

Development of an automatic weight measurement system for volcanic ash

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1. Introduction

Large quantities of volcanic ash cause a wide range of problems to health, traffic, agriculture and human life, to name a few. In addition, thick ash deposits would generate lahars during rainy days. For the evaluation of these effects, it is crucial to determine immediately the precise volume and weight of volcanic ash. Hence, we developed an automatic measurement system for measuring the weight of volcanic ash, which is called the Kohai-hyeto meter. Kohai means ash fall. Although the first Kohai-hyeto meter was very large and heavy, a small and mobile type was made.

2. Development results

The principle of the Kohai-hyeto measurement device is described here. The total weight of volcanic ash and rainwater is measured with the load cell which is set under the container (stainless steel, B 200mm, and H 300mm). At the same time, the total volume of the ash and rainwater can also be measured with the water level meter in the container. The weight of the ash and water can be separately calculated based on the measured data. The weight of ash can be converted to the thickness of ash by using the value of the unit volume weight of ash at the observation point.

This device is equipped with a remote drainage mechanism. The permeability of the deposit can be measured while draining the deposit.

The measurement data is preserved in the memory of the data logger. We can be taken those data sets every 0, 9, 12 and 15 o'clock using the cell phone telemeter system. This meter has the automatically two drain valves. The one is estimate of ash permeability in the container drained the bottom. And another one is protected over flow when water level reached a threshold value from the bottom of container, the valve open automatically. The system of this meter is supplied electric power with a solar photovoltaic module and a battery.

3. Laboratory Test

We examine kohai-hyeto meter out side of our laboratory for 2 weeks. First we tested for stability of sensors and relation between water level and water weight by rain fall or artificially water without sand. And we checked the valve operation.

According to this test, the meter showed calculated ash weight and thickness is nearly zero until 1st day without sand. But after a rain fall, the meter showed calculated sand weight up to 75 grams without sand. The calculated weight was gradually down to near 10 to 20 grams until 8th days. We consider that the reason of calculated ash weight's increase is water dropped out side of container and the other climate condition.

Second, we tested for sensitivity of calculated ash weight and thickness that was put the Toyoura standard sand (grain density 2.64g/cm^3) into the meter.

At first we threw 4.5grams sand four times, next 22.5grams three times, third 45.1grams three times. The laboratory Test result shows well correlative between actual thrown sand weight, thickness and calculated ones. Total thrown sand's weight is 221grams. The 1mm ash thickness is equivalent to about 45g/D . D's is catch area of container as 306.11 cm^2 .

We confirmed the drainage system was working correctly, because drain was done regularly and the water level had decreased.

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