

Module # 2(a)

Measurement devices (Dew point):-

- * A hygrometer is a sensor that senses the amount of evaporated water in air by a mechanical or electronic method.
- * A hygrometer is an instrument used for measuring the moisture content in the atmosphere.
- * The first practical hygrometer was invented by polymath Johann Heinrich Lambert in 1755.

Types of hygrometers:-

① Metal/pulp coil sensor:-

- * Composed of Metal and Paper Coil.
- * Coil expands/contracts as humidity changes.
- * Amount of expansion is calibrated to correspond with actual amount of humidity
- * Used to show humidity on a dial display.
- * Quite in accurate, differences between similar coils are 10% to 20%.



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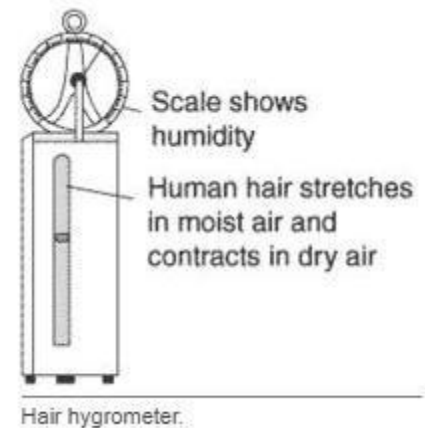
The metal paper coil hygrometer is very useful for giving a dial indication of humidity changes.

* Water vapour is absorbed by a salt-impregnated paper strip attached to a metal coil, causing the coil to change shape. These changes cause an indication on a dial.

(2) Hair Tension:-

These devices use a human and animal hair under tension.

The hair length changes with humidity and the length change may be magnified by a mechanism and indicated on a dial or scale.



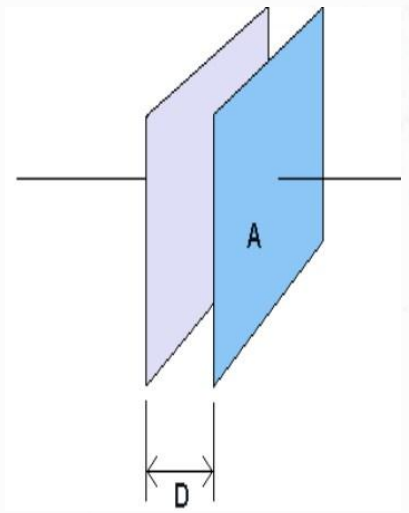
The pulley is connected to an index which moves over a graduated scale. The instrument can be made sensitive by removing oils from the hair, such as by first soaking the hair in diethyl ether.

(3) Electronic Capacitive Sensors

A capacitor is like a short-term battery where static charge can be built up and stored between two metal plates.

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Depending on the moisture b/w the two plates, more or less charge can be built up between them. This amount of charge is referred to as the dielectric constant.

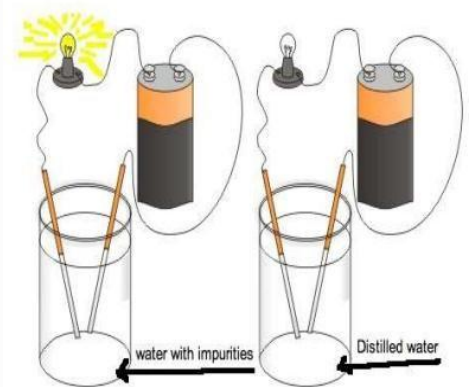


In Capacitive hygrometers, the effect of humidity on metal oxide material is measured. With calibration these sensors have an accuracy of $\pm 2\%$ RH in the range 5-95% RH.

Electronic capacitive hygrometers are low cost, small, and durable. They perform well in environments where temperatures fluctuate frequently.

4) Electronic Resistive Sensors:-

They are also called resistive hygrometers, the change in electric resistance of a material due to humidity is measured. Typical materials are salts and



Conductive polymers. Resistive sensors are less sensitive than capacitive sensors. The change in material properties is less, so they require more complex circuitry.

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The material properties also tend to depend both on humidity and temperature. The accuracy against condensation vary depending on the chosen resistive material.

Condensation-resistant sensors exist with an accuracy of up to $\pm 3\%$ RH.

⑤ Thermal hygrometers:-

In thermal hygrometers the change in thermal conductivity of air due to humidity is measured. These sensors measure absolute humidity rather than the relative humidity.

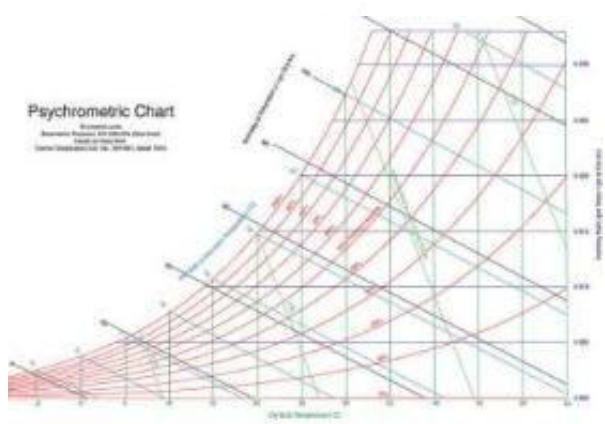
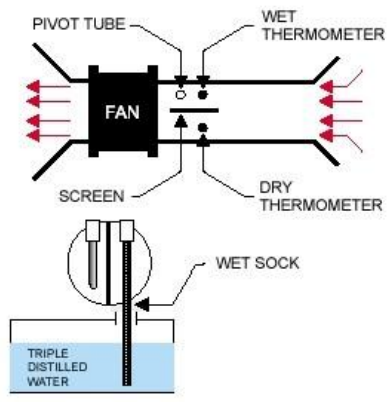


⑥ Psychrometer (wet and dry bulb hygrometer)

A psychrometer is a device that is made up of two thermometers that are placed in two different mediums.

One thermometer is placed in a wet location and is entitled the "wet bulb" thermometer. When above freezing this is the colder thermometer - when below freezing this is the warmer.

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Another thermometer is placed in a dry environment in similar location and is called "dry bulb" thermometer. This thermometer is usually open. Basically dry bulb temperature represents the measured air temperature.

The readings from each thermometer are plotted on a "psychrometric chart" and the corresponding humidity can be found based on the altitude. - Some times internally calculated and displayed directly by modern psychrometers.

Vapour Pressure:-

It is the pressure that vapor would exert in the absence of other gases.

- * It also known as partial pressure.
- * It is usually denoted by "e" and expressed in millibar.

Saturation Vapor Pressure:-

When a sample of air holds the maximum quantity of water vapors at a particular temperature it is said to be saturated.

- The pressure exerted by water vapors, when the air is fully saturated with water vapors is known as the saturated vapour pressure.

Meteorological Instruments:-

Various instruments are in use for measurement of meteorological elements observations. The most desirable requirement of instruments are Accuracy, reliability, simplicity of design, convenience of operation and maintenance and strength of construction.

1) Accuracy:- It is defined as the closeness of an observed value to the true value. The accuracy requirements change with the purpose - world Meteorological standards are discussed:

Element	Range of Accuracy	Element	Range of Accuracy
Pressure	± 0.1 to ± 0.5 mb	Humidity	± 2 to ± 3 %
Temperature	± 0.1 to ± 1.0 °C	Wind speed	± 0.5 miles/sec
Radiation	± 1 cal/cm ² /hr	Sunshine	± 0.1 hour

(2) Reliability:-

It means that the instrument should maintain a known accuracy over a long period of time.

(3) Simplicity of Design:-

The design of instrument should be simple.

(4) Convenience of operation and Maintenance:-

These are important since most meteorological instruments are in continuous use year in and may be situated far away from good repair facilities.

(5) Strength of Construction:-

Strong construction is especially desirable for those instruments, which are wholly or partially exposed to the weather.