



Lime 101: Characteristics, Handling and Best Practices

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INTRODUCING THE NEW MLC

MLC has launched a new global brand platform and has begun operating under the name MLC.

The transformation of the company's brand reflects MLC's vision, mission, and values and our identity as an international lime solutions partner with an unwavering commitment to safety, sustainability and service.



Discovering what's possible with calcium

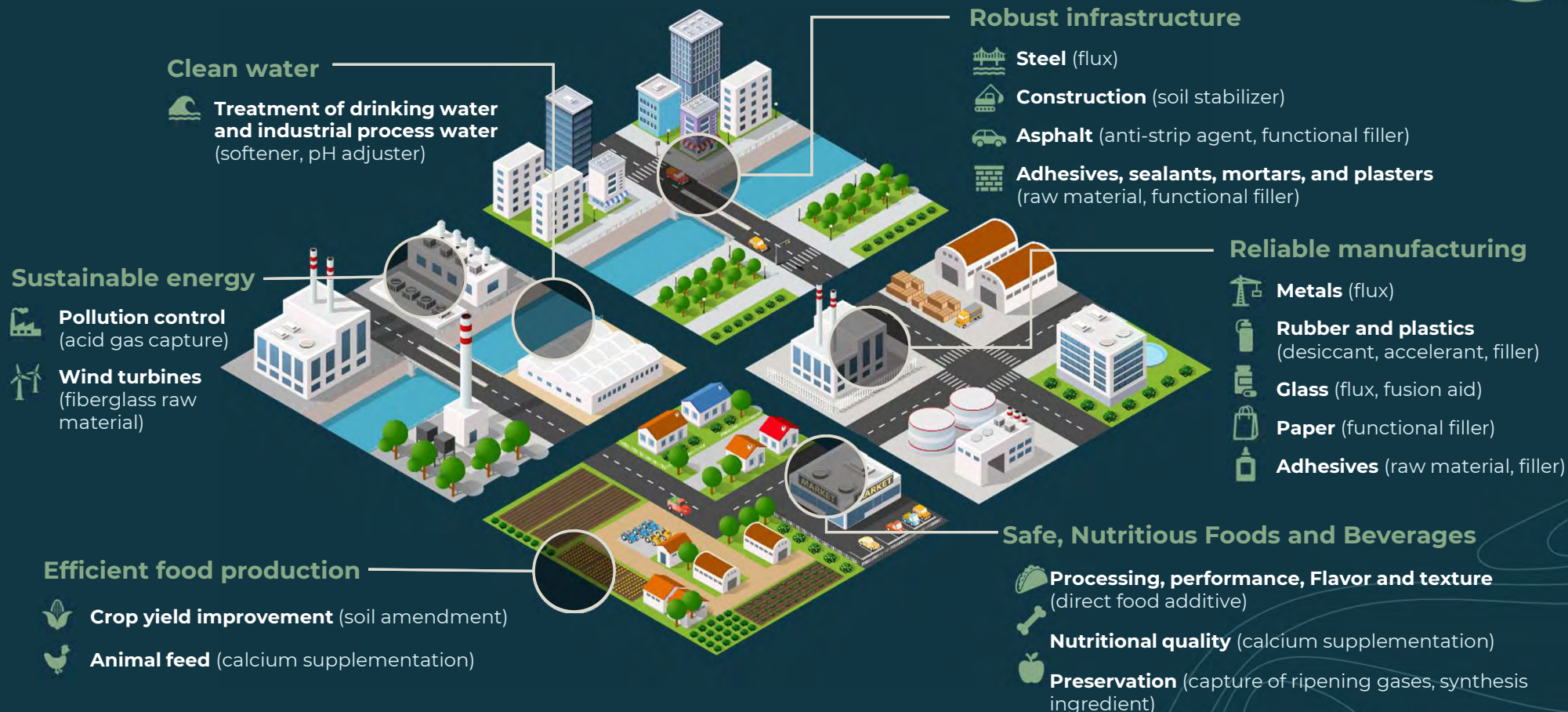




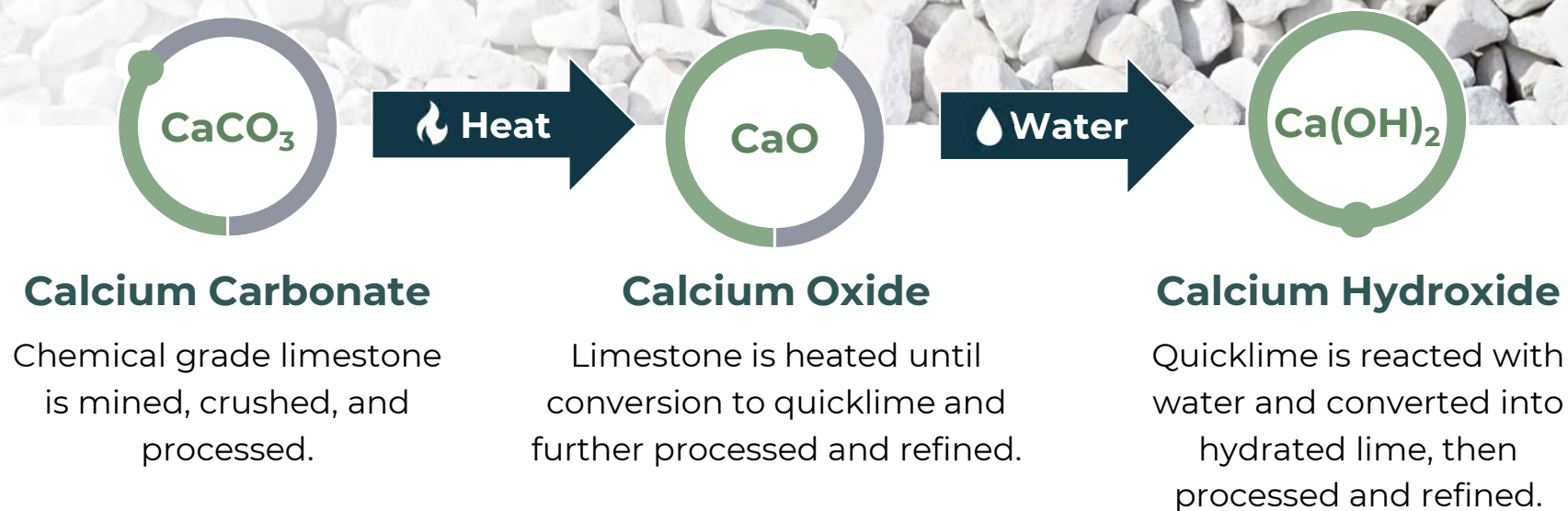
Agenda

- What is Lime?
- How is lime made?
- Lime in nixtamalization
- Some tips on handling lime
 - Safety
 - Material Handling

Lime Applications: an Essential Mineral



What is “Lime”?

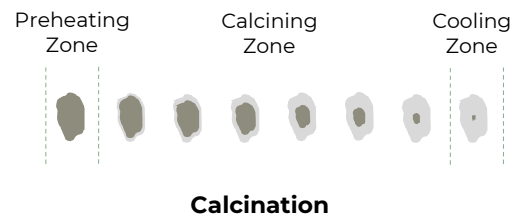
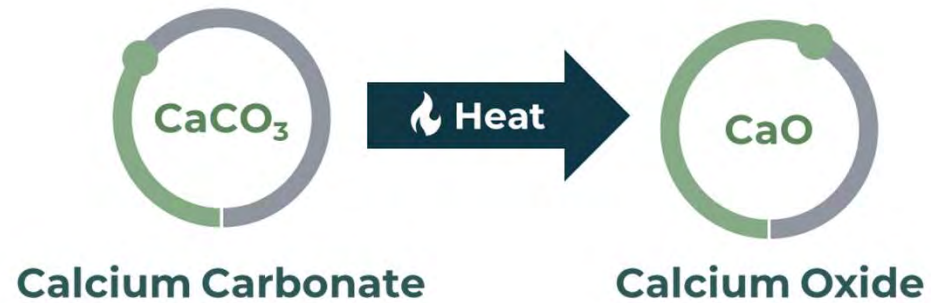


Lime is a catch-all term for the versatile industrial mineral.

Quicklime Production (Calcium Oxide)



Drilling & Blasting or
Quarrying Limestone
(Calcium Carbonate)



Quicklime (Calcium Oxide)



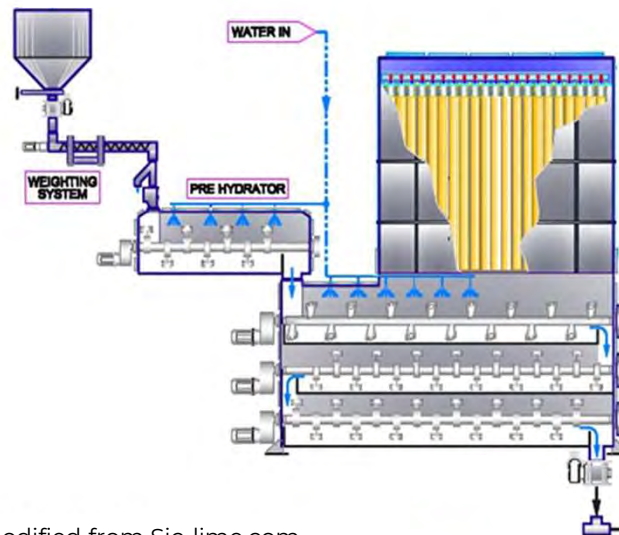
Calcium Hydroxide Production



Calcium Oxide

Calcium Hydroxide

Quicklime (Calcium Oxide)

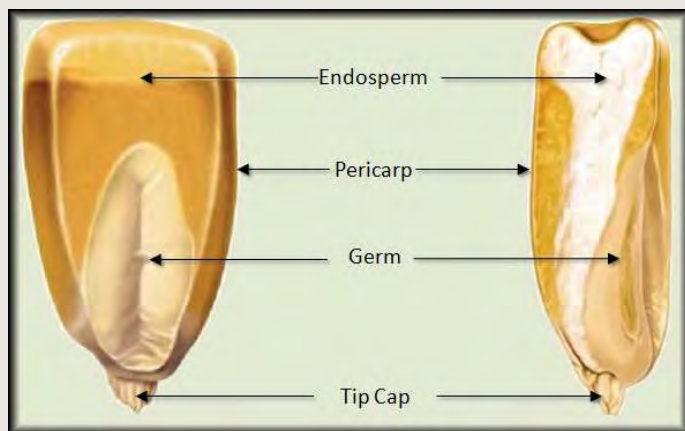


Modified from Sic-lime.com

Hydrated Lime
(Calcium Hydroxide)



Nixtamalization and the Role of Lime



A traditional Mesoamerican technique that involves cooking corn in an alkaline solution [*i.e.* $\text{Ca}(\text{OH})_2$] to remove the pericarp and to improve processability, digestibility and nutritional value for human consumption.

Cooking and steeping dried maize kernels in an alkaline lime solution (pH 11 – 12.4) results in:

- Increases pH which **dissolves and hydrolyzes** components in the pericarp facilitating removal
- Enhances **water absorption**
- Promotes **gelatinization**
- Improves **workability** of the masa
- Increases **calcium content**
- Influences **taste, color, texture, and product pH**





Lime in the Nixtamalization Process

Cooking

- Proportion of corn, water, hydrated lime: 100 : 200-300 : 1 (wt%) ratio, respectively.
- Lime is typically prepared as a slurry and pumped to the cooking vessel or added directly as dry powder
- Cooking stage starts once the liquid has reached 180 °F and cooks from 15-45 mins based on final use application of the masa.

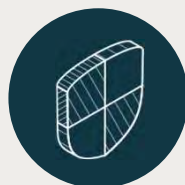


Steeping

- Heating is removed, and the "Steeping Stage" begins once temperature is below 140°F.
- Transferred to a soaking vessel, where the corn continues to steep for ≈12-16 hrs.
- The resulting nixtamal can then be rinsed and milled to form masa dough.



What is important in choosing a lime product for nixtamalization?



Meets Food-Grade Standards

- FDA registered production facilities.
- Product meets FCC specifications
- GFSI recognized Quality Control System



Delivery Demands

- Annual volume requirements
- Packaging options compatible with equipment
- Supply Chain/Logistics Services and Reliability



Product Quality

- High calcium content
- Low impurities
- Consider fuel source
- Refined particle size distribution



Utilize best practices when handling lime

Lime is highly alkaline material (pH \approx 12.4) and has the potential to cause irritation or burns. Quicklime reacts rapidly with moisture to generate heat.



Protect the skin



Protect respiratory passages



Protect the eyes

As with any chemical/ingredient, proper protections and controls should be utilized to mitigate risk and exposure as a result of handling the material.

Considerations for Receiving Material



- **Inventory Considerations**

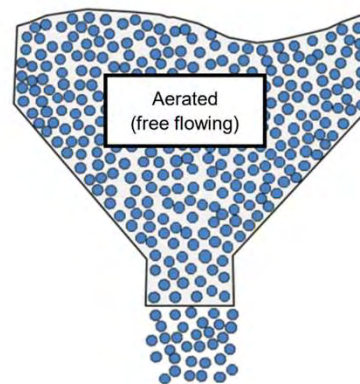
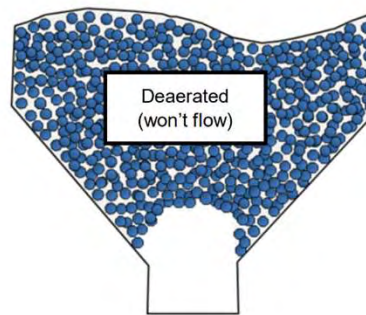
- Keep product Best Used-By Date in mind
- Keep unused product protected from air
- Climate controlled storage is best practice for bagged material

- **Delivery Options:**

- Bulk
- Super Sacks
- 50 lb. Bags
- Calcium Hydroxide Slurry

Material Handling of Dry Hydrated Lime

- Lime has its own personality for material flow. It is **aeratable but cohesive**.
- **Consolidated hydrate is cohesive**
 - Propensity for bridging and ratholing
- **Fluidized hydrate flows like water**
 - Free moving
- **Keys to reliable flow for dry hydrates!**
 - Keep a consistent bulk density (aeration)
 - Proper flow promotion and control systems
 - Intentional conveying line and silo design

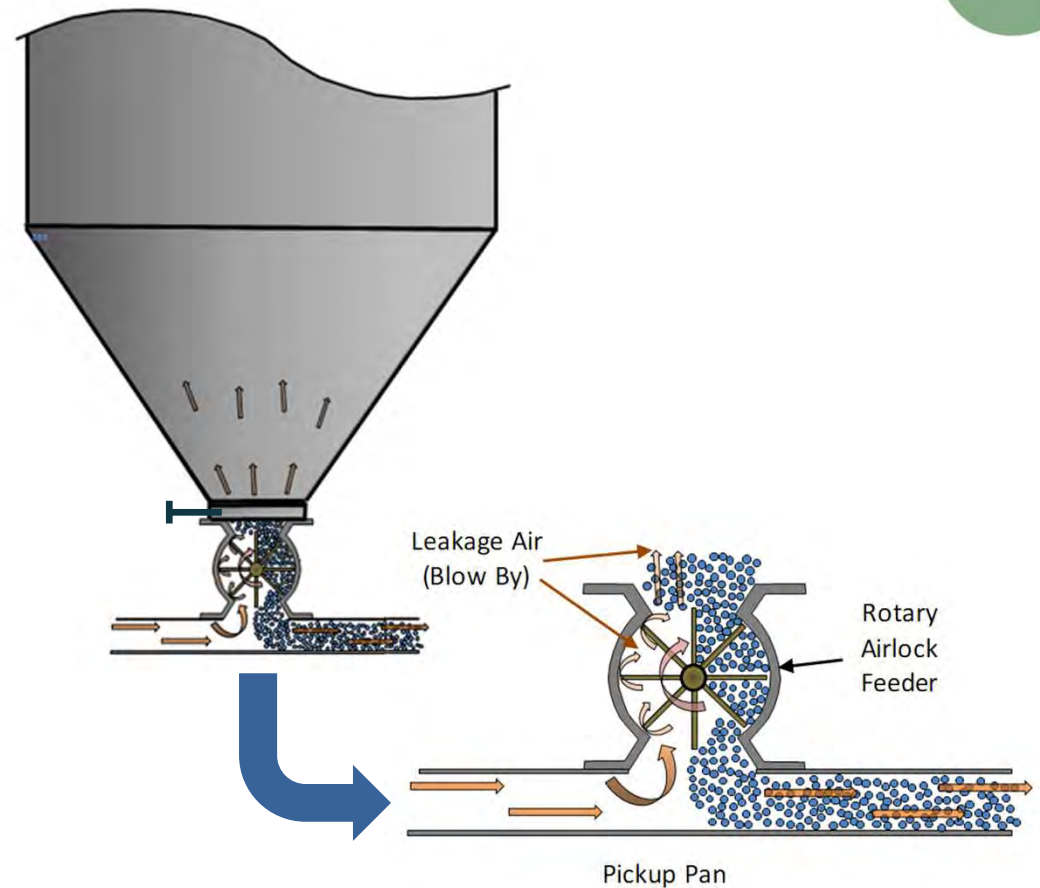


Moving Material from Storage



Silo Discharge

- **Flow promoters**
 - Aeration is generally preferred to vibration.
- **Knife gate directly under the silo cone** is recommended
- **Batching: Volumetric vs. Gravimetric**
 - Gravimetric is preferred
 - Proper flow promoters will help with volumetric feeding



Making a Slurry of Hydrated Lime



- **Mixing order Matters**
 - First water then hydrate
- **Agitation**
 - Goal is a strong Vortex to incorporate solids.
 - Intermittent agitation is best for long standing slurry
- **Direct addition of dry lime**
 - Feed slowly, do not “slug” material.
 - Feeding too fast or weak mixing can lead to “lime-bergs”
- **Goal should be a high-density slurry**
- **Density Meter**
 - Needed for continuous systems
 - Not necessary in properly design batch systems



Conveying Hydrated Lime Slurry



- **Pump Styles**
 - Positive displacement pumps tend to be best for dosing operations
 - Centrifugal pumps are okay to use in recirculation system with low backpressure
- **Minimum Pumping velocity for settling**
 - Line sizing and pump capacity should be considered
- **A high-density slurry** is your ally against scaling
- Routine **Flushing** is helpful



Disclaimer



Mississippi Lime Company d.b.a. MLC cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used.

It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use.

The information in this presentation is believed to be accurate, to the best of the Company's knowledge, as of the date issued.



Contacts for Additional Lime Technical Support

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Responding to Spills



- **All spills should be responded to in accord with your specific site requirements.**
 - Hydrated lime is **not** listed as a “hazardous substance” by the EPA.
 - Waste material can be disposed at approved landfills as "special waste" in accordance with U.S. Federal, State, and Local requirements.
- **Product should be collected using means to minimize dusting.**
 - Residual amounts can be flushed with large amounts of water.
 - Equipment can be washed with water, a mild vinegar and water solution, or detergent and water.
- **If dust is created:** wear an ANSI approved mask, and/or face shield/goggles. Consider long sleeved clothing and gloves to prevent contact with skin.
- **Do not step into dry lime.** Lime over shoe tops is an exposure.
- **Wet lime on the ground is a serious SLIP HAZARD.** Avoid stepping or walking into areas where hydrate is located, especially if the ground is wet.
- **Recover uncontaminated product where possible and reutilize or recycle for other beneficial purposes.**
 - Store collected materials in dry, sealed plastic bags or metal containers.

Best practices for handling lime

Skin Protection



Wear a long-sleeved shirt.
Rolled/short sleeves are not recommended.



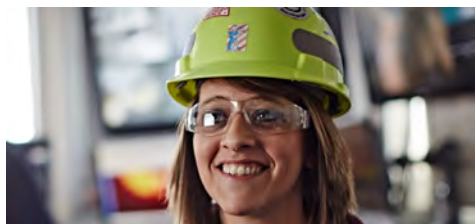
Wear high top shoes or laced boots.



Wear trouser legs tied or taped over shoe tops. Do not wear shorts.



Gloves should be worn and can be taped at shirt sleeve to prevent exposure.



Wear hat or cap to protect scalp from accumulated dust.



Do not wear clothes that bind too tightly around neck or wrists. Chafing may increase skin irritation.



Apply a protective barrier cream to exposed body parts when you will be exposed to lime dust for a prolonged period.



Showers and/or other means of washing hydrated lime from the body should be available.

Best practices for handling lime

Eye Protection



Wear safety glasses with side shields at a minimum.



Use safety goggles if a visible dust is created.



Do NOT wear contact lenses while handling lime.



Ensure you have eye wash equipment in service and can get to it if needed.



Take care when removing glasses or goggles to prevent accumulated dust from falling into eyes.

Best practices for handling lime



Respiratory Protection



Wear a dust mask (such as a paper N95 rated mask) if there is airborne dust or if dust will be created. Make sure that it fits properly and make sure you wear it.



Full face respirator or PAPR are optional based upon site Hazard Assessment results.



Engineering controls such as dust collection may be required.



Lime in the nixtamalization process (cont.)

3. Washing and Rinsing

- Removes loose pericarp, excess lime, and nejayote.
- Nixtamal is stirred and sprayed under pressure.
- Goal is 45 – 55% moisture in the nixtamal.
- Should be “squeaky” clean after this step

4. Grinding/Milling

- This step converts cleaned nixtamal to masa dough.
- Uses traditional volcanic stone grinders (most common), silicon carbide, or aluminum oxide
- Particle size chosen based on the type of maize product (Corn chips = coarse, corn tortillas = fine)
- Place to add preservatives, enzymes and other ingredients



Recommended first aid supplies



**West Penetone
Skin Protective
Cream 311**

www.penetone.com



**EyeSaline
Wall Station**

Amazon
Grainger



**Stye Sterile
Lubricant Eye
Ointment**

www.stye.com

Amazon
Walgreens



**5:1 ratio of
vinegar and
water blend for
rinsing skin***

* Never use
vinegar in the
eyes!

FSSC certified for food safety assurance

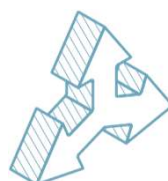


Process-based approach to food safety management, providing continuous assurance



**Recognized
Globally**

**Accepted by key accreditation
bodies** around the world,
including the
Global Food Safety Initiative (GFSI)



**Integrated and
Comprehensive**

Incorporates and builds upon
ISO 22000, HACCP, PAS 220 PRPs, as
well as integrating with other
important certifications and
schemes, such as ISO 9001



**Process-Based for
Continuous
Compliance**

Certifies the management process,
which promotes continuous
compliance and safety assurance
through rigorous auditing,
monitoring, and controls

**MLC maintains rigorous standards, certifications, and protocols
to protect the quality and safety of food-grade products.**

Equipment Services



T83 Trailer Mix System



Tote Mix System



T64 Trailer Mix System



T104 Trailer Make-Down System

Portable high-solids hydrated lime equipment can be used to:

- Supply lime slurry uninterrupted during retrofitting or maintenance on existing lime slurry systems
- Assist in education or on-site trials
- Validate operational savings over quicklime slaking or other chemicals