Passive and Active Condensate and Frost Control

Management of water condensate and frost on evaporator surfaces requires manipulation of various forces which affect formation, melting, and drainage. The bulk and interfacial intermolecular forces are mostly dipole-dipole, ionic, hydrogen bonding, and London (van der Waals) while, the bulk macroscopic forces are electrodynamic, electrostatic, gravity, external pressure, and viscous. Figure 1 lists some of the techniques used in the condensate/frost management which influences these two types of forces. This research project will qualitatively/quantitatively examine the effective techniques based on the energy consumed per water molecule.

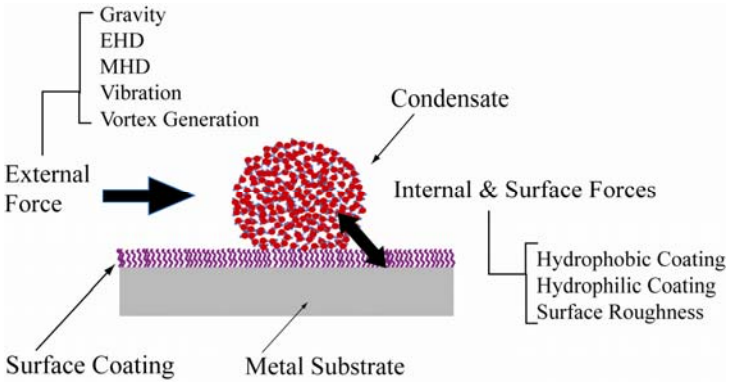

Figure 1. Various management technique's influence on different forces.

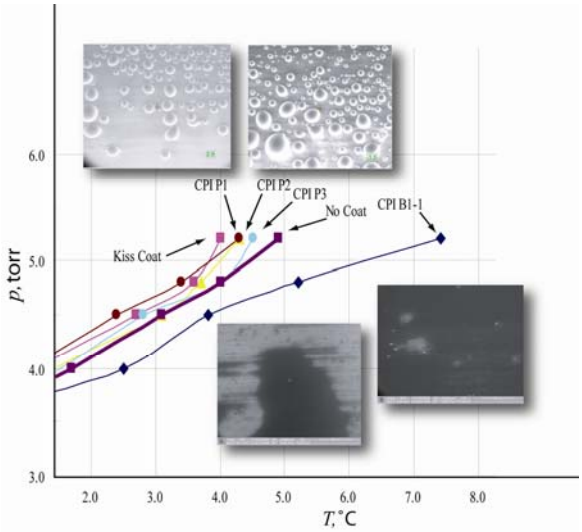

Figure 2. *p-T* graphs and ESEM images for hydrophobic and hydrophilic coatings.

We examine the hydrophobic and hydrophilic coatings affecting interfacial forces between water and the substrate (brazed aluminum). Using the ESEM (Environmental Scanning Electron Microscope, the hydrophobic and hydrophilic coatings are characterized as shown in Figure 2, with the *p-T* diagrams and micrographs.

Various external forces used to initiate or assist in the movement of liquid water will be investigated. The samples will be tested in air using optical microscopy and controlled humidity. These experiments will guide us in developing the energy diagram for effective condensate and frost management.

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