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Abstract

This paper reviews the current research and advances in humidity control for residential and commercial buildings. Desiccant and hygroscopic buffering zones are summarized. System types, performances and challenges are presented to help the reader select the best cooling dehumidification system for his application or project. More emphasis is put on liquid and hybrid systems along with advances in desiccant membranes and energy conservation. The paper concludes that liquid and hybrid desiccant cooling dehumidification systems offer higher flexibility and control for moisture removal, lower heating and cooling requirements for the regenerator and absorber, respectively, compared with the same for solid desiccant systems. Mixtures of multiple liquid desiccants offer better dehumidification results compared with single desiccant solutions. Hygroscopic humidity buffer zones play a significant role in predicting and meeting the comfort levels for building occupants.

Keywords: *Humidity control, solid liquid desiccants, membrane technologies, desiccant performance, hygroscopic buffer zone*

1. Introduction

The world demand for equipment needed for heating, ventilation and air-conditioning (HVAC) has increased from 50 billion US dollars in 2004 to more than 90 billion US dollars in 2014. This rate has increased in the US from almost 11 to 19 billion US dollars over the same period (Mujahid et al., 2015). Humidity control is an essential and vital parameter for the human comfort in indoor environments. Cooling and heating load requirements for any space air-conditioning is not exclusive with the sensible cooling and heating terms only, but rather both sensible and latent loads including the control of humidity (Mujahid et al., 2015). Energy consumption of a building can significantly increase if the humidity level is offset from the design set point. In high performance buildings, the percentage of dehumidification energy consumption from the building total energy consumption can rise from 1.5-2.7% to as high as 12.6-22.4% if the relative humidity (RH) is dropped from design value of 60% to 50% (Fang et al., 2011).

Conventional vapor compression cycles dehumidify the supplied air through cool-reheat processes. Desiccant systems provide efficient methods for controlling moisture content in the supplied air. In a conventional compression cycle, the latent load of moisture content is reduced by reducing the temperature of the air. The air temperature might drop below the set value to achieve the desired humidity level, thus a reheat coil is used to increase the sensible temperature of the air back to its set value. In addition to that, (Mujahid et al., 2015) showed that thermal comfort condition can be met with conventional cooling systems only when the sensible heat ratio is above 0.75.

Desiccant cooling can reduce energy consumption by reducing the thermal condensation load done by refrigerants inside the air handling units. Reducing the load on the refrigerant would make positive effects on global warming and ozone depletion accordingly, especially if the desiccant system is operated with renewable energy sources, such as, solar systems. (Fang et al., 2011) studied different