NASA Phase I Project Summary
(non-proprietary)

Firm: Creare Incorporated
Contract Number: NNX10CE43P
Project Title: Nonventing Thermal and Humidity Control for EVA Suits

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Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)

Future manned space exploration missions will need space suits with capabilities beyond the current state of the art. Portable Life Support Systems for these future space suits face daunting challenges, since they must maintain healthy and comfortable conditions inside the suit for long-duration missions while minimizing weight and venting no consumables. We propose an innovative system for temperature and humidity control in a space suit that is simple, rugged, lightweight, and nonventing. Creare's cooling and dehumidification garment absorbs both sensible heat (by conduction) and latent heat (by condensation). The condensed water is captured in Creare's absorber/radiator, which contains a powerful LiCl desiccant and maintains a low vapor pressure.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)

The goal is to control the temperature and humidity level in a spacesuit without venting water. We tested and assessed candidate materials for the cooling garment and identified the best material. We developed a design and fabrication approach to produce prototypical heat/water absorbing elements, and demonstrated by test that they could absorb heat and moisture at a high flux. We used data from these proof-of-concept tests to calculate how much area would be needed for full metabolic loads, and showed that it is feasible to use this technology in an EVA suit.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

Preliminary tests showed that the best candidate material was capable of absorbing 1.5 g/hr/in^2 of water under conditions that simulated operation in an EVA suit. This performance was over an order of magnitude better than alternative materials. We developed a design and fabrication approach for producing a cooling patch that was an appropriate size for use in a cooling garment. Tests of the candidate cooling patch under conditions that simulated operation in an EVA suit demonstrated heat absorption at a rate of 85 W/ft^2, 78% of which was due to direct absorption of water vapor. In these tests, the perspiring crew member was simulated by a water-soaked wick stretched over a heated copper plate and maintained at a temperature of 33.7°C.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)

The primary application for the cooling garment is in the portable life support system for future exploration space suits. The basic technology can also be used to simplify environmental control for manned spacecraft and lunar/planetary bases—for example taking the place of a condensing heat exchanger to control humidity in manned modules.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)

Elements of the cooling garment technology will be applicable to portable microclimate control systems needed for military, industrial, and HAZMAT applications. The basic dehumidification technology can also be used for water management in fuel cell power systems.

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