An Experimental Study of Ash fall influences on the Operation of a Cooling Tower of an Air Conditioning Unit

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A widespread volcanic ash dispersion associated with an explosive volcano eruption can affect buildings in many ways such as those including deformation or collapsing of buildings due to loads of ash accumulation on their roofs, degradation of the indoor air qualities resulted from the ash invasion, and so on. Promoting our understanding how these influences of ash falls are like is very important in considering appropriate measures against ash fall events. Among the ash fall influences on buildings, we are interested in the effects on the air conditioning facilities, because although the air conditioning is considered one of the most important elements in maintaining functions of, especially modern, buildings, studies on this topic are yet to be quite limited (e.g. Barnard, 2009) in number. From the view point, we have carried out experiments on the influences of ash fall on exterior part of an air conditioning system and have shown some results so far (Suwa et al, 2018). In this study, we performed the similar experiments to our previous study but as to the cooling tower this time. The system used here are very simple one consisting only of a small size, widely used cross-flow type cooling tower and a simple cooling water pipe layout with a single water pump and several valves equipped. Note that heat exchange units are not treated here. Natural volcano ash collected at the foot of Mt. Sakurajima was used. The ash particles smaller than 250 micron m diameter (distal area is of our primary concern here) was continuously provided from the sieve being placed just above the front of the air intake of the cooling tower until the cumulative fall depth reaches 50mm (1,600kg/m^3 density). While the rates of the air intake have not varied significantly during the experimet, which is clearly due to the ash being washed down by falling water droplets in the filler material of the cooling tower, the variation of the flow rate in the pipe system began to be discernible after cumulative ash fall exceeded about 30mm. This will be caused by gradual accumulation of the ash both in the water pit of the cooling tower and in the pipe layout. Air bubbles intruded in the pipe are found to be responsible for large fluctuation of the flow rate in the final stage of the experiments when ash fall depth exceeded 40mm. These variations in the flow rate can lead to lowering heat exchange efficiency followed by the stop of the air conditioning system. Another serious impact of the ash fall found here is erosion of the mechanical seal of the water pump by ash particle. The experiment had to be stopped when water leakage from the pump took place caused by seal erosion. Since mechanical seal generally used is the type for use for clear water, so it is stressed here that erosion of water pump can have significant impacts on air conditioning in the ash fall events

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