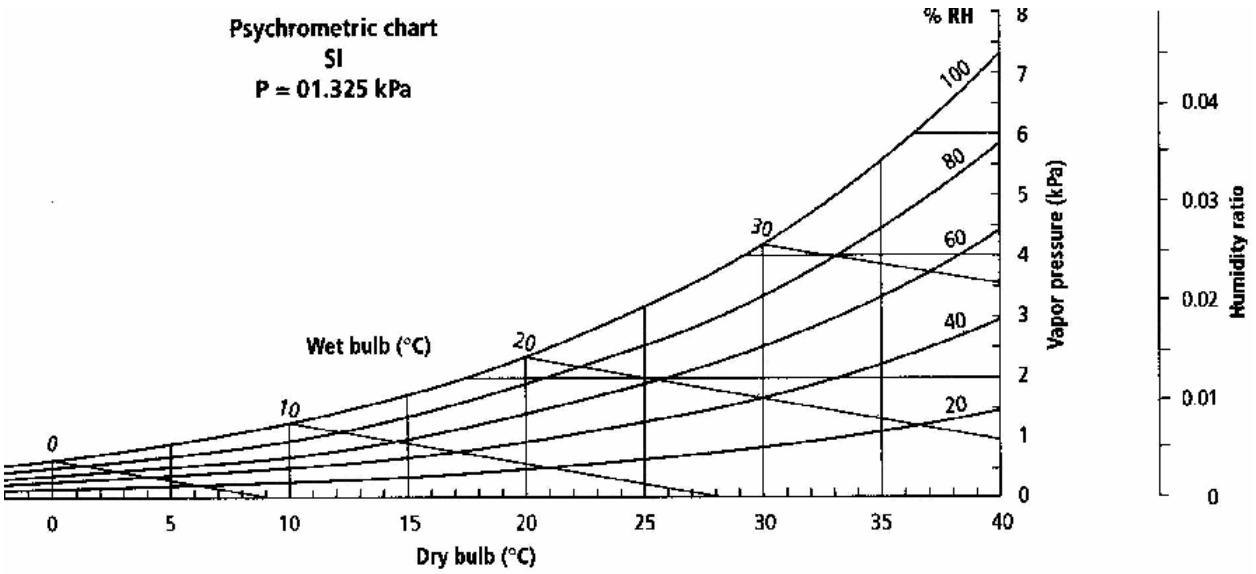
Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

Describe some of the negative effects of commodity water loss?

Product arriving at a distant market is found to have bruising, especially on fruit above the wheel axels. What likely happened to cause this bruising?



What is the relative humidity of air with a dry-bulb temperature of 20C and a wet bulb temperature of 18C?

What is the dew point of the above air?

What happens when air is cooled below its dew point?

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

A cold room is set to maintain air temperature at 12C. However, there is a drop of ~5C as the air moves across the refrigeration coils (e.g. actual air temperature drops from 15C to 10C as it comes off the refrigeration coils). Given that the warmer (15C) air is at ~ 95% RH, about what would the RH of the air after cooling 5C and then warming back up?

Describe how does the air diffusion shell (boundary layer) around a commodity affects the rate of water loss from a commodity?

How does the following effect the diffusion shell (boundary layer) around a commodity:

Placing a plastic wrap around or over the commodity in a carton.

Increasing the speed of air moving around the commodity.

If a company came to you with a chronic problem of unacceptable water loss on their iceberg lettuce, what steps would you recommend they check and possibly implement to minimize water loss?

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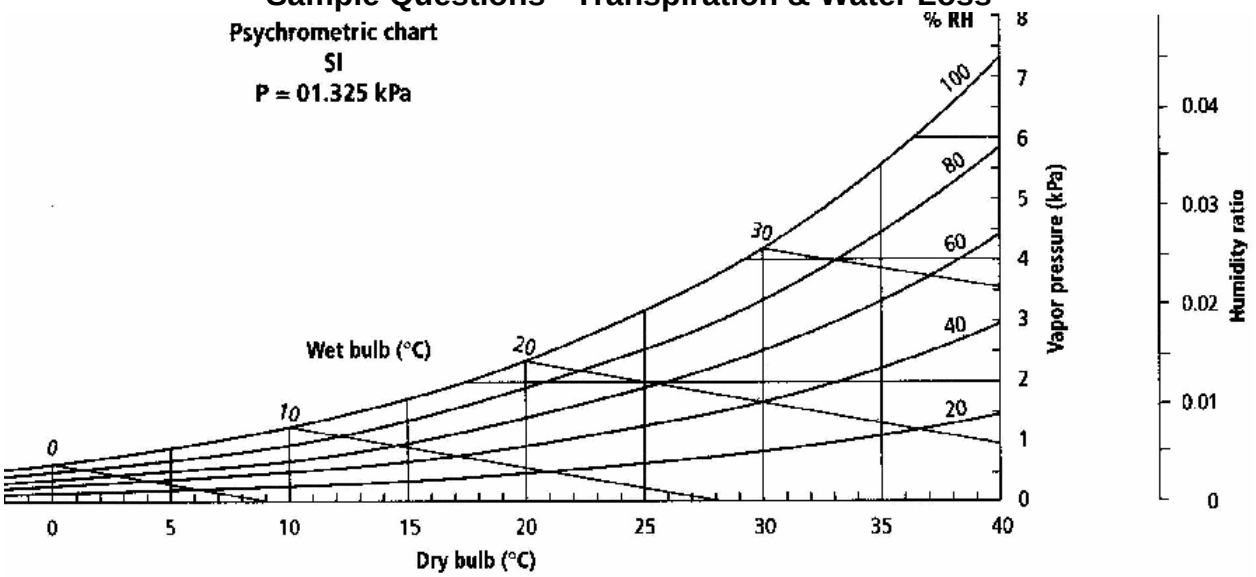


Commodity: Spinach

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)

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

$J = K * VPD$
$K = J/VPD$

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

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

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°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

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

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 ^{o}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 = Δ 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?

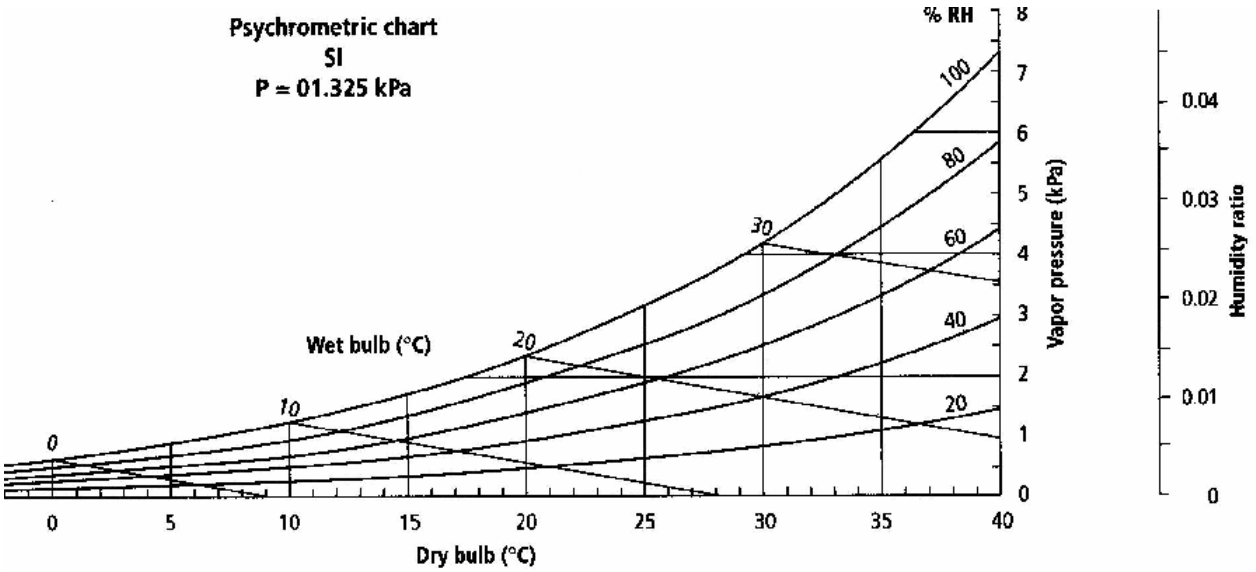
What is the VPD? $VPD = SVP_{tissue} – VP_{air}$

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

J = K * VPD

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss



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

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

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 ^{o}C at the calculated RH (look up from the psychrometric chart)? **~0.72 kPa**.

What is the approximate SVP at 5°C? **~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 5°C?

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

For the above examples, explain the difference in water loss between spinach and apples stored at the same temperature.

For the above examples, explain the difference in water loss from either commodity between storage at 20°C and 5°C.

GIVEN for many of the following questions:

	Vapor pressure (kPa)		
	RH (%)		
Temp. (°C)	100	90	80
30	4.4	4.0	3.6
20	2.4	2.1	1.9
10	1.3	1.1	1.0
5	0.9	0.7	0.5
0	0.6	0.5	0.4

Consider a 500 kg pallet of strawberries at 32°C and 50% relative humidity (RH) for 12 h during consolidation in the field and waiting outside the cooler before forced-air cooling. The fruit lose 5% of their initial weight due to transpiration during this 12-h period. The fruit are then cooled to 0°C pulp temperature and held at 0°C and 90% RH for 12 h.

- What is the initial rate of water (weight) loss when the strawberries are first placed in the cooler?
- What amount of weight would be lost by the strawberries in the 12 h after cooling?

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

Consider a storage room at 0°C and 90% RH. If the air outside is 25°C and 60% RH, will moisture be added or removed from the storage room if outside air enters the room?

If produce is moved from the storage room to the outside, will moisture condense on the produce?

Tomatoes in open pallet bins at 30°C and 80% RH are observed to lose weight at a rate of 4% per day. Once packed in cartons and placed in a ripening room at 20°C and 80% RH, however, the tomatoes are observed to lose only 1.5% of their weight in 1 day. Why do the apparent K values under the two conditions described above differ for tomatoes in the field and in the ripening room?

Estimate the rate of water loss during storage at 10°C and 90% RH after ripening.

A pallet of sweet corn weighing 500 kg is left in the holding area of a cooling facility for 5 hours at 20C and 80% RH. During this time period, the pallet of sweet corn loses 2% of its original weight. The sweet corn is cooled to 5C and placed in temporary cold storage at 0C and 90% RH.

a) What is the initial rate of water loss when the sweet corn is put into cold storage?

b) What will the rate of water loss be when the sweet corn reaches 0C?

c) How long would the sweet corn have to remain under the cold storage conditions before losing as much weight as it did during the 5-hour delay in the holding area?

Postharvest Sample Questions

Sample Questions - Transpiration & Water Loss

A pallet of celery in Belle Glade, Florida weighing 500 kg is left in the holding area of a cooling facility for 5 h at 20 °C and 80% RH. During this time period, the celery loses 2% of its original weight. The celery is then cooled to 5 °C and held overnight in a cold storage room at 0 °C before being loaded into a refrigerated truck at a temperature of 0 °C and 90% RH for transport to Chicago.

a) What is the initial rate of water loss when the celery is placed in the cold storage room?

b) What would the rate of water loss be when the celery reaches 0 °C?

c) Where would more water loss occur, during the 5 h delay in the holding area before cooling, or during 3 days in transit to Chicago? (Disregard the period during which the celery cools from 5 °C to 0 °C)

Which would probably have a higher rate of water loss, a growing leaf or a mature fruit, and why?

Discuss the role of temperature management with regard to Water loss.