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RSPT 1410
Humidity & Aerosol Therapy
Part 2

Wilkins: Chapter 32; p. 737-760
Cairo: Chapter 4, p. 88-109

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Equipment

- A _____ is a device that adds molecular water (water vapor) to gas, most often by simple evaporation - these devices are used primarily to humidify inspired gases
- A _____ is is a device that adds particulate water (aerosol) to gas through a process known as nebulization - these devices are used when *therapeutic* amounts of liquid are needed

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Equipment Principles

- Three variables affect how well a humidifier does its job
  - _____
  - _____
  - _____

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Factors Affecting Performance

- Temperature
  - the most important factor affecting humidifier performance
  - the _____ the temperature of a gas, the more water vapor it can hold
  - heated humidifiers always out perform unheated humidifiers
  - unheated humidifiers can actually _____ the water in the reservoir to 10°C below ambient

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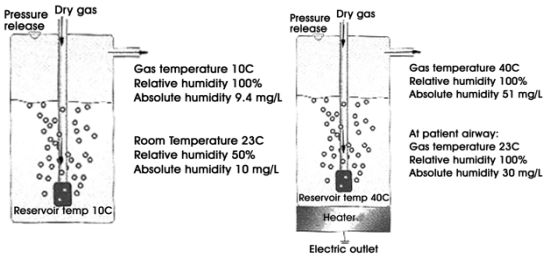
Effects of a Heated Reservoir



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Factors Affecting Performance

- Surface area
  - refers to the area of contact between the gas and water (_____)
  - the greater the area of contact, the more _____ will occur
  - the two most common ways to increase this interface are
    - bubble diffusion
    - "wick" technology

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Factors Affecting Performance

- Surface area (con't)
  - bubble diffusion
    - directs a stream of gas through an _____ diffuser which breaks the stream into small bubbles
    - as the bubbles rise, evaporation _____ their water vapor pressure
    - the smaller the bubbles, the _____ the gas/liquid interface

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Factors Affecting Performance

- Surface area (con't)
  - wick technology
    - uses porous water-absorbent material to increase surface area
    - the wick draws water into a honeycombed structure by _____
    - the textured surface of this structure increases the gas/ liquid interface

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Capillary action is defined as *a physical phenomenon whereby a liquid in a small tube tends to move upward, against the force of gravity; due to both adhesive and surface tension forces.*

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Factors Affecting Performance

- Contact time
  - the _____ a gas remains in contact with water, the greater the amount of evaporation
  - gas flow is the primary determinant of contact time - low flows increase contact time; high flows decrease contact time
  - with bubble humidifiers, the depth of the water also affects this time - the deeper the water, the longer the contact time as bubbles rise to the surface

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Types of Humidifiers

- Three primary types defined by the method used to _____ gas to water
  - bubble humidifier
  - passover humidifier
  - heat & moisture exchanger (HME)
- Bubble and passover types may incorporate heating devices, reservoir and feed systems
- Design specifications established by the American Society for Testing and Materials

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Types of Humidifiers

- Bubble humidifiers
  - use an underwater diffuser to break a gas stream into small bubbles
  - unheated bubble humidifiers are commonly used with _____ O_2 delivery systems
  - the goal of these devices is to raise the water vapor content of the gas

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Types of Humidifiers

- Bubble humidifiers
  - depending on brand and liter flow, these devices can provide and absolute humidity of approximate _____ mg/L
  - at 22°C (72°F) this represents a relative humidity of 82%, but only 36% body humidity
  - effectiveness _____ with increased gas flow
  - heating is not recommended because condensate can form in the small-bore tubing

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Types of Humidifiers

- Bubble humidifiers
  - typically incorporate a 2 psi pressure relief valve, which should provide at least an _____ alarm and which should return to normal position when the problem is corrected
  - may be purchased either pre-filled (disposable) or non-filled permanent (non-disposable)

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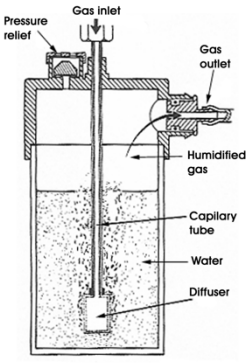
Bubble Humidifier



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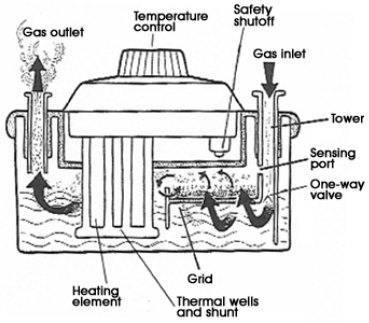
Cascade
Humidifier



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Types of Humidifiers

- Passover humidifiers
  - direct gas over a water surface
  - wick-type
    - wick is placed upright in a water reservoir surrounded by a heating element
    - capillary action continually draws water up from the reservoir, keeping the wick _____
    - as gas enters the chamber it flows around the wick, taking on water vapor
    - gas leaves the chamber fully _____

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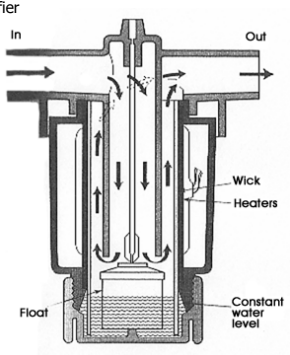
Wick-type
Passover Humidifier



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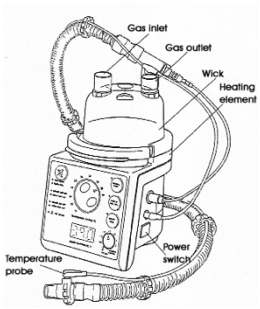
Typical Wick-type
Passover Humidifier



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Types of Humidifiers

- Passover humidifiers
  - membrane-type
    - uses a hydrophobic membrane to separate the water from the gas stream
    - water vapor molecules can pass through this membrane, but liquid water cannot
    - the dry gas passes over this membrane and takes on water vapor

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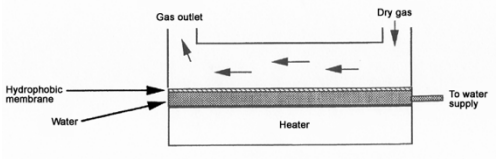
Membrane-type
Passover Humidifier



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Types of Humidifiers

- Heat & moisture exchangers
  - a.k.a. the "_____"
  - capture heat and moisture on _____ uses it to warm and humidify the next _____
  - used almost exclusively on ventilator circuits
  - three types
    - simple condenser
    - hygroscopic condenser
    - hydrophobic condenser

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Types of Humidifiers

- Heat & moisture exchangers
  - simple condenser
    - uses a condenser element with high thermal conductivity (metal gauze, parallel metal tubes)
    - during inhalation, inspired gas _____ the element
    - during exhalation, expired water vapor condenses on its surface and _____ it
    - during the next inhalation, cool, dry gas is warmed and humidified as it passes over the element
    - have approximately _____% efficiency

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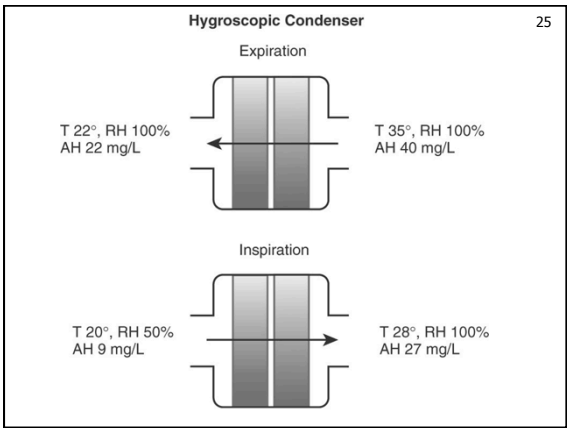
Types of Humidifiers

- Heat & moisture exchangers
  - hygroscopic condenser
    - uses a condenser element with low thermal conductivity (paper, wool, foam) impregnated with a hygroscopic salt
    - process is very similar to the simple condenser type except that the low thermal conductivity element can retain more heat and the salt helps to capture extra moisture
    - have approximately _____% efficiency



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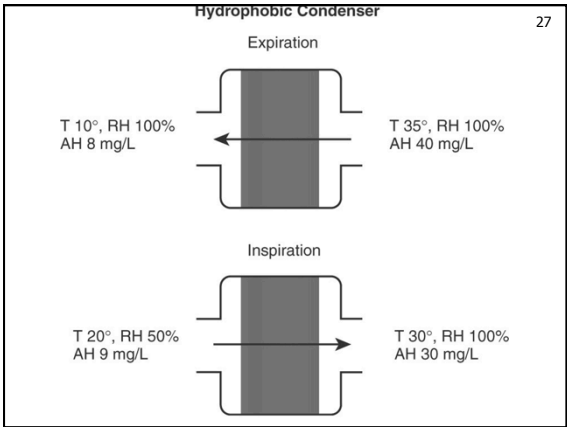
Types of Humidifiers

- Heat & moisture exchangers
  - hydrophobic condenser
    - uses a water-repellant element with a large surface area and low thermal conductivity
    - this produces a rather large change in temperature which results in _____ water being conserved for the next breath
    - also have approximately _____% efficiency



Typical HMEs

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