



PerMix

Perfect Mixing Technologies

Sterilization & Instantization of Powders

From Spices to Baby Formula: How the PerMix PAMD-SS Steam Injection Sterilizer Is Transforming Powder Processing

Steam sterilization has long been a balancing act between achieving microbial kill and preserving product quality. The PerMix PAMD-SS Steam Injection Sterilizer has changed that equation. Engineered as a fluidized-zone vertical paddle mixer, it delivers validated sterilization of powders using saturated steam — without clumping, over-hydration, or loss of functionality. From spice processors to infant nutrition manufacturers, industries are discovering how this single machine achieves food safety, uniform results, and product integrity.

The Science Behind the PAMD-SS

Inside the PAMD-SS, a precisely orchestrated sequence takes place:

1. Fluidization & Pre-Conditioning

Rotating paddles suspend powders in a dynamic fluidized bed, creating uniform heat transfer and eliminating cold zones. Optional jacket heating pre-warms the material to within 10°C of target temperature.

2. Steam Injection Phase

Clean, culinary-grade steam is injected through multiple sanitary nozzles. Because the bed is fluidized, steam disperses instantly across every particle surface. The process achieves lethal microbial reduction while adding less than 0.5 % moisture in most cases.

3. Controlled Hold Time

Using the built-in PLC/HMI, the cycle is programmed for precise temperature and dwell time — typically **121–135 °C for 15–180 seconds**, depending on microbial load, product sensitivity, and required log reduction.

4. Vacuum-Assisted Drying & Cooling

Once sterilization is complete, the integrated vacuum system removes residual steam and moisture. Cooling jackets or chilled-water circuits bring product temperature down rapidly, ensuring the powder remains free-flowing.

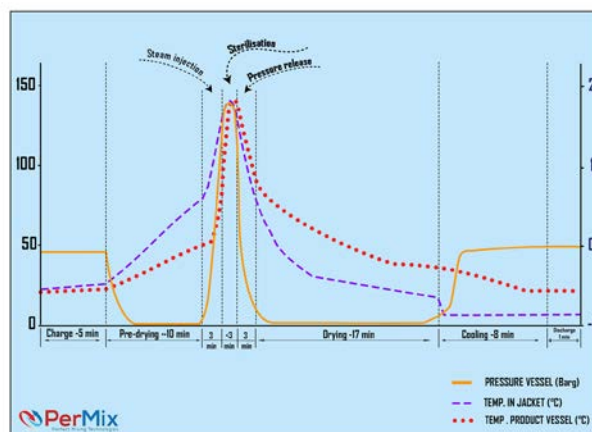
5. Verification & Batch Reporting

Temperature, humidity, and pressure sensors continuously monitor the process. Batch data, including F_0/A_0 values, are recorded automatically for QA validation and full traceability compliant with **21 CFR Part 11** when required.



Key Engineering Options:

- 316L stainless contact parts (304 non-contact standard)
- Sanitary design with polished welds and HEPA-filtered venting
- Load cells for batch weighing and steam-mass balance
- PAT inline moisture sensors
- CIP/SIP or dry-CIP capability
- ATEX/IECEx configurations for explosive powders
- N₂ or CO₂ inerting for oxidation-sensitive materials



The graph illustrates the changes in temperature and pressure over time during the sterilization process. The X-axis represents time, and the Y-axis represents temperature (dotted red and blue line) and pressure (yellow line).

Applications Across Industries

Spices & Herbs

Objective: Eliminate Salmonella and spoilage organisms without damaging volatile oils or color.

- Process: 121–128 °C for 30–90 s with < 0.6 % moisture gain.
- Techniques: Inert-gas blanket and rapid vacuum-dry cycle prevent aroma loss.
- Result: Pathogen-free, vibrant spices with authentic flavor and appearance.



Infant Formula & Baby Foods

Objective: Destroy Cronobacter sakazakii and Salmonella while maintaining nutrient stability.

- Process: 120–125 °C for 30–60 s under low-oxygen, low-moisture conditions.
- Techniques: Gentle heat curve avoids denaturing milk proteins or vitamins; probiotics and heat-sensitive actives can be added post-sterilization.
- Result: Sterile, free-flowing base powders ready for final blending and packaging.



Dairy Powders (WPC, WPI, SMP)

Objective: Reduce microbial load while preserving solubility and functionality.

- Process: 118–124 °C for 20–60 s.
- Techniques: Rapid vacuum-dry prevents casein denaturation; optional de-agglomerator ensures instantization.
- Result: Safe, easily dispersible dairy ingredients suitable for high-end formulations.



Nutraceuticals & Botanicals

Objective: Lower total plate count without degrading active compounds.

- Process: 118–122 °C for 60–120 s.
- Techniques: Inert-gas environment and precise humidity control preserve polyphenols and alkaloids.
- Result: Sterilized botanical extracts retaining potency and color.

Plant Proteins & Sports Nutrition Powders

Objective: Achieve microbial safety while maintaining texture and amino acid integrity.

- Process: 121–128 °C for 30–90 s with ≤ 0.5 % moisture gain.
- Techniques: Controlled steam dose combined with rapid vacuum cooling prevents denaturation.
- Result: Sterilized, odor-free proteins that retain solubility and flavor.



Applications Across Industries Continued

Bakery, Cocoa & Flavor Bases

Objective: Microbial control with full flavor retention.

- Process: 121–125 °C for 30–60 s.
- Techniques: Progressive steam ramping avoids "hot spots"; immediate vacuum-cool stabilizes volatile compounds.
- Result: Hygienic, aromatic powders that flow and dose perfectly.



Starches & Carbohydrate Powders

Objective: Kill spores without gelatinization.

- Process: 118–121 °C, short pulse.
- Techniques: Precise humidity control and rapid drying preserve granule structure.
- Result: Functional starches with unchanged viscosity profiles.



Pet Food & Feed Premixes

Objective: Sanitize animal nutrition powders for pathogen control and shelf stability.

- Process: 121–130 °C for 30–60 s depending on fat load.
- Techniques: Specialized steam diffusers handle greasy powders; sanitary construction allows full CIP.
- Result: Safe, nutrient-stable meal powders ready for extrusion or packaging.



Pharmaceutical Excipients & API Carriers

Objective: Bioburden reduction in lactose, MCC, or starch blends.

- Process: 121–125 °C for 30–120 s.
- Techniques: Validation via F_0/A_0 ; documentation with audit trails; gentle agitation preserves PSD.
- Result: Sterile excipients meeting pharmacopoeia standards.



Tea, Superfoods & Functional Blends

Objective: Yeast/mold reduction while keeping natural colors and actives.

- Process: 118–122 °C for 60–120 s.
- Techniques: Controlled humidity and inert gas avoid oxidation of sensitive ingredients such as matcha or beetroot powder.
- Result: Vibrant, clean, and free-flowing products for high-value blends.



Why the PAMD-SS Excels

Uniform Lethality:	Minimal Moisture Uptake:	Product Integrity:	Regulatory Confidence:
The fluidized zone ensures every particle reaches target temperature for full microbial kill.	Steam condenses as a microscopic film and is immediately removed under vacuum.	Short dwell times prevent flavor degradation, protein denaturation, and caking..	Fo/A ₀ validation, electronic batch reports, and full traceability meet HACCP, FDA, and EU standards.

Typical System Parameters

Parameter	Range/Value
Temperature	100 - 125 °C
Hold Time	15 - 360 s
Moisture Gain	< 0.5 % typical
Working Capacity	25 L – 3,000 L
Total Cycle	30 - 60 min (load to unload)
Materials	304/316L SS, polished sanitary finish
Options	Vacuum, inerting, CIP/SIP, ATEX/IECE _x , PLC/HMI data logging

The Outcome

Across industries, the PerMix PAMD-SS gives processors a validated kill step for powders without the compromises of conventional heat treatment. Whether it's black pepper, plant protein, or infant formula base, the result is the same:

- Microbially safe product
- Consistent color, aroma, and taste
- Preserved functionality
- Documented, repeatable process

In short, the PAMD-SS turns the once-difficult challenge of powder sterilization into a science of precision — making PerMix the trusted partner for manufacturers from spices to baby formula and every blend in between.

Instantization of Powders: How PerMix Makes Powders Flow, Dissolve, and Perform Better

When powders are "instantized," they transform from ordinary to exceptional — they mix faster, dissolve easier, and perform better in everything from protein shakes to pharmaceuticals. Instantization is where science meets convenience, and the PerMix Instantization System turns that science into an engineered process. Using controlled agglomeration with steam, liquid injection, and fluidized mixing, PerMix takes fine powders that normally clump or float and converts them into free-flowing, instantly dispersible products. Whether it's whey protein, coffee, infant formula, nutraceutical blends, or food ingredients, instantization adds measurable value to every batch.

What Is Instantization?

Instantization is the process of modifying powder particles to improve how they wet, disperse, and dissolve in liquids. Fine powders often repel water due to static charge, particle shape, or surface chemistry. By lightly agglomerating the particles into porous granules and binding them with controlled moisture or steam, PerMix creates powders that:

- **Disperse instantly** when added to liquid
- **Stay suspended** without caking or floating
- **Increase** bulk density and flowability
- **Maintain** original chemistry and activity

In short: instantization makes powders behave better without changing what they are.

How the PerMix Instantization Process Works

At the heart of the system is the **PerMix PAMD-SS or PFB-SD Series**, engineered for high-shear fluidization, precision dosing, and controlled thermal or moisture input.

1. Fluidization

The paddles suspend powder particles in a moving bed, creating an ideal environment for even exposure. The dynamic fluidization ensures that moisture, binders, or steam reach every particle simultaneously — the foundation of uniform agglomeration.

2. Steam or Liquid Injection

PerMix systems inject steam or atomized liquid through sanitary nozzles. Depending on the recipe, this may be water, sugar syrup, lecithin solution, oil, or a combination. The goal is to form tiny bridges between particles, allowing micro-agglomerates to form without over-wetting.

3. Agglomeration Phase

As particles collide and bind, the fluidized mixing action controls granule size. Process parameters like air temperature, humidity, and residence time are adjusted through the PLC/HMI interface. Typical exposure times are 10–60 seconds, ensuring precise agglomeration without denaturing heat-sensitive materials.

4. Drying & Stabilization

Vacuum or heated jacket drying removes the added moisture quickly. The result is a stable, porous agglomerate that remains dry and free-flowing. For sensitive products like proteins or nutraceuticals, low-temperature vacuum drying maintains bioactivity.

5. Cooling, Conditioning & Discharge

A final cooling cycle locks in structure and flow characteristics. Optional inline screening can ensure consistent particle size distribution (PSD) before packaging or downstream processing.



Why Choose PerMix for Instantization

The PerMix system's secret lies in its control. Every stage — from liquid atomization to drying and cooling — is programmable, repeatable, and gentle on the product.

- Instant wetting & dispersion achieved through precise steam or liquid dosing.
- Agglomerate uniformity ensured by fluidized mixing geometry.
- Minimal product loss with low dust generation and efficient moisture control.
- Short process times (5–15 minutes per batch) for high throughput.
- Scalable design from lab (5 L) to production (5,000 L).
- Materials of construction: 304, 316L, Hastelloy, or Hardox for abrasive powders.
- Options: vacuum drying, inert gas blanketing, integrated spray systems, load cells, CIP/SIP cleaning, and explosion-proof or ATEX designs.



Applications Across Industries

1. Protein Powders & Sports Nutrition

Goal: Create easily mixable powders that dissolve instantly in water or milk.

Method: Steam or liquid binder (e.g., soy or sunflower lecithin) lightly agglomerates protein fines into uniform granules.

Result: Smooth texture, no foaming or clumping, improved yield in filling lines.

2. Infant Formula & Nutritional Blends

Goal: Enhance solubility and dispersibility while maintaining nutrient value.

Method: Controlled steam injection followed by vacuum drying ensures sterility and flow without denaturing sensitive components.

Result: Uniform reconstitution, long shelf life, and precise consistency.

3. Coffee, Cocoa, and Beverage Mixes

Goal: Achieve rapid solubility and smooth mouthfeel.

Method: Steam agglomeration or fine mist addition of sugars or oils to bond hydrophobic particles.

Result: Powders that dissolve even in cold liquids — the "instant coffee" phenomenon perfected.

6. Functional Ingredients (Starches, Fibers, Minerals)

Goal: Improve dispersibility in liquid systems.

Method: Moisture-controlled steam exposure allows partial granule surface activation.

Result: Enhanced hydration, viscosity control, and smooth texture in sauces, soups, and beverages.

4. Dairy Powders (Whey, Casein, SMP)

Goal: Improve wetting and dispersibility for reconstitution.

Method: Steam pulse instantization with moisture gain <0.5 %, followed by vacuum cooling.

Result: Uniform, dust-free agglomerates with excellent solubility and shelf stability.

5. Nutraceuticals, Vitamins & Herbal Blends

Goal: Enhance flow, reduce dust, and ensure homogeneous reconstitution.

Method: Atomized binding with starch or maltodextrin solutions; optional steam treatment for microbial reduction.

Result: Consistent, consumer-friendly powder blends that maintain potency.

Engineering Details That Set PerMix Apart

- **Steam Control System:** Modulates flow, temperature, and pressure for consistent energy delivery.
- **Atomizing Nozzles:** Adjustable droplet size and distribution ensure perfect binder spread.
- **Integrated Vacuum Drying:** Removes moisture in seconds without overheating the product.
- **Chopper System:** Prevents over-agglomeration and maintains uniform particle size.
- **Instrumentation:** Multipoint RTDs, humidity probes, and inline moisture sensors for real-time control.
- **PLC/HMI with Recipe Management:** Ensures repeatability and quality validation.

Typical Process Parameters

Parameter	Typical Range
Steam Temperature	115–130 °C
Hold Time	10–60 s
Vacuum Level	-0.8 to -0.95 bar
Moisture Gain	< 0.5 %
Batch Cycle	5–15 min
Granule Size	100–500 µm adjustable

The Instant Advantage

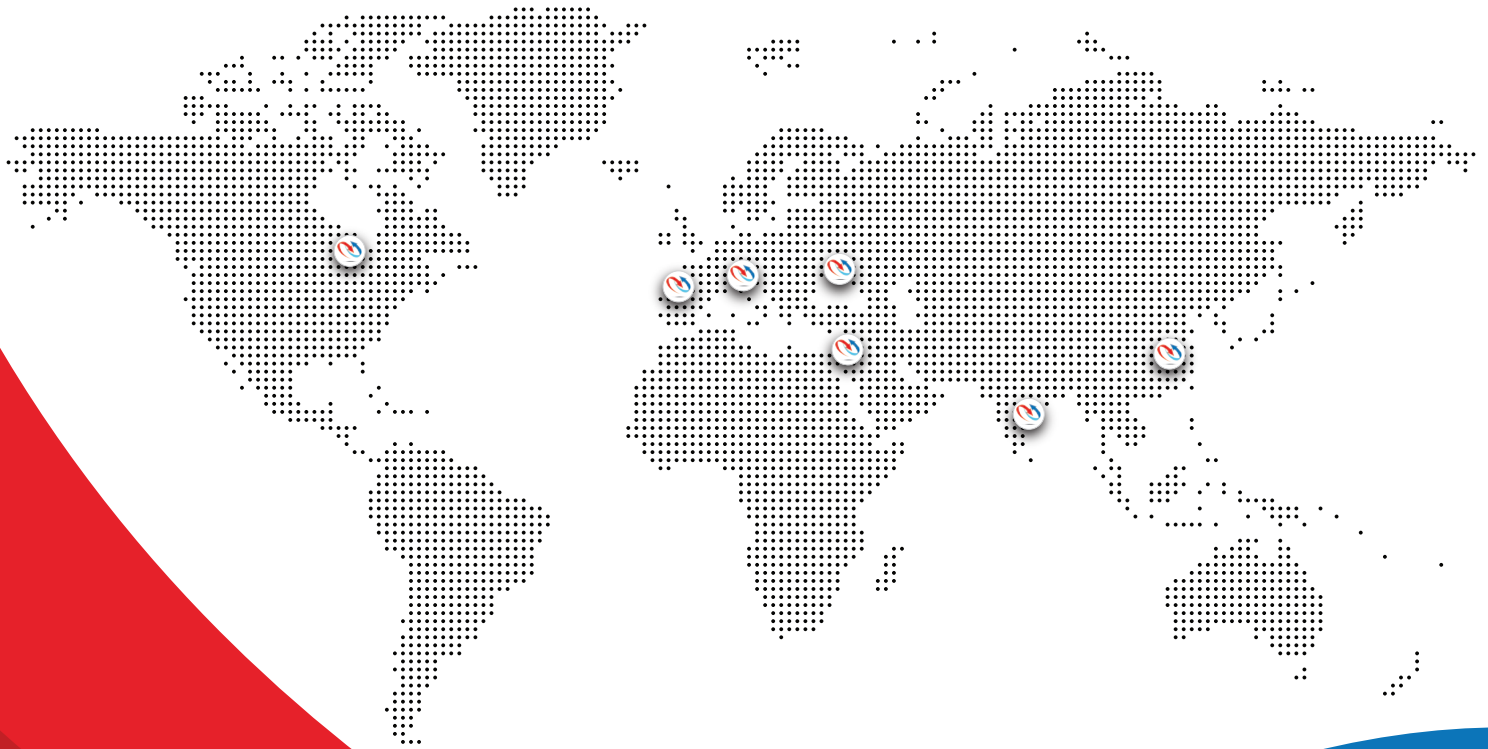
With the PerMix instantization system, manufacturers gain:

- **Better performance in liquids** — faster dispersion and no residue.
- **Higher yield** — reduced dust loss and improved filling efficiency.
- **Improved sensory quality** — smoother texture, balanced flavor, and stable color.
- **Enhanced safety** — optional simultaneous microbial reduction with steam.
- **Lower costs** — reduced process time and energy consumption.



From a technical standpoint, instantization is a controlled balance between heat, moisture, and motion — and PerMix has perfected that balance. By merging fluidized mixing with steam or atomized liquid dosing, the PerMix system creates powders that are **safe, stable, and instantly functional**.

From **protein supplements and baby formula to coffee, cocoa, and nutraceutical blends**, PerMix gives processors the tools to turn simple powders into **high-performance instant products** — faster, cleaner, and more efficiently than ever before.



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