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

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PURPOSE: 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 won't exceed 37°C of heat transfer from a 300°C conductive heat source. PROCEDURE: 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 safety panels. Created and tested prototypes with temperatures of up to 300°C for 30min. Recorded times and temperatures to find insulation value. Independent variables: different grams of ammonium nitrate, insulative fibers and alkaloids. Dependent variables: time of heat resistance, amount of hydrated polymer. Controlled variables: stovetop, aluminum pan, measurement tools, construction materials and time exposed to flame. DATA: 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.

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