

Protocol for removal of imazalil and thiabendazole residues from packhouse surfaces.

Research conducted and recommendations compiled by Karlien Muller (Auxano IPM Consulting)

Background

A number of packhouses handle both citrus and mangoes. Imazalil is used as a postharvest chemical on citrus fruit. The treated fruit leaves imazalil residues on packhouse surfaces which are transferred to mangoes when they are packed. This is highly problematic, as no imazalil residues are permitted on mangoes in the export market. Similarly, thiabendazole residues on the packline may also result in MRL exceedances.

Baking soda, (NaHCO_3), Skimmer Plus (ICA Chemicals) and sodium hypochlorite ("chlorine") were tested as agents to remove imazalil and thiabendazole residues from packhouse surfaces

According to literature, NaHCO_3 (baking soda) can remove superficial pesticide residues, especially thiabendazole from apple skin surfaces at a 1-2% concentration after 12-15 minutes of soaking. The deeper the chemical penetrates the skin of the fruit, the more difficult it becomes to remove the residue. It was found that the mode of action of the baking soda is solubilization of the thiabendazole (and other chemicals) so that it loosens from the surface.

Imazalil is unstable under alkaline conditions ($\text{pH} > 7.0$). Hence there is a possibility of Imazalil being broken down by NaHCO_3 . It is however determined that free chlorine (HOCl/OCl^-), typically from sodium hypochlorite or electrolyzed water, can react with- and transform imazalil, but the extent depends strongly on dose, pH, temperature, contact time and the combination of these factors. Chlorination usually *transforms* imazalil (producing chlorinated/oxidized transformation products).

It is essential that a follow up wash takes place with the ICA product "Skimmer Plus" (formulated to encapsulate and remove residues from surfaces). However thorough washing and scrubbing is required to enable the product to encapsulate residues (ICA citrus postharvest magazine, 2024). A final wash with clean water directly after the skimmer plus (NB not to allow product to dry on the line) is required to remove residues.

In the trials carried out, (only one round of chlorine, baking soda and skimmer plus wash) a reduction of imazalil and thiabendazole residues ranging between 44% and 89% was achieved (depending on the surface type and location in the pack line). It might be required to repeat the steps outlined below if residues are still detected on fruit (especially on fungicide tank, rollers

and belts after fungicide tank). This means that mangoes packed subsequent to the washing procedure must be sampled and sent for residue testing before a packline can be considered free of imazalil or thiabendazole residues. If the process needs to be repeated, repeat the use of baking soda and skimmer plus for optimal results.

It is extremely difficult to remove chemical residues from packhouse brushes. Therefore, it is recommended that separate sets of brushes are used for citrus and mangoes.

Packline Cleaning Procedure:

Chlorine: NB!!!! ONLY USE ON PLASTIC/BELTS AND STAINLESS-STEEL SURFACES AND COMPONENTS it corrodes materials such as mild steel and aluminium, especially with increased exposure.

1. Ensure that people wear PPE – rubber gloves and respiration mask.
2. Use/spray anti rust products on bolts and nuts/chains etc. close to surfaces being washed with chlorine and baking soda to reduce the risk of rusting.
3. Use clean 20 L paint buckets or similar containers, fill with 15 L of water.

First round: wash with soap / wax remover

4. Initial wash (to remove dust/wax/soap/etc.) on pack line – wash with normal soap/ wax remover product and water – this allows chlorine wash water and skimmer plus water to stay cleaner and effective for longer and lower change rate of washing water. It also assists in removing the residues stuck to soil and wax particles on the line.
5. Ensure the pH of the water is around 7 before adding any product. (pH strips will be sufficient). If the pH is too high, use HCL to bring it down. If it is too low, use NaOH to increase accordingly. Use low volumes of product and test with strips to ensure gradual adjustment of pH.
6. Start cleaning from the end of the packline (final packing belts, fruit carriers etc.) and move towards the start of the packline so that the process starts at a point with lowest chemical residue concentration and work your way upward to the higher concentration areas.
7. Use new cloths and brushes regularly, e.g. don't use the same brushes and cloths used for the initial cleaning to start the protocol wash (to avoid residue transfer from used cleaning equipment).

Second round: Baking soda

8. **Prep warm water ($\pm 30^{\circ}\text{C}$)** in 20 L buckets with baking soda at a 5% concentration. Therefore, 50 g per 1 L of water (1 kg/20 L).

9. Spray the baking soda mix with a knapsack (no chemical previously used in knapsack otherwise residues will transfer) across the packline so that it is properly wet and the water remains on the surfaces for 15-30 min. This time allows the baking soda to release the chemical residues from the surface.
10. After 15-30min (the longer the better), start scrubbing with soft brushes (shoe polish brushes) and cloths to assist in the final loosening of residues.
11. Use clean water to rinse the area properly and the cloths to dry the areas.

Third round: Chlorine

12. Mix a 200 ppm (2 g/L) solution of chlorine water (sodium hypochlorite) and wash plastic, belts, and stainless-steel surfaces. Be cautious when washing belts and fruit cups as water can drip down to chains and bolts etc. which may cause corrosion. Therefore, use wet the cloths rather than brushes to reduce dripping.
13. Lastly wash the fungicide tank and brushes.
14. If fungicide tanks and fungicide rollers are stainless steel – remove from pack line and use soft brushes to scrub and wash with chlorine water (200 ppm), and rinse with clean water immediately after chlorine wash (without letting the surface dry, as this allows residues to stick onto surface area). Rollers need to be removed and washed separately so that chlorine wash does not come into contact with bolts and nuts or chains etc. made from other materials.
15. When washing belts, wet the cloths and use the cloths to wash.
16. Wet the new cloths in the chlorine water, remove excess water and wash/wipe the surfaces.
17. Immediately after baking soda and chlorine wash, follow up with a **NEW** cloth dipped in clean water and rinse section washed before it dries.
18. *Use one set of cloths for fungicide tank and rollers – having high concentrations of imazalil and thiabendazole. (The active sticks to the cloth and deposits it to other surfaces). **OR** start from least levels of possible active (final packing belts) and wash backwards to end at fungicide tank.*
19. **NB!!! RESIDUES ARE EASILY TRANSFERRED FROM ONE AREA TO ANOTHER. TAKE CARE AND REGULARLY CHANGE CLEANING BRUSHES AND CLOTHS!!**

Final round: Skimmer Plus:

1. Mix a 20% skimmer plus solution in 20L buckets
2. Use **brushes and sponges to scrub all surfaces** of the pack line – from final packing belts to fungicide tank – (low concentration of residues to higher concentration residues) (better to remove rollers/cups/donuts etc).
3. Pressure and proper scrubbing are NB for the efficacy of this product as it encapsulates the remaining residues on the line.
4. Immediately after the skimmer plus wash (while the surface is still wet) rinse with clean water so that encapsulated residues are removed from the pack line and **do not dry on the surface.**

5. **All surfaces can be washed** – give special attention to aluminum and other surfaces not washed with chlorine, as residue levels on these surfaces will be present at higher concentrations.
6. Change skimmer plus water regularly.
7. **Brushes after fungicide application** – brushes are more difficult to wash and penetrate with skimmer plus.
8. All brush hairs are not connected to stainless steel roller hence **NB to make sure from your pack line supplier** which surfaces are stainless steel and which not.
9. **If all components are made from stainless steel (chlorine can be used) otherwise** – soak brushes for 60min in baking soda water, there after rinse with high pressure spray
10. Soak brushes in skimmer plus water for an hour – (in big bins or bath) and wash off with high pressure spray (clean water) and dry brushes in sun for a few days (UV breaks down chemical residue).
11. Residues take a drastic reduction but may increase where not properly rinsed with clean water.

If you want to determine the levels of residue still present on selected areas of the packline, swab using the following protocol:

1. Use normal cotton earbuds.
2. Use 3 earbuds per section, dip the cotton ends in a 20% skimmer plus solution.
3. Swab a ± 5 cm surface area with both sides of the cotton earbud on the sections from chemical application point onwards.
4. Mark clearly the location of the swab for reference.
5. Place earbuds in small zip lock bag (each area separate zip lock bag)
6. Mark the bags to test for postharvest chemicals – Imazalil and thiabendazole and send to **HORTEC** (as they are familiar with the protocol)
7. Remember – the results are measured in ppm on a swab, therefore, it is much more sensitive to detect residues. If swabs pick up less than 0.05 ppm, the chances are low that residues will be detected on fruit.

NB Employees must wear PPE (arm length rubber gloves, eye protection and face mask/respirator during chlorine wash).***

Please note that this protocol is a guideline and a document pointing out the risks, and reasoning behind the protocol. It is the

responsibility of every packhouse to ensure they optimise their risk management and results. SAMGA or Auxano IPM Consulting will not be held responsible or liable for any damages or lack of results from following this protocol.

Any questions/guidance in the process contact:

Auxano IPM Consulting
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Suggestions for PPE and equipment:

Rubber gloves



Brushes and sponges:



Cloths:



Masks:



Anti rust products: Neil Salter: Interflon. Email: nsalter@interflon.com. Cell: 071 490 7780



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- ✦ Silicone spray
- ✦ Cutting oil
- ✦ Rust dissolver
- ✦ Dry lubrication
- ✦ Graphite spray
- ✦ Corrosion protection



1 for 7

- ✦ Assembly grease
- ✦ Adhesive lubricant
- ✦ Chain grease
- ✦ Gear spray
- ✦ Battery terminal grease
- ✦ Spray on grease
- ✦ White grease



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