Practical Solutions for Small Scale Wash Stations and Post-Harvest Water Management

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Why focus on water?

• There are many factors that impact the quality and safety of postharvest water

• Water is used in many different postharvest operations and systems

• Pathogens are easily spread through water
Postharvest Water Uses

• Commodity movement
• Rinsing
• Packing line
• Hydrocooling
• Postharvest fungicide and wax
• Cleaning and sanitation
• Hand washing of employees
Post-harvest Water Quality is Critical!

An in-field contamination event can be amplified by post-harvest water. This means one piece of contaminated produce can lead to contamination of the entire lot or lots!
Water Sanitation is the Key

• Prevents cross-contamination

• Adding a sanitizer to water is **NOT** meant to “wash” the product, but instead meant to prevent the spread of contamination.
Postharvest Water Quality

- All water used for washing, cooling, or other processes on harvested or ripe product must be the microbial equivalent of drinking water, i.e. potable.

- *New proposed regulation:* No detectable generic *E. coli* in 100 ml water sample used for postharvest purposes
Really? Two different recommendations?

- Yes (sort of, the regulation is not final yet)
- **Important point:** Begin with clean water
- Once you have added ANY produce, the water is no longer clean so you need to **add a sanitizer**
- **Remember:** You are not cleaning the produce, you are preventing cross contamination
Managing Water Quality

1. Begin with **potable water** for postharvest activities

2. Add, maintain, monitor, and record sanitizer levels in all flumes, dump tanks, and even **single pass water**, if warranted

3. Monitor and record temperature of dump tank and flume water as well as pulp temperatures to prevent **infiltration**

4. Monitor and record pH, **turbidity**
When should I use a sanitizer?

• If the water will contact multiple food items
• Dump tank or other forms of bulk water
• Flume water for product transportation
• Water used on or in equipment for washing produce
• Wax application
Single Pass Water

- Single pass water must be potable (municipal or tested well)
- Food contact surface (i.e. table) must be clean and cleanable
- Ideally, hoses will be food grade
- Single pass assumes water is not being recycled
When is adding a sanitizer to single pass water critical?

• If single pass water is used inside equipment, a sanitizer should be used

• Reduces risks of biofilms forming in equipment
  – *Listeria* outbreak in cantaloupe in 2011

• Equipment construction and sanitation is also very important
  – Are equipment parts cleanable?
  – Is the equipment cleaned enough to reduce risks?
Bulk, Batch, Dump Tank Water

• Always, always, always add a sanitizer
• A mistake here can ruin all the work you have done to protect the crop
• Food safety and postharvest quality benefit from adding a sanitizer!
Adding sanitizer is NOT the only postharvest water issue!

• Water temperature is also a concern because of infiltration

• Infiltration occurs when the produce is warmer than the water
Infiltration and Risk

Higher risks associated with:

• Submersion > Floating > Spray
• Susceptible commodities
  – Tomatoes, cantaloupes, apples
• Wounded or bruised fruit
Infiltration & Bruising

- The risk of infiltration reinforces the need to add a sanitizer
How do I choose a sanitizer?

• Most common sanitizer is chlorine
  – Affordable and available
  – Corrosive, highly reactive, not very effective on certain organisms

• Many other options
  – Ozone, peroxyacetic acid, hydrogen peroxide

• Organic options exist
  – Tsunami, Spectrum, VigorOx 15 F&V
  – ALWAYS check with your certifier!
Making Sense Out of Labels

• Always read the label!
• Check out resources from UC Davis
Quiz!

What is the purpose of adding sanitizer to postharvest wash water?

A. To kill **ALL** pathogens on produce
B. To minimize cross-contamination
C. To make me happy
What are practical things I can monitor to make sure my sanitizer is effective?

These are cost effect, practical tools:

1. Free chlorine
   - Measures chlorine available to kill pathogens

2. pH
   - Chlorine is most effective between pH 6-7

3. Turbidity
   - Organic matter (soil, leaves, fruit pulp) can interfere with/bind chlorine
Managing Chlorine Demand

1. Free chlorine
2. Bound chlorine
3. Peak chlorine demand
   is the maximum amount of chlorine in batch water that is “used up” by soil and organic materials added with product during washing

Guron 2013
Step 1: Measuring Free Chlorine

• Assemble test materials
• Choose sampling site
• Take 100 ml sample
• High Range:
  • Dip 1-2 sec, wait 30 to color match
• Low range:
  • Dip 10 seconds, wait 30 seconds

TV Suslow 2012
Chlorine Monitoring Tools

1. Test Strips
   • Make sure free chlorine is measured

2. Colorimetric Kits
   • If sample dilution is required, dilute with distilled water

3. Electronic Sensors
   • Oxidation Reduction Potential (ORP), pH
Measuring Free Chlorine Using Strips

TV Suslow 2012
Measuring Peak Chlorine Demand

1. Make a typical wash volume w/ no bleach
2. Add typical harvest product and agitate
3. Add a small amount of chlorine and mix for 15 seconds
   • Record bleach amount added!
4. Measure with a free chlorine test strip
Measuring Peak Chlorine Demand

5. Repeat until free chlorine level hits 5 ppm
   • Repeat in 2 minutes again after you’ve reached 5 ppm
   • If it’s still at 5 ppm, you’re done; if not repeat steps 3-4.

6. Add up all volumes of chlorine you added
   • This is your peak chlorine demand

7. Repeat this with ‘dirty’ product

TV Suslow 2012
Managing Chlorine Demand

1. Determine the appropriate amount of sanitizer to add to your dump tank (peak chlorine demand)

2. Set up monitoring schedule and system (in-line or manual), and develop a standard operating procedure (SOP) for each:
   - pH
   - Chlorine concentration
   - Organic matter/turbidity

3. Keep records
Step 2: Measuring pH

- Assemble test materials
- Choose sampling site
- Take 100 ml (~4 oz.) sample
- Dip strip in about ½ inch
- Immerse for 5 seconds
- Read result within 10 seconds
- Record on log sheet
Step 3: Measuring Turbidity

• When lots of organic matter (high turbidity) is present:
  – More chlorine will need to be added to get the right amount of free chlorine
  – It will take longer to kill pathogens
  – You’ll need to change the water more frequently

• Two methods:
  A. Test strips
  B. Secchi disk
Step 3: Measuring Turbidity

- **Secchi disk method** traditionally used to measuring water quality in large bodies of water.
Step 3: Modified Secchi Disk Method

Modified Secchi Disk

Clear Polycarbonate Pasta Storage Cylinder ($4.39 at Target)

OK

OK - But Time to Check

Time to Change

Clean Transfer Vessel

TV Suslow 2012
Don’t Forget to Monitor Water and Pulp Temperature

• To prevent infiltration, water temperature should be higher (or within 10°F) than pulp temperature especially in dump tanks
• Measure pulp temperature and water temperature with dedicated thermometers
• Keep records!
Recordkeeping

- Necessary for audits
- Help visualize trends
- Ensures the system is working properly
- Makes sure the task is done, and done properly

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Temperature (°F)</th>
<th>Water pH Level</th>
<th>Type of Chemical Used</th>
<th>Amount Added (fl oz)</th>
<th>Chemical PPM</th>
<th>Water Turbidity (NTU)</th>
<th>Type of Produce Being Run</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
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</table>

Reviewed by:  
Date:  
Title: 
SOPs & Training Workers

• SOPs are essential to make sure the task is completed properly
• Workers who do these tasks must be trained to use the SOP
• Be specific in your SOP!
  • Anyone could walk on your farm and do the task
  • Include where the supplies are, how exactly to do each step, what to record
Wash Station Design Considerations

- Must be easily cleaned and sanitized
- Must be properly constructed
- Consider product flow - must keep unwashed and washed produce separated
- Properly dispose of water/prevent standing water
- Handwashing station is separate
Wash Station Flow

From field

Wash Tub 1  Wash Tub 2  Wash Tub 3

Packing Table

Screen Dry Table

Weigh Station

Spin Dryer

To truck, cooler, or storage
Template Resources

- University of Virginia
  - http://farmhack.net/tools/vegetable-washing-station

- Iowa State Leopold Center
  - http://www.leopold.iastate.edu/cool_tools/wash_stations1
Resources

• University of Wisconsin

• UC Davis

• Penn State University
Questions?

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Case Study

2011 Cantaloupe Outbreak
July 31-October 31, 2011

• Deadliest US foodborne illness outbreak in over 90 years
• 33 deaths, 146 sickened
• 28 states involved
• 1 farm location
• 4 outbreak strains
### Listeria Outbreaks by Commodity

<table>
<thead>
<tr>
<th>Year</th>
<th>Food Vehicle</th>
<th>Cases</th>
<th>Perinatal Cases</th>
<th>Deaths</th>
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<tbody>
<tr>
<td>1981</td>
<td>Coleslaw</td>
<td>41</td>
<td>34</td>
<td>18</td>
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<tr>
<td>1983</td>
<td>Pasteurized milk</td>
<td>49</td>
<td>7</td>
<td>14</td>
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<tr>
<td>1985</td>
<td>Mexican-style cheese</td>
<td>142</td>
<td>94</td>
<td>28</td>
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<tr>
<td>1998</td>
<td>Hot dogs</td>
<td>108</td>
<td>13</td>
<td>14</td>
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<tr>
<td>2000</td>
<td>Turkey deli meat</td>
<td>30</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>2000</td>
<td>Mexican-style cheese</td>
<td>13</td>
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<td>5</td>
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<td>2002</td>
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<td>2010</td>
<td>Chopped celery</td>
<td>10</td>
<td>0</td>
<td>5</td>
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<tr>
<td>2011</td>
<td>Cantaloupe</td>
<td>146</td>
<td>6</td>
<td>30</td>
</tr>
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</table>
Listeria Outbreak 2011

- Field (soil & fruit) samples were negative
- *Listeria* found throughout the processing and storage areas
  - Poor drainage allowed water to pool in and under the machinery
  - No documentation of monitoring sanitizer levels; if any
  - Difficulty to clean and sanitize equipment
  - Lack of pre-cooling
Listeria Outbreak 2011

Key Lessons

• A number of little things that added up to produce a very bad outcome
• Risk assessments are critical to understand the repercussions of certain actions
• Implement practices that you can manage and function properly
Additional Resources

- For more information on wash water treatments and their optimal ppm (mg/L) levels see:
Additional Resources


