Psychrometrics and its Use in HVAC

An Online Continuing Education Course for Engineers

Course Number: HV-4008

Credit: 4 Hours / 4 PDH / 4 CPD

PSYCHROMETRICS AND ITS USE IN HVAC

By

Manuel Calzada, PE

TABLE OF CONTENTS

INTRODUCTION

This course is designed to be a practical refresher course and reminder of psychrometrics for engineers that already have a basic knowledge in the area of HVAC.

The beginning of this course briefly covers the basic concepts that are essential to understand the properties and conditions of the air. After these concepts, this course covers the mass and energy conservation equations of the first law of thermodynamics that are essential in the understanding of HVAC applications. Examples are included to illustrate the use and calculation of the air properties.

The following section covers the benefits and use of a typical psychrometric chart. Additional illustrations and applications of psychrometrics and HVAC problems are included. The solutions to these problems are developed using the mass and energy conservation equations and the psychrometric chart. Typical HVAC problems and examples are covered in this section.

A sample of a psychrometric calculator to simplify the calculations and improve the accuracy of the problems is shown in the reference section of the course. A link to a functioning calculator (in an Excel File) is provided in the course quiz.

WHAT IS PSYCHROMETRICS ?

Psychrometrics is the study of the thermodynamic properties of the dry air when it is mixed with water vapor. The study and analysis of these properties are especially important in applications where moisture and heat transfer in air is critical.

AIR COMPOSITION

By volume, **Dry air** as it exists in the atmosphere is mainly and approximately composed of the following constituents:

Nitrogen	78%
Oxygen	21%
Argon	0.9%
Carbon dioxide	0.03%

The molecular weight of the dry air is 28.96, and the gas constant for air is 53.3 (ft-lb force)/(lb mass)(F absolute). These values are used to calculate some of the air properties.

When water vapor is added to the dry air, the thermodynamic properties of the **moist air** change significantly based on the amount of moisture that is actually added to or removed from the air. The amount of moisture that the air can absorb will vary from almost zero (dry air) to a maximum amount (saturation). The actual amount of water that can be absorbed by the air depends on the actual temperature and pressure of the air.

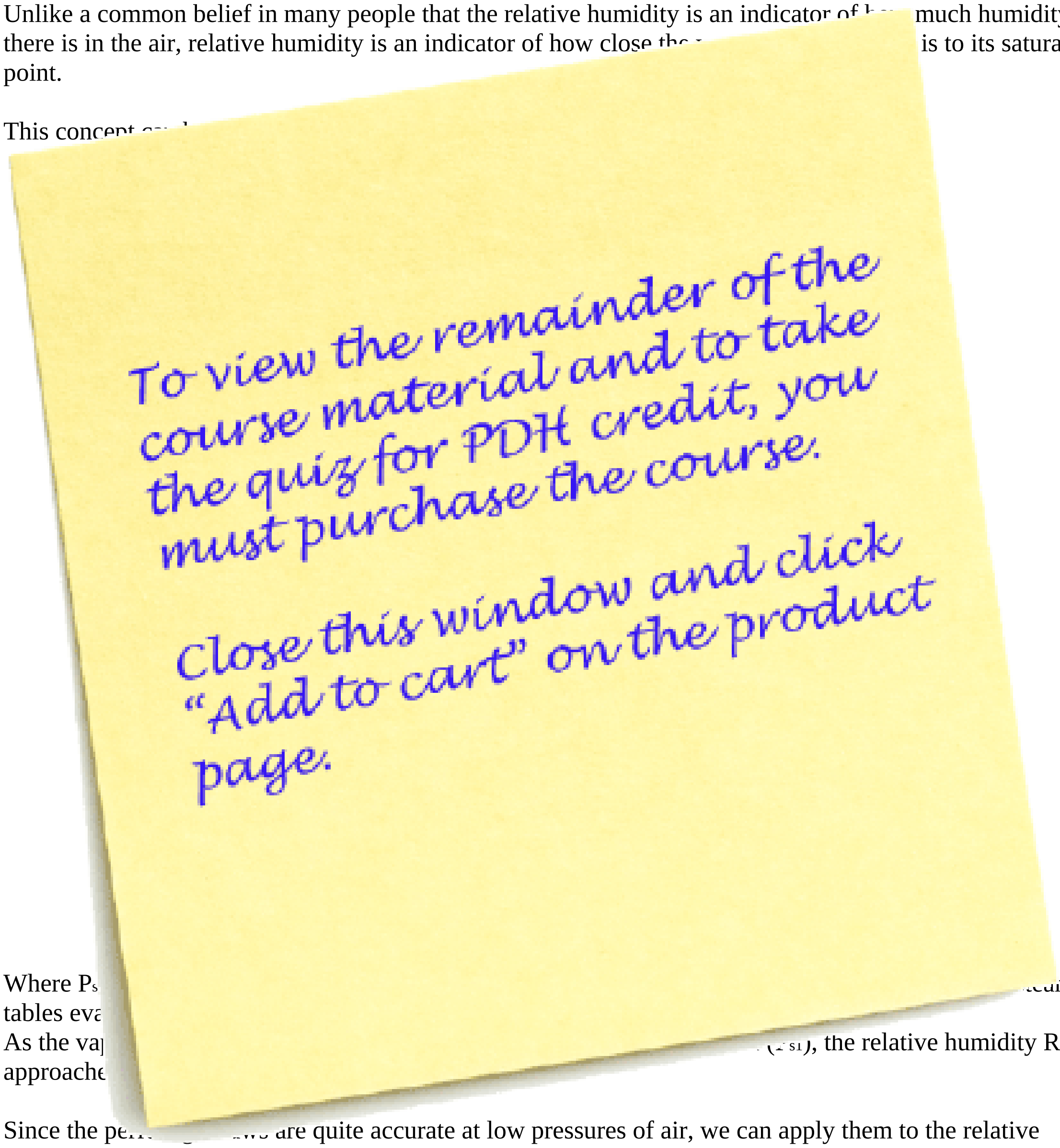
FUNDAMENTAL HUMIDITY PARAMETERS

Relative Humidity

Relative Humidity (**RH**) is defined as the ratio of the partial water vapor pressure in the air to the saturated partial pressure of the water vapor measured at the same temperature.

Unlike a common belief in many people that the relative humidity is an indicator of h much humidity there is in the air, relative humidity is an indicator of how close th is to its saturation point.

This concept



Where Ps eam tables eva

As the va (P_{s1}), the relative humidity RH approache

Since the pe are quite accurate at low pressures of air, we can apply them to the relative humidity concept (RH):

$$\mathbf{RH} = \frac{\mathbf{R_{w1}*T_{w1} / V_{w1}}}{\mathbf{R_{s1}*T_{s1} / V_{s1}}} \qquad \mathbf{(2)}$$

Where R_{w1} = Gas constant of water vapor at point 1