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MECHANICAL PROPERTIES AND CHARACTERIZATION OF VOLCANIC MUD BASED GEOPOLYMER, BLENDED CEMENT AND COMMERCIAL CEMENT

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Abstract

The volcanic mud sample was collected from Yauk Chaung Village, Kyaukphyu Township, Rakhine State and quarry dust from Loikaw Township, Kayah State. The physicochemical properties (moisture content, loss-on-ignition, specific gravity, fineness and pH) of volcanic mud and quarry dust samples were determined. The optimum conditions of sodium hydroxide concentration and the ratio of sodium hydroxide and sodium silicate which were used in the preparation of geopolymer have been determined. The physical properties such as normal consistency and setting time and the mechanical properties such as compressive and tensile strength of the prepared volcanic mud-quarry dust based geopolymer (GP), blended cement (BC, GP + Cement) and Commercial cement (CC, Alpha cement brand) (1:1, 1:2, 2:1) at different time intervals (7, 14, 28, 42, 56 and 70 days) have been determined. The compressive and tensile strength were found to maximum at 56 days for all type of cements. The prepared volcanic mud-quarry dust based geopolymer (GP), blended cement (BC, GP+Cement) and commercial cement (CC, Alpha cement brand) were characterized by ED XRF, XRD, SEM and FTIR. To determine the acid resistance, the prepared volcanic mud-quarry dust based geopolymer (GP), blended cement (BC,GP + Cement)with various ratios and commercial cement (CC, Alpha cement brand) are immersed in various dilute acid (10 % HCl,10 % H_2SO_4 and 10 % CH_3COOH). After three months immersion in acid, the mechanical and tensile strength were determined. In acid condition, all cements have resistance to 10 % HCl and 10% H_2SO_4 but no resistance to 10 % CH_3COOH.

Keywords : Geopolymer, compressive strength, tensile strength, ED XRF, XRD, SEM, FT IR,

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Introduction

Geopolymer material has captured the interest of many researchers from different industries because it demonstrates excellent properties such as resistance towards, fire, acid and thermal. Moreover, it is green due to the fact that it can be prepared from industrial waste and natural resource. Further advantages of geopolymer is the production of very economical and cost effective as the waste is available at low cost and the process is hassle free (He *et al*., 2010).

Any aluminosilicate source (such as metakaolin, kaolin slag volcanic mud and fly ash) that can dissolve in alkaline activator solution (such as NaOH or KOH) will act as geopolymer precursor and geopolymerize. The alkaline solutions play role in geopolymerization. It was dissolved the aluminosilicate species in the reaction (Yunsheng *et al*, 2008).

Geopolymers are novel class of materials that are formed by the polymerization of silicon, oxygen and aluminium species to form an amorphous three-dimensional framework structure (Kyi Kyi San, 2013). Most common alkali activator used in geopolymerization is a combination of NaOH or KOH and Na_2SiO_3 (Khin Moe Aye, 2013).

Geopolymerization occur in few stages involves in the releasing of silicate ($SiO_{4)}$ and alumina (AlO_4) as starting materials which activated by alkali and results in geopolymer gel as the final yield. Hydrolysis took place in the second stage where the water molecule presence helps to further break the bond and allow these SiO_4 and AlO_4 tetrahedral units to link with each other yielding polymeric precursors. Polycondensation occurs in the final stage where the geopolymer gel solidified and formed three-dimensional aluminosilicate network (Liew *et al.*, 2012).

Synthesis of geopolymers was affected by different types of raw materials, concentration and alkaline activator involved, curing time and temperature plus any other factors. These will affect the formation of aluminosilicate geopolymer network and consequently the properties of the end product. Geopolymer is well known of its unique characteristic where it can be prepared exclusively to fulfill the demand required in specific application (Hajimohammadi *et al.*, 2010). The prepsent investigation was undertaken to study the preparation and application of volcanic mud based geopolymer.

Materials and Methods

Sample Collection

The volcanic mud sample was collected from Yauk Chaung Village, Kyaukphyu Township, Rakhine State and quarry dust samples was collected from Loikaw Township, Kayah State.

Sample Preparation

Volcanic mud was piled up into a cone and dividing it into quarters. Opposite quarters were rejected and the remaining half-portion again treated as before, rolling the sample back and forth on a paper. After quartering, the sample was ground in an agate motor and pestle and then sieving with 200 mesh sieves.

Quarry dust sample was obtained by crushing the stone boulders of size 100 to 150 mm in the stone crushers. The aggregate was sieved and the sieved aggregates was less than 4.75 mm in size.

Methods

All chemicals used in this work were the products from British Drug House Chemical Ltd., Poole, England and from Kanto Chemical Co. Inc., Japan, unless otherwise stated. Commercial cement (Alpha cement brand) was purchased from Hlaing Tharyar Township, Yangon Region.

All analytical procedures of the experiment was carried out according to recommended standard methods (Vogel, 1964). The physicochemical properties such as moisture content, loss-on-ignition, specific gravity, fineness and pH of volcanic mud and quarry dust samples were determined. Various conventional and modern instrumental techniques were used throughout the experimental procedures. These include Energy Dispersive X-Ray Fluorescence (ED XRF), X-ray Diffraction (XRD), Scanning Electron Microscope (SEM) and Fourier Transform Infrared Spectroscopy(FT IR) techniques. During the experiment, all analytical determinations, instrumental analyses, monitoring of the process systems and the equipment together with the supporting facilities were carried out at Universities' Research Centre, University of Yangon.

Physicochemical Properties of Volcanic Mud - Quarry Dust Based Geopolymer, Blended Cement and Commercial Cement

Volcanic mud and quarry dust were mixed in the different ratios of 1:1, 1:2, 2:1, 1:3, 3:1, w/w to prepared geopolymer (GP) their properties were determined. Moreover, the blended cement were prepared by mixing the prepared geopolymer (GP), blended cement (BC, GP + Cement) and commercial cement (CC, Alpha Cement Brand) in the different ratios of 1:1, 1:2, 2:1, 1:3, 3:1 w/w and their properties were also studied in Table 1.

Table 1: Different Mixing Ratio of Physico-mechanical Properties of Volcanic Mud –Quarry Dust Based Geopolymer (GP), Blended Cement (BC) and Commercial Cement (CC)

Mixture	Ratiosw/w	Physico-mechanical Properties
Volcanic mud :Quarry dust (GP)	1:1 1:2 2:1 1:3 3:1	Physical Test (1) Normal consistency (2) Setting time
Blended Cement (GP:Commercial Cement)	1:1 1:2 2:1 1:3 3:1	Mechanical Strength (1) Compressive strength (2) Tensile strength

GP = Volcanic mud-quarry dust based geopolymer
Cement = Alpha Cement Brand

Preparation of Volcanic Mud and Quarry Dust (1:1 wt. ratio) Geopolymer and Blended Cement

Volcanic mud and quarry dust (1:1, 1:2, 2:1, 1:3 and 3:1 wt. ratio) were mixed with 3 mL of alkali solution (1:3v/v of Na_2SiO_3:NaOH and 28 % of water on a non-absorbent base. Immediately the mixture was placed in the plastic mould.After7, 14, 28, 56, 70 days, the specimens were removed from the plastic mould. The blended cements (BC) were prepared by various mixing ratios of the prepared GP:commercial cement (1:2) and commercial cement (Alpha cement brand). Table 2 show that the Preparation of volcanic mud and quarry dust (1:1) based geopolymer samples using various ratio of NaOH and Na_2SiO_3 Volcanic mud and quarry dust (1:1, 2:1, 1:2) wt. ratio was mixed with 3mL of alkali solution (1:3) v/v of NaOH : $Na_2SiO_3$and 28 % of water were mixed on a non-absorbent base. Immediately the mixture was placed in the plastic mould. After 7, 14, 28, 56, 70 days, the specimens were removed from the plastic mould. The blended cements (BC) were prepared by various mixing ratio of prepared GP: commercial cement (1:2) and commercial cement (Alpha Cement Brand Brand).

Table 2: Preparation of Volcanic Mud and Quarry Dust (1:1) Based Geopolymer Samples Using Various ratio of NaOH and Na_2SiO_3

GP Samples	Ratio of Alkali Solutions NaOH : $Na_2SiO_{3v/v}$	Concentration of NaOH (M)
A-1	1:1	
A-2	1:2	
A-3	2:1	4
A-4	1:3	
A-5	3:1	
B-1	1:1	
B-2	1:2	
B-3	2:1	8
B-4	1:3	
B-5	3:1	
C-1	1:1	
C-2	1:2	
C-3	2:1	12
C-4	1:3	
C-5	3:1	

Results and Discussion

The results are divided into two parts. The first part is concerned with the physicochemical properties, mechanical properties and the characterization of volcanic mud and quarry dust based geopolymer (GP), blended cement (BC, GP+cement) and commercial cement(CC, Alpha Cement Brand). The second part is the optimum conditions of sodium hydroxide concentration and sodium silicate for the preparation of volcanic mud and quarry dust based geopolymer and the comparison of the mechanical properties of the prepared geopolymer and commercial cement.

Physicochemical Properties of Volcanic Mud and Quarry Dust Sample

Moisture content

Moisture content of volcanic mud and quarry dust samples were found to be 3.7 % and 2.6 % respectively. It is possibly due to basic oxides and those of silicon, iron and aluminium. These oxides are able to absorb moisture (Ilangovana *et al*., 2008). The results are shown in Table 3.

pH

pH values of volcanic mud and quarry dust samples were 11.92 and 9.46 respectively. According to the pH values, the samples were highly alkaline not surprising of the nature of basic oxides. The results are shown in Table 3.

Loss on ignition (LOI)

LOI was essentially a measure of the unburnt carbon in volcanic mud and quarry dust samples. LOI value of volcanic mud was found as 5.3 % and quarry dust as 0.48 %. According to ASTM C 618 guide lines studies, LOI is acceptable for use as a substitute of cement (Hudson BP, 1997). The results are shown in Table 3.

Specific gravity

The average specific gravity of the volcanic mud and quarry dust were 2.59 and 2.57. The specific gravity of Portland Cement is 3.15. They are slightly less than that of Portland Cement (Alpha Cement Brand), thus using volcanic mud and quarry dust samples as a replacement material can reduce the weight of cement. The low specific gravity causes porous, weak and absorptive material and high specific gravity causes good quality of concrete (Ilangovana *et al*., 2008). The results are shown in Table 3.

Fineness

The fineness of volcanic mud and quarry dust depends on the methods of combustion and grinding. The fineness of volcanic mud was 27.8 % and quarry dust was 12.9%. The results are shown in Table 3.

Table 3: Physical Properties of Volcanic Mud and Quarry Dust Samples

No.	Sample	Moisture (%)	Loss-on-ignition (%)	pH	Specific gravity	Fineness (%)
1.	Volcanic mud	3.7	5.3	11.92	2.59	27.8
2.	Quarry dust	2.6	0.48	9.46	2.57	12.9

Physical properties of volcanic mud-quarry dust based geopolymer, blended cement and the commercial cement

The ASTM standards cement types having specified certain physical requirement for each type of cement. These properties include (1) Normal consistency (2) Setting time. Each one of these properties has an influence on the performance of the cement in concrete. Physical tests of different mixing ratio of volcanic mud-quarry dust based geopolymer (GP), blended cement (BC) and commercial cement (CC) [(1:1), (1:2), (2:1), (1:3), (3:1)] were prepared and tested for various properties.

Normal consistency

Quality control testing and research on cement properties is usually done on volcanic mud-quarry dust based geopolymer paste blended cement mortar and concrete are similar in function of the water ash and cement ratio. Vicat needle was used to determine the amount of mixing water to make cement paste of a given consistency. The resulting data and reported data are shown in Tables 4 and 5.

Setting time

The setting time depends on the composition of cement, temperature and quantity of water used in gauging for ordinary cement. The initial and final setting time of geopolymer is important in practice because it established the time available for transport placing and compaction of geopolymer. The initial setting time should not be less than 45 min and final setting time more than 480 min. Comparison of the setting time of geopolymer, blended cement and Alpha brand cement were also studied. The results are shown in Tables 4 and 5. In this research work initial and final setting times were within the limits of the ASTM (American Society for Testing and Materials) standard setting time (Bogue, 1955; ASTM. 150.72).

Table 4: Normal Consistency and Setting Time of the Prepared Volcanic Mud and Quarry Dust Based Geopolymer in Various Ratios

Samples	Normal Consistency (%)	Setting Time (min)	
		Initial	Final
GP_1	30	130	495
GP_2	34	110	425
GP_3	33	120	450
ASTM type (General use)	-	not less than 45	not more than 480

GP_1 1:1 -wt ratio of volcanic mud-quarry dust
GP_2 1:2 -wt ratio of volcanic mud and quarry dust
GP_3 2:1 -wt ratio of volcanic mud and quarry dust

Table 5: Normal Consistency and Setting Time of the Prepared Geopolymer (GP), Blended Cement (BC) and Commercial Cement (CC) Samples

Samples	Normal Consistency (%)	Setting Time (min)	
		Initial	Final
GP 1	30	130	495
BC	29	115	339
CC	28	100	235
ASTM type (General use)	-	not less than 45	not more than 480

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (alpha brand)
ASTM - American Society for Testing and Materials

Compressive strength of the prepared volcanic mud –quarry dust based geopolymers, blended cement and commercial cement

The mixture composition and ratio of alkali activator affect the compressive strength, the rapid increase in strength may be attributed to the high alkali concentration used to activate volcanic mud. The test results also indicated that the mole ratio of sodium silicate to sodium hydroxide affects the compressive strength because of the reaction from aluminosilicate materials in volcanic mud and the excess silicate binder water evaporation and structure formation. The compressive strength resulted from storage times of 7, 14, 28, 42, 56 and 70 days are shown in Tables 6 and 7. For volcanic mud –quarry based geopolymer of different ratios were carried out at different time intervals (7, 14, 28, 42, 56, 70 days).The highest compressive strength of (1:1) ratio of volcanic mud quarry dust based geopolymer (GP) is 42.41N/mm^2. However, the blended cement (GP:Cement) is the highest compressive strength of (1:2) ratio is 68.91 N/mm^2.Forthe commercial cement (Alpha Cement Brand), the highest compressive strength is 76.86 N/mm^2. The compressive strength was found to be maximum at 56 days for all type of cement.

Table 6: Compressive Strength of the Prepared Geopolymer (GP) at Different Storage Times

Samples	Compressive Strength (N/mm^2) at Different Storage Times (Days)					
	7	**14**	**28**	**42**	**56**	**70**
GP_1	15.47	19.19	25.25	30.36	42.41	40.85
GP_2	10.52	14.56	20.46	27.90	33.21	30.98
GP_3	12.53	17.16	22.48	29.47	35.36	33.54

GP_1 1:1 - wt ratio of volcanic mud-quarry dust
$GP_2$1:2 - wt ratio of volcanic mud and quarry dust
$GP_3$2:1 - wt ratio of volcanic mud and quarry dust

Table 7: Compressive Strengths of the Prepared Geopolymer, Blended Cement and Commercial Cement at Different Storage Times

Samples	Compressive Strength (N/mm^2) at Different Storage Times (Days)					
	7	14	28	42	56	70
GP_1	15.47	19.19	25.25	30.36	42.41	40.85
BC	28.65	33.86	42.75	49.98	68.91	65.71
CC	35.35	40.63	47.73	58.54	76.86	73.31

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (Alpha Cement Brand)

Tensile strength of the volcanic mud –quarry dust based geopolymer, blended cement and the commercial cement

The tensile strengths were measured based on molding methods for motor, volcanic mud –quarry dust based geopolymer (GP), blended cement (GP:Cement) in various ratio and cement (Alpha Cement Brand) at different storage times (7, 14, 28, 42, 56, 70)days. The results are shown in Tables 8 and 9. Table 8 indicates that the tensile strength of volcanic mud-quarry dust (GP_1,1:1) was the highest strength of 216 psi and Table 9 shows that as the time progressed, the highest tensile strength of blended cement (GP:Cement1:2) was 256 psi. The commercial cement CC (Alpha Cement Brand) has the highest tensile strength 284 psi in time interval 56 days. It was observed that the strength of volcanic mud-quarry dust based geopolymer depended on the blended ratio. The tensile strength increased with increase of time interval 56 days but decreased in time interval 70 days.

Table 8: Tensile Strength of the Prepared Geopolymer (GP) at Different Storage Times

Samples	Tensile Strength (psi) at Different Storage Times (Days)					
	7	14	28	42	56	70
GP_1	75	108	179	200	216	210
GP_2	50	86	120	150	180	169
GP_3	60	103	175	193	198	184

GP_1 1:1 - wt ratio of volcanic mud-quarry dust
GP_2 1:2 - wt ratio of volcanic mud and quarry dust
GP_3 2:1 - wt ratio of volcanic mud and quarry dust

Table 9: Tensile Strength of the Geopolymer, Blended Cement and Commercial Cement at Different Storage Times (Days)

Samples	Compressive Strength (N/mm^2) at Different Storage Times (Days)					
	7	**14**	**28**	**42**	**56**	**70**
GP_1	75	108	179	200	216	210
BC	100	103	180	210	256	248
CC	196	200	244	269	284	277

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (Alpha Cement Brand)

Characterization of the Prepared Volcanic Mud-Quarry Dust Based Geopolymer, Blended Cement and Commercial Cement

Semiquantitative analysis of volcanic mud-quarry dust based geopolymer (GP_1, 1:1), blended cement (BC,1:2) and Alpha Brand commercial cement (CC) were characterized by ED XRF. The chemical composition of the aluminosilicate precursors were determined. Figures 1, 2, 3 and Table 9 shows that the chemical composition of volcanic mud-quarry dust based geopolymer (GP_1,1:1) contained high content of silicon oxide than other elements. The prepared geopolymer (GP_1, 1:1) showed nearly the same composition with that of Alpha brand commercial cement (CC).

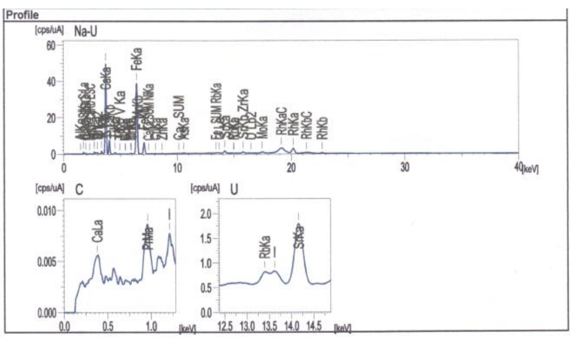

Figure 1: ED XRF spectrum of geopolymer (GP_1)

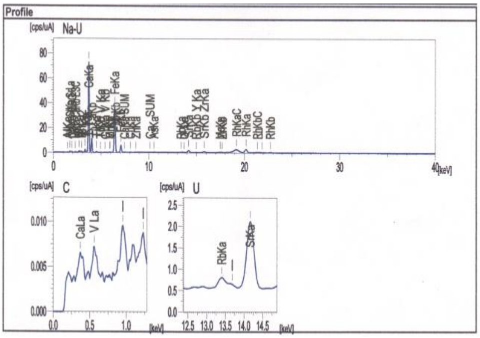

Figure 2: ED XRF spectrum of blended cement (BC)

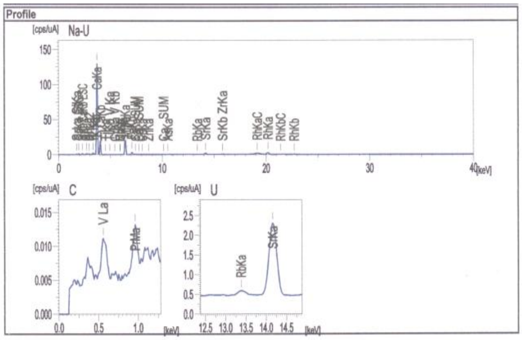

Figure 3: ED XRF spectrum of commercial cement (CC)

Table 10: Relative Abundance of Some Elements in the Prepared Geopolymer, Blended Cement and Commercial Cement Samples by ED XRF Method

Cement Samples	Relative abundance of some elements in different samples (%)						
	SiO_2	Fe_2O_3	CaO	K_2O	TiO_2	Al_2O_3	SrO
GP1	26.13	2.27	16.25	0.77	0.26	7.67	0.01
BC	25.84	2.79	26.28	1.29	0.29	7.89	0.03
CC	16.09	2.11	46.85	1.11	0.17	ND	0.05

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (Alpha cement brand)

XRD measurement

The basic material of the volcanic mud-quarry dust based geopolymer (GP_1,1:1) has the amorphous character only seldomcontaining needle-shaped minority crystals. Geopolymer exists a broad humpbetween 18-36° 2θ, which is the characteristic of amorphous geopolymer,in their patterns. Figures 4, 5 and 6 show that the major components are silica (SiO_2), alumina (Al_2O_3) and quartz. Quartz and semicrystalline were determined in the diffractogram. A hump between 15-34° 2θ was observed in the diffractogram (McLellan, 2011).

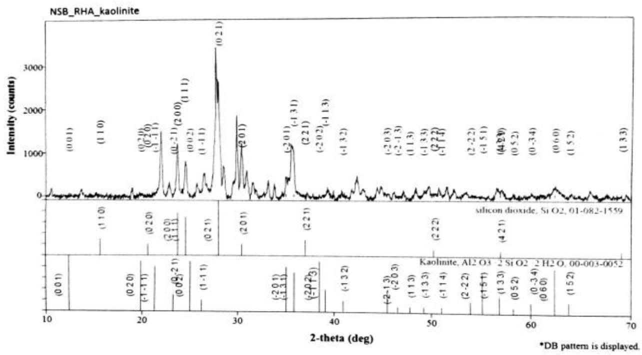

Figure 4: XRD diffactogram of the prepared geopolymer (GP_1)

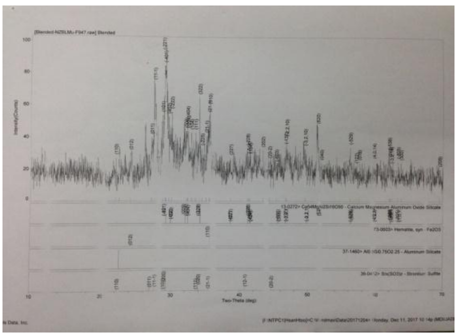

Figure 5: XRD diffractogram of the blended cement (BC)

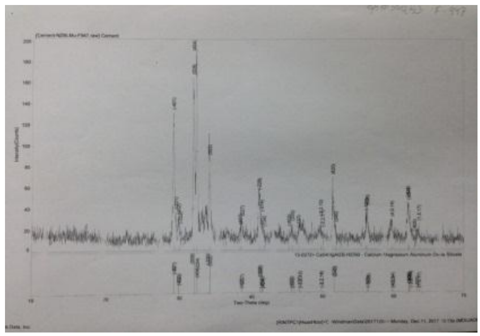

Figure 6: XRD diffractogram of the commercial cement(CC)

FT IR measurement

Figures 7, 8, 9 and Table 11 show tthe FTIR spectra of the prepared geopolymer (GP,1:1), the blended cement (BC,1:2) and the Alpha brand commercial cement (CC), respectively. The bands seen at 3415 cm^{-1} were due to stretching vibration of –OH and that at 774 cm^{-1} the bands were attributed to bending vibrations of tetrahedral groups.In addition one new band appeared at the region 1420 cm^{-1} due to formation of sodium carbonate.Geopolymer(GP1), blended cement (BC) and commercial cement (CC) were observed as the three dimensional network of polysodium aluminosilicate (Zhang, *et al*., 2010).

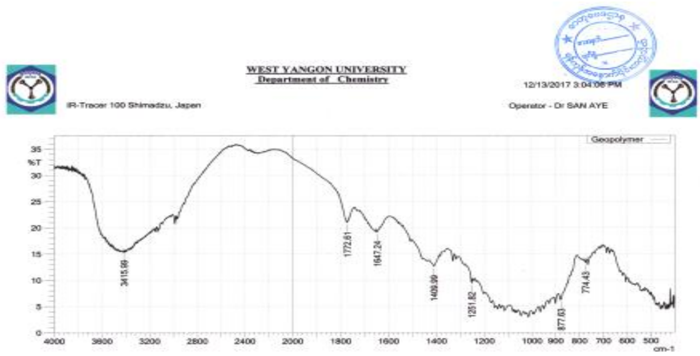

Figure 7: FT IR spectrum of the prepared geopolymer (GP_1)

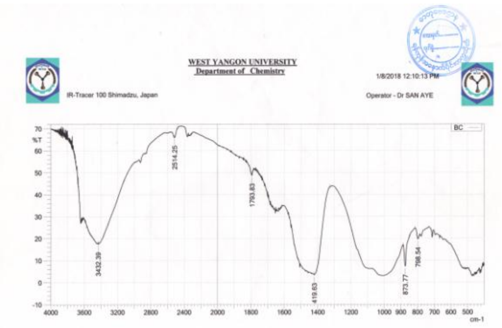

Figure 8: FT IR spectrum of the blended cement (BC)

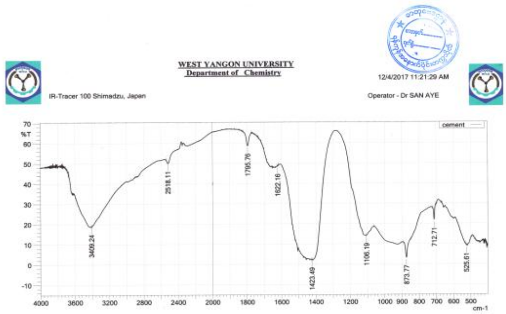

Figure 9: FT IR spectrum of thecommercial cement (BC)

Table 11: FTIR Spectral Assignment of the Prepared Geopolymer, Blended Cement and Commercial Cement Samples

Frequency (cm^{-1})			Literature Frequency (cm^{-1})	Band Assignment (cm^{-1})
GP_1	**BC**	**CC**		
3415	3410	3409	3000-3600	$\delta_{(O-H)}$
1409	1410	1423	1360	Bending vibration of O-H
877	875	873	800-850	Stretching vibration of Al-O-Al
774	679	712	565	Bending vibration of Si-O-Si

Zhang, *et al*., 2010

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)

BC = mixture of prepared GP and commercial cement (1:2 wt ratio)

CC = commercial cement (Alpha cement brand)

SEM measurement

SEM surface morphology of volcanic mud and quarry dust samples are shown in Figures 10, 11 and 12**.** These figures show the diameter of pores that may be approximately 1-10µm range. From the SEM micrographs, the microstructure of quarry dust appeared to be glassy, hollow and porous structure. In the microstructure of volcanic mud based geopolymer (GP), blended cement (BC) and commercial cement (CC) samples, the micrograph indicates crystalline nature. It can be considered that the pores are micro-porosity sized particles.

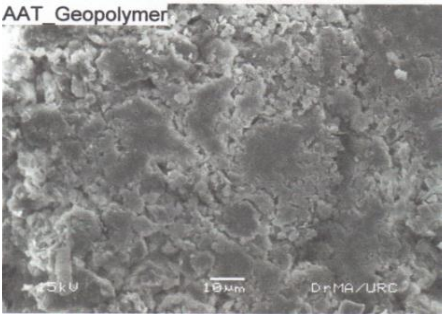

Figure 10: SEM micrograph of the prepared geopolymer (GP_1)sample at 1000 x magnification

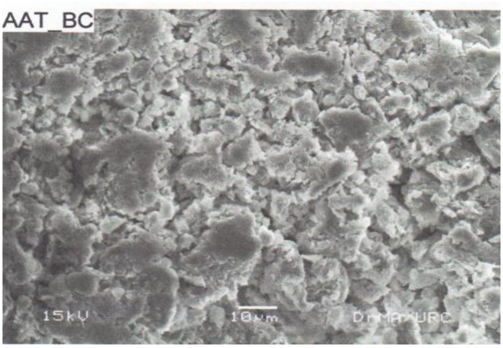

Figure 11: SEM micrograph of the blended cement (BC) sample at 1000 × magnification

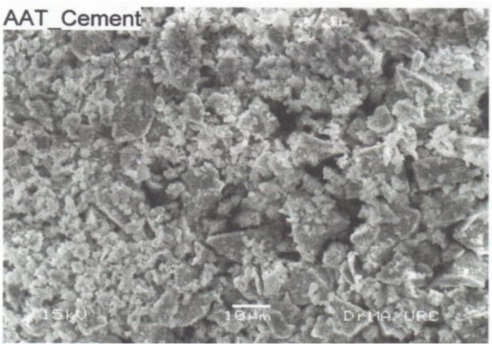

Figure 12: SEM micrograph of commercial cement (CC) sample at 1000 × magnification

Chemical Resistance of the prepared Volcanic Mud-Quarry Dust Based Geopolymer,Blended Cement and Alpha brand commercial cement

The resistance of volcanic mud-quarry dust based geopolymer (GP), blended cement (GP:cement) and commercial cement alone to attack from dilute acidity (10 % HCl, 10 % H_2SO_4, 10 % CH_3COOH). After three months immersion in dilute acid period, the cement containing the pozzolan resistanceno loss of compressive strength. Aceitic acid is more detrimental than mineral acid. So, samples in aceitic acid condition is less strength than sulphuric acid and hydrochloric acid condition. The results are shown in Tables 12 and 13.

Table 12: Compressive Strength of the prepared geopolymer, blended cement and commercial cement after Treating with Different Acids

Cement Samples	Compressive Strength of the samplesafter treating with different acids (N/mm^2)		
	10 % H_2SO_4	10 % HCl	10 % CH_3COOH
GP_1	25.62	27.86	20.35
BC	40.35	42.17	25.66
CC	50.25	52.76	45.71

GP_1 = mixture of volcanic mud and quarry dust (1:1 wt ratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (Alpha Cement Brand)

Table 13: Tensiles strength of the prepared geopolymer, blended cement and commercial cement after Treating with Different Acids (psi)

Cement Samples	Tensiles Strength of the samples after treating with different acids (psi)		
	10 % H_2SO_4	10 % HCl	10 % CH_3COOH
GP_1	174	190	169
BC	210	220	170
CC	242	283	190

GP_1= mixture of volcanic mud and quarry dust (1:1 wtratio)
BC = mixture of prepared GP and commercial cement (1:2 wt ratio)
CC = commercial cement (Alpha Cement Brand)

Conclusion

In this research, volcanic mud and quarry dust were used for the preparation of geopolymer. The determination of physicochemical properties of volcanic mud sample from Kyaukphyu Township and quarry dust sample from Loikaw Township was carried out. From the experimental work, moisture 3.7%, LOI 5.3% and pH 11.92, specific gravity 2.59 and fineness 27.8 were found in the volcanic mud sample. In the quarry dust sample, moisture 2.6 %, LOI 0.48 % and pH 9.46, specific gravity 2.57 and fineness12.9% were observed. From the EDXRF and XRD analysis, it was observed that the major oxide composition were present as SiO_2, CaO, Fe_2O_3 and Al_2O_3 in both samples. In the microstructure of volcanic mud sample, the micrograph indicates crystalline nature. FTIR spectrum shown that the geopolymeric structure was obtained successfully. This is due to the presence of significant band appeared and from the images captured respectively. Same amount of mud volcanic and quarry dust and different ratio (1:1, 1:2, 2:1) of NaOH (4, 8, 12) M and Na_2SiO_3 were used as experimental design. Blended cement (GP: cement) and commercial cement (Alpha Cement Brand) of different mixing ratios were carried out at different times. The mechanical strength of the prepared geopolymer (volcanic mud: quarry dust) increased with the higher amount of volcanic mud added but the best ratio was found to be 1:1. For the blended cement, pure cement and geopolymer ratio (2:1) was the best. The normal consistency values were found to be 30 % for prepared geopolymer at setting time between 130 and 495 min, 29 % for blended cement at 115 and 339 min and 28 % for commercial cement at 100 and 235 min. The maximum compressive strength of prepared geopolymer, blended cement and commercial cement were 42.41 N/mm^2, 68.91 N/mm^2 and 76.86 N/mm^2, respectively at 56 days. The highest tensile strength for prepared geopolymer, blended cement and commercial cement were 216 psi, 256 psi and 284 psi, respectively. To determine the acid resistance, prepared volcanic mud based geopolymer, blended cement (GP +cement) and commercial cement were treated with various acid 10 % HCl, 10 % H_2SO_4 and 10 % CH_3COOH. After three months immersion in acid, the mechanical and tensile strength were determined. Compressive and tensile strength of the prepared (GP), (BC) and (CC) after treating with 10 % HCl were found to be highest.

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