

Upward Spread Forced Smoldering Phenomenon: Effects and Applications

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Abstract : Smoldering is one of the most persistent types of combustion which can take place for very long periods (hours, days, months) if there is an abundance of fuel. It causes quite a notable number of accidents and is one of the prime suspects for fire and safety hazards. It can be ignited with weaker ignition and is more difficult to suppress than flaming combustion. Upward spread smoldering is the case in which the air flow is parallel to the direction of the smoldering front. This type of smoldering is quite uncontrollable, and hence, there is a need to study this phenomenon. As compared to flaming combustion, a smoldering phenomenon often goes unrecognised and hence is a cause for various fire accidents. A simplified experimental setup was raised to study the upward spread smoldering, its effects due to varying forced flow and its effects when it takes place in the presence of external heat sources and alternative energy sources such as acoustic energy. Linear configurations were studied depending on varying forced flow effects on upward spread smoldering. Effect of varying forced flow on upward spread smoldering was observed and studied: (i) in the presence of external heat source (ii) in the presence of external alternative energy sources (acoustic energy). The role of ash removal was observed and studied. Results indicate that upward spread forced smoldering was affected by various key controlling parameters such as the speed of the forced flow, surface orientation, interspace distance (distance between forced flow and the pilot fuel). When an external heat source was placed on either side of the pilot fuel, it was observed that the smoldering phenomenon was affected. The surface orientation and interspace distance between the external heat sources and the pilot fuel were found to play a huge role in altering the regression rate. Lastly, by impinging an alternative energy source in the form of acoustic energy on the smoldering front, it was observed that varying frequencies affected the smoldering phenomenon in different ways. The surface orientation also played an important role. This project highlights the importance of fire and safety hazard and means of better combustion for all kinds of scientific research and practical applications. The knowledge acquired from this work can be applied to various engineering systems ranging from aircrafts, spacecrafts and even to buildings fires, wildfires and help us in better understanding and hence avoiding such widespread fires. Various fire disasters have been recorded in aircrafts due to small electric short circuits which led to smoldering fires. These eventually caused the engine to catch fire that cost damage to life and property. Studying this phenomenon can help us to control, if not prevent, such disasters.

Keywords : alternative energy sources, flaming combustion, ignition, regression rate, smoldering

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