Using Specific Heat Capacity to Engineer a Thermal Evacuation Suit to Address Heat Transfer Processes

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OBJECTIVE: To engineer a high heat conduction thermal evacuation suit that also addresses superheated gas. Suit will allow a person to escape a fire of 980°C & convection heat of 32kph for 5min. without causing any permanent damage. METHODS/MATERIALS: Tested various silica for heat reflection & insulation. Modified polymer to achieve the highest amt. of insulation while retaining full mobility. Created prototypes and tested them on temp. of up to 980°C and superheated gas up to 32kph. Recorded their times and temp. to find their specific heat capacity and compared it against the current bunker gear used by firefighters. Test was designed to last 5min. in a scenario that would have the user exposed to 980°C flames and superheated gas. Independent variables: different types of silica, polymer and Nomex. Dependent variables: time of fire/heat resistance & superheated gas. Controlled variables: propane torch, heat gun, charcoal briquettes, measurement tools (laser digital thermometer, digital thermometer probe, & anemometer), construction materials, & time exposed to open flame. RESULTS: The best light-weight full mobility thermal evacuation suit has the right balance of silica and polymer with a safety layer of Nomex. This addressed a full immersion fire of 980°C with superheated gas while allowing full mobility without harming the user for 5min. CONCLUSION: Refrasil UC100-48 has the ability to be a high heat insulator and a shield from direct flame. The polymer proved to be a superior insulator and barrier to superheated gas. Silica stops open flame from penetrating, but it conducts heats up to 400°C. The polymer is a high heat insulator, which effectively delays heat transfer. The polymer also blocks any superheated gas due to its strong ionic bonds.

Awards Won:

Fourth Award of $500