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ASSESSMENT AND RECLAMATION OF MINED AREAS FOR AGRICULTURAL PURPOSE AT IBESE LIMESTONE MINES

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ABSTRACT: This research was conducted to assess the requirement to reclaim mined areas for Agricultural purpose. The survey of mined areas was done, measured survey data was used to generate the topographical map, calculation of area, volume of materials required and tonnage of the materials needed. The soil materials were analyzed to know the nutrient content for the materials required. The laboratory test was examined on Agricultural liming materials, required active metal content present, soil texture, soil PH and Agricultural soil nutrients content. The analysis was carried out to determine on Agricultural laboratory test of the materials needed. The results were revealed mined area covered, Volume and tonnage of the materials amount to 11,465,066,000,000 tons required materials. The analysis of the materials revealed that cement dust or lime and slag which has composition of $CaSiO_3$ respectively used for reclamation of mine. In summary, reclaimed area covered will be required Land suitability analysis, Optimal mining site planning and Agricultural liming materials for the purpose to be achieved.

KEYWORDS: Coordinate, Liming, Mined areas, Mine closure, Mine reclamation.

1. INTRODUCTION

1.1 PREAMBLE

Surface mining is one of the most intensive human disturbances that negatively impacts the environment and human health (Cao, 2007). It degrades ecosystem functions because it removes vegetation, alters the hydrological cycle and soil conditions, disrupts fundamental ecological relationships, and reduces biodiversity (Li *et al.*, 2011). Furthermore, surface mining causes serious pollution to the air, water and soil. These negative impacts pose serious threats to human health. For example, it has been found that the incidence of chronic pulmonary disorders, hypertension, lung cancer and kidney disease were higher around mining sites (Palmer and Wilcock, 2010) Mining activity also produces a large amount of waste rocks and tailings, which pile up on the surface and occupy relatively large areas of land (Li, 2006), reducing land use availability and increasing pressure on land supply. Many countries have conducted ecological restoration programs to recover the damaged ecosystems in post-mining sites (Dal, *et al.*, 2006; Zipper *et al.*, 2011; Dulias, 2010). Most mine reclamation projects have laid emphasis on engineering design. A series of engineering measures have been adopted to restore damaged ecosystems in mining sites, including restructuring landforms, importing soil, and revegetation (Gao, 1998; Sklenicka *et al.*, 2002; Wang *et al.*, 2001). Reclamation of the abandoned mined land is a complex procedure, involving many ecological processes. For example, soil remediation includes the management of all types of physical, chemical and biological processes of soils, such as soil pH, fertility, microbial community and various soil nutrient cycles (Sheoran *et al.*, 2010). In addition to the engineering measures, reclamation planning is also an essential component of its ecological restoration. The abandoned mined land could be reused or redeveloped into various land uses such as parks, residential areas and agricultural lands. The proper future land use types should be identified based on the suitability of local site conditions. Land suitability analysis is the foundation for establishment of a mined land reclamation planning (Wang *et al.*, 2011). Numerous studies have selected the optimal post-mining land use types based on land suitability analysis [Pavloudakis *et al.*, 2009; Soltanmohammadi *et al.*, 2010). Many factors are considered when measuring the suitability level for possible land reclamation alternatives, including topography, climate, and socioeconomic conditions. A large area of reclaimed land can be redeveloped to many different lands uses when the heterogeneous environmental conditions within a mining site are considered.

2.0 METHODOLOGY

2.1 METHOD OF DATA COLLECTION

(a) Survey method: The survey of mined areas was done, measured survey data was used to generate the topographical map, calculation of mined area, volume and tonnage of materials needed, with the aid of survey equipment or instrument such as Base and Rover Global Positioning System (GPS).

Then, calculated the latitude and longitude as coordinates measured points and elevation or depth as height of the receiver was measured and recorded (Brian, 2010).

2.1.2 Parameters of Survey Technique

The area of the figure should be calculated and reported in both $m^2$and ha. The mined area was computed using coordinates' method as presented in formula 1 and 2 respectively, (Irvine and Maclennan, 2006), (Clark, 1966). The general formula is given as:

$$\text{Area} = \left[\frac{1}{2}\left(\sum_{i=1}^{n}(E_1 N_{i+1} - E_{i+1} N_i\right)\right] \qquad (1)$$

Realized by forming a matrix of coordinates and cross multiplying

2.1.3 Field Notes Reduction

However, the presented column format maintains the normal E, N coordinate order used in traversing, but gives a negative answer in a clockwise traverse. The figure must close back to the start point, i.e., E_1 and N_1 must appear twice (Schofield and Breach, 2007).

$$\text{Area}= \frac{1}{2}(E_1N_2 - E_2N_1) + (E_2N_3 - E_3N_2) + (E_2N_4 - E_4N_3) + \ldots\ldots\ldots\ldots (E_n N_{i+n} - E_{i+n}\ N_n) \qquad (2)$$

Where:

Area (A) is Mined Area (MA) in M^2

Σ is Summation of coordinates in m

E is Easting coordinate in m

N is Northing coordinate in m

n is Serial number of coordinate or serial alphabetical letter

i is the n number i.e., 1+n

E_n is the E coordinate of n

N_n is the N coordinate of n

(2) Volume: is the total volume of the overburden materials for mined area i.e., topographical mined area multiply average elevation or depth, as presented in formula 3

$$V = A \times H \qquad (3)$$

Where:

V is the volume in m^3

A is the topographical mined area in m^2

H is the average elevation or depth of mined area in m i.e.

Highest depth – lowest depth

(3) Tonnage: is the total estimated of the overburden materials for mined area. Tonnage is the volume multiply tonnage factor, as presented in formula 4

$$T = V \times Sg \quad (4)$$

Where:

T is the tonnage in Tons

V is the volume of the material in m^3

Sg is the specific gravity or tonnage factor Tons/m^3

Tonnage factor is specific gravity of the mineral (Braden, 2018)

(b) Laboratory test:

2.1.4 Determination of liming materials quality

The limestone material comprises of oxides of metal such as calcium oxides (CaO), silicate oxide (SiO_2), Aluminum II oxide (Al_2O_3), Iron II oxide (Fe_2O_3) magnesium oxide (MgO) and potassium oxide (K_2O) for liming material.

2.1.5 Calculation of Parameters

$$\text{Molecular Weight} = AM \times NE \quad (5)$$

Where:

Mw=Molecular Weight,

AM = Atomic Mass of element,

NE= Number of Electron

$$OM = \frac{MWC}{MWO} \quad (6)$$

Where:

OM = Other Material

MWC= Molecular Weight of Constituent material

MWO = Molecular Weight of Other material

$$P = 100\% - 10\% \quad (7)$$

Where:

P =purity,

100%= Percentage of standard,

10% = Percentage of water content of material

$$FCCE = \frac{90}{100} \; x\, 1.0 = 0.9 \text{ is constant} \quad (8)$$

Where:

FCCE = final calcium carbonate Equivalent

$$F = \sum_{n=1}\left[(\%R\ X\ \%RTV) + (\%PR\ X\ \%RTV)n+1 \; + (\%P\ X\%RTV)n+2 \;\right] \quad (9)$$

Where:

F = Fineness factor,

%R= Percentage of remain,

% RTV = Percentage of reactive

%PR = Percentage of passes and remain,

%P = percentage of passes

$$ECC = F \times FCCE \quad (10)$$

Where:

ECC = Effective calcium carbonate

F = Fineness factor

FCCE = Final calcium carbonate Equivalent

Table 3: Calculating the fineness efficiency rating (Mark *et. al*., 2001)

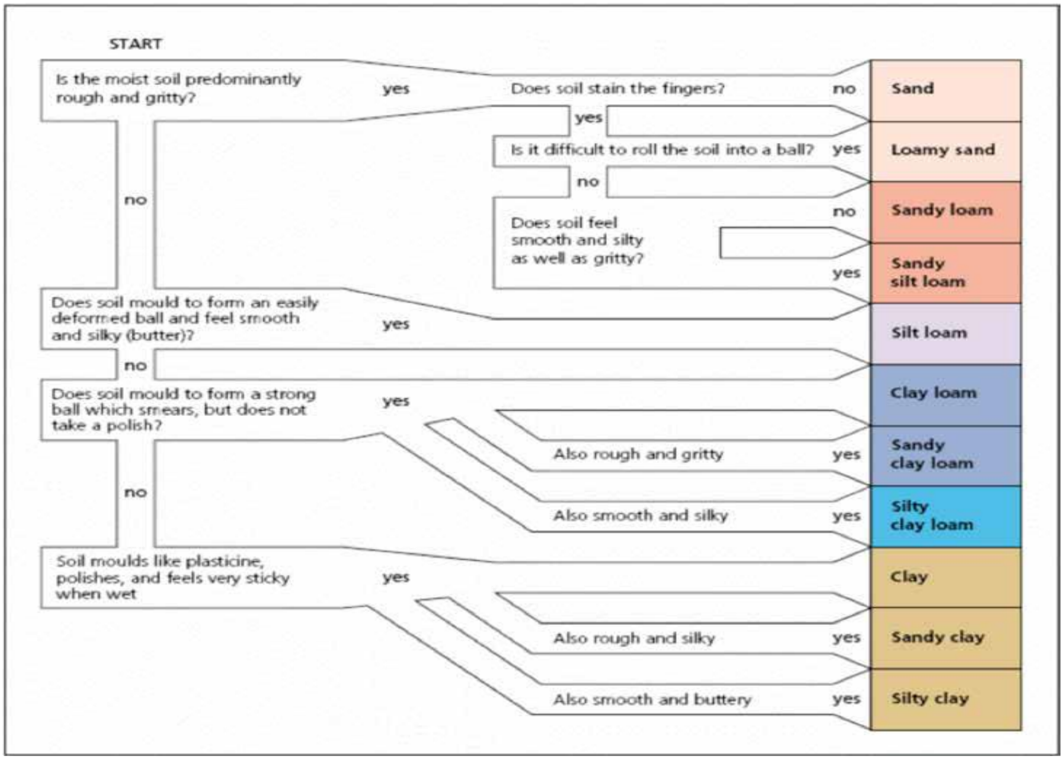
	A	B	C	D
Sieve Size (Mesh)	**Particle Size (mm)**	**Efficiency factor**	**% of Material**	**Efficiency Rating (%)**
Retained on 8 mesh	>2.0	0	X 10	0
8 to 20	2.0 to 0.85	0.2	X 20	4
20 to 60	0.85 to 0.25	0.6	X 25	15
Passing 60 mesh	< 0.25	10	X 45	45

2.1.6 Determination of metal content

The examined performance on sterilization with variation of metals such as zinc (zn), lead (pb) manganese (Mn) and copper (cu).

2.1.7 Determination of Soil Texture

This is defined the proportion of sand, silt, clay sized particles in mineral soils across major soil, categories. Laboratory analysis done by classification using texture triangular diagram mostly practicalized in classes of mineral soils can be identified by hand texturing as presented in figure 10.



10: Texture Triangular Diagram (Technical note 2013) Soils information texture and liming recommendations.

2.1.8 Determination of Parameter

i. **PH Test** this was measured of its acidicity and alkalinity base on a scale 0 to 14. 0 is strong acidic, 14 is strong alkaline while 7 is neutral. The soil pH can be used to estimated the lime requirement of a soil range from 6 – 7.5 for the suitability used. The glass electrode PH meter method was applied to determine PH of the soil. The PH meter was calibrated with buffers of PH value 4.0 and 4.9 range to water added level. Lime requirement test was used for limestone materials. PH samples was taken by inserting the electrode of the pH meter turn into soil solution and measurement from the meter(Afeni *et al.*, 2012), as presented in formula 11.

$$PH = -\log_{10} H^{+,} \qquad (11).$$

Where:

PH is the minus the logarithm of the concentration valve.

H^+ is the hydrogen ion.

ii**. Nitrogen test** is the rate at which must organic fertilizers are applied to often based on crop nitrogen requirement. Nitrogen is typically the most limiting nutrient during most growing seasons, and yearly applications are often required. Regular micro Kjeldahl method was applied to determine nitrogen in the soil. The dry sample sieved with 500ml micro Kjeldahl flask was added to 20ml of water. The concentration of H_2SO_4 pipette solution with addition copper oxide as catalyst, with boric acid (CH_3O_3) as indicator, each digest was distilled over the acid till about 50ml distillate was collected, and titrated against 0.5 standard HCL. The colour for which end point was green to pink, as presented in formula 12.

$$\text{Percentage of nitrogen} = \frac{M \text{ x T x } 0.014 \text{ x } V_1 \text{ x } 100\%}{W} \qquad (12).$$

Where:

% Is the percentage of nitrogen of the soil,

M is the molarity of acid used,

T is the titre volume,

V_1 is the volume of digest,

V_2 is the volume of digest used,

W is the weight of sample, 0.014 is multiplication factor. (i.e., milligram equivalent of nitrogen in ammonia) (Farmer, 2000).

iii. **Phosphorus test** is not detrimental to crops, but they do increase the possibility of farm phosphorus movement primarily through sediment water. An ion-selective electrode method was applied to determine phosphorus for on farm testing. Field

testing was needed to determine the suitability of the farm measured to assess phosphorus for soil Agriculture quality consideration (Scott, 2017).
iv. **Potassium test** is not harmful to the environment, but reduce plant calcium (Ca) and magnesium (Mg) uptake. The forage grown on soil test of potassium soil was fed to ruminant livestock, there is an increased risk of magnesium deficiency, which effects was resulted in the metabolic disease to crops or plants An ion-selective electrode method was applied to determine potassium for on farm testing. Field testing was needed to determine the suitability of the farm measured to assess potassium for soil Agriculture quality consideration (Scott, 2017).

v**. Soil organic carbon test** is the soil analysis data derived from organic matter with constant rating measured. It was required nitrogen level in soil sample using for the interpretation of the Agricultural soil. The percentage organic matter in the soil was measured as a function of percentage carbon content, and calculated, as presented in formula 13.

$$\text{Percentage of soil organic carbon} = \frac{(MeK_2Cr_2O_7 - MeFeSO_4) \times 0.003 \times 100F}{W_{air} - D_{ss}} \qquad (13).$$

Where:

% is the percentage of soil organic carbon,
$MeK_2Cr_2O_7$ is the titre value,
Me is the milliequivalent (value used x normality),
MeFeSO4 is the titre value of sodium solution, F is correction factor (1.33),
Normality $FeSO_4$ is 0.003,
W_{air} is the weight of air,
D_{ss} is the dried soil sample,
% Organic matter is the % organic carbon x 1.72 g (1.72 g is a constant)
(Sinha, *et al.*, 2000).

vi. **Soil organic matter test** is often the primary goal of most organic farms nutrient management programs. It was the reservoir supply nutrients to plants and soil organism required. To maintain soil carbon and organic matter was intensively tilled system requires input of organic materials such as composts, manures, fertilizer, crop residues, and cover crops. The Walkley Black wet oxidation method was applied to determine soil organic matter. It requires reagent of concentrated H_2SO_4 added to the solution and soil reagent. The burette reading for each titration reading was done in standardization of dichromate by blank titration (Twort *et al.*, 1991), as presented in formula 14.
Percentage organic matter = % organic carbon x 1.72 g (1.72 g is a constant). (14).
Where:

% is the percentage of soil organic matter;
% is the percentage of soil organic carbon,
1.72 g is a constant.

3.0 RESULTS AND DISCUSSION

3.1 SURVEY DATA FOR CHAINAGE POINT This is survey data for chainage interval or boundary points to calculate the parameters required or needed such as mined area, volume and tonnage of the materials required. This is cross multiplication of coordinate points as presented in table 6.

Table 6: Solution of parameters

	Result from the table 5 with formula given out the positive coordinates		Result from the table 5 with formula given out the negative coordinates
E_AN_B	503,853x774, 439=390,203,413,500	E_BN_A	530,840 x 774,655 = 390,302,175,200
E_BN_C	503,840x 774,444 = 390,195,865,000	E_CN_B	504,111 x 774439 = 390,403,218,700

E_CN_D	504,111x 774,164 = 390,264,588,200	E_BN_C	504,597 x 774,444 = 390,782,119,100
E_DN_E	504,597x774,163=390,640,327,300	E_EN_D	503,847 x 774,164 = 390,060,208,900
E_EN_F	503,847 x 773,911 = 389932735600	E_FN_E	504,338 x 774,163 = 390,439,819,100
E_FN_G	504,338 x 773,922 = 39031827600	E_GN_F	504,117 x 773,911 = 390,141,691,600
E_GN_H	504,117 x 773,680 = 390025240600	E_HN_G	505,093 x 773,922 = 390,902,584,700
E_HN_I	505,093 x 773,665 = 390772775800	E_IN_H	504,842 x 773,680 = 390,586,158,600
E_IN_J	504,842 x 773,416 = 390452880300	E_JN_I	503,348 x 773,665 = 389,422,730,400
E_JN_K	503,348 x 773409 = 389293873300	E_KN_J	502,591 x 773,416 = 388,711,920,900
E_KN_L	502,591 x 773,130 = 388568179800	E_LN_K	502,603 x 773,409 = 388,717,683,600
E_LN_M	502,603 x 773,158 = 388591530300	E_MN_L	503,846 x 773,130 = 389,538,458,000
E_MN_N	503,846 x 772,902 = 389423581100	E_NN_M	504,349 x 773,158 = 389,941,464,100
E_NN_O	504,349 x 772,900 = 389811342100	E_ON_N	502,340 x 772,902 = 388,259,590,700
E_ON_P	502,340 x 772669 = 388142545500	E_PN_O	505,160 x 772900 = 390,438,164,000
E_PN_Q	505,160 x 772,655 = 390314399800	E_QN_P	503,848 x 772,669 = 389,307,730,300
E_QN_R	503,848 x 772,386 = 38916541300	E_RN_Q	502,344 x 772,655 = 389,683,913,300
E_RN_S	504,344 x 772,401 = 38955809900	E_SN_R	502,350 x 772,386 = 388,008,107,100
E_SN_T	502,350 x 772,068 = 387848359800	E_TN_S	504,870 x 772,401 = 389,962,092,900
E_TN_U	504,870 x 772,078 = 389799019900	E_UN_T	502,578 x 772068 = 388,024,391,300
E_UN_V	502,578 x 771,790 = 387843965800	E_VN_U	503,846 x 772,078 = 389,008,412,000
E_VN_W	503,846 x 771706 = 388820981300	E_WN_V	502,929 x 771,709 = 388,114,835,700
E_WN_X	502,929 x 771,873 = 388197316000	E_XN_W	503,592 x 771,706 = 388,624,958,000
E_XN_Y	503,846 x 771,347 = 388444178400	E_YN_X	502,593, x771,873=387,937,966,700
E_YN_Z	502,593 x 771,212 = 387605752700	E_ZN_Y	504,345x 771,347=389,205,002,700
E_ZN_A	504,345 x 774,655 = 390693376000	E_AN_Z	503,853 x 771,212 = 388,577,479,800
Total	= 9,734,622,771,000m^2	Total	=10, 12,922,890,000m^2

Total positive coordinates - Total negative coordinates

9,734,622,771,000m^2 - 10,124,922,890,000m^2

=- 390,300,119,000m^2

Taking absolute value = 390,300,119,000m^2

Area = $\frac{390,300,119,000}{2}$ =195,150,059,500m^2

Area = $\frac{195,150,059,300\text{m}^2}{1000}$ = 195,150,059.5ha

(ii) Volume = Area x Average depth, Average depth =45m – 20m = 25m

Volume= 195,150,059,500 x 25

Volume= 4,878,751,488,000m^3

(iii) Tonnage = volume x Tonnage factor, tonnage factor of limestone in that is range from 2.2 to 2.5,
2.2 + 2.5 = 4.7/2 = 2.35i.e. average is 2.35 tons/m^3

Tonnage = 4,878,751,488,000 x 2.35

Tonnage = 11,465,066,000,000tons

3.2 RESULTS OF REPRESENTATIVE SAMPLE ANALYSIS FOR RECLAMATION

The resul**ts** of the analysis of materials / soil samples as presented in Table 6 for the sampling location. It was analyzed with calibrated machine in America standard. The analysis to the materials required done in the laboratory to project the summary of the results that analyzed.

Table 8: Result for Representative Sample Analysis for Reclamation

No			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Sample I.D		0.75/1	1.25/4	1.5/2	1.75/A	1.75/5	2.0/8	2.25/14	2.25/22	2.5/19	2.75/17	3.0/10	3.0/14	3.0/23	3.25/3	3.5/3	3.5/14	3.75/11	3.75/19	4.0/8	4.25/15
	Parameter	units																				
1	CaO	%	43	50	55	55	52	54	53	53	46	55	54	53	51	43	54	54	54	54	53	53
2	SiO_2	%	75	63	70	83	63	65	77	66	77	84	78	86	66	65	81	87	78	66	76	53
3	Al2O3	%	12	16	21	10	21	16	22	6	18	14	16	14	27	20	14	15	9	14	9	26
4	Fe_2O_3	%	8	4	7	7	7	11	8	17	8	7	8	12	11	9	3	4	8	10	3	11
5	MgO	%	3	1	2	1	1	3	5	4	2	4	2	3	5	2	2	8	3	5	3	8
6	K_2O	%	1	1	2	1	1	1	1	1	1	1	1	2	3	2	1	1	1	2	1	5
7	Zn	ppm	0.5	0.7	0.6	0.7	0.7	.06	0.5	0.7	0.6	0.5	0.7	0.6	0.5	0,7	0.6	0.7	0.5	0.6	0.7	0.6
8	Mn	ppm	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.8	0.8	0.8	0.9	0.8	0.9	0.8	0.9	0.8	0.9	0.8	0.8	0.9
9	Cu	ppm	1.1	1.2	1.3	1.3	1.2	1.1	1.3	1.2	1.3	1.3	1.2	1.1	1.2	1.2	1.3	1.3	1.1	1.3	1.2	1.3
10	Pb	ppm	0.3	0.4	0.5	0.3	0.4	0.5	0.5	0.3	0.4	0.5	0.4	0.5	0.4	0.5	0.5	0.3	0.3	0.3	0.4	0.4
11	PH		7.0	7.2	7.3	7.4	7.0	7.1	7.4	7.1	7.4	7.2	7.3	7.2	7.1	7.4	7.2	7.3	7.1	7.0	7.2	7.3
12	OC	%	1.8	1.9	1.8	1.7	1.8	1.8	1.7	1.9	1.8	1.9	1.9	1.7	1.8	1.7	1.9	1 .9	1.8	1.8	1.7	1.7
13	OM	%	3.1	3.0	3.2	3.0	3.3	3.1	3.1	3.2	3.4	3.3	3.1	3.2	3.1	3.2	3.1	3.0	3.3	3.1	3.0	3.2
14	N_2	%	3.2	3.5	3.0	3.4	3.5	3.0	3.4	3.3	3.1	3.2	3.2	3.5	3.1	3.0	3.4	3.2	3.0	3.1	3.3	3.3
15	P	ppm	6.3	8.3	8.1	6.2	7.4	8.3	8.2	6.2	8.1	7.4	8.3	8.1	6.4	7.2	8.0	6.2	8.3	7.4	8.0	6.3

16	Texture		Sandy loam	Loamy sand	Silt loam	Clay loam	Sandy silt loam	Sandy clay loamy	Sandy clay loam	Loamy sand	Clay	Loamy sand	Silt loam	Sandy loam	Silty clay	Silt loam	Silt loam	Silty clay	Sandy clay	Silt clay	Sandy clay	Silty clay
17	DOM		Sandy sludge	Marl	Top humus soil	Calcureous clay	Sundstone	Ferruginousclay`	Ferruginous clay	Marl	Highly silceous clay	Marl`	Top humus soil	Sandy sludge	Grey laminated shale	Top humus soil	Top humus soil	Grey laminated shale	Top humus soil	Black laminated shale	Top humus soil	Black laminated shale

As presented in Table 8, for Results Analyzed where OC means Organic Carbon, OM means Organic Matter, DOM means Description of Material.

Table 9: Guideline for interpretation

Guideline for interpretation								
Average soil, natural and screening level						Liming equivalent material		
Metal	NH	NY	US	USEPA	WHO	Liming material	Composition	Calcium Carbonate Equivalent %
Ca						Burnt lime or quick lime	CaO	179
Si						Hydrated lime or slaked lime	Ca(OH)	136
Al						Dolomite lime	$CaMg(CO_3)_2$	109
Fe	NG	NG	18,000	NG	NG	Agricultural Lime	$Ca\ CO_3$	85-100
Mg						Cement dust or cement lime	$CaSiO_3$	86
K						Marl	$CaCO_3$	70-90
Zn	98	65.2	180	23,000	NG	Slag	$CaSio_3$	60-80
Mn	NG	NG	NG	NG	NG			
Cu	31	14.2	17	NG	NG			
Pb	51	18.7	16	200-400	0.1-0.3			

As presented in Table 9. Guideline for interpretation where NG means Not given
Guidelines on Heavy metal concentrations in soils edited from (1 Sanborn, Head & Associates, Inc (SHA), (1998) New Hampshire (NH), 2 Schacklette and Boerngen, (1984) United States. (U.S.) 3 Al-Wardy, (2002) New York (NY), 4 US Environmental Protection Agency, (1996) US EPA,5 Saunders Olivia and Buob Thomas (2010)).
Guidelines on liming Equivalent Material Edited from (Tisdale et al., (1993), Donahue and Auburn, (1999), and Mark et al., (2001)).

3.3 ANALYSIS AND INTERPRETATION OF THE RESULTS

The composition of the liming materials observed can be derived from the Calcium Oxide (burnt lime, quick lime (CaO) and Silicate (ii) oxide (SiO_2) of the constituent material. The results revealed the composition of SiO_2 has greater limestone saturation factor (LSF) respectively tend to range from 53 – 87% value as moderate level of rating measured. The proper soil sampling was critical obtained accurate limestone material recommendation. The liming materials resulted from analyzed relating to agricultural lime which has slightly moderate related materials value range that has composition available for $CaCO_{3,}$ CCE range from 85 – 100%. Also, called Calcite or Calcitic limestone. Marl has composition available of $CaCO_3$ same as agricultural lime with CCE range 70 - 90%. The liming materials observed majorly are slag and cement lime or dust qualities that have composition available of $CaSiO_3$ and $CaSiO_3$of CCE range from 60-80% and 86%. Finely ground liming materials are lastly costly for neutralizing soil acidity for Agricultural used). Neutralizing values and fineness determine the effectiveness of limestone for raising soil PH. The measured of a limestone to neutralize soil acidity depends upon its calcium carbonate equivalence (CCE), which is expressed as a percentage. Pure calcium carbonate or calcitic limestone is the standard and has a CCE of 100%. All other liming materials are compared with this standard. The CCE of sale limestone products should be available through the vendor.

Some heavy metals were analyzed in different quantities of material such as: Mn, Cu, Zn and Pb. The concentrations are presented in table 8. The results analyzed for the heavy metals crossed checked such as zinc (Zn) range from 0.5-0.7, manganese (Mn) range from 0.8 – 0.9 lead (Pb) range from 0.3 – 0.4, copper (Cu) range from 1.1 – 1.3 were observed. The analyzed results for heavy metals has less range value trace observation from materials. The materials were guided base on standard measured presented in compared of the result interpretation rated from various organization stated such asSanborn, Head & Associates, Inc (SHA). Background metals concentration study, New Hampshire soils, New Hampshire Department of Environmental Services, Concord, New Hampshire, NH. Element concentrations in soils and other surficial materials of the conterminous United States. U.S. Geological Survey, Elemental Distribution in the surface and subsurface soils of central and western New York, NY.US Environmental Protection Agency, Office of Solid Waste and Emergency Response Soil Screening Guidance as stated in table 9. The soils could be considered not contaminated with metals. It is thus inferred that the origin of metals in soils was weathering and other geochemical processes of other rocks and mineralization and not the limestone ore. It was noted that soils from the region were not contaminated with metals Pb, Zn, Cu and Mn however great care should be taken to avoid enhancing the metal levels to toxic amounts through human activities. The spread of heavy metals is a common phenomenon near factories due to damping of mine tailings. Zn, Cu and Pb concentrations have been shown to be enhanced and to have increased as well as spread to nearby areas (Al-Khashman & Shawabkeh, 2006). The levels of metals in the present study demonstrate that there may be little or no potential toxicity risk posed from the exploration of limestone in this environment, however, as conditions become favourable (eg. more acidic pH, weathering of the rock, etc), the possibility of higher leaching potential of these metals from topsoil into subsoil and eventually into ground water could be experienced. Also, continuous piling up on topsoil of dust containing traces of these metals would at a point threaten the environment. (Effiong *et. al*., 2012).

Soil PH is an indicator required for lime with combination of soil texture are needs to examined lime requirement. The soul texture recorded mostly common to the materials has sand clay loamy properties that was tend to have moderate level of rating measured. The level of acidity in the soil samples were very low, but the PH of the soil was ranged between 7.0 – 7.4 which is slightly alkaline. PH of 7.0 need lead binds trend tightly to soil particles at very low has similar exist for copper. The chemical such as lead and zinc has less plant needs of high PH greater than 7.0. The pH ranges were favourable for most arable crop production, and would not hamper good growth of the plants. (Afeni *et. al.*, 2012).

Table 10. General guidelines on interpretation of soil carbon and nitrogen test results (Twort *et al.*, 1991).

	Measured Value	Rating
Organic Carbon %	>3.0	High
	1.5 – 3.0	Moderate
	0.5 – 1.5	Low
	<0.5	Very low
Total Nitrogen %	>0.25	High
	0.12 – 0.25	Moderate
	0.05 – 0.12	Low
	<0.05	Very low

Table 11 Guidelines for interpreting Nitrogen, phosphorus, potassium soil test results (Fulton, et. al., 2010)

	Nitrogen (no3-N)		Phosphorus		potassium
Fertility level	PPM	1hs/acre	Bray PI method PO_4 concentration (PPM)	Olsen method PO_4 concentration	Extractable K (PPM)
Very low					< 75
Low	<10	<36	<20	<10	75 – 150

Medium	10 – 20	36 – 72	2- - 40	10 – 20	150 – 250
High	20 – 30	72 – 108	40 – 100	20 – 40	205 – 800
Very high excessive	>30	>108	>100	>40	>800

The frequency of soil sampling to determine lime requirement will depend on soil properties, crop and the source and amount of Nitrogen and others nutrient applied. The result was analyzed using standard soil test are presented in Table 10 (Afeni *et al*., 2012) and 11 respectively for Agricultural soils. The result was analyzed using standard for soil test as proposed in the table 9. Nitrogen level in all the soil samples were high, that range from 3.0 to 3.5 value which greater than 0.25 value for high. The soil organic carbon analyzed was tends to range from 1.7 to 1.9 value as moderate level of rating measured. The soil organic matter improves the soil moisture, soil structure and stability, water holding capacity and conditions for microbial growth, and hence an important factor for the soil as a rooting environment. Typical topsoil commonly contains about 2-5% by weight of organic matter. Most of the soil samples were within the range, sample of higher organic matter (3.3%) (Afeni *et. al.*, 2012).

4.1 CONCLUSION

At the end of this research work, it is expected that the aim and objectives will have been achieved. The study proposed to aim and objectives was achieved by quantified the mined areas and asses the materials required for its reclamation for Agricultural purpose. Mined areas required approximately of 195,150,059,500m^2 or 195,150,059.5ha areas covered with amount of volume was recorded to 4,878,751,488,000m^3 and tonnage amount to 11,465,066,000,000tons required materials to reclaim the areas disturbed or exhausted in mines. Mined areas reclaimed back to over 80 percent when the mineral supply exhausted based on the description of the mines, overlain by additive materials such as shale, laterite and overburden unit almost three times as thick as constituent material i.e limestone. The research conducted revealed with respected to liming materials recorded basically are cement dust or cement lime and slag which has composition of $CaSiO_3$ respectively. Also, the reclamation areas with respected to classes of soil texture recorded mostly as sand clay loamy properties was tend to slightly moderate useful for agricultural purpose to particular crop. The suggestion of planting crop to the reclaimed areas was based on the analysed result of the required materials in three categories as stated,

a. Planting crop that has same or similar result of analysed materials required such as Cocoyam.
b. Planting crop as covered crop which can produce nutrients i.e nitrogen and other organic carbon to meet standard soil agriculture requirement for crop produces such as Watermelon
c. Planting crop that will be required add manure such as N.P.K fertilizer to meet standard soil Agriculture requirement such as Banana or Plantain.

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