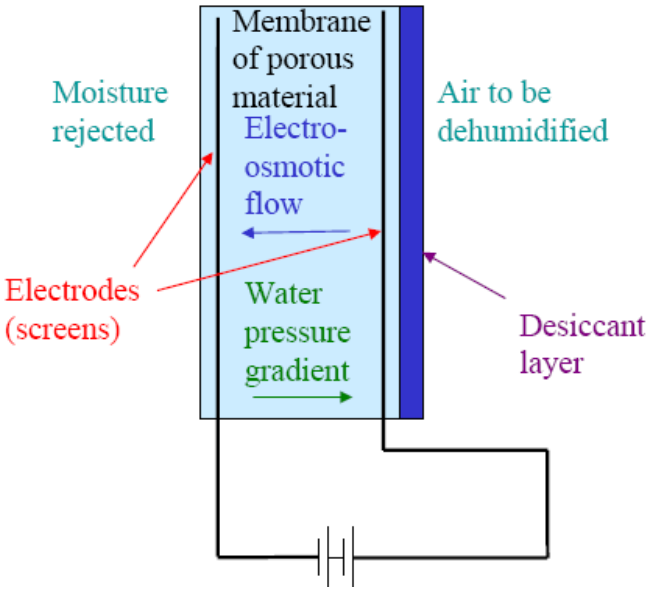
Air-Conditioning and Refrigeration Technology Institute

Project Summary

Electro-osmosis for Dehumidification

Air conditioners provide both cooling and dehumidification. They do so by cooling the air, wringing out the moisture and returning the air to a more moderate temperature. The process of over-cooling (to approximately 55°F) is inefficient, since air is perceived to be comfortable around 70°F. In theory, an air conditioner delivering 70°F air can be 50% more efficient than one that has to over-cool to 55°F. However in practice, the efficiency gains are more moderate. Scientists and engineers are continually looking for methods of dehumidifying air without over-cooling it. They call this "decoupling" the dehumidification from the cooling process. ARTI is investigating electro-osmosis as an effective method of providing dehumidification, primarily for residential applications, but the concept can be applied to commercial, industrial, automotive and other applications.



When an electrical voltage is applied across a porous membrane, ions will be attracted from one terminal to another and water will be dragged along in the process. While the process is microscopic, if enough membranes are piled together, the amount of moisture moved can be significant. This scientific principle has been known and is used in other applications, such as keeping ground water from seeping into basements. The question is: can advances in materials yield membranes that make this concept both technically and economically feasible for dehumidification?

Modeling based on the published properties for Nafion® indicated the feasibility of electro-osmotic dehumidification for separating the control of latent and sensible load in air conditioning systems. The experiments with Nafion® membranes demonstrated an electro-osmotic effect. However, the flux was several orders of magnitude lower than that predicted by the model. Further research is needed to reconcile the experimental data and modeling in order to determine feasibility.

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Interim report for Phase I, ARTI Report No. 10090-01 is posted on the ARTI website: www.arti-reseach.org.
The project final report, ARTI Report Number 10090-02, March 2008 is posted on the ARTI website, www.arti-research.org

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