A Manufacturing Process Design for Producing an Adhesive-Bonded Membrane-based Energy Recovery Ventilator with High Aspect Ratio Support Ribs

By Steven Kawula

Candidate for Master of Science in Materials Science

Major Professor: Dr. Brian Paul

Abstract

Heating, ventilation, and air conditioning systems represent nearly half of building energy usage in the United States. Recent building regulations requiring increased air turnover within buildings will result in even greater air conditioning usage. To alleviate these concerns, membrane-based heat-and-moisture exchangers known as energy recovery ventilators have been developed to reduce the energy expenditure of air conditioning systems by pre-conditioning incoming air through sensible and latent heat transfer with building air exhaust. In this work, we propose and validate a manufacturing process design for channel lamination based on surface mount adhesives capable of meeting the process requirements of a membrane-based ventilator. In particular, the device requires rib supports with height-to-width aspect ratios greater than one. The proposed manufacturing process design is capable of meeting this process requirement by stretching the adhesive after initial adhesive tacking. A manufacturing process flow diagram, a machine tool specification and a cost model are proposed for meeting process requirements. A set of design constraints are developed detailing the adhesive requirements necessary for meeting requirements. The cost model is validated by building a sub-scale mesochannel array demonstrating the ability to meet process requirements. Results show that additional work is needed to validate the curing step but that the process is capable of producing a mesochannel array with an acceptable level of variation.

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School of Mechanical, Industrial and Manufacturing Engineering

Oregon State University