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An Evaluation of Sieving Effect of Volcanic Ash Fine Particles by A Statistical Particles Image Analysis

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1. Introduction

The analysis of particle size and shape characterization is an important evaluation of volcanic ash. It is well known that particles size and shape is one of dominant parameter of volcanic ash for flowability, flying property and abrasively. A sieving is used for particle size analysis of volcanic ash as common method. However, particle has possibility to have shape effect when it goes on through mesh of a sieve. In conventionally, a manual microscope approach has been used for few number of particles shape observation. It is not able to described particle shape as significant number. On the other hand, a fine particle characterization of volcanic ash (less than 50μm) has also importance to hazard protection issue which is a fine particle has possibility to long duration time in air. Our group has reported particle characterization and classification of a volcanic ash fine particle using by images for the purpose of determining particle size distribution which is based on described in ISO13322. The particles are appropriately dispersed and fixed on an optical microscope implemented a fully automated sample stage and an automated real time particle image analysis function on software. This report will be discussed for effect of sieving and precise classification against volcanic ash fine particle by a statistical particle image analysis.

2. Material and method

In this study, the volcanic ash was sampling from Ito flow in Kagoshima. This sample was already filtered coarse particles before, and sieved by a analytical sieve (TOKYO SCREEN CO.,LTD), these mesh size were 75μm, 50μm, 32μm. It was passed to 75μm, 50μm and only trapped on 32μm. As a statistical particle image analysis, Morphologi G3-SE (Malvern Instruments) was used for evaluation of particle size and shape. The observation mode was diascopic mode (Transmittance mode) and magnification was 100x in total magnification. The sample was dispersed with SDU (Sample Dispersion Unit) which attached Morphologi G3-SE. Number of measured particles was 120,000 and a parameter filter function on software was used based on shape and pixel number of particle image.

3. Result

A classification based on sieving were under 32μm sample (sample 1), over 32μm sample (sample 2) and no pretreated sample (sample 3). Those samples were analyzed on over 60,000 particles by statistical particle image analysis. As a result, Number Based Circle Equivalent Mean (NCED Mean) was 8.7μm (sample1), 13.9μm (sample 2) and 9.6μm (sample 3) on each. However, 510 particles of over 32μm particles were detected in sample 1. It was assuming from this result that shape effect happened. Therefore the result of focus on over 32μm particle to consideration of more precise classifications was shown in Table 1. This result showed sample 1 was the most elongate in the same size particles. Intensity Mean (IM) is reflected to sample thickness and transparency. High IM particles are tin particles or glass like particles in normally. Therefore, it can possible to classification glass liked particle or non glass like particle in volcanic ash based on IM parameter. According to results, sample 1 was most of including a glass like particle in amount of particles (Table 2, Fig 1).

4. Conclusions

In summarize of this study, it was clarified particle shape effect against sieving.This report will be more discuss about application and capability of numerical definition of volcanic ash by the statistical particle image analysis as new approach for this research area.

Keywords: Volcanic ash, Particle size, Particle shape, Particle image analysis, Sievng

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Table 1: Each Class Data

Class	sample	Number of particles	CE Diameter Mean (μm)	Aspect Ratio Mean
Class 1 (32~37μm)	sample 1	357	34.8	0.62
	sample 2	3,548	34.6	0.65
	sample 3	991	34.4	0.64
Class 2 (37~42μm)	sample 1	115	38.9	0.55
	sample 2	4,046	39.5	0.66
	sample 3	633	39.3	0.63
Class 3 (over 42μm)	sample 1	38	45.2	0.52
	sample 2	4,910	47.0	0.62
	sample 3	570	46.8	0.59

Table 2: Intensity Mean by Class

class	sample	Mean Intensity	Intensity mean > 60	
			Number	%
class 1 (32~37μm)	sample 1	59	138	39%
	sample 2	51	882	25%
	sample 3	54	306	31%
class 2 (37~42μm)	sample 1	63	54	47%
	sample 2	57	1,558	39%
	sample 3	56	233	37%
class 3 (over 42μm)	sample 1	70	24	63%
	sample 2	68	2,857	58%
	sample 3	68	352	61%

High intensity (glass like) particle   Low intensity (no glass like) particles

Fig1: Picture with intensity mean