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# Experimental Verification of Various Parameter Affecting to Psychrometric Processes

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***Abstract—*** The Technological Revolution takes place all over the world. To compensate with the pace of world, this concept is useful. The goal of this project was to design and build a Air Conditioning Test rig System and works on simple vapour compression refrigeration cycle using R134 a as a refrigerant. The system is fabricated such that student can study all the air conditioning processes. It is also useful to understand working of all the components of system, their performance and control etc. All the components are mounted on the display board, so that students can observe their working easily. We can evaluate actual and theoretical C.O.P. of the system also plot of refrigeration cycle on P-H & T-S charts and psychometric processes on psychometric charts. Comparative study of different refrigerants with respect to properties, applications and environmental issues and equipment-operating principles, operating and safety controls employed in air conditioning systems can be handle on this projects. It is technology which reduces time to study various psychometric processes on single it's very important things in 21st century.

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## I. INTRODUCTION

Beforehand the aerating and cooling for human solace was considered extravagance in the greater part of the nation's however now a days it is a need. Along these lines ventilating industry is becoming fastly all through the world. Because of expansion in populace and industrialization uncomfort might be because of the deficient supply of ***oxygen*** or terrible temperature. Full aerating and cooling does the programmed control of a barometrical situation either for solace of person or creatures or for the correct execution of some mechanical or experimental procedures. The reason for aerating and cooling is to supply adequate volume of clean air containing a particular measure of water vapor and at a temperature equipped for keeping up foreordained climatic conditions. Cooling is characterized as concurrent control over the air, with respect to its temperature, dampness, movement and immaculateness. Ventilating has now a days a lot of utilizations. It is utilized as a part of solace, industry, make, pharmaceutical, solution and sustenance safeguarding etc. It now has turned into a regular affair. Refrigeration Air-molding field is presently growing quickly. Window sort room aeration and cooling system is utilized to condition the demeanor of a specific space, for example, office room, room of a house, drawing office, room and so on. It cools the air and once in a while dehumidifies it. It works naturally once it is put into operation.

## II. WHAT IS PSYCHROMETRY?

Psychrometrics (got from the Greek: psukhros = cool) is investigation of air-water vapor blends at various conditions. To cite the 1989 ASHRAE Handbook of Fundamentals, "Psychrometrics manages the thermodynamic properties of wet air and uses these properties to examine conditions and procedures including soggy air." Take a note; it is not the same as psychometric, which your spell checker may offer you as an option! While the investigation of immaculate psychrometrics includes various distinctive perspectives, we might confine this course to the use of psychrometrics for use on human solace noticeable all around molding framework. In aerating and cooling framework, we utilize psychrometric properties for environment control.

## III. PSYCHROMETRICS CHART

A psychrometric outline presents physical and warm properties of soggy air in a graphical structure. Figurings of air properties generally are not exceptionally direct. A wide range of mathematical statements are frequently expected to acquire one single point. Standard psychrometric outlines are in this way welcome devices to perform psychrometric

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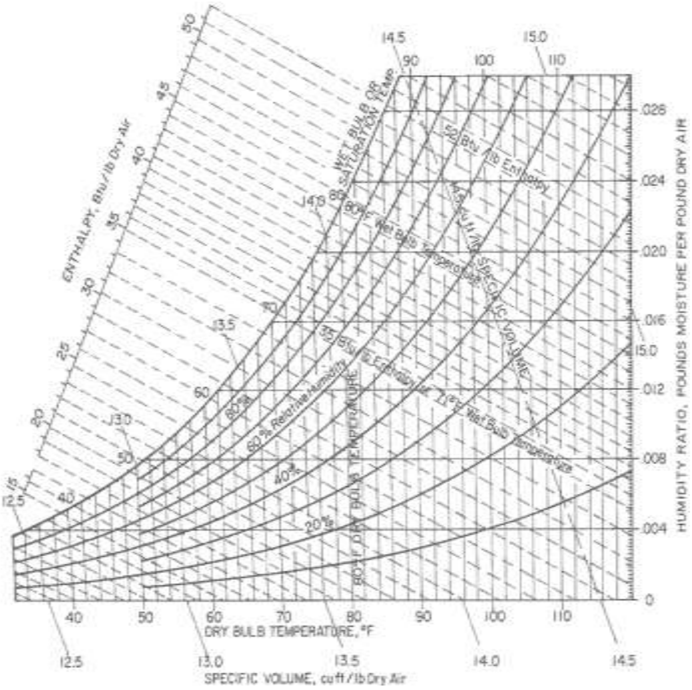
investigation. Psychrometric properties are reliant on the air weight, so their determination at various rises is loaded with mistakes that might be extensive at higher heights. Psychrometric diagrams produced for particular air conditions dispose of blunders yet need general materialness. The PC projects to handle these assignments incredibly decrease blunders and permit quick and dependable psychrometric estimations for any given air weight.

Psychrometric diagrams are printed for the most part for ocean level environmental weight. Since essentially all psychrometric air forms including HVAC outline happen inside a 30o F and 120oF territory, most psychrometric graphs just demonstrate this extent as a down to earth measure.Psychrometric properties are additionally accessible as information tables, mathematical statements, and slide rulers.

Figure beneath is a psychrometric diagram in standard units, which portrays the essential sodden air properties: dry-knob and wet-globule temperatures, relative stickiness, mugginess ratio,specific volume, dew point or immersion temperature, andenthalpy.




## IV. PSYCROMETRIC PROCESSES

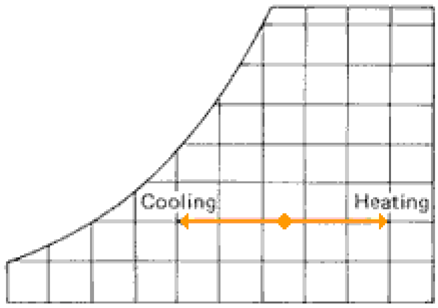
There consist various psycrometric processes as follows:

1. Sensible Cooling and Heating process.
2. Cooling with dehumidification process.
3. Cooling with humidification process.
4. Heating with dehumidification Process.
5. Heating with humidification Process.

1) Sensible Cooling and Heating process

The addition or removal of heat, without any change in the moisture content (AH), resulting in the change in DBT. The status point will move horizontally to the left (cooling) or to the right (heating).

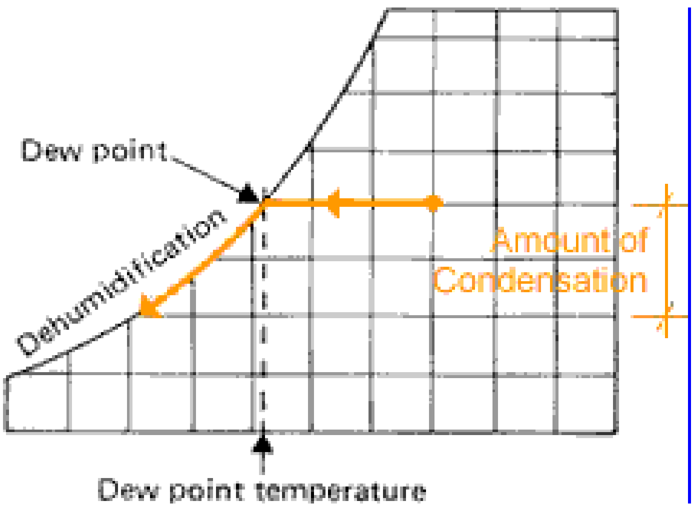
Note that while the AH (represented on the y axis) does not change, the change in temperature means the relative humidity (RH) changes. *The relative humidity increases if the temperature lowers and vice versa.*




**SENSIBLE COOLING AND HEATING**

*2) Cooling With Dehumidification Process*

Cooling with dehumidification is the procedure in wich buildup happen with sensible cooling. At the point when soggy air is cooled underneath its dew-point by acquiring it contact with a chilly surface, a percentage of the water vapor noticeable all around consolidates and leaves the air stream as fluid, accordingly both the temperature and dampness proportion of air abatements . This is the procedure air experiences in an ordinary aerating and cooling framework. In spite of the fact that the real process way will differ contingent on the sort of frosty surface, the surface temperature, and stream conditions, for effortlessness the procedure line is thought to be a straight line. The warmth and mass exchange rates can be communicated regarding the underlying and last conditions by applying the preservation of mass.




**Cooling With Dehumidification**

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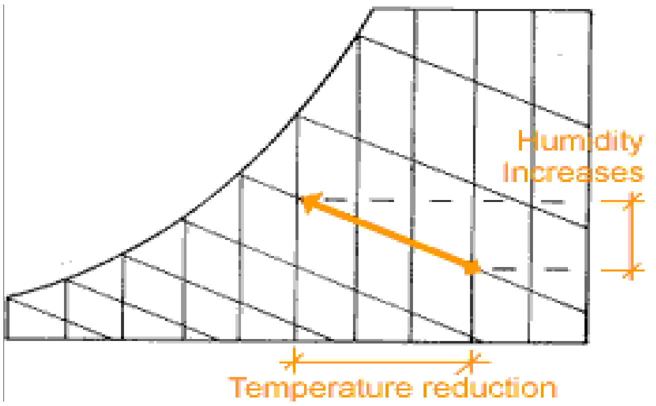
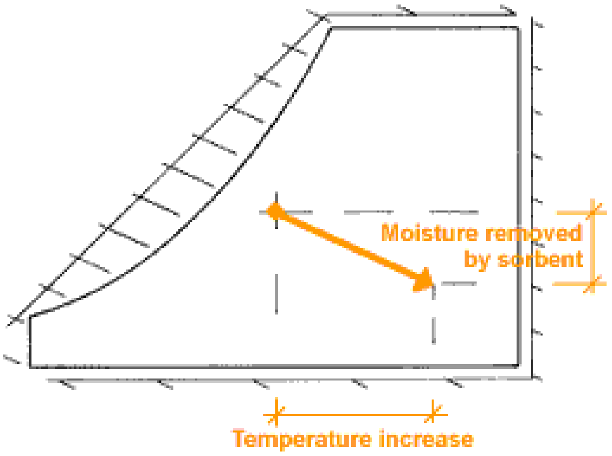
*3) Cooling With Humidification Process*

As the name implies, during this process, the air temperature drops and its humidity increases. This can be achieved by spraying cool water in the air stream. The temperature of water should be lower than the dry-bulb temperature of air but higher than its dew-point temperature to avoid condensation. It can be seen that during this process there is sensible heat transfer from air to water and latent heat transfer from water to air. Hence, the total heat transfer depends upon the water temperature.




*4) Heating with dehumidification Process.*

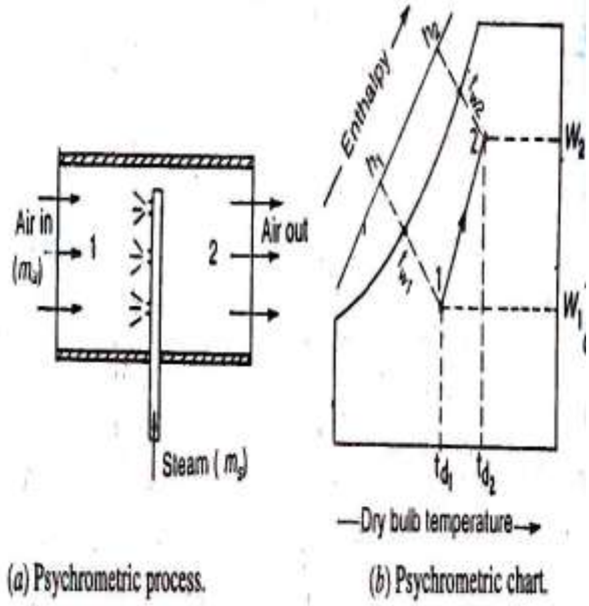
This process can be achieved by using a hygroscopic material, which absorbs or adsorbs the water vapor from the moisture. If this process is thermally isolated, then the enthalpy of air remains constant, as a ***result*** the temperature of air increases as its moisture content decreases. This hygroscopic material can be a solid or a liquid. In general, the absorption of water by the hygroscopic material is an exothermic reaction, as a result heat is released during this process, which is transferred to air and the enthalpy of air increases.




**Heating with dehumidification**

*5)Heating with humidification Process.*

If moisture is evaporated into an air volume without any heat input or removal, the latent heat of evaporation is taken from the atmosphere. The sensible heat content - thus the DBT - is reduced, but the latent heat content is ***increased***. The status point moves up and to the left, along a WBT line. This is the process involved in evaporative cooling. Note that this process increases the relative humidity. It increases only until it hits the saturation line, at which it becomes 100%. Beyond it there is no decrease in sensible temperature. . This is the reason why during hot and humid months, evaporative cooling is ineffective and uncomfortable.




## V. DESIGN CONSIDERATION

1 The equipment consists of a hermetically sealed compressor, air cooled condenser, blower for air circulation through a duct mounted on a frame, an evaporator is placed in the duct, also there are heaters of suitable capacity in the duct. The refrigerant used in the system is R22. The mass flow rate of air through duct can be varied by arrangement provided on the blower unit. The humidity of air is increased by introducing steam generated in small boiler. The relative humidity of air at inlet and outlet can be measured by noting dry / wet bulb temperatures. The duct is insulated from outside to avoid heat loss.

The control panel consists of switches, voltmeter, ammeter etc. as well as energy meter for measuring the power consumption of compressor. The refrigeration circuit and duct are mounted on a fabricated frame.

*V) SPECIFICATION*

| *SUB-TITLE* | *PARAMETER* | *DESCRIPTION* |
|---|---|---|
| Refrigeration System | Capacity | 0.30 TR @Rated test conditions |
| | Compressor | Hermetically sealed. Make: Emerson / Tecumseh / Danfoss / any equivalent make |
| | Condenser | Forced convection air cooled |
| | Condenser fan | Axial flow |
| | Drier/ filter | Provided. |
| | Expansion device | Capillary Tube |
| | Evaporator Forced | convection air cooled. |
| | Dehumidifier or Reheater | 1000 Watts; Finned Type. |
| | Humidifier | Provided |
| | Refrigerant R-134 a. | |
| Controls & Indications | HP / LP Cut-out | Synergy / Alco / Danfoss / Castle or equivalent make. |
| | Temperature | Multi Channel digital indicator |
| | Pressure | For Suction and Discharge pressure |
| | Refrigerant Flow | Flow Glass tube Rotameter provided |
| | Air temperature | DBT & WBT measurement by sling psychrometer. |
| | Air flow measurement . | By inclined tube manometer |
| Electrical System | Supply | 220-240 Volts, 50 Hz, 1 phase. |
| | Input power | 1.2 kW |
| | Rated current | 5.5 Amps |
| | Indicating lamps | Provided for compressor and heater. |
| | Energy-meters | Range 0-20 A; provided for Compressor |
| Construction | Material | M.S Panel |
| | Outer finish | Powder coating |

**AIR CONDITIONING TESTRIG**

VI) Conclusions

1. It is possible to test and rate evaporative air conditioners for water efficiency and to evaluate their water consumption in different climatic regions.

2. Evaporative air conditioners would be suitable for inclusion into the WELS Scheme. However, in view of the relationship between water and energy consumption of evaporative air conditioners, it is recommended that performance rating/labelling of both energy and water consumption should be introduced simultaneously.

Incorporating evaporative air conditioners in the WELS program without incorporating an energy rating/labelling system may highlight a potentially negative aspect without promoting their positive energy saving/peak demand impacts. This may place evaporative air conditioners at a less favourable market position in comparison to refrigerated air conditioners.

3. The two main components of water consumption for evaporative air conditioners are water used for cooling and water dumped/bled off for preventing the accumulation of salts. In view of the range of water consumption rates of evaporative air conditioners, particularly the portion used in water dumping/bleeding, the development of independent rating/labelling methodology for water consumption is likely to lead to the use of improved systems and reduced water consumption.

4. Although the WELS Scheme aims to provide consumers with information on the total water use of labelled appliances, it is recommended that the water labelling

should focus on water dumping/bleeding from evaporative air conditioners, as the water used for cooling is a measure of the cooling effect. The introduction of water labelling is likely to encourage manufacturers to use improved technologies for controlling water dumping or to preset the bleeding rate in accordance with the minimum requirements for particular locations.

5. Even after allowing for increased water tariffs, it is estimated that evaporative air conditioners have lower running costs as they use less electrical energy compared with reverse cycle air conditioners. The use of evaporative cooling also has a positive impact on reducing peak electrical power demand in comparison with refrigerated systems.

6. With depleting water resources, the water consumption of evaporative air conditioners has become an important issue in Australia and may impact on the evaporative air conditioning market. Little independent evidence or monitoring data exists to quantify water consumption rates of evaporative air conditioners. This report has attempted to quantify the water consumption; however more in situ monitoring data collection is necessary.

7. Although no reliable data is available on annual monitored water consumption by evaporative air conditioners, our computations suggest that, on average, evaporative air conditioners consume approximately 4-18 kilolitres per annum, which is 2-9% of the total annual water use in typical Australian households.

8. Through international literature search, no water labelling/rating system for evaporative air conditioners is currently in use. Only a small number of energy rating/labelling methods are available.

9. A study to develop a standard testing procedure, required testing facilities and methodology for independent testing, rating/labelling of both water and energy use in evaporative air conditioners is recommended as the next step for progressing the rating.

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