Understanding Heat Transfer Mechanisms in Forest Fire Spread: Fuel Particle Heat Transfer

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The purpose of the experiment was to understand the physics behind heat transfers involved in fine particle forest fires, as well as to understand how radiation, convection, wind speed, and the shape of the particle play a role. The hypothesis was that as ambient air speed increases in a high temperature, fine-particle environment, convective cooling increasingly becomes the dominant variable during the heat absorption process. The procedures were separated into three main sections: setting-up and building equipment, establishing the relative heat flux, and analyzing fine-particle heat transfers. Overall, the results of the experiment supported the hypothesis. The results showed that the available radiative heat flux decreased by more than half once a wind speed greater than 0 m/s was introduced, causing the maximum temperature to plummet from 80 degrees Celsius to less than 30 degrees Celsius. From these results, it can be concluded that convective cooling caused the extreme drop in heat flux in the radiation trials, as the wind tunnel carried heat away from the particle. The results of the experiment also showed that the temperature was higher on the backs of the fine particles than on the front of the particles when the mode of heat transfer was convection only. It is assumed that a phenomenon known as vortex shedding occurred due to convective heating, causing the backs of the particles to be warmed as the fronts of the particles were cooled. Due to its two influential forms, convection appears to be the dominant variable in this environment.

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