100th Anniversary volume*, pp 681-722.
- Fu W, Yang JW, Yang ML, Pang BC, Liu XJ, Niu HJ, Huang XR. 2014. Mineralogical and geochemical characteristics of a serpentinite-derived laterite profile from East Sulawesi, Indonesia: implications for the lateritization process and Ni supergene enrichment in the tropical rainforest. *J Asian Earth Sci.* 93: 74–88.
- Gaudin A, Decarreau A, Noack Y, Grauby O. 2005. Clay mineralogy of the nickel laterite ore developed from serpentinitised peridotites at Murrin Murrin, Western Australia. *Australian Journal of Earth Sciences.* 52: 231-241.
- Glazkovsky AA, Gorbunov GI, Sysoev FA. 1977. *Deposits of Nickel*. In: Smirnov VI (ed) Ore deposits of the USSR, Volume II. Pitman Publishing, London. pp 3-79.
- Gleeson S.A, Butt CRM, Elias M. 2003. Nickel Laterites: A Review. *Society of Economic Geologists.* 54: 14-16.
- Golightly JP. 2010. *Progress in understanding the evolution of nickel laterites*. In: Goldfarb RJ, Marsh EE, Monecke T (eds) The Challenge of Finding New Mineral Resources: Global Metallogeny, Innovative Exploration, and New Discoveries Volume II. Society of Economic Geologists Special Publication 15, pp 451-475.
- Kadarusman A, Miyashita S, Maruyama S, Parkinson CD, Ishikawa A. 2004. Petrology, geochemistry and paleogeographic reconstruction of the East Sulawesi Ophiolite, Indonesia. *Tectonophysics.* 392:55–83.
- Lamoureux, S. 1999. Spatial and interannual variations in sedimentation trends recorded in nonglacial varved sediments from the Canadian high arctic. *Journal Paleolim.* 21: 73–84.
- Lechler P.J. and Desilets M.O. 1987. A Review of The Use of Loss on Ignition as A Measurement of Total Volatiles in Whole-Rock Analysis. *Chemical Geology.* 63: 341-344.

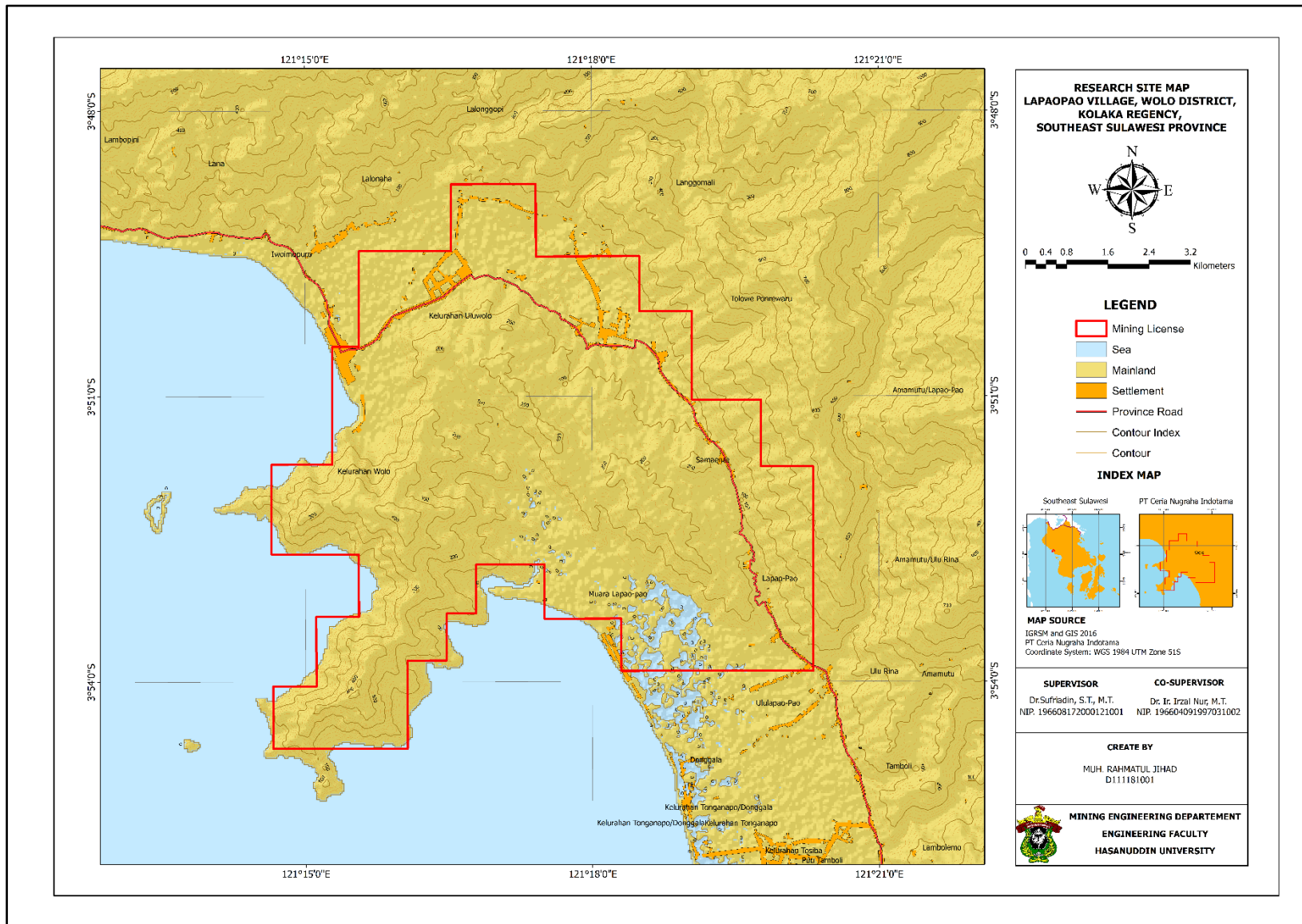
- Manceau A, Calas G. 1985. Heterogeneous distribution of nickel in hydrous silicates from New Caledonia ore deposits. *American Mineralogist*. 70: 549-558.
- Mihaylov, I., Krause, E., Colton, D.F., Okita, Y., Duterque, J.P., and Perraud, J.L. 2000. *The development of a novel hydrometallurgical process for nickel and cobalt recovery from Goro laterite ore*. Canadian Institute of Mining, Metallurgy and Petroleum Bulletin. 93: 124-130.
- Pelletier BG. 1996. *Serpentines in nickel silicate ore from New Caledonia*. In: Grimsey EJ, Neuss I (eds) Nickel '96. Australasian Institute of Mining and Metallurgy, Melbourne, Publication Series 6/96. pp 197-205.
- Sevin B, Ricordel-Prognon C, Quesnel F, Cluzel D, Lesimple S, Maurizot P. 2012. First palaeomagnetic dating of ferricrete in New Caledonia: new insight on the morphogenesis and palaeoweathering of Grande Terre. *Terra Nova*. 24: 77-85.
- Simons, C.S.. 1988. *The production of nickel: Extractive metallurgy past, present and future*, in Tyroler, G.P., and Landolt, C.A., eds.. Extractive metallurgy of nickel and cobalt: Pennsylvania, The Metallurgical Society.
- Sutherland, R. A., 1998. *Loss on ignition estimates of organic matter and relationships to organic carbon in fluvial bed sediments*. Hydrobiologia 389.
- Tavlan M, Thorne R, Herrington RJ. 2011. Uplift and lateritization history of the Çaldag̃ ophiolite in the context of Neo-Tethyan ophiolite obduction and uplift: implications for the Cenozoic weathering history of western Anatolia. *Journal of the Geological Society*. 168: 927-940.
- Thorne RL, Roberts S, Herrington R. 2012. Climate change and the formation of nickel laterite deposits. *Geology*. 40:331-334.
- Truckenbrodt, W., Kotschoubey, B., and Schellmann, W. 1991. Composition and origin of the clay cover on North Brazilian laterites. *Geologische Rundschau*. 80: 591-610.
- Valeton I, Biermann M, Reche R, Rosenberg F. 1987. Genesis of nickel laterites and bauxites in Greece during the Jurassic and Cretaceous, and their relation to ultrabasic parent rocks. *Ore Geology Reviews*. 2: 359-404.
- Wilburn DR. 2012. Cobalt Mineral Exploration and Supply from 1995 through 2013. *USGS Scientific Investigations Report 2011-5084*. 16: 34-45.
- Zachara, J.M., Fredrickson, J.K., Smith, S.C., and Gassman, P.L..2001. Solubilization of Fe(III) oxide-bound trace metals by a dissimulatory Fe(III) reducing bacterium. *Geochimica et Cosmochimica Acta*. 65: 75-93.

Zhang and Wang J.J. 2013. *Evaluating Loss on Ignition Method for Determinations of Soil Organic and Inorganic Carbon in Arid Soils of Northwestern China*. University of Chinese Academy of Science, Beijing: China.

Zhang Y, Junmao Q, & Wang, Cui K, Fu T, Wang J, Yuanhong. 2019. Mineralogical Characteristics of the Nickel Laterite, Southeast Ophiolite Belt, Sulawesi Island, Indonesia. *Mining, Metallurgy & Exploration*. 5-10.

## **APPENDIX**

**APPENDIX A**  
**MAP OF THE SAMPLING LOCATION**



**RESEARCH SITE MAP  
LAPAOPAO VILLAGE, WOLO DISTRICT,  
KOLAKA REGENCY,  
SOUTHEAST SULAWESI PROVINCE**

0 0.4 0.8 1.6 2.4 3.2  
Kilometers

**LEGEND**

- Mining License
- Sea
- Mainland
- Settlement
- Province Road
- Contour Index
- Contour

**INDEX MAP**

South-east Sulawesi

PT Ceria Nugraha Indotama

**MAP SOURCE**  
IGRSM and GIS 2016  
PT Ceria Nugraha Indotama  
Coordinate System: WGS 1984 UTM Zone 51S

SUPERVISOR	CO-SUPERVISOR
Dr. Sufrudin, S.T., M.T. NIP. 196608172000121001	Dr. Ir. Izzal Nur, M.T. NIP. 196604091997031002

**CREATE BY**  
MUH. RAHMATUL JIHAD  
D111181001

**MINING ENGINEERING DEPARTEMENT  
ENGINEERING FACULTY  
HASANUDDIN UNIVERSITY**

**APPENDIX B**  
**XRD RESULTS**



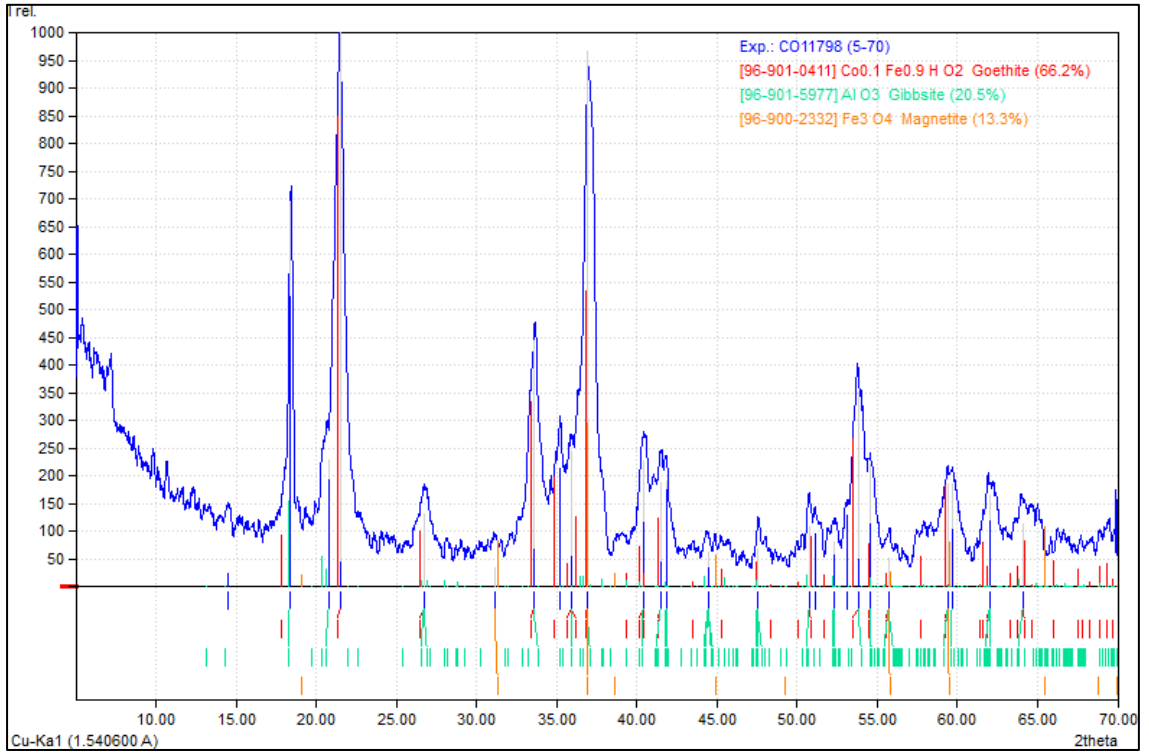
# 1. Sample LIM-1

## Matched Phases

<i>Index</i>	<i>Amount (%)</i>	<i>Name</i>	<i>Formula sum</i>
A	66.2	Goethite	Co <sub>0.1</sub> Fe <sub>0.9</sub> H O <sub>2</sub>
B	20.5	Gibbsite	Al O <sub>3</sub>
C	13.3	Magnetite	Fe <sub>3</sub> O <sub>4</sub>
	13.0	Unidentified peak area	

## Peak List

<i>No.</i>	<i>2theta [°]</i>	<i>d [Å]</i>	<i>I/I0</i>	<i>FWHM</i>	<i>Matched</i>
1	14.52	6.0955	25.2	0.5407	
2	18.4	4.818	695.94	0.2977	B
3	20.78	4.2712	230.45	0.518	B
4	21.48	4.1336	1000	0.7382	A
5	26.72	3.3336	131.44	0.903	A,B
6	31.16	2.868	34.24	1.5367	C
7	33.62	2.6636	445.36	0.8518	A,B
8	35.2	2.5475	215.2	2.9491	
9	35.92	2.4981	245.19	0.68	A,B
10	36.94	2.4314	968.38	0.8935	A,B,C
11	40.44	2.2287	228.17	1.2372	A,B
12	41.54	2.1722	187.22	2.7119	A,B
13	41.86	2.1563	190.16	1.2617	B
14	44.48	2.0352	61.64	1.2617	B
15	47.56	1.9103	67.34	0.9283	A,B
16	50.74	1.7978	109.18	1.4258	A,B
17	51.14	1.7847	96.99	2.4968	
18	52.32	1.7472	80.57	1.558	B
19	53.12	1.7227	129.13	1.558	
20	53.82	1.702	352.81	1.3259	A,B
21	54.54	1.6812	221.59	3.141	A,B
22	55.74	1.6478	53.32	2.013	A,B,C
23	59.38	1.5552	186.26	1.4331	A,B,C
24	59.7	1.5476	185.9	1.3673	B
25	62	1.4956	166.01	1.1816	A,B
26	64.06	1.4524	114.29	2.6665	A,B



## 2. Sample LIM-2

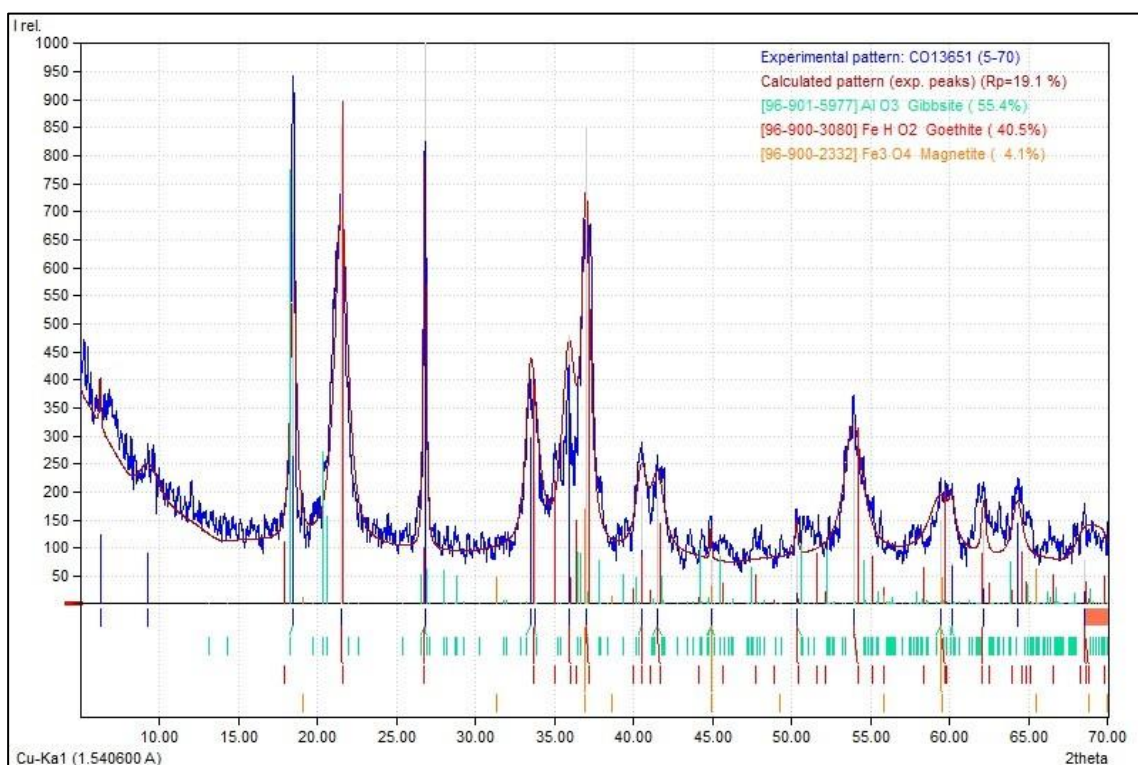
### Matched Phases

Index	Amount (%)	Name	Formula sum
A	55.4	Gibbsite	Al O <sub>3</sub>
B	40.5	Goethite	Fe H O <sub>2</sub>
C	4.1	Magnetite	Fe <sub>3</sub> O <sub>4</sub>
	12.3	Unidentified peak area	

### Peak List

No.	2theta [°]	d [Å]	I/I <sub>0</sub>	FWHM	Matched
1	6.28	14.0628	123.53	0.12	
2	9.32	9.4815	89.24	1.5168	
3	18.5	4.7921	662.03	0.473	A
4	21.52	4.126	853.31	0.9904	B
5	26.8	3.3239	1000	0.2225	A,B

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
6	33.46	2.6759	301.18	0.68	A
7	33.76	2.6528	216.4	1	A,B
8	35.9	2.4995	480.76	1	A,B
9	37	2.4276	849.31	0.6598	A,B,C
10	40.5	2.2255	191.98	0.8	A,B
11	41.52	2.1732	188.59	0.9857	A,B
12	44.9	2.0171	78.38	0.12	A,C
13	50.3	1.8125	84.11	0.2	A,B
14	53.9	1.6996	330.17	1.3711	A,B
15	59.4	1.5547	149.13	1.7102	A,B,C
16	60.14	1.5373	73.34	0.3726	A
17	62.14	1.4926	131.65	0.32	A,B
18	64.26	1.4484	143.21	0.76	
19	68.5	1.3687	76.79	1.3851	B



### 3. Sample SAP-1

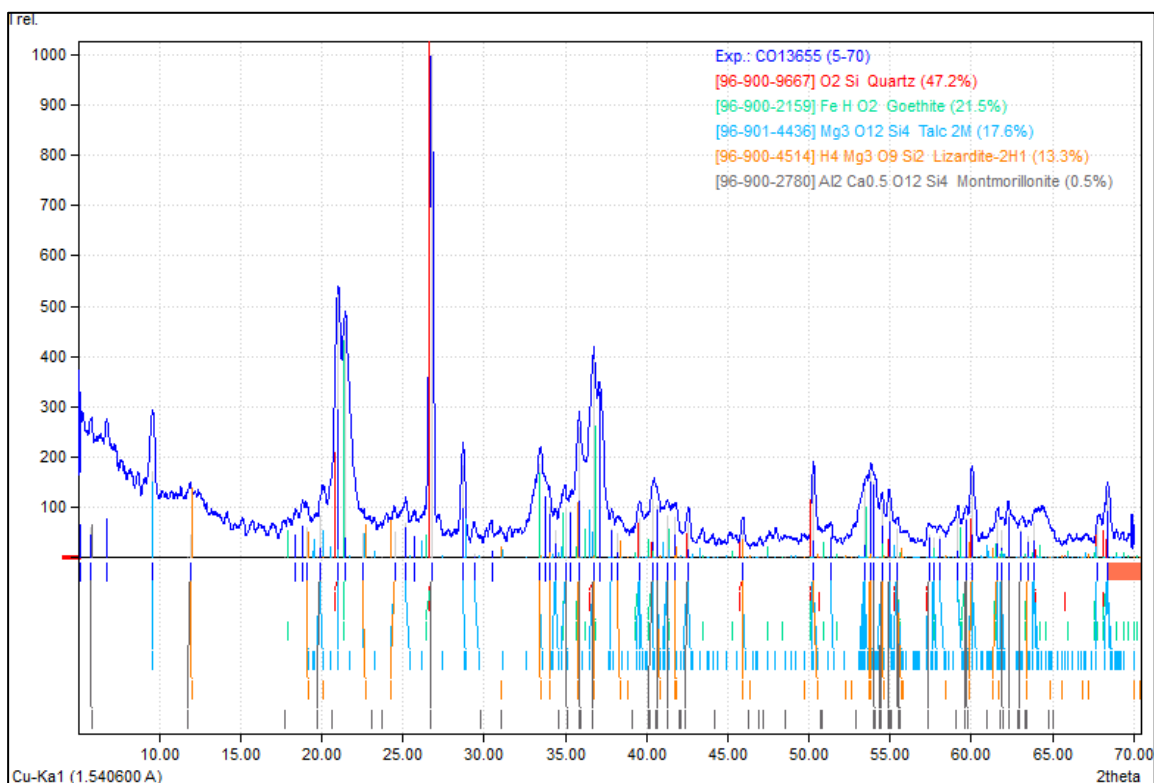
#### Matched Phases

<i>Index</i>	<i>Amount (%)</i>	<i>Name</i>	<i>Formula sum</i>
A	47.2	Quartz	O2 Si
B	21.5	Goethite	Fe H O2
C	17.6	Talc 2M	Mg3 O12 Si4
D	13.3	Lizardite-2H1	H4 Mg3 O9 Si2
E	0.5	Montmorillonite	Al2 Ca0.5 O12 Si4
	22.5	<i>Unidentified peak area</i>	

#### Peak List

<i>No.</i>	<i>2theta [°]</i>	<i>d [Å]</i>	<i>I/I0</i>	<i>FWHM</i>	<i>Matched</i>
1	5.16	17.1123	66.21	0.04	
2	5.79	15.2557	58.98	0.2	E
3	6.75	13.0767	77.63	0.28	
4	9.6	9.2051	172.48	0.28	C
5	11.89	7.4388	44.84	0.52	D,E
6	18.41	4.8163	46.22	0.4	
7	18.83	4.7079	63.42	0.36	
8	19.08	4.6477	58.69	0.36	C,D
9	19.94	4.4492	81.95	0.44	C,E
10	21.02	4.2239	521.73	0.48	A,C
11	21.43	4.1425	469.97	0.72	B
12	22.5	3.9484	49.21	1.28	C,D
13	24.5	3.6304	51.83	0.76	C,D
14	25.18	3.5335	69.2	0.4	C
15	25.73	3.459	43.54	3.16	
16	26.76	3.3293	1000	0.28	A,B,E
17	28.72	3.1062	183.83	0.28	C
18	29.42	3.0336	7.87	0.2698	C
19	30.54	2.9248	13.4	0.8485	
20	33.45	2.6766	185.54	0.76	B,C,D
21	33.78	2.6513	122.53	0.76	
22	34	2.6347	101.82	0.4	D
23	34.39	2.6058	54.32	3.32	C

<b>No.</b>	<b>2theta [°]</b>	<b>d [Å]</b>	<b>I/I0</b>	<b>FWHM</b>	<b>Matched</b>
24	35.04	2.5588	96.95	0.76	B,C,E
25	35.3	2.5406	91.04	1.44	
26	35.86	2.5024	257.69	0.52	B,D,E
27	36.73	2.4446	394.8	0.72	A,B,C,D,E
28	37.11	2.421	330.49	0.64	
29	37.88	2.3735	57.25	0.36	C
30	38.25	2.3513	46.88	0.72	D
31	39.54	2.2773	77.6	0.48	A,B,C
32	40.35	2.2335	115.22	0.64	A,B,C,E
33	40.7	2.2151	102.43	1.16	C,D,E
34	41.28	2.185	83.36	1.44	B,C,E
35	41.73	2.1626	79.25	0.44	D
36	42.56	2.1225	69.85	0.24	A,C,E
37	45.91	1.975	52.92	0.24	A,C,D
38	50.28	1.8132	163.57	0.28	A,B,C,D
39	51.31	1.7791	42.32	0.2	C
40	53.46	1.7126	136.46	1.12	B,C
41	53.84	1.7014	166.94	0.84	C,D
42	54.02	1.6962	149.18	1.24	C,E
43	54.49	1.6826	105.45	1.44	B,C,D,E
44	54.95	1.6695	112.43	0.56	A,C,E
45	55.45	1.6557	56.22	0.36	A,B,C,D,E
46	57.38	1.6046	45.69	0.32	A,C,E
47	57.72	1.5959	40.11	0.96	B,C
48	58.08	1.5868	41	0.68	C
49	59.16	1.5605	78.91	0.88	B,C
50	59.67	1.5484	78.35	1.32	B,C,E
51	60.04	1.5396	161.99	0.4	A,C,D
52	61.61	1.5041	74.16	0.48	B,C,D
53	61.87	1.4985	54.47	1.24	B,C,E
54	62.27	1.4898	85.34	0.36	C,E
55	63.04	1.4734	53.12	3.64	E
56	63.5	1.4639	43.83	3.24	B,D
57	63.88	1.4561	67.94	0.96	A,B,C
58	67.79	1.3813	62.89	0.36	A,B,C
59	68.43	1.37	133.94	0.4	A,B,C



## 4. Sample SAP-2

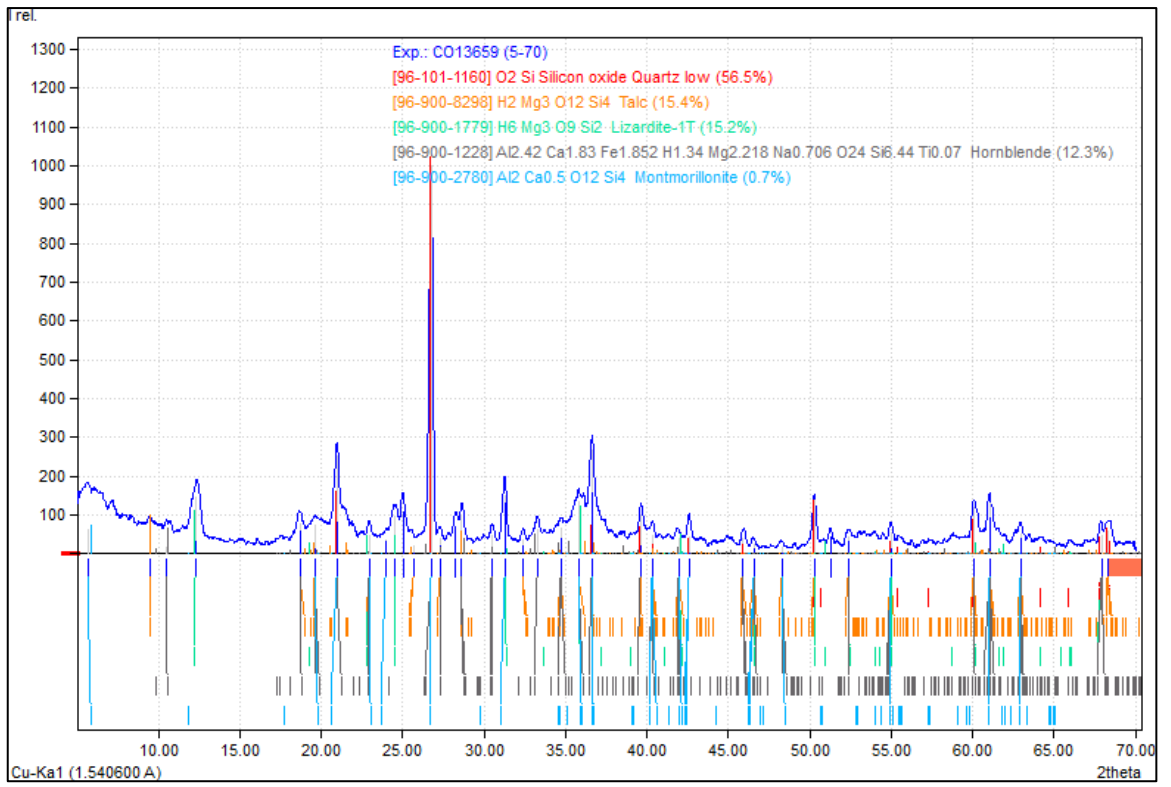
### Matched Phases

Index	Amount (%)	Name	Formula sum
A	56.5	Silicon oxide Quartz low	O2 Si
B	15.4	Talc	H2 Mg3 O12 Si4
C	15.2	Lizardite-1T	H6 Mg3 O9 Si2
D	12.3	Hornblende	Al2.42 Ca1.83 Fe1.852 H1.34 Mg2.218 Na0.706 O24 Si6.44 Ti0.07
E	0.7	Montmorillonite	Al2 Ca0.5 O12 Si4
	36.1	Unidentified peak area	

### Peak List

No.	2theta [°]	d [Å]	I/I0	FWHM	Matched
1	5.64	15.657	63.73	0.6459	E
2	9.46	9.3415	15.6	0.5851	B
3	10.5	8.4184	16.75	0.2433	D
4	12.3	7.1902	147.47	0.5243	C
5	18.72	4.7363	77.48	0.7584	B,D
6	19.66	4.5119	72.37	0.6035	B,D,E

<b>No.</b>	<b>2theta [°]</b>	<b>d [Å]</b>	<b>I/I0</b>	<b>FWHM</b>	<b>Matched</b>
7	20.94	4.2389	250.89	0.4485	A,D,E
8	22.92	3.877	46.15	0.6984	B,C,D,E
9	23.96	3.711	37.77	0.6206	E
10	24.5	3.6304	97.56	0.5428	C
11	25.06	3.5506	107.57	0.6371	
12	25.64	3.4716	22.76	0.4508	B
13	26.72	3.3336	1000	0.2644	A,D,E
14	27.32	3.2618	39.68	0.4989	B,D
15	28.22	3.1598	69.71	0.7335	
16	28.62	3.1165	100.77	0.3971	B,D
17	30.52	2.9267	47.2	0.3396	D
18	31.32	2.8537	148.88	0.3327	C,E
19	32.42	2.7594	35.32	0.3512	B
20	33.3	2.6884	63.71	0.5489	D
21	34.72	2.5817	65.87	0.5489	B,D
22	35.84	2.5035	133.56	0.5489	B,C,D,E
23	36.62	2.4519	268.12	0.4833	A,B,D,E
24	39.64	2.2718	97.8	0.4868	A,B,D
25	40.36	2.2329	46.77	1.0587	A,B,D,E
26	41.94	2.1524	41.29	1.0587	B,C,D,E
27	42.58	2.1215	44.02	1.3869	A,E
28	45.9	1.9755	41.34	0.4531	A,B,D
29	46.54	1.9498	24.67	0.2541	B,C,D,E
30	48.28	1.8835	16.67	0.3532	B,D,E
31	50.26	1.8139	138.65	0.2775	A,B,C
32	51.3	1.7795	43.92	0.3484	
33	52.4	1.7447	45.11	0.5292	B,C,D
34	55.02	1.6677	56.79	0.3919	A,B,C,D,E
35	60.1	1.5383	120.94	0.4554	A,B,C,D
36	61.04	1.5168	130.43	0.5066	B,D,E
37	62.94	1.4755	52.18	0.7301	B,D,E
38	67.94	1.3786	48.49	1.2623	A,B,C,D
39	68.34	1.3715	57.18	0.9108	A,B





**APPENDIX C**

**REGRESSION LINE EQUATION AND CORRELATION**

**COEFFICIENT OF LIMONITE SAMPLE**

<b>Sample Name</b>	<b>SiO<sub>2</sub> (%)</b>	<b>Al<sub>2</sub>O<sub>3</sub> (%)</b>	<b>Na<sub>2</sub>O (%)</b>	<b>MgO (%)</b>	<b>Fe<sub>2</sub>O<sub>3</sub> (%)</b>	<b>CaO (%)</b>	<b>K<sub>2</sub>O (%)</b>	<b>TiO<sub>2</sub> (%)</b>
RJD001	10.3231	7.5491	0.0596	1.887	58.7321	0.0262	0.0000	0.0683
RJD002	3.0262	6.9265	0.06	1.2321	63.8952	0.0109	0.0000	0.0563
RJD003	4.5511	8.0253	0.0613	1.7339	63.0209	0.0035	0.0000	0.0579
RJD004	3.7264	8.3759	0.0616	1.8678	62.5324	0.0049	0.0000	0.0791
RJD005	3.2303	9.5816	0.0626	1.5888	61.6314	0.0098	0.0000	0.1064
RJD006	4.4657	12.1569	0.0595	0.9369	64.2281	0.002	0.0000	0.2326
Average	4.887133	8.769217	0.060767	1.541083	62.34002	0.00955	0.0000	0.1001
Minimum Value	3.0262	6.9265	0.0595	0.9369	58.7321	0.002	0.0000	0.0563
Maximal Value	10.3231	12.1569	0.0626	1.887	64.2281	0.0262	0.0000	0.2326

<b>Sample Name</b>	<b>MnO (%)</b>	<b>P (%)</b>	<b>S (%)</b>	<b>Cr<sub>2</sub>O<sub>3</sub> (%)</b>	<b>Ni (%)</b>	<b>Co (%)</b>	<b>LOI</b>	<b>SUM</b>
RJD001	1.259	0.0118	0.0000	4.2344	2.2266	0.1003	11.77	98.9
RJD002	1.7769	0.0123	0.0000	4.4319	1.5566	0.109	12.18	95.74
RJD003	2.0356	0.0126	0.0100	4.0385	1.3782	0.1335	12.9	98.41
RJD004	1.3199	0.0119	0.0100	3.7032	1.3154	0.093	13.63	97.15
RJD005	1.9482	0.0124	0.0100	3.4467	1.2198	0.1319	13.92	97.3
RJD006	0.4423	0.0184	0.0100	2.5076	0.9011	0.0412	14.31	100.61
Average	1.46365	0.013233	0.006667	3.72705	1.43295	0.101483	13.11833	98.01833
Minimum Value	0.4423	0.0118	0.0000	2.5076	0.9011	0.0412	11.77	95.74
Maximal Value	2.0356	0.0184	0.0100	4.4319	2.2266	0.1335	14.31	100.61

### 1. Regression Line Equation and Correlation Coefficient of Nickel (Ni)

	<b>X (Ni)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	2.2266	11.77	4.9577	138.5329	26.207082
	1.5566	12.18	2.4230	148.3524	18.959388
	1.3782	12.9	1.8994	166.4100	17.77878
	1.3154	13.63	1.7303	185.7769	17.928902
	1.2198	13.92	1.4879	193.7664	16.979616
	0.9011	14.31	0.8120	204.7761	12.894741
<b>Total</b>	8.5977	78.7100	13.3104	1037.6147	110.7485
<b>(Total Ni)<sup>2</sup></b>	73.9204				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{95.47572554}{5.9417} \right| \right) \right) = \mathbf{16.0687683}$$

$$b = \left( \left( \left| \frac{-12.233913}{5.9417} \right| \right) \right) = \mathbf{-2.058993658}$$

So, the equation of the regression line is  $y = -2.059 x + 16.069$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$	
2.2266	11.77	1.43295	13.1184	0.7937	-1.3484	0.6299	1.8182	-1.07015766	
1.5566	12.18	1.43295	13.1184	0.1237	-0.9384	0.015289	0.8806	-0.11603316	
1.3782	12.9	1.43295	13.1184	-0.0547	-0.2184	0.002998	0.0477	0.0119574	
1.3154	13.63	1.43295	13.1184	-0.1176	0.5116	0.013818	0.2617	-0.06013858	
1.2198	13.92	1.43295	13.1184	-0.2132	0.8016	0.045433	0.6426	-0.17086104	
0.9011	14.31	1.43295	13.1184	-0.5319	1.1916	0.282864	1.4199	-0.63375246	
8.5977	78.71					0.990283	5.0707	-2.0389855	
						<b>S<sup>2</sup></b>	0.165047	0.845113893	-0.339830917
						<b>S</b>	0.40626	0.919300763	

$$r = \left( \left( \left| \frac{-0.339830917}{0.40626 \times 0.919300763} \right| \right) \right) = -0.9099$$

So the degree of correlation of the two variables is approx 90%.

## 2. Regression Line Equation and Correlation Coefficient of Chromium Oxide (Cr<sub>2</sub>O<sub>3</sub>)

	X (Cr <sub>2</sub> O <sub>3</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
	4.2344	11.77	17.9301	138.5329	49.838888
	4.4319	12.18	19.6417	148.3524	53.980542
	4.0385	12.9	16.3095	166.4100	52.09665
	3.7032	13.63	13.7137	185.7769	50.474616
	3.4467	13.92	11.8797	193.7664	47.978064
	2.5076	14.31	6.2881	204.7761	35.883756
<b>Total</b>	22.3623	78.7100	85.7629	1037.6147	290.2525
<b>(Total Cr<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	500.0725				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{259.680251}{14.5074} \right| \right) \right) = \mathbf{17.9033}$$

$$b = \left( \left( \left| \frac{-18.621537}{14.5074} \right| \right) \right) = \mathbf{-1.2839}$$

So, the equation of the regression line is  $y = -1.2839x + 17.9033$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
4.2344	11.77	3.72705	13.1184	0.5074	-1.3484	0.2574	1.8182	-0.68411074
4.4319	12.18	3.72705	13.1184	0.7049	-0.9384	0.496813522	0.8806	-0.66143124
4.0385	12.9	3.72705	13.1184	0.3115	-0.2184	0.097001102	0.0477	-0.06802068
3.7032	13.63	3.72705	13.1184	-0.0239	0.5116	0.000568823	0.2617	-0.01220166
3.4467	13.92	3.72705	13.1184	-0.2804	0.8016	0.078596123	0.6426	-0.22472856
2.5076	14.31	3.72705	13.1184	-1.2195	1.1916	1.487058303	1.4199	-1.45309662
22.3623	78.71					2.417441895	5.0707	-3.1035895
					<b>S<sup>2</sup></b>	0.402906983	0.845113893	-0.517264917
					<b>S</b>	0.634749543	0.919300763	

$$r = \left( \left( \left| \frac{-0.517264917}{0.634749543 \times 0.919300763} \right| \right) \right) = -0.88645$$

So the degree of correlation of the two variables is approx 88%.

### 3. Regression Line Equation and Correlation Coefficient of Cobalt (Co)

	<b>X (Co)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.1003	11.77	0.0101	138.5329	1.180531
	0.1090	12.18	0.0119	148.3524	1.32762
	0.1335	12.9	0.0178	166.4100	1.72215
	0.0930	13.63	0.0086	185.7769	1.26759
	0.1319	13.92	0.0174	193.7664	1.836048
	0.0412	14.31	0.0017	204.7761	0.589572
<b>Total</b>	0.6089	78.7100	0.0675	1037.6147	7.9235
<b>(Total Co)<sup>2</sup></b>	0.3708				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{0.4889}{0.0343} \right| \right) \right) = 14.2593$$

$$b = \left( \left( \left| \frac{-0.3855}{0.0343} \right| \right) \right) = -11.2426$$

So, the equation of the regression line is  $y = -11.2426 x + 14.2593$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.1003	11.77	0.101483	13.1184	-0.0012	-1.3484	0.0000	1.8182	0.001595607
0.1090	12.18	0.101483	13.1184	0.0075	-0.9384	5.65E-05	0.8806	-0.00705364
0.1335	12.9	0.101483	13.1184	0.0320	-0.2184	0.001025	0.0477	-0.00699244
0.0930	13.63	0.101483	13.1184	-0.0085	0.5116	7.2E-05	0.2617	-0.004340073
0.1319	13.92	0.101483	13.1184	0.0304	0.8016	0.000925	0.6426	0.024382
0.0412	14.31	0.101483	13.1184	-0.0603	1.1916	0.003634	1.4199	-0.07183362
0.6089	78.71					0.005714	5.0707	-0.064242167
					<b>S<sup>2</sup></b>	0.000952	0.845113893	-0.010707028
					<b>S</b>	0.03086	0.919300763	

$$r = \left( \left( \left| \frac{-0.0108}{0.0309 \times 0.9194} \right| \right) \right) = -0.3775$$

So the degree of correlation of the two variables is approx 37%.



#### 4. Regression Line Equation and Correlation Coefficient of Alumina (Al<sub>2</sub>O<sub>3</sub>)

	X (Al <sub>2</sub> O <sub>3</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
	7.5491	11.77	56.9889	138.5329	88.852907
	6.9265	12.18	47.9764	148.3524	84.36477
	8.0253	12.9	64.4054	166.4100	103.52637
	8.3759	13.63	70.1557	185.7769	114.163517
	9.5816	13.92	91.8071	193.7664	133.375872
	12.1569	14.31	147.7902	204.7761	173.965239
<b>Total</b>	52.6153	78.7100	479.1237	1037.6147	698.2487
<b>(Total Al<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	2768.3698				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{973.2653}{106.373} \right| \right) \right) = 9.1496$$

$$b = \left( \left( \left| \frac{48.1418}{106.373} \right| \right) \right) = 0.4526$$

So, the equation of the regression line is  $y = 0.4526 x + 9.1496$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$	
7.5491	11.77	8.769217	13.1184	-1.2201	-1.3484	1.4887	1.8182	1.645205313	
6.9265	12.18	8.769217	13.1184	-1.8427	-0.9384	3.395605	0.8806	1.72920532	
8.0253	12.9	8.769217	13.1184	-0.7439	-0.2184	0.553412	0.0477	0.1624714	
8.3759	13.63	8.769217	13.1184	-0.3933	0.5116	0.154698	0.2617	-0.201220807	
9.5816	13.92	8.769217	13.1184	0.8124	0.8016	0.659967	0.6426	0.65120648	
12.1569	14.31	8.769217	13.1184	3.3877	1.1916	11.4764	1.4199	4.03676346	
52.6153	78.71					17.72876	5.0707	8.023631167	
						<b>S<sup>2</sup></b>	2.954794	0.845113893	1.337271861
						<b>S</b>	1.718951	0.919300763	

$$r = \left( \left( \left| \frac{1.3373}{1.7190 \times 0.9194} \right| \right) \right) = \mathbf{0.8423}$$

So the degree of correlation of the two variables is approx 84%.

### 5. Regression Line Equation and Correlation Coefficient of Silica (SiO<sub>2</sub>)

	<b>X (SiO<sub>2</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	10.3231	11.77	106.5664	138.5329	121.502887
	3.0262	12.18	9.1579	148.3524	36.859116
	4.5511	12.9	20.7125	166.4100	58.70919
	3.7264	13.63	13.8861	185.7769	50.790832
	3.2303	13.92	10.4348	193.7664	44.965776
	4.4657	14.31	19.9425	204.7761	63.904167
<b>Total</b>	29.3228	78.7100	180.7002	1037.6147	376.7320
<b>(Total SiO<sub>2</sub>)<sup>2</sup></b>	859.8266				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{3177.0737}{224.374} \right| \right) \right) = 14.1553$$

$$b = \left( \left( \left| \frac{-47.6058}{224.374} \right| \right) \right) = -0.2122$$

So, the equation of the regression line is **y = -0.2122 x + 14.1553**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
10.3231	11.77	4.887133	13.1184	5.4360	-1.3484	29.5497	1.8182	-7.329857453
3.0262	12.18	4.887133	13.1184	-1.8609	-0.9384	3.463073	0.8806	1.74629984
4.5511	12.9	4.887133	13.1184	-0.3360	-0.2184	0.112918	0.0477	0.07338968
3.7264	13.63	4.887133	13.1184	-1.1607	0.5116	1.347302	0.2617	-0.593831173
3.2303	13.92	4.887133	13.1184	-1.6568	0.8016	2.745097	0.6426	-1.3281176
4.4657	14.31	4.887133	13.1184	-0.4214	1.1916	0.177606	1.4199	-0.50217996
29.3228	78.71					37.39573	5.0707	-7.934296667
					<b>S<sup>2</sup></b>	6.232622	0.845113893	-1.322382778
					<b>S</b>	2.496522	0.919300763	

$$r = \left( \left( \left| \frac{-1.3224}{2.4966 \times 0.9194} \right| \right) \right) = -0.5762$$

So the degree of correlation of the two variables is approx 57%.

## 6. Regression Line Equation and Correlation Coefficient of Manganese Oxide (MnO)

	X (MnO)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
	1.2590	11.77	1.5851	138.5329	14.81843
	1.7769	12.18	3.1574	148.3524	21.642642
	2.0356	12.9	4.1437	166.4100	26.25924
	1.3199	13.63	1.7421	185.7769	17.990237
	1.9482	13.92	3.7955	193.7664	27.118944
	0.4423	14.31	0.1956	204.7761	6.329313
<b>Total</b>	8.7819	78.7100	14.6194	1037.6147	114.1588
<b>(Total MnO)<sup>2</sup></b>	77.1218				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{148.1595}{10.5945} \right| \right) \right) = \mathbf{13.9847}$$

$$b = \left( \left( \left| \frac{-6.2706}{10.5945} \right| \right) \right) = \mathbf{-0.5919}$$

So, the equation of the regression line is  $y = -0.5919x + 13.9847$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
1.2590	11.77	1.46365	13.1184	-0.2047	-1.3484	0.0419	1.8182	0.27595006
1.7769	12.18	1.46365	13.1184	0.3133	-0.9384	0.098126	0.8806	-0.2939538
2.0356	12.9	1.46365	13.1184	0.5720	-0.2184	0.327127	0.0477	-0.12491388
1.3199	13.63	1.46365	13.1184	-0.1438	0.5116	0.020664	0.2617	-0.0735425
1.9482	13.92	1.46365	13.1184	0.4846	0.8016	0.234789	0.6426	0.38841528
0.4423	14.31	1.46365	13.1184	-1.0214	1.1916	1.043156	1.4199	-1.21704066
8.7819	78.71					1.765743	5.0707	-1.0450855
					<b>S<sup>2</sup></b>	0.29429	0.845113893	-0.174180917
					<b>S</b>	0.542485	0.919300763	

$$r = \left( \left( \left| \frac{-0.1742}{0.5445 \times 0.9194} \right| \right) \right) = -0.3493$$

So the degree of correlation of the two variables is approx 34%.

### 7. Regression Line Equation and Correlation Coefficient of Magnesia (MgO)

	X (MgO)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
	1.8870	11.77	3.5608	138.5329	22.20999
	1.2321	12.18	1.5181	148.3524	15.006978
	1.7339	12.9	3.0064	166.4100	22.36731
	1.8678	13.63	3.4887	185.7769	25.458114
	1.5888	13.92	2.5243	193.7664	22.116096
	0.9369	14.31	0.8778	204.7761	13.407039
<b>Total</b>	9.2465	78.7100	14.9760	1037.6147	120.5655
<b>(Total MgO)<sup>2</sup></b>	85.4978				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{63.9513}{4.3582} \right| \right) \right) = 14.6738$$

$$b = \left( \left( \left| \frac{-4.3989}{4.3582} \right| \right) \right) = -1.0093$$

So, the equation of the regression line is  $y = -1.0093 x + 14.6738$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
1.8870	11.77	1.541083333	13.1184	0.3459	-1.3484	0.1197	1.8182	-0.466434033
1.2321	12.18	1.541083333	13.1184	-0.3090	-0.9384	0.0954707	0.8806	0.28994996
1.7339	12.9	1.541083333	13.1184	0.1928	-0.2184	0.037178267	0.0477	-0.04211116
1.8678	13.63	1.541083333	13.1184	0.3267	0.5116	0.10674378	0.2617	0.167148247
1.5888	13.92	1.541083333	13.1184	0.0477	0.8016	0.00227688	0.6426	0.03824968
0.9369	14.31	1.541083333	13.1184	-0.6042	1.1916	0.3650375	1.4199	-0.71994486
9.2465	78.71					0.726365468	5.0707	-0.733142167
					<b>S<sup>2</sup></b>	0.121061	0.845113893	-0.122190361
					<b>S</b>	0.347938	0.919300763	

$$r = \left( \left( \left| \frac{-0.1222}{0.3480 \times 0.9194} \right| \right) \right) = -0.3821$$

So the degree of correlation of the two variables is approx 38%.



### 8. Regression Line Equation and Correlation Coefficient of Calcine (CaO)

	<b>X (CaO)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.0262	11.77	0.0007	138.5329	0.308374
	0.0109	12.18	0.0001	148.3524	0.132762
	0.0035	12.9	0.0000	166.4100	0.04515
	0.0049	13.63	0.0000	185.7769	0.066787
	0.0098	13.92	0.0001	193.7664	0.136416
	0.0020	14.31	0.0000	204.7761	0.02862
<b>Total</b>	0.0573	78.7100	0.0009	1037.6147	0.7181
<b>(Total CaO)<sup>2</sup></b>	0.0033				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{0.0330}{0.00237} \right| \right) \right) = 13.9314$$

$$b = \left( \left( \left| \frac{-0.2015}{0.00237} \right| \right) \right) = -85.1345$$

So, the equation of the regression line is **y = -85.1345 x + 13.9314**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.0262	11.77	0.00955	13.1184	0.0167	-1.3484	0.0003	1.8182	-0.02245086
0.0109	12.18	0.00955	13.1184	0.0014	-0.9384	1.8225E-06	0.8806	-0.00126684
0.0035	12.9	0.00955	13.1184	-0.0061	-0.2184	3.66025E-05	0.0477	0.00132132
0.0049	13.63	0.00955	13.1184	-0.0047	0.5116	2.16225E-05	0.2617	-0.00237894
0.0098	13.92	0.00955	13.1184	0.0002	0.8016	6.25E-08	0.6426	0.0002004
0.0020	14.31	0.00955	13.1184	-0.0076	1.1916	5.70025E-05	1.4199	-0.00899658
0.0573	78.71					0.000394335	5.0707	-0.0335715
					<b>S<sup>2</sup></b>	6.57225E-05	0.845113893	-0.00559525
					<b>S</b>	0.008106941	0.919300763	

$$r = \left( \left( \left| \frac{-0.0056}{0.0082 \times 0.9194} \right| \right) \right) = -0.7508$$

So the degree of correlation of the two variables is approx 75%.

### 9. Regression Line Equation and Correlation Coefficient of Sodium Oxide (Na<sub>2</sub>O)

	X (Na <sub>2</sub> O)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
	0.0596	11.77	0.0036	138.5329	0.701492
	0.0600	12.18	0.0036	148.3524	0.7308
	0.0613	12.9	0.0038	166.4100	0.79077
	0.0616	13.63	0.0038	185.7769	0.839608
	0.0626	13.92	0.0039	193.7664	0.871392
	0.0595	14.31	0.0035	204.7761	0.851445
<b>Total</b>	0.3646	78.7100	0.0222	1037.6147	4.7855
<b>(Total Na<sub>2</sub>O)<sup>2</sup></b>	0.1329				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{-0.000313064}{0.00004736} \right| \right) \right) = -6.6104$$

$$b = \left( \left( \left| \frac{0.015376}{0.00004736} \right| \right) \right) = 324.6622$$

So, the equation of the regression line is **y = 324.6622 x + -6.6104**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$	
0.0596	11.77	0.060767	13.1184	-0.0012	-1.3484	0.0000	1.8182	0.001573133	
0.0600	12.18	0.060767	13.1184	-0.0008	-0.9384	5.88E-07	0.8806	0.00071944	
0.0613	12.9	0.060767	13.1184	0.0005	-0.2184	2.84E-07	0.0477	-0.00011648	
0.0616	13.63	0.060767	13.1184	0.0008	0.5116	6.94E-07	0.2617	0.000426333	
0.0626	13.92	0.060767	13.1184	0.0018	0.8016	3.36E-06	0.6426	0.0014696	
0.0595	14.31	0.060767	13.1184	-0.0013	1.1916	1.6E-06	1.4199	-0.00150936	
0.3646	78.71					7.89E-06	5.0707	0.002562667	
						<b>S<sup>2</sup></b>	1.32E-06	0.845113893	0.000427111
						<b>S</b>	0.001147	0.919300763	

$$r = \left( \left( \left| \frac{0.00043}{0.001147 \times 0.9194} \right| \right) \right) = 0.4050$$

So the degree of correlation of the two variables is approx 40%.

**10. Regression Line Equation and Correlation Coefficient of Ferric Oxide (Fe<sub>2</sub>O<sub>3</sub>)**

	<b>X (Fe<sub>2</sub>O<sub>3</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	58.7321	11.77	3449.4596	138.5329	691.276817
	63.8952	12.18	4082.5966	148.3524	778.243536
	63.0209	12.9	3971.6338	166.4100	812.96961
	62.5324	13.63	3910.3010	185.7769	852.316612
	61.6314	13.92	3798.4295	193.7664	857.909088
	64.2281	14.31	4125.2488	204.7761	919.104111
<b>Total</b>	374.0401	78.7100	23337.6693	1037.6147	4911.8198
<b>(Total Fe<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	139905.9964				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{-309.6061}{120.02} \right| \right) \right) = -2.5797$$

$$b = \left( \left( \left| \frac{30.224}{120.02} \right| \right) \right) = 0.2519$$

So, the equation of the regression line is **y = 0.2519 x + -2.5797**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
58.7321	11.77	62.34002	13.1184	-3.6079	-1.3484	13.0171	1.8182	4.864914833
63.8952	12.18	62.34002	13.1184	1.5552	-0.9384	2.418595	0.8806	-1.45938404
63.0209	12.9	62.34002	13.1184	0.6809	-0.2184	0.463602	0.0477	-0.14870492
62.5324	13.63	62.34002	13.1184	0.1924	0.5116	0.037011	0.2617	0.098423313
61.6314	13.92	62.34002	13.1184	-0.7086	0.8016	0.502138	0.6426	-0.56802712
64.2281	14.31	62.34002	13.1184	1.8881	1.1916	3.564859	1.4199	2.2498401
374.0401	78.71					20.00327	5.0707	5.037062167
					<b>S<sup>2</sup></b>	3.333878	0.845113893	0.839510361
					<b>S</b>	1.825891	0.919300763	

$$r = \left( \left( \left| \frac{0.8396}{1.8259 \times 0.9194} \right| \right) \right) = -0.5002$$

So the degree of correlation of the two variables is approx 50%.

**APPENDIX D**

**REGRESSION LINE EQUATION AND CORRELATION**

**COEFFICIENT OF SAPROLITE SAMPLE**

No	Sample Name	SiO <sub>2</sub> (%)	Al <sub>2</sub> O <sub>3</sub> (%)	Na <sub>2</sub> O (%)	MgO (%)	Fe <sub>2</sub> O <sub>3</sub> (%)	CaO (%)	K <sub>2</sub> O (%)	TiO <sub>2</sub> (%)
1	SDJ001	43.8962	0.8535	0.0778	44.2615	9.1194	0.68	0	0.0002
2	SDJ002	44.0492	0.7031	0.0755	44.0648	9.0402	0.5927	0	0.0017
3	SDJ003	46.1202	1.0509	0.0749	39.7488	9.9491	0.5631	0	0.0027
4	SDJ004	52.9438	1.0959	0.0733	35.6738	8.3327	0.5565	0	0
5	SDJ005	45.2759	0.805	0.0766	42.6867	9.7233	0.376	0	0.0018
6	SDJ006	44.1165	1.2847	0.0788	43.1593	9.0617	0.6287	0	0.0003
7	SDJ007	44.0185	1.0298	0.0769	43.348	8.4391	0.6575	0	0.0008
8	SDJ008	54.777	1.0341	0.0728	33.9616	7.9963	0.5095	0	0
9	SDJ009	45.3135	1.1753	0.0775	40.2798	9.4364	0.8171	0	0.0025
10	SDJ010	43.2836	1.354	0.077	39.4207	8.4984	0.9917	0	0
11	SDJ011	49.6275	1.8473	0.0738	29.2488	13.8202	0.7308	0	0.0096
12	SDJ012	49.4819	1.7404	0.0739	29.0849	13.8378	0.7352	0	0.0108
13	SDJ013	45.3808	1.4722	0.0744	35.4084	11.8924	0.7665	0	0.0052
14	SDJ014	71.9886	0.6693	0.065	15.3666	7.1433	0.6114	0	0
15	SDJ015	43.2845	0.9311	0.0754	40.3643	9.5589	0.4684	0	0.0018
16	SDJ016	43.9299	1.3865	0.0768	39.6476	8.2683	0.9816	0	0.0001
17	SDJ017	46.1175	1.5835	0.071	31.6187	12.7793	0.7648	0	0
18	SDJ018	52.4981	1.6601	0.0683	20.4423	17.7349	0.4842	0	0.0117
19	SDJ019	46.2486	1.7922	0.072	28.9981	15.0224	0.7136	0	0.0102
20	SDJ020	48.1257	1.8639	0.0752	32.6986	9.4057	1.1212	0	0.0007



No	Sample Name	SiO <sub>2</sub> (%)	Al <sub>2</sub> O <sub>3</sub> (%)	Na <sub>2</sub> O (%)	MgO (%)	Fe <sub>2</sub> O <sub>3</sub> (%)	CaO (%)	K <sub>2</sub> O (%)	TiO <sub>2</sub> (%)
21	SDJ021	42.295	0.7355	0.0759	40.1936	9.3692	0.361	0	0.0016
22	SDJ022	51.6239	1.7313	0.0708	26.274	12.3308	0.8552	0	0.0051
23	SDJ023	48.2506	2.6629	0.0725	26.4896	14.1483	1.1128	0	0.0003
24	SDJ024	51.2496	1.9454	0.0705	26.0749	11.5006	0.5814	0	0.0001
25	SDJ025	49.1973	4.6977	0.0657	10.2305	25.8197	0.2729	0	0.0441
26	SDJ026	45.6417	2.3773	0.0733	28.4501	13.5028	0.854	0	0
27	SDJ027	47.8915	1.3359	0.0713	28.0114	12.168	0.4409	0	0.0073
28	SDJ028	42.5341	2.3286	0.07	26.639	16.3064	0.4149	0	0.0022
29	SDJ029	42.4553	2.3311	0.0687	26.7289	16.3188	0.4128	0	0.0028
30	SDJ030	34.2403	3.259	0.0662	13.9556	33.8397	0.0802	0	0.017
31	SDJ031	33.4209	3.0813	0.066	13.7084	33.6732	0.0702	0	0.0181
32	SDJ032	45.4024	0.5952	0.0693	32.7579	9.325	0.0547	0	0.0035
33	SDJ033	33.8091	1.9248	0.0649	16.0458	31.4186	0.0899	0	0.0195
Average		46.31785	1.64663	0.072485	31.06191	13.59942	0.586406	0	0.005506
Minimum Value		33.4209	0.5952	0.0649	10.2305	7.1433	0.0547	0	0
Maximal Value		71.9886	4.6977	0.0788	44.2615	33.8397	1.1212	0	0.0441

<b>No</b>	<b>Sample Name</b>	<b>MnO (%)</b>	<b>P (%)</b>	<b>S (%)</b>	<b>Cr<sub>2</sub>O<sub>3</sub> (%)</b>	<b>Ni (%)</b>	<b>Co (%)</b>	<b>LOI</b>	<b>SUM</b>
1	SDJ001	0.1122	0.0094	0	0.4581	0.3181	0.0118	1.86	101.32
2	SDJ002	0.1112	0.0093	0	0.4441	0.2468	0.0117	2.01	101.09
3	SDJ003	0.1251	0.0096	0	0.5232	0.5012	0.0135	2.68	100.84
4	SDJ004	0.1061	0.0096	0	0.4738	0.4586	0.0101	2.77	102.03
5	SDJ005	0.1307	0.0093	0	0.5047	0.3923	0.0132	2.98	102.56
6	SDJ006	0.1286	0.0091	0	0.4637	0.3165	0.0117	3.06	101.98
7	SDJ007	0.1074	0.0092	0	0.3997	0.2688	0.0116	3.2	101.28
8	SDJ008	0.1045	0.0094	0	0.444	0.4653	0.0105	3.3	102.2
9	SDJ009	0.1221	0.0094	0	0.4778	0.2924	0.0123	4.1	101.8
10	SDJ010	0.113	0.0093	0	0.4412	0.3338	0.0116	4.27	98.45
11	SDJ011	0.1867	0.0094	0	0.8362	0.7922	0.0183	4.77	101.15
12	SDJ012	0.1823	0.0095	0	0.8379	0.7883	0.0189	4.84	100.83
13	SDJ013	0.1477	0.0094	0	0.5888	0.8366	0.0172	5.06	100.8
14	SDJ014	0.0777	0.0092	0	0.3572	0.2643	0.0081	5.22	101.5
15	SDJ015	0.1199	0.009	0	0.53	0.754	0.0142	5.23	100.56
16	SDJ016	0.1151	0.0093	0	0.4487	0.3496	0.0106	6	100.85
17	SDJ017	0.1677	0.0094	0	0.6633	0.984	0.0196	6.07	99.84
18	SDJ018	0.2332	0.0099	0	0.935	1.1731	0.0249	6.56	100.63
19	SDJ019	0.2115	0.0097	0	0.7753	0.794	0.0224	6.61	100.45
20	SDJ020	0.1234	0.0095	0	0.5541	0.742	0.0115	7.09	101.06

<b>No</b>	<b>Sample Name</b>	<b>MnO (%)</b>	<b>P (%)</b>	<b>S (%)</b>	<b>Cr<sub>2</sub>O<sub>3</sub> (%)</b>	<b>Ni (%)</b>	<b>Co (%)</b>	<b>LOI</b>	<b>SUM</b>
21	SDJ021	0.1177	0.0091	0	0.4768	0.7637	0.0157	7.15	100.78
22	SDJ022	0.152	0.0096	0	0.7103	0.4701	0.0159	7.21	100.96
23	SDJ023	0.1732	0.0096	0	0.8519	1.0311	0.0178	7.96	101.72
24	SDJ024	0.1437	0.0095	0	0.6459	0.9607	0.0162	8.7	100.91
25	SDJ025	0.4173	0.0103	0	1.2555	1.8099	0.0663	8.31	100.31
26	SDJ026	0.2012	0.0096	0	0.6743	1.2465	0.0197	8.31	100.08
27	SDJ027	0.1538	0.0093	0	0.6645	0.7952	0.0183	9.41	100.15
28	SDJ028	0.1952	0.0097	0	0.9059	2.1932	0.0221	9.83	99.23
29	SDJ029	0.1969	0.0097	0	0.914	2.1939	0.0223	9.83	99.26
30	SDJ030	0.4697	0.0104	0	1.7528	3.3697	0.0495	10.64	98.32
31	SDJ031	0.4566	0.0107	0	1.7264	3.3282	0.0488	10.98	97.2
32	SDJ032	0.0937	0.0093	0	0.4912	1.7238	0.0162	11.03	99.82
33	SDJ033	0.4607	0.0104	0	1.5696	3.4481	0.0528	11.26	96.66
	Average	0.180539	0.009548	0	0.721088	1.042606	0.020161	6.312121	100.5036
	Minimum Value	0.0777	0.009	0	0.3572	0.2468	0.0081	1.86	96.66
	Maximal Value	0.4697	0.0107	0	1.7528	3.4481	0.0663	11.26	102.56

## 1. Regression Line Equation and Correlation Coefficient of Nickel (Ni)

X (Ni)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.3181	1.86	0.1012	3.4596	0.591666
0.2468	2.01	0.0609	4.0401	0.496068
0.5012	2.68	0.2512	7.1824	1.343216
0.4586	2.77	0.2103	7.6729	1.270322
0.3923	2.98	0.1539	8.8804	1.169054
0.3165	3.06	0.1002	9.3636	0.96849
0.2688	3.2	0.0723	10.2400	0.86016
0.4653	3.3	0.2165	10.8900	1.53549
0.2924	4.1	0.0855	16.8100	1.19884
0.3338	4.27	0.1114	18.2329	1.425326
0.7922	4.77	0.6276	22.7529	3.778794
0.7883	4.84	0.6214	23.4256	3.815372
0.8366	5.06	0.6999	25.6036	4.233196
0.2643	5.22	0.0699	27.2484	1.379646
0.7540	5.23	0.5685	27.3529	3.94342
0.3496	6	0.1222	36.0000	2.0976
0.9840	6.07	0.9683	36.8449	5.97288
1.1731	6.56	1.3762	43.0336	7.695536
0.7940	6.61	0.6304	43.6921	5.24834
0.7420	7.09	0.5506	50.2681	5.26078
0.7637	7.15	0.5832	51.1225	5.460455

	<b>X (Ni)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.4701	7.21	0.2210	51.9841	3.389421
	1.0311	7.96	1.0632	63.3616	8.207556
	0.9607	8.7	0.9229	75.6900	8.35809
	1.8099	8.31	3.2757	69.0561	15.040269
	1.2465	8.31	1.5538	69.0561	10.358415
	0.7952	9.41	0.6323	88.5481	7.482832
	2.1932	9.83	4.8101	96.6289	21.559156
	2.1939	9.83	4.8132	96.6289	21.566037
	3.3697	10.64	11.3549	113.2096	35.853608
	3.3282	10.98	11.0769	120.5604	36.543636
	1.7238	11.03	2.9715	121.6609	19.013514
	3.4481	11.26	11.8894	126.7876	38.825606
<b>Total</b>	34.4060	208.3000	62.7665	1577.2888	285.9428
<b>(Total Ni)<sup>2</sup></b>	1183.7728				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{3236.1047}{887.52} \right| \right) \right) = 3.6463$$

$$b = \left( \left( \left| \frac{2269.3423}{887.52} \right| \right) \right) = 2.5569$$

So. the equation of the regression line is **y = 3.6463 x + 2.5569**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.3181	1.86	1.042606	6.3122	-0.7245	-4.4522	0.5249	19.8221	3.225646
0.2468	2.01	1.042606	6.3122	-0.7958	-4.3022	0.633307	18.5089	3.423717
0.5012	2.68	1.042606	6.3122	-0.5414	-3.6322	0.293121	13.1929	1.966495
0.4586	2.77	1.042606	6.3122	-0.5840	-3.5422	0.341063	12.5472	2.068666
0.3923	2.98	1.042606	6.3122	-0.6503	-3.3322	0.422898	11.1036	2.16695
0.3165	3.06	1.042606	6.3122	-0.7261	-3.2522	0.52723	10.5768	2.361442
0.2688	3.2	1.042606	6.3122	-0.7738	-3.1122	0.598776	9.6858	2.408239
0.4653	3.3	1.042606	6.3122	-0.5773	-3.0122	0.333282	9.0733	1.738961
0.2924	4.1	1.042606	6.3122	-0.7502	-2.2122	0.562809	4.8938	1.659606
0.3338	4.27	1.042606	6.3122	-0.7088	-2.0422	0.502406	4.1706	1.447524
0.7922	4.77	1.042606	6.3122	-0.2504	-1.5422	0.062703	2.3784	0.386176
0.7883	4.84	1.042606	6.3122	-0.2543	-1.4722	0.064672	2.1674	0.374389
0.8366	5.06	1.042606	6.3122	-0.2060	-1.2522	0.042438	1.5680	0.257961
0.2643	5.22	1.042606	6.3122	-0.7783	-1.0922	0.60576	1.1929	0.850066
0.7540	5.23	1.042606	6.3122	-0.2886	-1.0822	0.083293	1.1712	0.312329
0.3496	6	1.042606	6.3122	-0.6930	-0.3122	0.480257	0.0975	0.216356
0.9840	6.07	1.042606	6.3122	-0.0586	-0.2422	0.003435	0.0587	0.014194
1.1731	6.56	1.042606	6.3122	0.1305	0.2478	0.017029	0.0614	0.032336
0.7940	6.61	1.042606	6.3122	-0.2486	0.2978	0.061805	0.0887	-0.07403
0.7420	7.09	1.042606	6.3122	-0.3006	0.7778	0.090364	0.6050	-0.23381

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.7637	7.15	1.042606	6.3122	-0.2789	0.8378	0.077789	0.7019	-0.23367
0.4701	7.21	1.042606	6.3122	-0.5725	0.8978	0.327763	0.8060	-0.514
1.0311	7.96	1.042606	6.3122	-0.0115	1.6478	0.000132	2.7152	-0.01896
0.9607	8.7	1.042606	6.3122	-0.0819	2.3878	0.006709	5.7016	-0.19558
1.8099	8.31	1.042606	6.3122	0.7673	1.9978	0.58874	3.9912	1.5329
1.2465	8.31	1.042606	6.3122	0.2039	1.9978	0.041573	3.9912	0.407339
0.7952	9.41	1.042606	6.3122	-0.2474	3.0978	0.06121	9.5964	-0.76641
2.1932	9.83	1.042606	6.3122	1.1506	3.5178	1.323866	12.3749	4.047559
2.1939	9.83	1.042606	6.3122	1.1513	3.5178	1.325478	12.3749	4.050022
3.3697	10.64	1.042606	6.3122	2.3271	4.3278	5.415366	18.7299	10.0712
3.3282	10.98	1.042606	6.3122	2.2856	4.6678	5.22394	21.7884	10.6687
1.7238	11.03	1.042606	6.3122	0.6812	4.7178	0.464025	22.2576	3.213737
3.4481	11.26	1.042606	6.3122	2.4055	4.9478	5.786401	24.4807	11.9019
34.4060	208.3					26.89455	262.4740	68.76795
					<b>S<sup>2</sup></b>	0.814986	7.953756113	2.083877
					<b>S</b>	0.902766	2.820240435	

$$r = \left( \left( \left| \frac{2.083877}{0.9028 \times 2.8203} \right| \right) \right) = \mathbf{0.8185}$$

So the degree of correlation of the two variables is approx 81%.

## 2. Regression Line Equation and Correlation Coefficient of Chromium Oxide (Cr<sub>2</sub>O<sub>3</sub>)

X (Cr <sub>2</sub> O <sub>3</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.4581	1.86	0.2099	3.4596	0.852066
0.4441	2.01	0.1972	4.0401	0.892641
0.5232	2.68	0.2737	7.1824	1.402176
0.4738	2.77	0.2245	7.6729	1.312426
0.5047	2.98	0.2547	8.8804	1.504006
0.4637	3.06	0.2150	9.3636	1.418922
0.3997	3.2	0.1598	10.2400	1.27904
0.4440	3.3	0.1971	10.8900	1.4652
0.4778	4.1	0.2283	16.8100	1.95898
0.4412	4.27	0.1947	18.2329	1.883924
0.8362	4.77	0.6992	22.7529	3.988674
0.8379	4.84	0.7021	23.4256	4.055436
0.5888	5.06	0.3467	25.6036	2.979328
0.3572	5.22	0.1276	27.2484	1.864584
0.5300	5.23	0.2809	27.3529	2.7719
0.4487	6	0.2013	36.0000	2.6922
0.6633	6.07	0.4400	36.8449	4.026231
0.9350	6.56	0.8742	43.0336	6.1336
0.7753	6.61	0.6011	43.6921	5.124733
0.5541	7.09	0.3070	50.2681	3.928569
0.4768	7.15	0.2273	51.1225	3.40912



	<b>X (Cr<sub>2</sub>O<sub>3</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.7103	7.21	0.5045	51.9841	5.121263
	0.8519	7.96	0.7257	63.3616	6.781124
	0.6459	8.7	0.4172	75.6900	5.61933
	1.2555	8.31	1.5763	69.0561	10.433205
	0.6743	8.31	0.4547	69.0561	5.603433
	0.6645	9.41	0.4416	88.5481	6.252945
	0.9059	9.83	0.8207	96.6289	8.904997
	0.9140	9.83	0.8354	96.6289	8.98462
	1.7528	10.64	3.0723	113.2096	18.649792
	1.7264	10.98	2.9805	120.5604	18.955872
	0.4912	11.03	0.2413	121.6609	5.417936
	1.5696	11.26	2.4636	126.7876	17.673696
<b>Total</b>	23.7959	208.3000	21.4961	1577.2888	173.3420
<b>(Total Cr<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	566.2449				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{352.8009}{143.125} \right| \right) \right) = 2.46499$$

$$b = \left( \left( \left| \frac{763.5991}{143.125} \right| \right) \right) = 5.33529$$

So. the equation of the regression line is **y = 5.33529 x + 2.46499**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.4581	1.86	0.721088	6.3122	-0.2630	-4.4522	0.0692	19.8221	1.170875
0.4441	2.01	0.721088	6.3122	-0.2770	-4.3022	0.076722	18.5089	1.191657
0.5232	2.68	0.721088	6.3122	-0.1979	-3.6322	0.03916	13.1929	0.718768
0.4738	2.77	0.721088	6.3122	-0.2473	-3.5422	0.061151	12.5472	0.875943
0.5047	2.98	0.721088	6.3122	-0.2164	-3.3322	0.046824	11.1036	0.721048
0.4637	3.06	0.721088	6.3122	-0.2574	-3.2522	0.066249	10.5768	0.837077
0.3997	3.2	0.721088	6.3122	-0.3214	-3.1122	0.10329	9.6858	1.000223
0.4440	3.3	0.721088	6.3122	-0.2771	-3.0122	0.076778	9.0733	0.834644
0.4778	4.1	0.721088	6.3122	-0.2433	-2.2122	0.059189	4.8938	0.538201
0.4412	4.27	0.721088	6.3122	-0.2799	-2.0422	0.078337	4.1706	0.571587
0.8362	4.77	0.721088	6.3122	0.1151	-1.5422	0.013251	2.3784	-0.17753
0.8379	4.84	0.721088	6.3122	0.1168	-1.4722	0.013645	2.1674	-0.17197
0.5888	5.06	0.721088	6.3122	-0.1323	-1.2522	0.0175	1.5680	0.165651
0.3572	5.22	0.721088	6.3122	-0.3639	-1.0922	0.132414	1.1929	0.397438
0.5300	5.23	0.721088	6.3122	-0.1911	-1.0822	0.036515	1.1712	0.206795
0.4487	6	0.721088	6.3122	-0.2724	-0.3122	0.074195	0.0975	0.085039
0.6633	6.07	0.721088	6.3122	-0.0578	-0.2422	0.003339	0.0587	0.013996
0.9350	6.56	0.721088	6.3122	0.2139	0.2478	0.045758	0.0614	0.053007
0.7753	6.61	0.721088	6.3122	0.0542	0.2978	0.002939	0.0887	0.016144
0.5541	7.09	0.721088	6.3122	-0.1670	0.7778	0.027885	0.6050	-0.12988

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.4768	7.15	0.721088	6.3122	-0.2443	0.8378	0.059677	0.7019	-0.20466
0.7103	7.21	0.721088	6.3122	-0.0108	0.8978	0.000116	0.8060	-0.00969
0.8519	7.96	0.721088	6.3122	0.1308	1.6478	0.017112	2.7152	0.215552
0.6459	8.7	0.721088	6.3122	-0.0752	2.3878	0.005653	5.7016	-0.17953
1.2555	8.31	0.721088	6.3122	0.5344	1.9978	0.285596	3.9912	1.067649
0.6743	8.31	0.721088	6.3122	-0.0468	1.9978	0.002189	3.9912	-0.09347
0.6645	9.41	0.721088	6.3122	-0.0566	3.0978	0.003202	9.5964	-0.1753
0.9059	9.83	0.721088	6.3122	0.1848	3.5178	0.034156	12.3749	0.650132
0.9140	9.83	0.721088	6.3122	0.1929	3.5178	0.037215	12.3749	0.678626
1.7528	10.64	0.721088	6.3122	1.0317	4.3278	1.06443	18.7299	4.465044
1.7264	10.98	0.721088	6.3122	1.0053	4.6678	1.010652	21.7884	4.692596
0.4912	11.03	0.721088	6.3122	-0.2299	4.7178	0.052848	22.2576	-1.08457
1.5696	11.26	0.721088	6.3122	0.8485	4.9478	0.719973	24.4807	4.198268
23.7959	208.3					4.337124	262.4740	23.13936
					<b>S<sup>2</sup></b>	0.131428	7.953756113	0.701193
					<b>S</b>	0.36253	2.820240435	

$$r = \left( \left( \left| \frac{0.7012}{0.3626 \times 2.8203} \right| \right) \right) = 0.6859$$

So the degree of correlation of the two variables is approx 68%.

### 3. Regression Line Equation and Correlation Coefficient of Cobalt (Co)

X (Co)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.0118	1.86	0.0001	3.4596	0.021948
0.0117	2.01	0.0001	4.0401	0.023517
0.0135	2.68	0.0002	7.1824	0.03618
0.0101	2.77	0.0001	7.6729	0.027977
0.0132	2.98	0.0002	8.8804	0.039336
0.0117	3.06	0.0001	9.3636	0.035802
0.0116	3.2	0.0001	10.2400	0.03712
0.0105	3.3	0.0001	10.8900	0.03465
0.0123	4.1	0.0002	16.8100	0.05043
0.0116	4.27	0.0001	18.2329	0.049532
0.0183	4.77	0.0003	22.7529	0.087291
0.0189	4.84	0.0004	23.4256	0.091476
0.0172	5.06	0.0003	25.6036	0.087032
0.0081	5.22	0.0001	27.2484	0.042282
0.0142	5.23	0.0002	27.3529	0.074266
0.0106	6	0.0001	36.0000	0.0636
0.0196	6.07	0.0004	36.8449	0.118972
0.0249	6.56	0.0006	43.0336	0.163344
0.0224	6.61	0.0005	43.6921	0.148064
0.0115	7.09	0.0001	50.2681	0.081535
0.0157	7.15	0.0002	51.1225	0.112255

	<b>X (Co)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.0159	7.21	0.0003	51.9841	0.114639
	0.0178	7.96	0.0003	63.3616	0.141688
	0.0162	8.7	0.0003	75.6900	0.14094
	0.0663	8.31	0.0044	69.0561	0.550953
	0.0197	8.31	0.0004	69.0561	0.163707
	0.0183	9.41	0.0003	88.5481	0.172203
	0.0221	9.83	0.0005	96.6289	0.217243
	0.0223	9.83	0.0005	96.6289	0.219209
	0.0495	10.64	0.0025	113.2096	0.52668
	0.0488	10.98	0.0024	120.5604	0.535824
	0.0162	11.03	0.0003	121.6609	0.178686
	0.0528	11.26	0.0028	126.7876	0.594528
<b>Total</b>	0.6653	208.3000	0.0195	1577.2888	4.9829
<b>(Total Co)<sup>2</sup></b>	0.4426				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{0.7411}{0.1999} \right| \right) \right) = 3.7057$$

$$b = \left( \left( \left| \frac{25.8541}{0.1999} \right| \right) \right) = 129.2835$$

So. the equation of the regression line is **y = 129.2835 x + 3.7057**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.0118	1.86	0.020161	6.3122	-0.0084	-4.4522	0.0001	19.8221	0.037223
0.0117	2.01	0.020161	6.3122	-0.0085	-4.3022	7.16E-05	18.5089	0.036399
0.0135	2.68	0.020161	6.3122	-0.0067	-3.6322	4.44E-05	13.1929	0.024193
0.0101	2.77	0.020161	6.3122	-0.0101	-3.5422	0.000101	12.5472	0.035637
0.0132	2.98	0.020161	6.3122	-0.0070	-3.3322	4.85E-05	11.1036	0.023194
0.0117	3.06	0.020161	6.3122	-0.0085	-3.2522	7.16E-05	10.5768	0.027516
0.0116	3.2	0.020161	6.3122	-0.0086	-3.1122	7.33E-05	9.6858	0.026642
0.0105	3.3	0.020161	6.3122	-0.0097	-3.0122	9.33E-05	9.0733	0.0291
0.0123	4.1	0.020161	6.3122	-0.0079	-2.2122	6.18E-05	4.8938	0.017389
0.0116	4.27	0.020161	6.3122	-0.0086	-2.0422	7.33E-05	4.1706	0.017482
0.0183	4.77	0.020161	6.3122	-0.0019	-1.5422	3.46E-06	2.3784	0.002869
0.0189	4.84	0.020161	6.3122	-0.0013	-1.4722	1.59E-06	2.1674	0.001856
0.0172	5.06	0.020161	6.3122	-0.0030	-1.2522	8.77E-06	1.5680	0.003707
0.0081	5.22	0.020161	6.3122	-0.0121	-1.0922	0.000145	1.1929	0.013173
0.0142	5.23	0.020161	6.3122	-0.0060	-1.0822	3.55E-05	1.1712	0.006451
0.0106	6	0.020161	6.3122	-0.0096	-0.3122	9.14E-05	0.0975	0.002985
0.0196	6.07	0.020161	6.3122	-0.0006	-0.2422	3.14E-07	0.0587	0.000136
0.0249	6.56	0.020161	6.3122	0.0047	0.2478	2.25E-05	0.0614	0.001174
0.0224	6.61	0.020161	6.3122	0.0022	0.2978	5.01E-06	0.0887	0.000667
0.0115	7.09	0.020161	6.3122	-0.0087	0.7778	7.5E-05	0.6050	-0.00674

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.0157	7.15	0.020161	6.3122	-0.0045	0.8378	1.99E-05	0.7019	-0.00374
0.0159	7.21	0.020161	6.3122	-0.0043	0.8978	1.82E-05	0.8060	-0.00383
0.0178	7.96	0.020161	6.3122	-0.0024	1.6478	5.57E-06	2.7152	-0.00389
0.0162	8.7	0.020161	6.3122	-0.0040	2.3878	1.57E-05	5.7016	-0.00946
0.0663	8.31	0.020161	6.3122	0.0461	1.9978	0.002129	3.9912	0.092177
0.0197	8.31	0.020161	6.3122	-0.0005	1.9978	2.12E-07	3.9912	-0.00092
0.0183	9.41	0.020161	6.3122	-0.0019	3.0978	3.46E-06	9.5964	-0.00576
0.0221	9.83	0.020161	6.3122	0.0019	3.5178	3.76E-06	12.3749	0.006822
0.0223	9.83	0.020161	6.3122	0.0021	3.5178	4.58E-06	12.3749	0.007526
0.0495	10.64	0.020161	6.3122	0.0293	4.3278	0.000861	18.7299	0.126975
0.0488	10.98	0.020161	6.3122	0.0286	4.6678	0.00082	21.7884	0.133683
0.0162	11.03	0.020161	6.3122	-0.0040	4.7178	1.57E-05	22.2576	-0.01869
0.0528	11.26	0.020161	6.3122	0.0326	4.9478	0.001065	24.4807	0.161493
0.6653	208.3					0.00606	262.4740	0.783455
					<b>S<sup>2</sup></b>	0.000184	7.953756113	0.023741
					<b>S</b>	0.013551	2.820240435	

$$r = \left( \left( \left| \frac{0.0237}{0.0136 \times 2.8203} \right| \right) \right) = \mathbf{0.6213}$$

So the degree of correlation of the two variables is approx 62%.

#### 4. Regression Line Equation and Correlation Coefficient of Manganese Oxide (MnO)

X (MnO)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.1122	1.86	0.0126	3.4596	0.208692
0.1112	2.01	0.0124	4.0401	0.223512
0.1251	2.68	0.0157	7.1824	0.335268
0.1061	2.77	0.0113	7.6729	0.293897
0.1307	2.98	0.0171	8.8804	0.389486
0.1286	3.06	0.0165	9.3636	0.393516
0.1074	3.2	0.0115	10.2400	0.34368
0.1045	3.3	0.0109	10.8900	0.34485
0.1221	4.1	0.0149	16.8100	0.50061
0.1130	4.27	0.0128	18.2329	0.48251
0.1867	4.77	0.0349	22.7529	0.890559
0.1823	4.84	0.0332	23.4256	0.882332
0.1477	5.06	0.0218	25.6036	0.747362
0.0777	5.22	0.0060	27.2484	0.405594
0.1199	5.23	0.0144	27.3529	0.627077
0.1151	6	0.0132	36.0000	0.6906
0.1677	6.07	0.0281	36.8449	1.017939
0.2332	6.56	0.0544	43.0336	1.529792
0.2115	6.61	0.0447	43.6921	1.398015
0.1234	7.09	0.0152	50.2681	0.874906
0.1177	7.15	0.0139	51.1225	0.841555



	<b>X (MnO)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.1520	7.21	0.0231	51.9841	1.09592
	0.1732	7.96	0.0300	63.3616	1.378672
	0.1437	8.7	0.0206	75.6900	1.25019
	0.4173	8.31	0.1741	69.0561	3.467763
	0.2012	8.31	0.0405	69.0561	1.671972
	0.1538	9.41	0.0237	88.5481	1.447258
	0.1952	9.83	0.0381	96.6289	1.918816
	0.1969	9.83	0.0388	96.6289	1.935527
	0.4697	10.64	0.2206	113.2096	4.997608
	0.4566	10.98	0.2085	120.5604	5.013468
	0.0937	11.03	0.0088	121.6609	1.033511
	0.4607	11.26	0.2122	126.7876	5.187482
<b>Total</b>	5.9578	208.3000	1.4545	1577.2888	43.8199
<b>(Total MnO)<sup>2</sup></b>	35.4954				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{41.9072}{12.504} \right| \right) \right) = 3.3516$$

$$b = \left( \left( \left| \frac{205.0483}{12.504} \right| \right) \right) = 16.3987$$

So. the equation of the regression line is **y = 16.3987 x + 3.3516**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.1122	1.86	0.180539	6.3122	-0.0683	-4.4522	0.0047	19.8221	0.304261
0.1112	2.01	0.180539	6.3122	-0.0693	-4.3022	0.004808	18.5089	0.298312
0.1251	2.68	0.180539	6.3122	-0.0554	-3.6322	0.003074	13.1929	0.201367
0.1061	2.77	0.180539	6.3122	-0.0744	-3.5422	0.005541	12.5472	0.263679
0.1307	2.98	0.180539	6.3122	-0.0498	-3.3322	0.002484	11.1036	0.166075
0.1286	3.06	0.180539	6.3122	-0.0519	-3.2522	0.002698	10.5768	0.168917
0.1074	3.2	0.180539	6.3122	-0.0731	-3.1122	0.005349	9.6858	0.227624
0.1045	3.3	0.180539	6.3122	-0.0760	-3.0122	0.005782	9.0733	0.229046
0.1221	4.1	0.180539	6.3122	-0.0584	-2.2122	0.003415	4.8938	0.12928
0.1130	4.27	0.180539	6.3122	-0.0675	-2.0422	0.004562	4.1706	0.137929
0.1867	4.77	0.180539	6.3122	0.0062	-1.5422	3.8E-05	2.3784	-0.0095
0.1823	4.84	0.180539	6.3122	0.0018	-1.4722	3.1E-06	2.1674	-0.00259
0.1477	5.06	0.180539	6.3122	-0.0328	-1.2522	0.001078	1.5680	0.041121
0.0777	5.22	0.180539	6.3122	-0.1028	-1.0922	0.010576	1.1929	0.112321
0.1199	5.23	0.180539	6.3122	-0.0606	-1.0822	0.003677	1.1712	0.065624
0.1151	6	0.180539	6.3122	-0.0654	-0.3122	0.004282	0.0975	0.02043
0.1677	6.07	0.180539	6.3122	-0.0128	-0.2422	0.000165	0.0587	0.00311
0.2332	6.56	0.180539	6.3122	0.0527	0.2478	0.002773	0.0614	0.013049
0.2115	6.61	0.180539	6.3122	0.0310	0.2978	0.000959	0.0887	0.00922
0.1234	7.09	0.180539	6.3122	-0.0571	0.7778	0.003265	0.6050	-0.04444

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.1177	7.15	0.180539	6.3122	-0.0628	0.8378	0.003949	0.7019	-0.05265
0.1520	7.21	0.180539	6.3122	-0.0285	0.8978	0.000814	0.8060	-0.02562
0.1732	7.96	0.180539	6.3122	-0.0073	1.6478	5.39E-05	2.7152	-0.01209
0.1437	8.7	0.180539	6.3122	-0.0368	2.3878	0.001357	5.7016	-0.08797
0.4173	8.31	0.180539	6.3122	0.2368	1.9978	0.056056	3.9912	0.473
0.2012	8.31	0.180539	6.3122	0.0207	1.9978	0.000427	3.9912	0.041276
0.1538	9.41	0.180539	6.3122	-0.0267	3.0978	0.000715	9.5964	-0.08283
0.1952	9.83	0.180539	6.3122	0.0147	3.5178	0.000215	12.3749	0.051573
0.1969	9.83	0.180539	6.3122	0.0164	3.5178	0.000268	12.3749	0.057553
0.4697	10.64	0.180539	6.3122	0.2892	4.3278	0.083614	18.7299	1.251429
0.4566	10.98	0.180539	6.3122	0.2761	4.6678	0.076209	21.7884	1.288596
0.0937	11.03	0.180539	6.3122	-0.0868	4.7178	0.007541	22.2576	-0.40969
0.4607	11.26	0.180539	6.3122	0.2802	4.9478	0.07849	24.4807	1.386179
5.9578	208.3					0.378908	262.4740	6.213583
					<b>S<sup>2</sup></b>	0.011482	7.953756113	0.18829
					<b>S</b>	0.107154	2.820240435	

$$r = \left( \left( \left| \frac{0.1883}{0.1072 \times 2.8203} \right| \right) \right) = \mathbf{0.6231}$$

So the degree of correlation of the two variables is approx 62%.

## 5. Regression Line Equation and Correlation Coefficient of Silica (SiO<sub>2</sub>)

X (SiO <sub>2</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
43.8962	1.86	1926.8764	3.4596	81.646932
44.0492	2.01	1940.3320	4.0401	88.538892
46.1202	2.68	2127.0728	7.1824	123.602136
52.9438	2.77	2803.0460	7.6729	146.654326
45.2759	2.98	2049.9071	8.8804	134.922182
44.1165	3.06	1946.2656	9.3636	134.99649
44.0185	3.2	1937.6283	10.2400	140.8592
54.7770	3.3	3000.5197	10.8900	180.7641
45.3135	4.1	2053.3133	16.8100	185.78535
43.2836	4.27	1873.4700	18.2329	184.820972
49.6275	4.77	2462.8888	22.7529	236.723175
49.4819	4.84	2448.4584	23.4256	239.492396
45.3808	5.06	2059.4170	25.6036	229.626848
71.9886	5.22	5182.3585	27.2484	375.780492
43.2845	5.23	1873.5479	27.3529	226.377935
43.9299	6	1929.8361	36.0000	263.5794
46.1175	6.07	2126.8238	36.8449	279.933225
52.4981	6.56	2756.0505	43.0336	344.387536
46.2486	6.61	2138.9330	43.6921	305.703246
48.1257	7.09	2316.0830	50.2681	341.211213
42.2950	7.15	1788.8670	51.1225	302.40925

	<b>X (SiO<sub>2</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	51.6239	7.21	2665.0271	51.9841	372.208319
	48.2506	7.96	2328.1204	63.3616	384.074776
	51.2496	8.7	2626.5215	75.6900	445.87152
	49.1973	8.31	2420.3743	69.0561	408.829563
	45.6417	8.31	2083.1648	69.0561	379.282527
	47.8915	9.41	2293.5958	88.5481	450.659015
	42.5341	9.83	1809.1497	96.6289	418.110203
	42.4553	9.83	1802.4525	96.6289	417.335599
	34.2403	10.64	1172.3981	113.2096	364.316792
	33.4209	10.98	1116.9566	120.5604	366.961482
	45.4024	11.03	2061.3779	121.6609	500.788472
	33.8091	11.26	1143.0552	126.7876	380.690466
<b>Total</b>	1528.4892	208.3000	72263.8893	1577.2888	9436.9440
<b>(Total SiO<sub>2</sub>)<sup>2</sup></b>	2336279.2345				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{628301.1003}{48429.11079} \right| \right) \right) = \mathbf{12.9737}$$

$$b = \left( \left( \left| \frac{-6965.14737}{48429.11079} \right| \right) \right) = \mathbf{-0.1439}$$

So, the equation of the regression line is  $y = \mathbf{-0.1439 x + 12.9737}$

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
43.8962	1.86	46.31785455	6.3122	-2.4217	-4.4522	5.8644	19.8221	10.78169037
44.0492	2.01	46.31785455	6.3122	-2.2687	-4.3022	5.146793447	18.5089	9.760205585
46.1202	2.68	46.31785455	6.3122	-0.1977	-3.6322	0.039067319	13.1929	0.71792084
52.9438	2.77	46.31785455	6.3122	6.6259	-3.5422	43.90315317	12.5472	-23.47042399
45.2759	2.98	46.31785455	6.3122	-1.0420	-3.3322	1.085669275	11.1036	3.472000936
44.1165	3.06	46.31785455	6.3122	-2.2014	-3.2522	4.845961835	10.5768	7.159245253
44.0185	3.2	46.31785455	6.3122	-2.2994	-3.1122	5.287031326	9.6858	7.156051216
54.7770	3.3	46.31785455	6.3122	8.4591	-3.0122	71.55714182	9.0733	-25.48063794
45.3135	4.1	46.31785455	6.3122	-1.0044	-2.2122	1.008728053	4.8938	2.221833125
43.2836	4.27	46.31785455	6.3122	-3.0343	-2.0422	9.206700647	4.1706	6.196554633
49.6275	4.77	46.31785455	6.3122	3.3096	-1.5422	10.95375303	2.3784	-5.10413522
49.4819	4.84	46.31785455	6.3122	3.1640	-1.4722	10.01118364	2.1674	-4.658107718
45.3808	5.06	46.31785455	6.3122	-0.9371	-1.2522	0.878071221	1.5680	1.173379702
71.9886	5.22	46.31785455	6.3122	25.6707	-1.0922	658.9871722	1.1929	-28.03758819
43.2845	5.23	46.31785455	6.3122	-3.0334	-1.0822	9.201239798	1.1712	3.282696289
43.9299	6	46.31785455	6.3122	-2.3880	-0.3122	5.702326911	0.0975	0.745519409
46.1175	6.07	46.31785455	6.3122	-0.2004	-0.2422	0.040141944	0.0587	0.048525871
52.4981	6.56	46.31785455	6.3122	6.1802	0.2478	38.19543388	0.0614	1.531464824
46.2486	6.61	46.31785455	6.3122	-0.0693	0.2978	0.004796192	0.0887	-0.020624004
48.1257	7.09	46.31785455	6.3122	1.8078	0.7778	3.268305188	0.6050	1.406142195

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
42.2950	7.15	46.31785455	6.3122	-4.0229	0.8378	16.18335869	0.7019	-3.370347538
51.6239	7.21	46.31785455	6.3122	5.3060	0.8978	28.15411837	0.8060	4.763767609
48.2506	7.96	46.31785455	6.3122	1.9327	1.6478	3.735504992	2.7152	3.18477796
51.2496	8.7	46.31785455	6.3122	4.9317	2.3878	24.32211323	5.7016	11.7760218
49.1973	8.31	46.31785455	6.3122	2.8794	1.9978	8.291206126	3.9912	5.752556129
45.6417	8.31	46.31785455	6.3122	-0.6762	1.9978	0.457184969	3.9912	-1.350821551
47.8915	9.41	46.31785455	6.3122	1.5736	3.0978	2.476360017	9.5964	4.874838889
42.5341	9.83	46.31785455	6.3122	-3.7838	3.5178	14.31679846	12.3749	-13.31049174
42.4553	9.83	46.31785455	6.3122	-3.8626	3.5178	14.91932762	12.3749	-13.58769438
34.2403	10.64	46.31785455	6.3122	-12.0776	4.3278	145.8673238	18.7299	-52.26924056
33.4209	10.98	46.31785455	6.3122	-12.8970	4.6678	166.3314365	21.7884	-60.20040443
45.4024	11.03	46.31785455	6.3122	-0.9155	4.7178	0.838057025	22.2576	-4.318931455
33.8091	11.26	46.31785455	6.3122	-12.5088	4.9478	156.4689403	24.4807	-61.89081574
1528.4892	208.3					1467.548812	262.4740	-211.0650718
					<b>S<sup>2</sup></b>	44.47117611	7.953756113	-6.395911267
					<b>S</b>	6.66867124	2.820240435	

$$r = \left( \left( \left| \frac{-6.3960}{6.6687 \times 2.8203} \right| \right) \right) = \mathbf{0.3401}$$

So the degree of correlation of the two variables is approx 34%.

## 6. Regression Line Equation and Correlation Coefficient of Magnesia (MgO)

X (MgO)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
44.2615	1.86	1959.0804	3.4596	82.32639
44.0648	2.01	1941.7066	4.0401	88.570248
39.7488	2.68	1579.9671	7.1824	106.526784
35.6738	2.77	1272.6200	7.6729	98.816426
42.6867	2.98	1822.1544	8.8804	127.206366
43.1593	3.06	1862.7252	9.3636	132.067458
43.3480	3.2	1879.0491	10.2400	138.7136
33.9616	3.3	1153.3903	10.8900	112.07328
40.2798	4.1	1622.4623	16.8100	165.14718
39.4207	4.27	1553.9916	18.2329	168.326389
29.2488	4.77	855.4923	22.7529	139.516776
29.0849	4.84	845.9314	23.4256	140.770916
35.4084	5.06	1253.7548	25.6036	179.166504
15.3666	5.22	236.1324	27.2484	80.213652
40.3643	5.23	1629.2767	27.3529	211.105289
39.6476	6	1571.9322	36.0000	237.8856
31.6187	6.07	999.7422	36.8449	191.925509
20.4423	6.56	417.8876	43.0336	134.101488
28.9981	6.61	840.8898	43.6921	191.677441
32.6986	7.09	1069.1984	50.2681	231.833074
40.1936	7.15	1615.5255	51.1225	287.38424



	<b>X (MgO)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	26.2740	7.21	690.3231	51.9841	189.43554
	26.4896	7.96	701.6989	63.3616	210.857216
	26.0749	8.7	679.9004	75.6900	226.85163
	10.2305	8.31	104.6631	69.0561	85.015455
	28.4501	8.31	809.4082	69.0561	236.420331
	28.0114	9.41	784.6385	88.5481	263.587274
	26.6390	9.83	709.6363	96.6289	261.86137
	26.7289	9.83	714.4341	96.6289	262.745087
	13.9556	10.64	194.7588	113.2096	148.487584
	13.7084	10.98	187.9202	120.5604	150.518232
	32.7579	11.03	1073.0800	121.6609	361.319637
	16.0458	11.26	257.4677	126.7876	180.675708
<b>Total</b>	1025.0430	208.3000	34890.8396	1577.2888	5823.1297
<b>(Total MgO)<sup>2</sup></b>	1050713.1518				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{1298803.576}{1100685} \right| \right) \right) = \mathbf{12.8998}$$

$$b = \left( \left( \left| \frac{-21353.17766}{1100685} \right| \right) \right) = \mathbf{-0.2121}$$

So. the equation of the regression line is **y = -0.2121 x + 12.8998**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
44.2615	1.86	31.06190909	6.3122	13.1996	-4.4522	174.2292	19.8221	-58.76721865
44.0648	2.01	31.06190909	6.3122	13.0029	-4.3022	169.075172	18.5089	-55.94103727
39.7488	2.68	31.06190909	6.3122	8.6869	-3.6322	75.46207367	13.1929	-31.55252516
35.6738	2.77	31.06190909	6.3122	4.6119	-3.5422	21.26953776	12.5472	-16.33623998
42.6867	2.98	31.06190909	6.3122	11.6248	-3.3322	135.1357637	11.1036	-38.73612827
43.1593	3.06	31.06190909	6.3122	12.0974	-3.2522	146.3468668	10.5768	-39.34313471
43.3480	3.2	31.06190909	6.3122	12.2861	-3.1122	150.9480298	9.6858	-38.23677213
33.9616	3.3	31.06190909	6.3122	2.8997	-3.0122	8.408207368	9.0733	-8.734448956
40.2798	4.1	31.06190909	6.3122	9.2179	-2.2122	84.96951281	4.8938	-20.39181827
39.4207	4.27	31.06190909	6.3122	8.3588	-2.0422	69.86938546	4.1706	-17.07032279
29.2488	4.77	31.06190909	6.3122	-1.8131	-1.5422	3.287364576	2.3784	2.79617684
29.0849	4.84	31.06190909	6.3122	-1.9770	-1.4722	3.908564946	2.1674	2.910552784
35.4084	5.06	31.06190909	6.3122	4.3465	-1.2522	18.89198322	1.5680	-5.442675916
15.3666	5.22	31.06190909	6.3122	-15.6953	-1.0922	246.3427275	1.1929	17.14241659
40.3643	5.23	31.06190909	6.3122	9.3024	-1.0822	86.53447663	1.1712	-10.06704744
39.6476	6	31.06190909	6.3122	8.5857	-0.3122	73.71408839	0.0975	-2.680452702
31.6187	6.07	31.06190909	6.3122	0.5568	-0.2422	0.310016116	0.0587	-0.134854758
20.4423	6.56	31.06190909	6.3122	-10.6196	0.2478	112.7760972	0.0614	-2.631539133
28.9981	6.61	31.06190909	6.3122	-2.0638	0.2978	4.259307964	0.0887	-0.614602347
32.6986	7.09	31.06190909	6.3122	1.6367	0.7778	2.678757132	0.6050	1.273018189

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
40.1936	7.15	31.06190909	6.3122	9.1317	0.8378	83.38777886	0.7019	7.650530644
26.2740	7.21	31.06190909	6.3122	-4.7879	0.8978	22.92407346	0.8060	-4.298584782
26.4896	7.96	31.06190909	6.3122	-4.5723	1.6478	20.90601042	2.7152	-7.53425092
26.0749	8.7	31.06190909	6.3122	-4.9870	2.3878	24.87025967	5.7016	-11.90798031
10.2305	8.31	31.06190909	6.3122	-20.8314	1.9978	433.9476047	3.9912	-41.61698908
28.4501	8.31	31.06190909	6.3122	-2.6118	1.9978	6.821546727	3.9912	-5.217872202
28.0114	9.41	31.06190909	6.3122	-3.0505	3.0978	9.305605714	9.5964	-9.449867062
26.6390	9.83	31.06190909	6.3122	-4.4229	3.5178	19.56212483	12.3749	-15.5589096
26.7289	9.83	31.06190909	6.3122	-4.3330	3.5178	18.77496778	12.3749	-15.24265938
13.9556	10.64	31.06190909	6.3122	-17.1063	4.3278	292.6258107	18.7299	-74.03268448
13.7084	10.98	31.06190909	6.3122	-17.3535	4.6678	301.1442778	21.7884	-81.00270973
32.7579	11.03	31.06190909	6.3122	1.6960	4.7178	2.876385164	22.2576	8.001345911
16.0458	11.26	31.06190909	6.3122	-15.0161	4.9478	225.4835322	24.4807	-74.29670456
1025.0430	208.3					3051.047111	262.4740	-647.0659896
					<b>S<sup>2</sup></b>	92.45597307	7.953756113	-19.60806029
					<b>S</b>	9.615402907	2.820240435	

$$r = \left( \left( \left| \frac{-19.6081}{9.6155 \times 2.8203} \right| \right) \right) = -0.7231$$

So the degree of correlation of the two variables is approx 72%.

## 7. Regression Line Equation and Correlation Coefficient of Calcine (CaO)

X (CaO)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.6800	1.86	0.4624	3.4596	1.2648
0.5927	2.01	0.3513	4.0401	1.191327
0.5631	2.68	0.3171	7.1824	1.509108
0.5565	2.77	0.3097	7.6729	1.541505
0.3760	2.98	0.1414	8.8804	1.12048
0.6287	3.06	0.3953	9.3636	1.923822
0.6575	3.2	0.4323	10.2400	2.104
0.5095	3.3	0.2596	10.8900	1.68135
0.8171	4.1	0.6677	16.8100	3.35011
0.9917	4.27	0.9835	18.2329	4.234559
0.7308	4.77	0.5341	22.7529	3.485916
0.7352	4.84	0.5405	23.4256	3.558368
0.7665	5.06	0.5875	25.6036	3.87849
0.6114	5.22	0.3738	27.2484	3.191508
0.4684	5.23	0.2194	27.3529	2.449732
0.9816	6	0.9635	36.0000	5.8896
0.7648	6.07	0.5849	36.8449	4.642336
0.4842	6.56	0.2344	43.0336	3.176352
0.7136	6.61	0.5092	43.6921	4.716896
1.1212	7.09	1.2571	50.2681	7.949308
0.3610	7.15	0.1303	51.1225	2.58115

	<b>X (CaO)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.8552	7.21	0.7314	51.9841	6.165992
	1.1128	7.96	1.2383	63.3616	8.857888
	0.5814	8.7	0.3380	75.6900	5.05818
	0.2729	8.31	0.0745	69.0561	2.267799
	0.8540	8.31	0.7293	69.0561	7.09674
	0.4409	9.41	0.1944	88.5481	4.148869
	0.4149	9.83	0.1721	96.6289	4.078467
	0.4128	9.83	0.1704	96.6289	4.057824
	0.0802	10.64	0.0064	113.2096	0.853328
	0.0702	10.98	0.0049	120.5604	0.770796
	0.0547	11.03	0.0030	121.6609	0.603341
	0.0899	11.26	0.0081	126.7876	1.012274
<b>Total</b>	19.3514	208.3000	13.9259	1577.2888	110.4122
<b>(Total CaO)<sup>2</sup></b>	374.4767				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{764.126913}{85.0769} \right| \right) \right) = \mathbf{8.9817}$$

$$b = \left( \left( \left| \frac{-387.293525}{85.0769} \right| \right) \right) = \mathbf{-4.5523}$$

So. the equation of the regression line is **y = -4.5523 x + 8.9817**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.6800	1.86	0.586406061	6.3122	0.0936	-4.4522	0.0088	19.8221	-0.416698937
0.5927	2.01	0.586406061	6.3122	0.0063	-4.3022	3.96137E-05	18.5089	-0.027077786
0.5631	2.68	0.586406061	6.3122	-0.0233	-3.6322	0.000543172	13.1929	0.084652273
0.5565	2.77	0.586406061	6.3122	-0.0299	-3.5422	0.000894372	12.5472	0.105933248
0.3760	2.98	0.586406061	6.3122	-0.2104	-3.3322	0.04427071	11.1036	0.701115075
0.6287	3.06	0.586406061	6.3122	0.0423	-3.2522	0.001788777	10.5768	-0.13754835
0.6575	3.2	0.586406061	6.3122	0.0711	-3.1122	0.005054348	9.6858	-0.221258558
0.5095	3.3	0.586406061	6.3122	-0.0769	-3.0122	0.005914542	9.0733	0.231656436
0.8171	4.1	0.586406061	6.3122	0.2307	-2.2122	0.053219694	4.8938	-0.510341133
0.9917	4.27	0.586406061	6.3122	0.4053	-2.0422	0.164263177	4.1706	-0.827691283
0.7308	4.77	0.586406061	6.3122	0.1444	-1.5422	0.02084961	2.3784	-0.222684333
0.7352	4.84	0.586406061	6.3122	0.1488	-1.4722	0.022139636	2.1674	-0.219054438
0.7665	5.06	0.586406061	6.3122	0.1801	-1.2522	0.032433827	1.5680	-0.225513631
0.6114	5.22	0.586406061	6.3122	0.0250	-1.0922	0.000624697	1.1929	-0.027298381
0.4684	5.23	0.586406061	6.3122	-0.1180	-1.0822	0.01392543	1.1712	0.127706159
0.9816	6	0.586406061	6.3122	0.3952	-0.3122	0.15617825	0.0975	-0.123379548
0.7648	6.07	0.586406061	6.3122	0.1784	-0.2422	0.031824398	0.0587	-0.043207012
0.4842	6.56	0.586406061	6.3122	-0.1022	0.2478	0.010446079	0.0614	-0.025326662
0.7136	6.61	0.586406061	6.3122	0.1272	0.2978	0.016178298	0.0887	0.037878355
1.1212	7.09	0.586406061	6.3122	0.5348	0.7778	0.286004558	0.6050	0.415962726

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.3610	7.15	0.586406061	6.3122	-0.2254	0.8378	0.050807892	0.7019	-0.188845198
0.8552	7.21	0.586406061	6.3122	0.2688	0.8978	0.072250182	0.8060	0.241323199
1.1128	7.96	0.586406061	6.3122	0.5264	1.6478	0.277090579	2.7152	0.867391933
0.5814	8.7	0.586406061	6.3122	-0.0050	2.3878	2.50606E-05	5.7016	-0.011953472
0.2729	8.31	0.586406061	6.3122	-0.3135	1.9978	0.09828605	3.9912	-0.626322408
0.8540	8.31	0.586406061	6.3122	0.2676	1.9978	0.071606516	3.9912	0.534599172
0.4409	9.41	0.586406061	6.3122	-0.1455	3.0978	0.021172014	9.5964	-0.450748675
0.4149	9.83	0.586406061	6.3122	-0.1715	3.5178	0.029414329	12.3749	-0.60332402
0.4128	9.83	0.586406061	6.3122	-0.1736	3.5178	0.030139064	12.3749	-0.6107114
0.0802	10.64	0.586406061	6.3122	-0.5062	4.3278	0.256244576	18.7299	-2.190758589
0.0702	10.98	0.586406061	6.3122	-0.5162	4.6678	0.266468697	21.7884	-2.40954665
0.0547	11.03	0.586406061	6.3122	-0.5317	4.7178	0.282711335	22.2576	-2.508482853
0.0899	11.26	0.586406061	6.3122	-0.4965	4.9478	0.246518268	24.4807	-2.456612687
19.3514	208.3					2.578087579	262.4740	-11.73616742
					$S^2$	0.078123866	7.953756113	-0.355641437
					$S$	0.279506469	2.820240435	

$$r = \left( \left( \left| \frac{-0.3557}{0.2796 \times 2.8203} \right| \right) \right) = \mathbf{0.4512}$$

So the degree of correlation of the two variables is approx 45%.

## 8. Regression Line Equation and Correlation Coefficient of Sodium Oxide (Na<sub>2</sub>O)

X (Na <sub>2</sub> O)	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.0778	1.86	0.0061	3.4596	0.144708
0.0755	2.01	0.0057	4.0401	0.151755
0.0749	2.68	0.0056	7.1824	0.200732
0.0733	2.77	0.0054	7.6729	0.203041
0.0766	2.98	0.0059	8.8804	0.228268
0.0788	3.06	0.0062	9.3636	0.241128
0.0769	3.2	0.0059	10.2400	0.24608
0.0728	3.3	0.0053	10.8900	0.24024
0.0775	4.1	0.0060	16.8100	0.31775
0.0770	4.27	0.0059	18.2329	0.32879
0.0738	4.77	0.0054	22.7529	0.352026
0.0739	4.84	0.0055	23.4256	0.357676
0.0744	5.06	0.0055	25.6036	0.376464
0.0650	5.22	0.0042	27.2484	0.3393
0.0754	5.23	0.0057	27.3529	0.394342
0.0768	6	0.0059	36.0000	0.4608
0.0710	6.07	0.0050	36.8449	0.43097
0.0683	6.56	0.0047	43.0336	0.448048
0.0720	6.61	0.0052	43.6921	0.47592
0.0752	7.09	0.0057	50.2681	0.533168
0.0759	7.15	0.0058	51.1225	0.542685



	<b>X (Na<sub>2</sub>O)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	0.0708	7.21	0.0050	51.9841	0.510468
	0.0725	7.96	0.0053	63.3616	0.5771
	0.0705	8.7	0.0050	75.6900	0.61335
	0.0657	8.31	0.0043	69.0561	0.545967
	0.0733	8.31	0.0054	69.0561	0.609123
	0.0713	9.41	0.0051	88.5481	0.670933
	0.0700	9.83	0.0049	96.6289	0.6881
	0.0687	9.83	0.0047	96.6289	0.675321
	0.0662	10.64	0.0044	113.2096	0.704368
	0.0660	10.98	0.0044	120.5604	0.72468
	0.0693	11.03	0.0048	121.6609	0.764379
	0.0649	11.26	0.0042	126.7876	0.730774
<b>Total</b>	2.3920	208.3000	0.1739	1577.2888	14.8285
<b>(Total Na<sub>2</sub>O)<sup>2</sup></b>	5.7217				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{0.7545}{0.0172} \right| \right) \right) = 43.9737$$

$$b = \left( \left( \left| \frac{-8.9147}{0.0172} \right| \right) \right) = -519.5774$$

So. the equation of the regression line is **y = -519.5774 x + 43.9737**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.0778	1.86	0.072484848	6.3122	0.0053	-4.4522	0.0000	19.8221	-0.023664118
0.0755	2.01	0.072484848	6.3122	0.0030	-4.3022	9.09114E-06	18.5089	-0.012971785
0.0749	2.68	0.072484848	6.3122	0.0024	-3.6322	5.83296E-06	13.1929	-0.008772313
0.0733	2.77	0.072484848	6.3122	0.0008	-3.5422	6.64472E-07	12.5472	-0.00288743
0.0766	2.98	0.072484848	6.3122	0.0041	-3.3322	1.69345E-05	11.1036	-0.013712508
0.0788	3.06	0.072484848	6.3122	0.0063	-3.2522	3.98811E-05	10.5768	-0.020538136
0.0769	3.2	0.072484848	6.3122	0.0044	-3.1122	1.94936E-05	9.6858	-0.013740835
0.0728	3.3	0.072484848	6.3122	0.0003	-3.0122	9.93205E-08	9.0733	-0.000949299
0.0775	4.1	0.072484848	6.3122	0.0050	-2.2122	2.51517E-05	4.8938	-0.011094518
0.0770	4.27	0.072484848	6.3122	0.0045	-2.0422	2.03866E-05	4.1706	-0.009220842
0.0738	4.77	0.072484848	6.3122	0.0013	-1.5422	1.72962E-06	2.3784	-0.002028227
0.0739	4.84	0.072484848	6.3122	0.0014	-1.4722	2.00265E-06	2.1674	-0.002083386
0.0744	5.06	0.072484848	6.3122	0.0019	-1.2522	3.66781E-06	1.5680	-0.002398153
0.0650	5.22	0.072484848	6.3122	-0.0075	-1.0922	5.6023E-05	1.1929	0.008174952
0.0754	5.23	0.072484848	6.3122	0.0029	-1.0822	8.49811E-06	1.1712	-0.003154777
0.0768	6	0.072484848	6.3122	0.0043	-0.3122	1.86205E-05	0.0975	-0.00134719
0.0710	6.07	0.072484848	6.3122	-0.0015	-0.2422	2.20478E-06	0.0587	0.00035963
0.0683	6.56	0.072484848	6.3122	-0.0042	0.2478	1.7513E-05	0.0614	-0.001037005
0.0720	6.61	0.072484848	6.3122	-0.0005	0.2978	2.35078E-07	0.0887	-0.000144388
0.0752	7.09	0.072484848	6.3122	0.0027	0.7778	7.37205E-06	0.6050	0.002111845

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.0759	7.15	0.072484848	6.3122	0.0034	0.8378	1.16633E-05	0.7019	0.002861214
0.0708	7.21	0.072484848	6.3122	-0.0017	0.8978	2.83871E-06	0.8060	-0.001512657
0.0725	7.96	0.072484848	6.3122	0.0000	1.6478	2.29568E-10	2.7152	2.49667E-05
0.0705	8.7	0.072484848	6.3122	-0.0020	2.3878	3.93962E-06	5.7016	-0.004739421
0.0657	8.31	0.072484848	6.3122	-0.0068	1.9978	4.60342E-05	3.9912	-0.01355477
0.0733	8.31	0.072484848	6.3122	0.0008	1.9978	6.64472E-07	3.9912	0.00162851
0.0713	9.41	0.072484848	6.3122	-0.0012	3.0978	1.40387E-06	9.5964	-0.003670424
0.0700	9.83	0.072484848	6.3122	-0.0025	3.5178	6.17447E-06	12.3749	-0.0087412
0.0687	9.83	0.072484848	6.3122	-0.0038	3.5178	1.43251E-05	12.3749	-0.01331434
0.0662	10.64	0.072484848	6.3122	-0.0063	4.3278	3.94993E-05	18.7299	-0.027199567
0.0660	10.98	0.072484848	6.3122	-0.0065	4.6678	4.20533E-05	21.7884	-0.030269976
0.0693	11.03	0.072484848	6.3122	-0.0032	4.7178	1.01433E-05	22.2576	-0.015025478
0.0649	11.26	0.072484848	6.3122	-0.0076	4.9478	5.75299E-05	24.4807	-0.037528313
2.3920	208.3					0.000519922	262.4740	-0.270139939
					<b>S<sup>2</sup></b>	1.57552E-05	7.953756113	-0.008186059
					<b>S</b>	0.003969285	2.820240435	

$$r = \left( \left( \left| \frac{-0.0082}{0.0039 \times 2.8203} \right| \right) \right) = \mathbf{0.7313}$$

So the degree of correlation of the two variables is approx 73%.

## 9. Regression Line Equation and Correlation Coefficient of Alumina (Al<sub>2</sub>O<sub>3</sub>)

X (Al <sub>2</sub> O <sub>3</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
0.8535	1.86	0.7285	3.4596	1.58751
0.7031	2.01	0.4943	4.0401	1.413231
1.0509	2.68	1.1044	7.1824	2.816412
1.0959	2.77	1.2010	7.6729	3.035643
0.8050	2.98	0.6480	8.8804	2.3989
1.2847	3.06	1.6505	9.3636	3.931182
1.0298	3.2	1.0605	10.2400	3.29536
1.0341	3.3	1.0694	10.8900	3.41253
1.1753	4.1	1.3813	16.8100	4.81873
1.3540	4.27	1.8333	18.2329	5.78158
1.8473	4.77	3.4125	22.7529	8.811621
1.7404	4.84	3.0290	23.4256	8.423536
1.4722	5.06	2.1674	25.6036	7.449332
0.6693	5.22	0.4480	27.2484	3.493746
0.9311	5.23	0.8669	27.3529	4.869653
1.3865	6	1.9224	36.0000	8.319
1.5835	6.07	2.5075	36.8449	9.611845
1.6601	6.56	2.7559	43.0336	10.890256
1.7922	6.61	3.2120	43.6921	11.846442
1.8639	7.09	3.4741	50.2681	13.215051
0.7355	7.15	0.5410	51.1225	5.258825

	<b>X (Al<sub>2</sub>O<sub>3</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	1.7313	7.21	2.9974	51.9841	12.482673
	2.6629	7.96	7.0910	63.3616	21.196684
	1.9454	8.7	3.7846	75.6900	16.92498
	4.6977	8.31	22.0684	69.0561	39.037887
	2.3773	8.31	5.6516	69.0561	19.755363
	1.3359	9.41	1.7846	88.5481	12.570819
	2.3286	9.83	5.4224	96.6289	22.890138
	2.3311	9.83	5.4340	96.6289	22.914713
	3.2590	10.64	10.6211	113.2096	34.67576
	3.0813	10.98	9.4944	120.5604	33.832674
	0.5952	11.03	0.3543	121.6609	6.565056
	1.9248	11.26	3.7049	126.7876	21.673248
<b>Total</b>	54.3388	208.3000	113.9164	1577.2888	389.2004
<b>(Total Al<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	2952.7052				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{2580.1085}{806.537} \right| \right) \right) = 3.1989$$

$$b = \left( \left( \left| \frac{1524.8405}{806.537} \right| \right) \right) = 1.8907$$

So. the equation of the regression line is **y = 1.8907 x + 3.1989**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.8535	1.86	1.646630303	6.3122	-0.7931	-4.4522	0.6291	19.8221	3.531174735
0.7031	2.01	1.646630303	6.3122	-0.9435	-4.3022	0.890249433	18.5089	4.05925607
1.0509	2.68	1.646630303	6.3122	-0.5957	-3.6322	0.354894594	13.1929	2.163811607
1.0959	2.77	1.646630303	6.3122	-0.5507	-3.5422	0.303303867	12.5472	1.950796879
0.8050	2.98	1.646630303	6.3122	-0.8416	-3.3322	0.708341567	11.1036	2.804480496
1.2847	3.06	1.646630303	6.3122	-0.3619	-3.2522	0.130993544	10.5768	1.177069732
1.0298	3.2	1.646630303	6.3122	-0.6168	-3.1122	0.380479623	9.6858	1.919699269
1.0341	3.3	1.646630303	6.3122	-0.6125	-3.0122	0.375193372	9.0733	1.845063779
1.1753	4.1	1.646630303	6.3122	-0.4713	-2.2122	0.222152255	4.8938	1.042676896
1.3540	4.27	1.646630303	6.3122	-0.2926	-2.0422	0.085632494	4.1706	0.597609605
1.8473	4.77	1.646630303	6.3122	0.2007	-1.5422	0.040268327	2.3784	-0.309472807
1.7404	4.84	1.646630303	6.3122	0.0938	-1.4722	0.008792756	2.1674	-0.138047748
1.4722	5.06	1.646630303	6.3122	-0.1744	-1.2522	0.030425931	1.5680	0.218421625
0.6693	5.22	1.646630303	6.3122	-0.9773	-1.0922	0.955174521	1.1929	1.067440157
0.9311	5.23	1.646630303	6.3122	-0.7155	-1.0822	0.511983615	1.1712	0.774346894
1.3865	6	1.646630303	6.3122	-0.2601	-0.3122	0.067667775	0.0975	0.081212681
1.5835	6.07	1.646630303	6.3122	-0.0631	-0.2422	0.003985435	0.0587	0.015290159
1.6601	6.56	1.646630303	6.3122	0.0135	0.2478	0.000181433	0.0614	0.003337791
1.7922	6.61	1.646630303	6.3122	0.1456	0.2978	0.021190537	0.0887	0.043350656
1.8639	7.09	1.646630303	6.3122	0.2173	0.7778	0.047206121	0.6050	0.16899237

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
0.7355	7.15	1.646630303	6.3122	-0.9111	0.8378	0.830158429	0.7019	-0.763344968
1.7313	7.21	1.646630303	6.3122	0.0847	0.8978	0.007168958	0.8060	0.076016454
2.6629	7.96	1.646630303	6.3122	1.0163	1.6478	1.032804097	2.7152	1.674609207
1.9454	8.7	1.646630303	6.3122	0.2988	2.3878	0.089263332	5.7016	0.713402282
4.6977	8.31	1.646630303	6.3122	3.0511	1.9978	9.309026296	3.9912	6.095427041
2.3773	8.31	1.646630303	6.3122	0.7307	1.9978	0.533878206	3.9912	1.459731921
1.3359	9.41	1.646630303	6.3122	-0.3107	3.0978	0.096553321	9.5964	-0.962580333
2.3286	9.83	1.646630303	6.3122	0.6820	3.5178	0.465082668	12.3749	2.399033
2.3311	9.83	1.646630303	6.3122	0.6845	3.5178	0.468498766	12.3749	2.4078275
3.2590	10.64	1.646630303	6.3122	1.6124	4.3278	2.59973604	18.7299	6.978013575
3.0813	10.98	1.646630303	6.3122	1.4347	4.6678	2.058277139	21.7884	6.696751212
0.5952	11.03	1.646630303	6.3122	-1.0514	4.7178	1.105505682	22.2576	-4.960437884
1.9248	11.26	1.646630303	6.3122	0.2782	4.9478	0.07737838	24.4807	1.376328027
54.3388	208.3					24.44050419	262.4740	46.20728788
					<b>S<sup>2</sup></b>	0.740621339	7.953756113	1.400220845
					<b>S</b>	0.860593597	2.820240435	

$$r = \left( \left( \left| \frac{1.4003}{0.8607 \times 2.8203} \right| \right) \right) = 0.5769$$

So the degree of correlation of the two variables is approx 57%.

## 10. Regression Line Equation and Correlation Coefficient of Ferric Oxide (Fe<sub>2</sub>O<sub>3</sub>)

X (Fe <sub>2</sub> O <sub>3</sub> )	Y (LOI)	X <sup>2</sup>	Y <sup>2</sup>	XY
9.1194	1.86	83.1635	3.4596	16.962084
9.0402	2.01	81.7252	4.0401	18.170802
9.9491	2.68	98.9846	7.1824	26.663588
8.3327	2.77	69.4339	7.6729	23.081579
9.7233	2.98	94.5426	8.8804	28.975434
9.0617	3.06	82.1144	9.3636	27.728802
8.4391	3.2	71.2184	10.2400	27.00512
7.9963	3.3	63.9408	10.8900	26.38779
9.4364	4.1	89.0456	16.8100	38.68924
8.4984	4.27	72.2228	18.2329	36.288168
13.8202	4.77	190.9979	22.7529	65.922354
13.8378	4.84	191.4847	23.4256	66.974952
11.8924	5.06	141.4292	25.6036	60.175544
7.1433	5.22	51.0267	27.2484	37.288026
9.5589	5.23	91.3726	27.3529	49.993047
8.2683	6	68.3648	36.0000	49.6098
12.7793	6.07	163.3105	36.8449	77.570351
17.7349	6.56	314.5267	43.0336	116.340944
15.0224	6.61	225.6725	43.6921	99.298064
9.4057	7.09	88.4672	50.2681	66.686413
9.3692	7.15	87.7819	51.1225	66.98978



	<b>X (Fe<sub>2</sub>O<sub>3</sub>)</b>	<b>Y (LOI)</b>	<b>X<sup>2</sup></b>	<b>Y<sup>2</sup></b>	<b>XY</b>
	12.3308	7.21	152.0486	51.9841	88.905068
	14.1483	7.96	200.1744	63.3616	112.620468
	11.5006	8.7	132.2638	75.6900	100.05522
	25.8197	8.31	666.6569	69.0561	214.561707
	13.5028	8.31	182.3256	69.0561	112.208268
	12.1680	9.41	148.0602	88.5481	114.50088
	16.3064	9.83	265.8987	96.6289	160.291912
	16.3188	9.83	266.3032	96.6289	160.413804
	33.8397	10.64	1145.1253	113.2096	360.054408
	33.6732	10.98	1133.8844	120.5604	369.731736
	9.3250	11.03	86.9556	121.6609	102.85475
	31.4186	11.26	987.1284	126.7876	353.773436
<b>Total</b>	448.7809	208.3000	7787.6517	1577.2888	3276.7735
<b>(Total Fe<sub>2</sub>O<sub>3</sub>)<sup>2</sup></b>	201404.2962				

$$a = \frac{(\sum Y_i)(\sum X_i^2) - (\sum X_i)(\sum X_i Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$b = \frac{n \sum X_i Y_i - (\sum X_i)(\sum Y_i)}{n \sum X_i^2 - (\sum X_i)^2}$$

$$a = \left( \left( \left| \frac{151614.473}{55588.2} \right| \right) \right) = 2.7275$$

$$b = \left( \left( \left| \frac{14652.466}{55588.2} \right| \right) \right) = 0.2636$$

So. the equation of the regression line is **y = 0.2636 x + 2.7275**

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
9.1194	1.86	13.59942121	6.3122	-4.4800	-4.4522	20.0706	19.8221	19.94595044
9.0402	2.01	13.59942121	6.3122	-4.5592	-4.3022	20.78649806	18.5089	19.6146815
9.9491	2.68	13.59942121	6.3122	-3.6503	-3.6322	13.32484495	13.1929	13.25869671
8.3327	2.77	13.59942121	6.3122	-5.2667	-3.5422	27.73835233	12.5472	18.65577988
9.7233	2.98	13.59942121	6.3122	-3.8761	-3.3322	15.02431565	11.1036	12.9160111
9.0617	3.06	13.59942121	6.3122	-4.5377	-3.2522	20.5909138	10.5768	14.75757693
8.4391	3.2	13.59942121	6.3122	-5.1603	-3.1122	26.62891501	9.6858	16.05995168
7.9963	3.3	13.59942121	6.3122	-5.6031	-3.0122	31.39496732	9.0733	16.87772172
9.4364	4.1	13.59942121	6.3122	-4.1630	-2.2122	17.33074561	4.8938	9.209435525
8.4984	4.27	13.59942121	6.3122	-5.1010	-2.0422	26.02041741	4.1706	10.41730552
13.8202	4.77	13.59942121	6.3122	0.2208	-1.5422	0.048743273	2.3784	-0.340485047
13.8378	4.84	13.59942121	6.3122	0.2384	-1.4722	0.056824447	2.1674	-0.350941252
11.8924	5.06	13.59942121	6.3122	-1.7070	-1.2522	2.913921419	1.5680	2.137531962
7.1433	5.22	13.59942121	6.3122	-6.4561	-1.0922	41.68150111	1.1929	7.051375588
9.5589	5.23	13.59942121	6.3122	-4.0405	-1.0822	16.32581167	1.1712	4.372652056
8.2683	6	13.59942121	6.3122	-5.3311	-0.3122	28.42085338	0.0975	1.664376042
12.7793	6.07	13.59942121	6.3122	-0.8201	-0.2422	0.672598803	0.0587	0.198633358
17.7349	6.56	13.59942121	6.3122	4.1355	0.2478	17.1021848	0.0614	1.024771644
15.0224	6.61	13.59942121	6.3122	1.4230	0.2978	2.024868631	0.0887	0.423763083
9.4057	7.09	13.59942121	6.3122	-4.1937	0.7778	17.5872976	0.6050	-3.261876359

$X_i$	$Y_i$	$X_r$	$Y_r$	$(X_i - X_r)$	$(Y_i - Y_r)$	$(X_i - X_r)^2$	$(Y_i - Y_r)^2$	$(X_i - X_r)(Y_i - Y_r)$
9.3692	7.15	13.59942121	6.3122	-4.2302	0.8378	17.8947715	0.7019	-3.544079332
12.3308	7.21	13.59942121	6.3122	-1.2686	0.8978	1.60939978	0.8060	-1.138968124
14.1483	7.96	13.59942121	6.3122	0.5489	1.6478	0.301267924	2.7152	0.904442467
11.5006	8.7	13.59942121	6.3122	-2.0988	2.3878	4.40505048	5.7016	-5.01156529
25.8197	8.31	13.59942121	6.3122	12.2203	1.9978	149.3352137	3.9912	24.41367296
13.5028	8.31	13.59942121	6.3122	-0.0966	1.9978	0.009335659	3.9912	-0.193029858
12.1680	9.41	13.59942121	6.3122	-1.4314	3.0978	2.048966687	9.5964	-4.434256631
16.3064	9.83	13.59942121	6.3122	2.7070	3.5178	7.327734158	12.3749	9.52260998
16.3188	9.83	13.59942121	6.3122	2.7194	3.5178	7.395020992	12.3749	9.5662307
33.8397	10.64	13.59942121	6.3122	20.2403	4.3278	409.6688854	18.7299	87.59587854
33.6732	10.98	13.59942121	6.3122	20.0738	4.6678	402.9565948	21.7884	93.70038463
9.3250	11.03	13.59942121	6.3122	-4.2744	4.7178	18.2706767	22.2576	-20.16586439
31.4186	11.26	13.59942121	6.3122	17.8192	4.9478	317.5231327	24.4807	88.16573281
448.7809	208.3					1684.491216	262.4740	444.0141005
					<b>S<sup>2</sup></b>	51.04518836	7.953756113	13.45497274
					<b>S</b>	7.144591546	2.820240435	

$$r = \left( \left( \left| \frac{13.4549}{7.1446 \times 2.8203} \right| \right) \right) = \mathbf{0.6678}$$

So the degree of correlation of the two variables is approx 66%.









**APPENDIX E**  
**CONSULTATION CARD**

**Lampiran B 10**  
**Kartu Konsultasi Tugas Akhir**

**JUDUL:** Analysis of Relationship Between Loss on Ignition and Elemental of Lateritic Nickel Ore in The Wolo Area, Southeast Sulawesi Province

(Konsultasi minimal 8 kali)

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
11/ Juli /2022	<ul style="list-style-type: none"> <li>• Perbaiki BAB 1. 2. 3</li> <li>• Perbaiki Penulisan</li> <li>• Lengkapi laporan</li> </ul>	MA
15/ Juli /2022	<ul style="list-style-type: none"> <li>• Lengkapi Bab 4</li> <li>• Perbaiki kesimpulan</li> </ul>	MA
22/ Juli /2022	<ul style="list-style-type: none"> <li>• Perbaiki Abstrak</li> <li>• Penggunaan kata dalam laporan</li> </ul>	MA
25/ Juli /2022	<ul style="list-style-type: none"> <li>• Perbaiki Lampiran, daftar isi</li> <li>• daftar gambar</li> </ul>	MA

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
29/ Juli/2022	<ul style="list-style-type: none"> <li>• Perbaiki difactogram pada analisis XRD</li> <li>• Perbaiki nilai peaks mineral</li> </ul>	
2/ Agustus/2022	<ul style="list-style-type: none"> <li>• Perbaiki perhitungan</li> <li>• Minimalisir hasil pembacaan XRD</li> </ul>	
4/ Agustus/2022	<ul style="list-style-type: none"> <li>• Perbaiki penulisan abstrak</li> <li>• Lengkapi laporan</li> </ul>	
5/ Agustus/2022	<ul style="list-style-type: none"> <li>• Perbaiki artikel</li> <li>• Poster</li> </ul>	
8/ Agustus/2022		
9/ September/2022	<ul style="list-style-type: none"> <li>•) Asistensi hasil Revisi Seminar Hasil</li> <li>•) Perbaiki Pembahasan</li> </ul>	
13/ September/2022	<ul style="list-style-type: none"> <li>•) Perbaiki Abstrak</li> <li>•) Perbaiki Artikel Ilmiah</li> </ul>	
15/ September/2022	ACC	

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
3/Agustus/2022	<ul style="list-style-type: none"> <li>→ Asistensi Laporan Bab 1 - 5</li> <li>→ Perbaiki penggunaan kata</li> <li>→ Perbaiki hasil</li> </ul>	M —
4/Agustus/2022	<ul style="list-style-type: none"> <li>→ Asistensi Lampiran laporan</li> <li>→ Perbaiki format lampiran</li> </ul>	M —
5/Agustus/2022	→ ACC	M —
15/September/2022	→ Revisi perbaikan semirat hasil	M —
14/September/2022	→ ACC	M —

*Catatan: Lembar konsultasi asli dilampirkan pada satu dokumen skripsi.*