Chemical Top-Up as Part of Postharvest Treatment Management

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Why chemical top-up matters

The Challenges

- Water becomes dirty from dust and debris carried by fruit
- Depletion of water volumes and chemical concentrations
- Build-up of co-formulants

✓ ***PROPER CONCENTRATION***

- Protects fruit from postharvest rot
- Ensures quality and shelf life

✗ ***INCORRECT CONCENTRATION***

- Too low: Inadequate protection
- Too high: Wasted chemicals, costs

- **Most citrus chemicals cannot be tested with strips**
- **Contribution of co-formulants are impossible to know**
- **Accurate calculations are essential**

Understanding water depletion

Two ways in which ways water is lost:

1. Carry-out

- Fruit physically removes water from the tank as it exits the application point

2. Evaporation

- Water evaporates from wet fruit surfaces and baths, especially in warm packhouses

This rate also depends on packhouse conditions

Understanding chemical depletion

The essential consideration here is the carry-out rate

- The fruit surface carries off treatment solution
- The carry-out rate measures how much solution (in liters) is removed per ton of fruit processed.
- This rate varies by:
  - Cultivar (fruit size, skin texture)
  - Application method (drench, spray, dip)
  - Line speed and contact time
  - Fruit temperature

Keep in mind: Environmental effects and co-formulants

Key concepts you need to know

1. Concentration

- Amount of active chemical per liter of water (usually ppm or mg/L)
- Example: 500 ppm = 500 mg per liter

2. Tank volume

- Total capacity of your treatment tank (in liters)
- This must be known accurately!

3. Carry-out rate

- How much water each ton of fruit removes from the tank

#3 is different for each cultivar and treatment type

Important formula

- Top-up chemical (grams) = Concentration × Carry-out per ton of fruit processed + compensation for water needed to be added back to tank

Top-up procedure: step by step

1. **Record fruit processed**
   - Track total tons of fruit that went through treatment since last top-up
2. **Calculate water loss**
   - Multiply tons processed by carry-out rate for your cultivar (from calibration curve)
3. **Add fresh water**
   - Replace the water volume lost (measured or calculated amount)
4. **Calculate chemical needed**
   - Use formula: (Concentration × Carry-out × Tons) + (Concentration × Water Added)
5. **Add chemical & mix**
   - Weigh chemical accurately, add to tank, ensure thorough mixing before continuing
6. **Document everything**
   - Record date, time, tons processed, water added, chemical added in logbook

Understanding calibration curves

What is a Calibration Curve?

- It is a graph showing the relationship between fruit processed and water removed from your treatment tank. It tells you exactly how much water each ton of fruit carries away for YOUR packhouse setup.

Why You Need It

- Every packhouse is different
- Different cultivars behave differently
- Application method affects carry-out
- Provides accurate data for YOUR setup

What It Tells You

- Carry-out rate (L/ton)
- How consistent your process is
- If something changes over time
- Baseline for accurate top-ups

One-Time Setup

- Create curves at season start for each cultivar you pack

Long-Term Value

- Use same curve throughout season unless equipment changes

Better Control

- More accurate than guessing or using generic rates

Think of it as your packhouse's unique "fingerprint" for each cultivar

Creating your calibration curve

Process Known Amount

- Run 5-10 tons through system, record exact weight from tickets

Measure Water Drop

- Measure volume lost using tank dimensions. Calculate volume lost using tank dimensions.

Calculate Rate

- Water lost ÷ tons = L/ton rate

Repeat 5-8 Times

- More data points = more accurate curve

Record All Data

- Document cultivar, tons, water lost, rate, date, conditions

- **Sample Data**

Test 1: 8.5 tons → 29.8 L

Test 2: 10.2 tons → 35.4 L

Test 3: 7.8 tons → 27.1 L

Test 4: 9.6 tons → 33.5 L

- **Pro Tips**

Test during normal production.

Don't add water during test.

Creating your calibration curve

1 Choose Your Cultivar

- Select one cultivar to test (e.g., Valencia, Navel, Lemon)

  ⚠ **Important:**

  Create separate curves for each cultivar you pack regularly

2 Prepare Your Tank

- Fill treatment tank to a known, marked level with clean water
- **Requirements:**

  Know exact starting volume OR mark starting level clearly

  Tank must be clean and empty before starting

Gather Your Tools

- Measurement
  - Measuring container
  - Scale (if measuring mass)
- Recording
  - Data sheet
  - Pen/clipboard
- Production
  - Weight tickets
  - Stopwatch (optional)

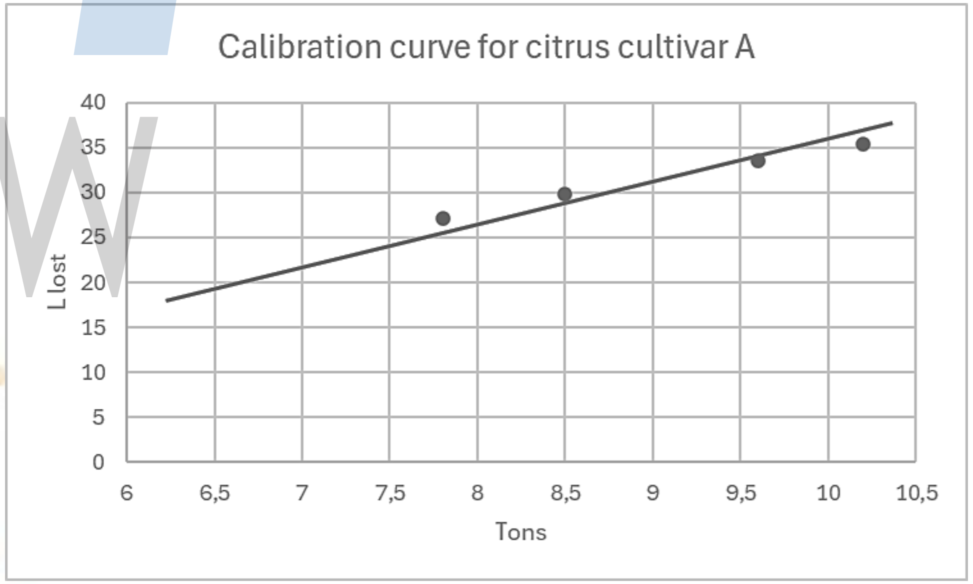
Ready to collect data? Continue to next slide...

Data collection: setting up a calibration curve

- Plot Your Data
  - X-axis: Tons of fruit
  - Y-axis: Water lost (L)
- Draw Best-Fit Line
  - Draw straight line through data points
- Calculate Rate
  - Slope = Liters ÷ Tons
- Example
  - If 35 L lost for 10 tons:
  - 35 ÷ 10 = 3.5 L/ton

Sample data sheet

Tons	L lost
7,8	27,1
8,5	29,8
9,6	33,5
10,2	35,4



Using your calibration curve

Quick Reference Chart

Example values - create your own!

Everyone using system should know which curve to use

Cultivar	Rate (L/ton)
Valencia	**3.5**
Navel	**4.2**
Lemon	**2.8**
Grapefruit	**3.9**

1. Check cultivar being packed
Use the correct curve for that fruit type

2. Record tons processed
From weight tickets since last top-up

3. Apply your rate
Use carry-out rate from curve in calculations

✓ Post the curve visibly for easy reference

✓ Update annually and redo if process or equipment changes

✓ Train All Staff

Worked example of the top-up procedure

Given Information

- Target concentrations:

1000 ppm (product A) and 1400 ppm (product B)

- Fruit processed: **15 tons**
- Carry-out rate: **3.5 L/ton** (Valencia oranges)
- Tank capacity: **2000 L**

Step 1: Calculate Water Loss

- Water lost = 15 tons × 3.5 L/ton

= 52.5 liters

Step 2: Chemical for Water Lost

- Chemical A = 1000 mg/L × 52.5 L

= 52.500 mg = 52.5 g

Step 3: Chemical for Fresh Water

- Chemical B = 1400 mg/L × 52.5 L

= 73.500 mg = 73.5 g

Your quick refence card

1. Record tonnage processed: *Check packhouse scale reading / weighing cards since last top-up*
2. Look up carry-out rate: *Find value for current cultivar in calibration curve*
3. Calculate water volume:

   Liters = Carry-out rate × Tons processed
4. Calculate chemical amount

   Chemical = (Water ÷ 1000) × Target conc. (g/L)
5. Add water first - *Never add chemical to empty tank!*
6. Add chemical and mix: *Mix thoroughly for 5 minutes minimum*
7. Document in log: *Record date, cultivar, tons, water, chemical, operator*

FINAL THOUGHTS

- Every drop of water in your packhouse is either protecting your fruit or putting it at risk.
- When water quality <u>isn't managed properly</u>, you're not just losing chemicals down the drain—you're <u>increasing the chances of fruit arriving at export markets with quality issues</u> that damage both your returns and your reputation.

FINAL THOUGHTS

Two things to focus on:

- First, test your water regularly—what you can measure, you can manage.
- Second, optimize your chemical use based on what the water actually needs, not guesswork. You'll reduce spoilage claims and cut costs on overtreatment.

THANK YOU

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