Name(s)

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Project Number

S0617

Project Title

Facilitating Emergency Thermal Protection via an Integration of Materials Augmented by an Endothermic Process

Abstract

Objectives

To extend the endothermic chemical reaction of ammonium nitrate by adding a hydrated polymer and alkaloid to create a survival shelter from a firetruck cab that will not exceed 37°C of heat transfer from a 300°C conductive heat source for 30min.

Methods

Tested various combinations of ammonium nitrate, hydrated polymer and alkaloid to convert conductive heat transfer into a cooling effect for cab. Tested different insulative materials individually to find the correct order to make interior panels. Once ideal combinations were found, created and tested prototypes with temperatures of up to 300°C for 30min. Recorded times and temperatures to find their insulation value and compared it against the current standard operating procedure. Test was designed to last 30min in a scenario that would have the user exposed to fully immersed flames. Independent variables: different grams of ammonium nitrate, different insulative fibers and alkaloids. Dependent variables: time of fire/heat resistance, amount of polymer and water. Controlled variables (constants): stovetop, aluminum pan, measurement tools (laser digital thermometer and digital thermometer probe), construction materials, and time exposed to flame.

Results

It was shown that one can create an endothermic gel, but at the cost of a drop in endothermic reaction time and temperature. The ideal way to extend the endothermic reaction is to find the right ratio of ammonium nitrate to water and maintain the separation of insulative materials.

Conclusions

The ratio of 1:1 ammonium nitrate to water provided the most efficient cooling effect. The most effective way to deliver the catalyst to the polymer and ammonium nitrate was through a hydrating bladder system. The final design used the US Forestry fire shelter as a reflective layer, ceramic fiber and a hydrated polymer as insulative layers, and an activated ammonium nitrate to convert the heat transfer into an endothermic reaction.

Summary Statement

To convert a firetruck cab into a survival shelter through the integration of materials augmented by ammonium nitrate s endothermic process.

Help Received

Mr. Steve Freers provided insight into chemical structures and processes of various materials. Mr. Henry Modregon assisted with experiments.