CHARACTERIZATION OF PINATUBO VOLCANIC EJECTA AND ITS MAGNETIC SEPARATION IN DRY SYSTEM

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1. INTRODUCTION

Mt. Pinatubo in the Philippines erupted in June 1991 after being dormant for about 600 years. Approximately seven cubic km. of volcanic ejecta were deposited due to this eruption.[1)] It has become active then and when rainy season comes, mudflows called lahar is unstoppable. Many lives have been lost and this has made many people homeless in the country. This seems to be destructive, but on the other hand, deposited materials could have many industrial uses.

The study aims to upgrade the volcanic ejecta deposits to make it possible for use in higher value products such as advanced materials and glasses. This involves characterization of the material and recovery of suitable components by physical processing method such as magnetic separation.

2. MATERIALS AND METHODS

2.1. Characterization

Lahar flow of 1995 was used in the study. Characterization was done in accordance with the process flow shown in Fig. 1. The sample was dried and subsequently separated into eight size fractions by dry screen analysis: -75μm, 75-150μm, 150-300μm, 300-600μm, 600μm-1.2mm, 1.2-2.4mm, 2.4-4.8mm and +4.8mm. Each size fraction was subjected to X-ray analysis: X-ray diffraction(XRD) for mineral identification and X-ray fluorescence(XRF) for chemical composition.

One (1) size fraction, i.e., 150-300μm was passed through a Hallimond magnetic separator. The separated products, magnetic and nonmagnetic ones, were both collected and subjected to X-ray analysis. The process was repeated until almost pure material is obtained.

2.2. Magnetic Separation

Four size fractions (75-150μm, 150-300 μm, 300-600μm, 600μm-1.2mm) were used for magnetic separation study. The samples were separated and characterized according to process flow shown in Fig. 2. Dry process was employed and magnetic separation was done using a coupled-pole magnetic separator. This equipment has two rollers, the diameter of which is approximately 110mm.

Separation was carried out at three magnetic field intensities; 5000, 10000 and 15000gauss, measured by means of a gauss-meter. The feed rate ranged from 35-40g/min and the rotating speed was about 123-128rpm. The separated fractions (magnetic and nonmagnetic) were both collected and subjected to X-ray analysis.

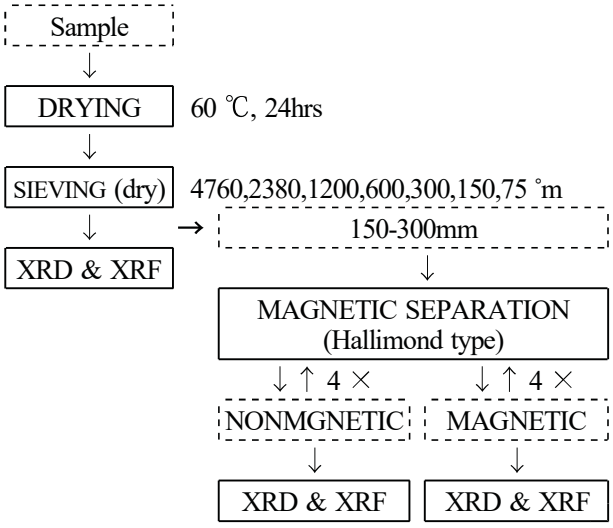


Fig. 1. Process flowchart for characterization.

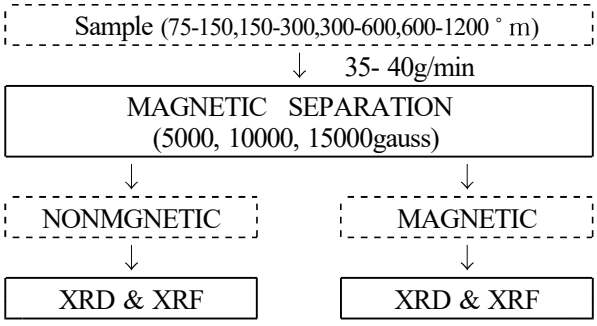


Fig. 2. Process flowchart for magnetic separation

3. RESULTS AND DISCUSSION

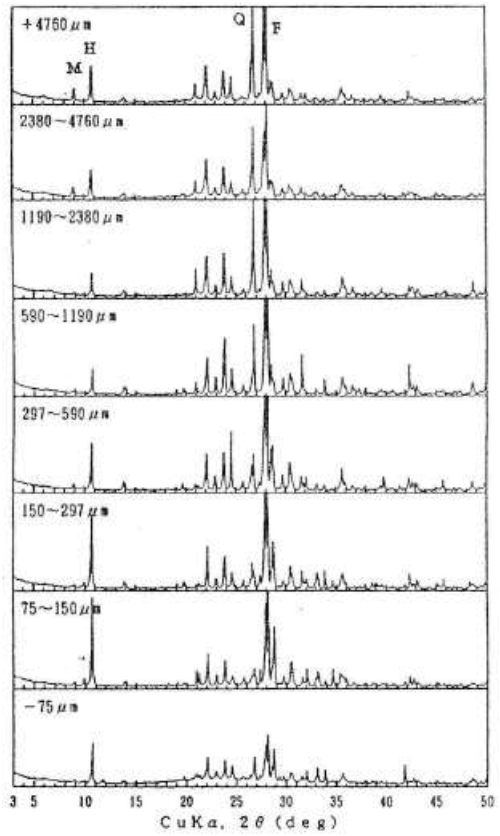
The chemical composition of each size fraction is tabulated in Table 1. The major oxides are SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, and Na_2O. Present in small quantity are K_2O and TiO_2. The SiO_2 content ranged from 52 to 66wt%. Higher SiO_2 content is observed on greater than 1190 ˚m particles . This is brought about by the presence of free silica as quartz. This is exemplified in the X-ray diffraction patterns of the eight size fractions in Fig. 3. Based on these patterns, other minerals contained in the sample are feldspar, horndblende and mica.

Almost pure feldspar was obtained by passing four times more the nonmagnetic product collected at first separation. The magnetic product was subjected to the same process. X-ray analysis of these two samples are presented in Fig. 4. By calculations, feldspar has the following composition:

$52.56(NaAlSi_3O_8)\cdot 44.97(CaAl_2Si_2O_8)\cdot 2.47(KAlSi_3O_8)$.

This composition belongs to the plagioclase group of feldspar specifically andesine. The hornblende is the alkali-amphibole type with the following formula:

$2[(Na_{0.5}Ca_{1.5})(Mg_{2.1}Fe^{+2}_{1.9}Al)(Si_{7.5}Al_{0.5})O_{22}(OH)_2]$.



F: feldspar, H: hornblende, Q: quartz, M: mica.

Fig. 3. XRD patterns of the different size fractions.

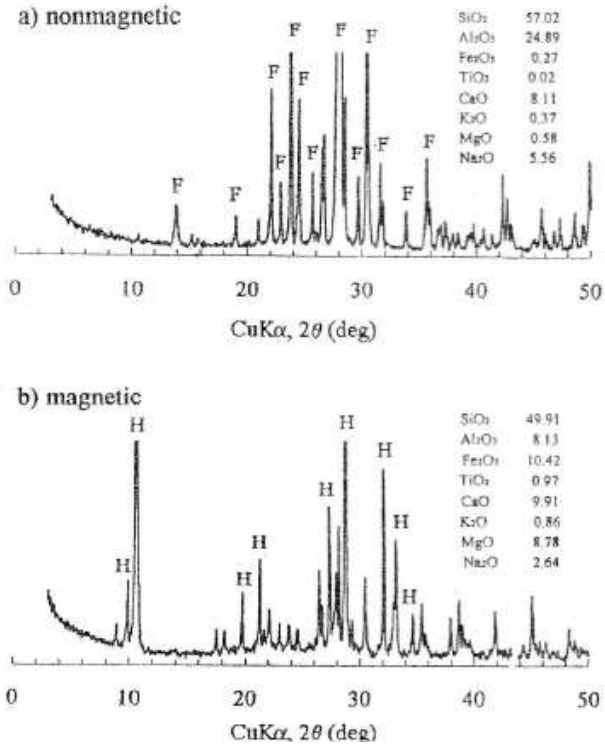


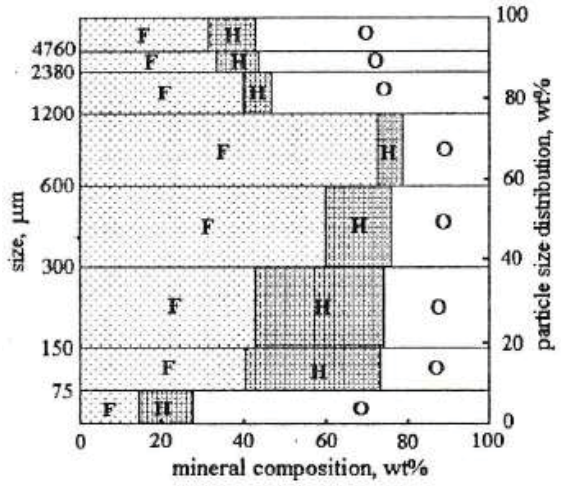
Fig. 4. X-ray analysis of separated products.

Table 1. Chemical composition of Lahar sample.

	-75μm	75-150μm	150-300μm	300-600μm	600μm-1.2mm	1.2-2.4mm	2.4-4.8mm	+4.8mm
SiO_2	63.35	52.81	53.04	56.55	61.70	65.87	63.90	64.15
Al_2O_3	14.21	15.09	16.56	19.92	20.61	17.74	15.40	16.29
Fe_2O_3	4.98	8.58	7.74	4.69	2.92	3.57	5.16	4.91
TiO_2	0.67	1.67	1.29	0.70	0.37	0.49	0.79	0.74
CaO	4.95	8.29	7.46	7.03	6.59	6.25	5.10	5.48
MgO	2.64	4.03	3.92	2.27	1.58	2.01	2.82	2.63
Na_2O	3.57	4.01	4.19	4.77	4.79	4.37	3.85	3.88
K_2O	1.80	0.79	0.60	0.56	0.66	0.97	1.36	1.38
Ig. loss	1.28	0.27	0.14	0.07	0.14	0.45	0.24	0.56

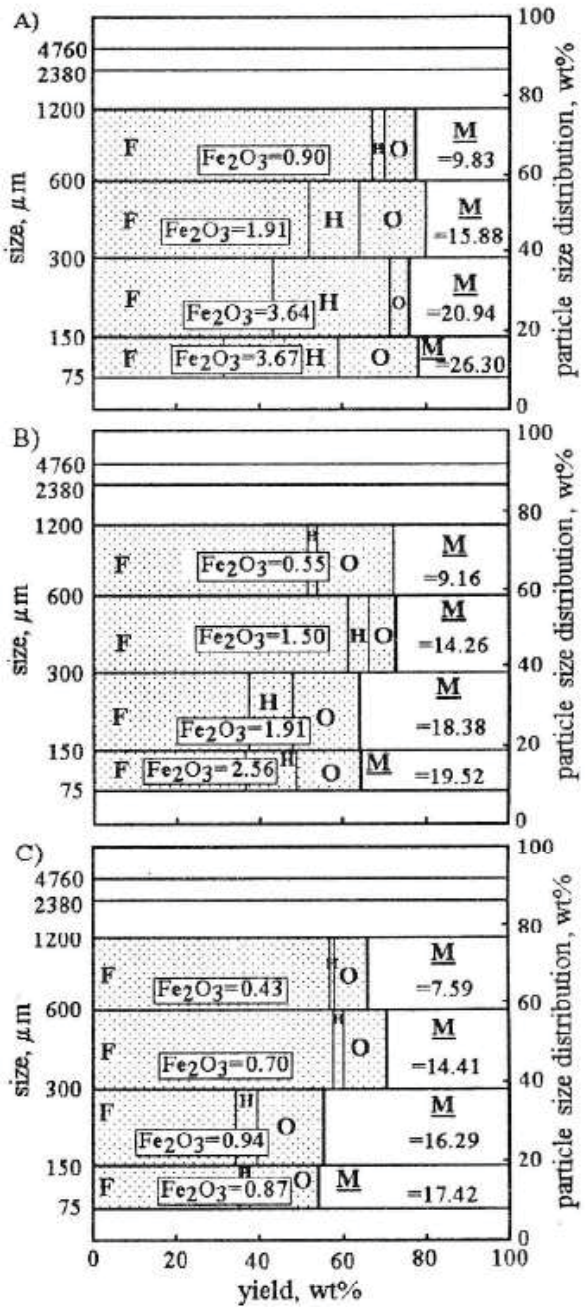
The result of dry screen analysis and the composition of minerals in each size fraction are presented in Fig. 5. About 47wt% feldspar is contained in the sample, 17wt% is hornblende and the rest are quartz and mica. The greatest amount of feldspar and least amount of hornblende is exhibited by 600μm-1.2mm followed by 300-600μm then 150-300μm. These size ranges comprise more than 50wt% of the material.

In Fig. 6, the yield and the corresponding Fe_2O_3 content of separated fractions at 15000gauss are shown. As intensity of magnetic field is increased, more magnetic materials are collected; thereby lowering the Fe_2O_3 content of the nonmagnetic products. The Fe_2O_3 content of the nonmagnetic materials were based from the XRF data. In the case of the magnetic products, values were calculated ones. The least Fe_2O_3 content, 0.43wt%, was obtained at 15000gauss. It is exhibited by 600μm-1.2mm particles. Approximately 60-80 wt% of the total feed is collected as nonmagnetic, the amount of feldspar contained is almost 50wt%.



F: feldspar, H: hornblende, O: quartz, mica, etc.

Fig. 5. Particle size distribution and mineral composition.



A)5000gauss,B)10000gauss,C)15000gause, F,H,O: nonmagnetic (F: feldspar, H: hornblende, O: quartz, mica, etc.), M: magnetic,

Fig. 6. The yield and Fe_2O_3 content of separated fractions.

4. CONCLUSION

On the basis of the above mentioned results, the change in the Fe_2O_3 content signifies that magnetic components of sample could be separated by dry magnetic separation method. The yield or degree of separation is being influenced by a number of variables such as particle size of starting material and magnetic field strength. The nonmagnetic materials recovered consisted predominantly of plagioclase feldspar specifically andesine. As such, it can be used in the production of glass, as ceramic material, and in the production of synthetic zeolites.

REFERENCE:

1) R.S.Punongbayan, C.G.Newhall and E.L.Listanco, Bull. Volcanol. Soc. Japan, 37 [1] 55-59 (1992).