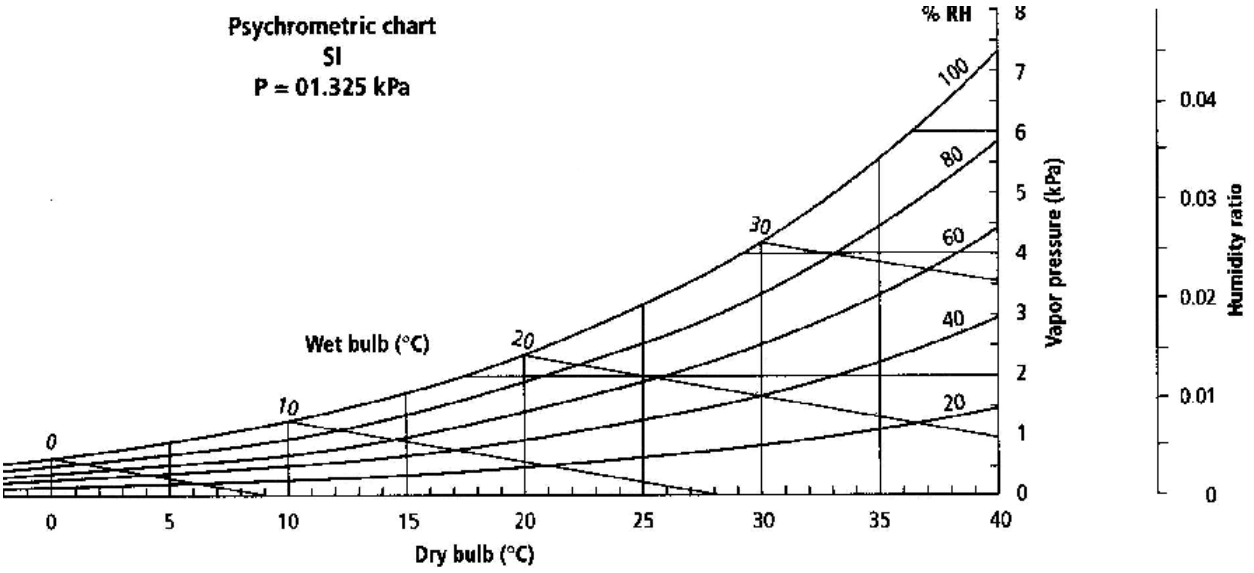
Example Psychrometric and Water Loss Problems

Fall 2014



Commodity: Spinach

Storage room dry bulb temperature: **20°C**
Storage room wet bulb temperature: **13°C**
What is the storage room humidity (look it up on the psychrometric chart)?

What is the approximate VP of the room air at 20°C at the calculated RH (look up from the psychrometric chart)?

What is the approximate saturation vapor pressure (SVP) at 20 °C?

Initial commodity weight: **200 g**
Commodity weight after 1 day in storage: **152 g**
Calculate commodity weight loss after 1 days in storage:

What is the vapor pressure difference (VPD) between the commodity and the storage room air?

$VPD = SVP_{tissue} - VP_{air}$

What is the rate of water loss per hour (in percent water loss per hour)?

$J = \Delta$ weight during storage ÷ length of storage (hr)

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What is the proportionality constant (K) for this commodity?

J = K * VPD

K = J/VPD

If this commodity is instead placed in a 5^{o}C cold room with a wet bulb temperature of 4^{o}C,

What is the relative humidity of the air be (look up from the psychrometric chart)?

What is the approximate VP of the room air at 5 ^{o}C at the calculated RH (look up from the psychrometric chart)?

What is the approximate SVP at 5^{o}C?

What is the VPD? VPD = $SVP_{tissue} - VP_{air}$

What is the expected rate of water loss when this commodity is stored at 5^{o}C?

J = K * VPD

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Commodity: Apple

Storage room dry bulb temperature: **20°C**
Storage room wet bulb temperature: **13°C**
What is the storage room humidity (look it up on the psychrometric chart)?

What is the approximate VP of the room air at 20°C at the calculated RH (look up from the psychrometric chart)?

What is the approximate SVP at 20 °C?

Initial commodity weight: **164 g**
Commodity weight after 7 days in storage: **162 g**
Calculate commodity weight loss after 7 days in storage:

What is the VPD between the commodity and the storage room air?

$VPD = SVP_{tissue} - VP_{air}$

What is the rate of water loss per hour (in percent water loss per hour)?

$J = \Delta$ weight during storage ÷ length of storage (hr)

What is the proportionality constant (K) for this commodity?

$J = K * VPD$

$K = J/VPD$

If this commodity was then cooled to 5°C and stored at the 5°C cold room with a wet bulb temperature of 4°C,

What is the relative humidity of the air (look up from the psychrometric chart)?

What is the approximate VP of the room air at 5°C at the calculated RH (look up from the psychrometric chart)?

What is the approximate SVP at 5°C?

What is the VPD? VPD = $SVP_{tissue} - VP_{air}$

What is the expected rate of water loss when this commodity is stored at 5°C?

$J = K * VPD$

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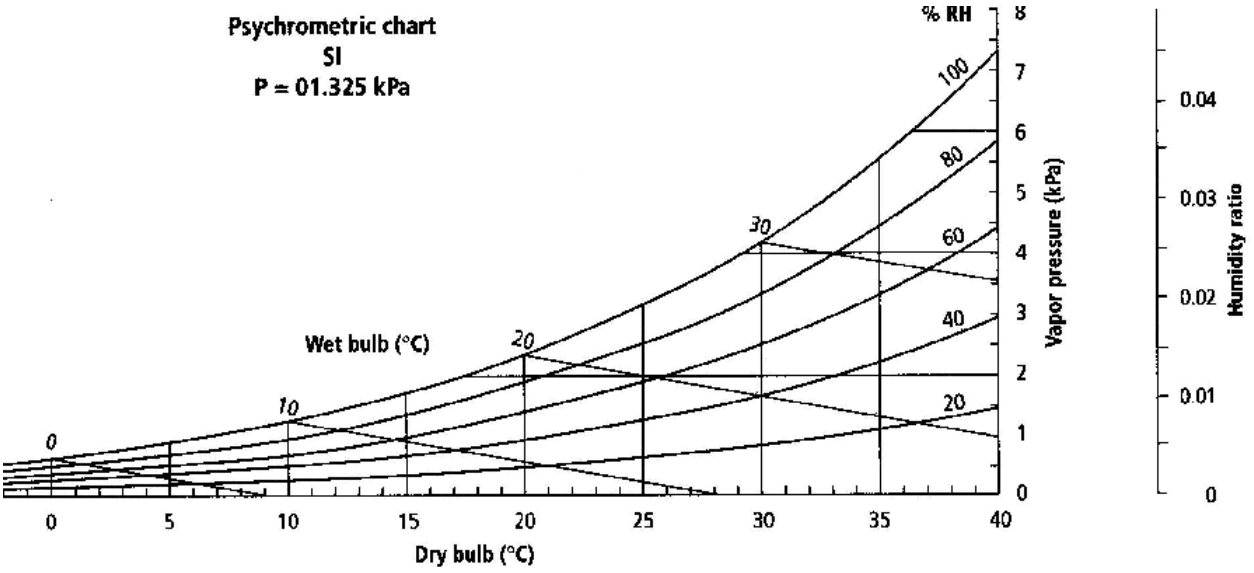

Answers

Commodity: Spinach

Storage room dry bulb temperature: **20°C**
Storage room wet bulb temperature: **13°C**
What is the storage room humidity (look it up on the psychrometric chart)? **~45%**

What is the approximate VP of the room air at 20°C at the calculated RH (look up from the psychrometric chart)? **~1.2 kPa**.
What is the approximate SVP at 20 °C? **~2.3 kPa**

Initial commodity weight: **200 g**
Commodity weight after 1 day in storage: **152 g**
Calculate commodity weight loss after 1 days in storage: **200-152 = 48 g**

What is the VPD between the commodity and the storage room air?
VPD = SVP_{tissue} - VP_{air} = 2.3 kPa – 1.2 kPa = **1.1 kPa**

What is the rate of water loss per hour (in percent water loss per hour)?
J = Δ weight during storage ÷ length of storage (hr) = 48 g ÷ (1day * 24 hr/day)
= 48 g ÷ 24 hr = **2 g/hr = 1%/hr**

What is the proportionality constant (K) for this commodity?
J = K * VPD
K = J/VPD = 1%/hr ÷ 1.1 kPa = **0.91%/hr•kPa**

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If this commodity is instead placed in a 5ºC cold room with a wet bulb temperature of 4ºC,

What is the relative humidity of the air be (look up from the psychrometric chart)? **~88%**

What is the approximate VP of the room air at 5 ºC at the calculated RH (look up from the psychrometric chart)? **~0.72 kPa**.

What is the approximate SVP at 5ºC? **~0.88 kPa**

What is the VPD? VPD = $SVP_{tissue} - VP_{air}$ = 0.88 – 0.72 = **0.16 kPa**.

What is the expected rate of water loss when this commodity is stored at 5ºC?

J = K * VPD = **0.91%/hr•kPa * 0.16 kPa = 0.15%/hr**

Commodity: Apple

Storage room dry bulb temperature: **20ºC**

Storage room wet bulb temperature: **13ºC**

What is the storage room humidity (look it up on the psychrometric chart)? **~45%**

What is the approximate VP of the room air at 20ºC at the calculated RH (look up from the psychrometric chart)? **~1.2 kPa**.

What is the approximate SVP at 20 ºC? **~2.3 kPa**

Initial commodity weight: **164 g**

Commodity weight after 7 days in storage: **162 g**

Calculate commodity weight loss after 7 days in storage: **164-162 = 2 g**

What is the VPD between the commodity and the storage room air?

VPD = SVP_{tissue} - VP_{air} = 2.3 kPa – 1.2 kPa = **1.1 kPa**

What is the rate of water loss per hour (in percent water loss per hour)?

J = Δ weight during storage ÷ length of storage (hr) = 2 g ÷ (7days * 24 hr/day)

= 2 g ÷ 168 hr **= 0.012 g/hr = 0.0073%/hr**

What is the proportionality constant (K) for this commodity?

J = K * VPD

K = J/VPD = 0.0073%/hr ÷ 1.1 kPa = **0.0072%/hr•kPa**

If this commodity was then cooled to 5ºC and stored at the 5ºC cold room with a wet bulb temperature of 4ºC,

What is the relative humidity of the air (look up from the psychrometric chart)? **~88%**

What is the approximate VP of the room air at 5ºC at the calculated RH (look up from the psychrometric chart)? **~0.72 kPa**.

What is the approximate SVP at 5ºC? **~0.88 kPa**

What is the VPD? VPD = $SVP_{tissue} - VP_{air}$ = 0.88 – 0.72 = **0.16 kPa**.

What is the expected rate of water loss when this commodity is stored at 5ºC?

J = K * VPD = **0.0072%/hr•kPa * 0.16 kPa = 0.0012%/hr**

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Explain the difference in water loss between spinach and apples stored at the same temperature.

Explain the difference in water loss from either commodity between storage at 20^{o}C and 5^{o}C.