PROC-X

MANUPACTURING CROUP

PreciXion | DP | AIS | FuXion | EmuXion | QuanXion | QuantumX

COMPLETE PROCESSING SOLUTIONS FOR THE SPICE INDUSTRY

From Raw Ingredient Receiving to Finished, Food-Safe, Free-Flowing Spice Products

Bulk Material Handling • Dosing • Milling • Blending • Sterilization • Instantization • Agglomeration • Inspection • Packaging

Spices may look simple.
Processing them consistently is not.

A modern spice processing facility must simultaneously control particle size, aroma and volatile oil retention, color, moisture, water activity, microbial load, bulk density, blend uniformity, flowability, dust generation, cross-contamination, allergen segregation, foreign-material risk, operator exposure, explosion hazards, and product traceability.

Proc-X Manufacturing Group engineers the equipment between these variables—not simply individual machines.

Through specialized technologies for bulk material handling, milling, mixing, thermal processing, product inspection, and packaging, Proc-X develops complete systems designed around the physical behavior and quality requirements of the spice being processed.

Engineered Around the Process.

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SPICES ARE NOT JUST POWDERS

Understanding the Material Is the Beginning of Good Process Design

Spice processing presents a combination of challenges rarely encountered together in other dry-food applications.

A dried chili, black peppercorn, coriander seed, turmeric root, garlic powder, cinnamon, oregano, paprika, and seasoning premix can behave completely differently inside the same processing equipment.

Effective system design begins by understanding these differences.

PARTICLE CHARACTERISTICS

Spices may enter the process as:

- Whole seeds
- Roots
- Bark
- Dried leaves
- Dried fruit
- Flakes
- Granules
- Coarse powders
- Fine powders
- Extract-coated powders
- Salt-containing blends
- Sugar-containing blends

Their response to conveying, grinding, blending, and thermal processing varies accordingly.

OIL CONTENT

Many spices contain significant quantities of natural oils.

During aggressive grinding, mechanical energy becomes heat. Excessive temperature can:

- Release volatile oils
- Change aroma profiles
- Darken product
- Produce smearing within the mill
- Increase screen blinding
- Create sticky powders
- Reduce storage stability

The correct milling technology must therefore be selected based on more than particle size alone.

BULK DENSITY

Spice ingredients within a formulation may have dramatically different bulk densities.

If uncontrolled, density differences can contribute to:

- Segregation
- Poor feeding accuracy
- Inconsistent blender charging
- Variable package weights
- Non-uniform finished product

PARTICLE SHAPE

A ground pepper particle behaves differently from a leaf flake.

Fibrous materials may resist fracture. Crystalline materials fracture easily. High-oil products may deform instead of fracture.

"There is no universal spice mill— and there should not be a universal spice process."

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ONE PROCESS. ONE ENGINEERING RESPONSIBILITY.

A Complete Proc-X Spice Processing Architecture

Proc-X approaches spice processing as an interconnected production system.

01 RECEIVING

Raw materials can arrive in:

- Bulk bags / FIBCs
- Paper sacks
- Plastic sacks
- Drums
- IBCs
- Totes
- Gaylords
- Bulk silos

02 STORAGE

Ingredients can be transferred into:

- Day bins
- Surge hoppers
- Silos
- Mobile IBCs
- Small-ingredient bins

03 DOSING

Accurate batch formulation using:

- Loss-in-weight feeders
- Gain-in-weight systems
- Load-cell hoppers
- Screw feeders
- Vibratory feeders
- Manual micro-ingredient stations

04 MILLING

Particle-size reduction using the appropriate grinding technology for the spice and target PSD.

05 BLENDING

Homogeneous mixing of spices, salt, sugar, starches, carriers, flavors, colors, and functional ingredients.

06 STERILIZATION

Microbial reduction using controlled thermal, vacuum, moisture, and residence-time conditions.

07 INSTANTIZATION / AGGLOMERATION

Modification of fine powders to improve wettability, dispersibility, flowability, bulk density, and dust control.

08 SCREENING & INSPECTION

Removal of oversize and foreign material with integrated sieving and metal detection.

09 PACKAGING

Automated filling into bags, pouches, jars, containers, bulk bags, and cartons.

10 AUTOMATION

One control philosophy can coordinate the entire process.

Proc-X engineers the interfaces between each unit operation—not merely the individual machines.

BULK MATERIAL HANDLING

Moving Spices Without Destroying the Product

AIS — Automated Ingredient Systems

The first challenge in a spice facility is often not grinding or mixing. It is getting the ingredients to those machines predictably.

Improper conveying can create:

- Product degradation
- Dust
- Segregation
- Ingredient loss
- Cross-contamination
- Excessive fines
- Material buildup
- Poor feeding accuracy

***Proc-X / AIS** engineers conveying technology around the product.*

PNEUMATIC CONVEYING

Dilute Phase

Suitable where:

- Product degradation is acceptable
- Conveying distance is moderate
- High conveying velocity is practical

Advantages include:

- Simple routing
- Enclosed transfer
- Flexible plant layouts
- Multiple pickup and discharge points

Dense Phase

Dense-phase conveying uses lower gas velocity and higher solids loading.

For sensitive spices, this can reduce:

- Particle degradation
- Attrition
- Dust generation
- Product heating
- Pipeline wear

Dense-phase systems are particularly valuable where preserving flakes, granules, or particle structure is important.

MECHANICAL CONVEYING

Applications may utilize:

- Flexible screw conveyors
- Tubular drag conveyors
- Bucket elevators
- Belt conveyors
- Screw conveyors

"The correct solution depends upon distance + elevation + particle fragility + sanitation requirement + throughput + plant layout."

INGREDIENT DOSING

Accuracy Starts Before the Mixer

A blender cannot correct an inaccurate formulation.

Proc-X designs dosing systems around ingredient consumption and required weighing accuracy.

MACRO INGREDIENT DOSING

Macro ingredients represent the larger portions of the formulation.

Typical examples may include:

- Salt
- Sugar
- Starch
- Major spice components
- Carriers
- Flour
- Maltodextrin

Typical Technologies

- Load-cell mounted weighing hoppers
- Loss-in-weight screw feeders
- Gain-in-weight batch systems
- Pneumatic transfer from silos
- Big-bag discharge stations
- IBC/tote discharge

WEIGH HOPPERS | LOSS-IN-WEIGHT SCREW FEEDER | PNEUMATIC TRANSFER | BIG-BAG DISCHARGE

MICRO INGREDIENT DOSING

The smallest ingredients often have the largest effect on the finished product.

Examples include:

- High-potency flavors
- Extracts
- Colors
- Anti-caking agents
- Functional ingredients
- Preservatives

Micro ingredients may require much tighter weighing tolerances.

Solutions include:

- Individual loss-in-weight feeders
- Small screw feeders
- Vibratory feeders
- Automated micro-batch weighing
- Barcode-assisted manual additions

MICRO SCREW FEEDER | VIBRATORY FEEDER | MICRO-BATCH WEIGHING | MANUAL ADDITION (BARCODE ASSISTED)

THE ENGINEERING PRINCIPLE

The required weighing accuracy should be evaluated relative to the actual ingredient addition, not merely the maximum capacity of the scale.

A system capable of weighing hundreds of kilograms accurately may still be unsuitable for a formulation requiring repeatable additions of a few hundred grams.

SPICE MILLING TECHNOLOGY

Particle Size Reduction Is a Process—Not a Machine Selection

The correct mill depends upon the fracture mechanics of the ingredient and the desired finished-product characteristics.

Proc-X can engineer systems around multiple milling principles.

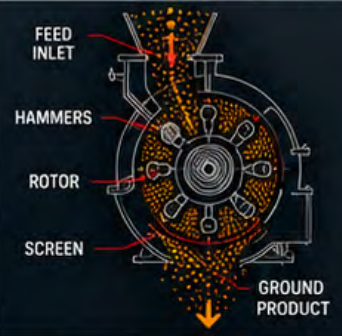
DP Milling Technologies

1 HAMMER MILLING

Well suited for:

- General-purpose size reduction
- Coarser spice grinding
- Robust feed products
- High throughput

Particle size is controlled through rotor speed, hammer configuration, and screen opening.



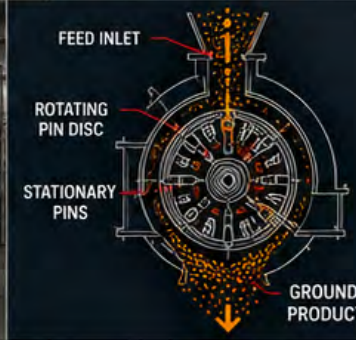
2 PIN MILLING

High-speed impact between rotating and stationary pins.

Particularly effective for:

- Fine spice powders
- Crystalline ingredients
- Controlled dry grinding

Pin mills can produce relatively fine products without requiring conventional screens in every configuration.

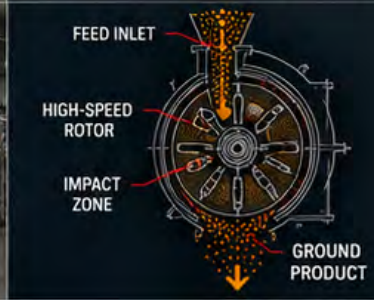


3 TURBO / IMPACT MILLING

High-speed rotor systems provide intensive impact and turbulence.

Suitable for:

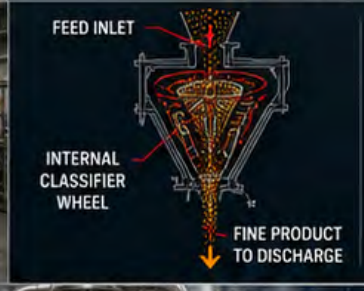
- General spice grinding
- Fibrous materials
- High-throughput applications
- Intermediate-to-fine particle sizes



4 AIR CLASSIFYING MILLING

The mill combines grinding and internal aerodynamic classification.

Particles remain in the grinding chamber until sufficiently fine to pass the classifier.



Advantages include:

- Narrower particle-size distributions
- Adjustable cut point
- Reduced reliance on screens
- Fine grinding capability
- Closed-loop system possibilities

CRYOGENIC MILLING

When spice quality is limited by temperature, the solution may be to control the temperature rather than simply change mills.

IDEAL FOR:

- Heat-Sensitive Spices
- Volatile Retention
- Resinous Materials
- Quality Preservation

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CRYOGENIC SPICE MILLING

Protecting Volatile Oils, Aroma and Color

Grinding creates heat.

For oil-rich and temperature-sensitive spices, this heat can become a process limitation.

Cryogenic grinding introduces a controlled cooling medium—typically liquid nitrogen—into the feed or milling circuit.

This can reduce product temperature sufficiently to make oily or elastic materials more brittle.

POTENTIAL BENEFITS

- Reduced volatilization of aromatic compounds
- Lower grinding temperature
- Reduced product smearing
- Reduced mill fouling
- Improved fracture behavior
- Finer grinding potential
- Better color retention
- Improved throughput on difficult products

COMMON APPLICATIONS

Cryogenic processing may be evaluated for:

- Nutmeg
- Clove
- Cinnamon
- Cumin
- Coriander
- Chili
- Pepper
- Cardamom
- Other oil-rich spices

LOWER TEMPERATURE. PRESERVED QUALITY.

AROMA ↑ COLOR ↑ OIL RETENTION ↑

Cryogenic grinding should not automatically be specified simply because a spice contains oil.

Proc-X evaluates: feed temperature • oil content • desired PSD • target throughput • allowable product temperature • nitrogen consumption • final product characteristics

The result is an engineered process rather than unnecessary operating cost.

Engineered Around the Process.

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PRECISION SPICE BLENDING

Homogeneity Without Destroying the Product

QuantumX *Mixing Technologies*

Spice blending can involve components differing significantly in particle size, bulk density, shape, flowability, concentration, and oil content.

The mixer must create homogeneity while minimizing unnecessary particle damage.

1 RIBBON MIXERS

Double-ribbon agitators generate axial and radial product movement.

Ideal for many:

- Seasoning blends
- Dry spice blends
- Salt/spice combinations
- Powder formulations

Advantages:

- Proven technology
- Large batch capacities
- High throughput
- Relatively simple operation

2 PADDLE MIXERS

Paddle agitators produce strong convective movement while generally treating particles more gently than aggressive high-shear systems.

Useful for:

- Fragile products
- Spice flakes
- Low-density powders
- Rapid batch turnover

3 PLOUGH MIXERS

Plough-shaped mixing tools create intense three-dimensional product movement.

Optional high-speed choppers can break agglomerates and disperse small ingredients.

Suitable where processes require:

- Rapid mixing
- Liquid addition
- Agglomerate breakup
- Coating
- Conditioning
- Intensive dispersion

4 CONICAL MIXERS

Low-shear mixing systems can be selected where:

- Product degradation must be minimized
- Gentle blending is required
- Low residual product retention is important

> *"The best mixer is the mixer matched to the product— not the mixer a supplier happens to manufacture."*

LIQUID ADDITION, COATING & CONDITIONING

Adding More Than Dry Ingredients

QuantumX Mixing Technologies

Modern seasoning formulations increasingly incorporate liquids. These may include flavor oils, oleoresins, extracts, water, emulsions, binding agents, and anti-dusting agents.

Simply spraying a liquid into a powder does not guarantee uniform distribution. Successful liquid addition requires controlling droplet size, spray pattern, addition rate, powder movement, local wetting, mixing intensity, addition time, and post-addition mixing.

PROC-X SYSTEMS CAN INCORPORATE:

- Metering pumps
- Spray manifolds
- Atomizing nozzles
- Heated liquid circuits
- Jacketed piping
- Load-cell verification
- Recipe-controlled addition

High-speed choppers or intensifiers can be incorporated where localized wet agglomerates must be broken apart.

"The objective is not simply to add the correct quantity. It is to distribute that quantity across the greatest possible product surface area."

SPICE STERILIZATION & MICROBIAL REDUCTION

Food Safety Without Unnecessarily Sacrificing Quality

Proc-X vacuum processing systems use combinations of heat, moisture, vacuum, residence time and agitation to achieve validated microbial reduction while preserving aroma, color, and volatile oils.

THE REAL OBJECTIVE

- Achieve the required microbial reduction while controlling aroma
- Protect natural color and visual appeal
- Preserve volatile oils and flavor impact
- Control moisture and water activity
- Maintain ideal texture and flowability
- Deliver consistent, validated results
- Ensure food safety and regulatory compliance

TYPICAL VACUUM PROCESS CYCLE

1 LOAD
Product is charged into a closed hygienic vessel.

2 PRECONDITION
Agitation establishes a uniform product bed.

3 THERMAL / MOISTURE TREATMENT
Controlled steam, moisture and heat expose the product to validated conditions.

4 HOLD
Required temperature and exposure time are maintained.

5 VACUUM DRYING
Vacuum removes added and inherent moisture.

6 COOLING
Product is cooled to a stable discharge temperature.

7 DISCHARGE
Processed spice moves to downstream screening, inspection, or packaging.

> *"The goal is not simply to reach high temperature — it is to achieve microbial reduction while controlling quality."*

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INSTANTIZATION & AGGLOMERATION

Turning Difficult Fine Powders Into Functional Ingredients

Instantization modifies fine powders to improve wettability, dispersibility, flowability, bulk density and dust control by creating controlled porous agglomerates.

THE AGGLOMERATION PROCESS

1. **CONDITION** — Fine powder enters the process.
2. **WET** — A precisely controlled liquid is introduced.
3. **NUCLEATE** — Fine particles form small agglomerate nuclei.
4. **GROW** — Particles attach and agglomerates develop.
5. **DRY** — Excess moisture is removed.
6. **CLASSIFY** — Oversize and undersize fractions are separated.
7. **RECYCLE** — Off-specification fines are returned to the process.

IDEAL FOR A WIDE RANGE OF APPLICATIONS:

- Beverage seasonings
- Soup mixes
- Broths
- Sauce powders
- Instant culinary products
- Functional spice blends

> *"Agglomeration turns difficult fine powders into more functional and user-friendly ingredients."*

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HYGIENIC DESIGN & CLEANABILITY

Every Product Contact Surface Matters

QuantumX Mixing Technologies

Spice processing often involves allergens, strong colors, strong aromas, and oils that can be difficult to remove.

Proc-X equipment is engineered for complete cleanability—protecting product integrity, minimizing changeover time, and meeting the most stringent food safety standards.

- 304 or 316L stainless steel construction
- Ground & polished welds
- Radiused internal corners
- Minimized horizontal surfaces
- Hygienic seals & sanitary fittings
- Tool-free access & inspection doors
- Removable spray devices
- Hygienic bearing arrangements
- Reduced internal ledges
- Drainable construction

BUILT FOR EFFECTIVE CLEANING & SANITATION

Every detail—from weld finish to spray pattern—is designed to reduce residue, limit cross-contamination, and ensure consistent, reliable sanitation every time.

DRY CLEANING

- Vacuum cleaning
- Wipe-down with food-safe cloths
- Compressed-air cleaning where permitted
- Rapid internal access for fast turnaround

WET CLEANING / CIP

- CIP spray devices
- Automated wash sequences
- Heated cleaning solutions
- Chemical dosing
- Rinse cycles
- Drainability for complete removal

> *"Cleanability should be engineered into the equipment—it cannot effectively be added after fabrication."*

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DUST CONTROL & EXPLOSION PROTECTION

Fine Spice Dust Is a Process-Safety Issue

Many organic powders—including spices, herbs, and seasoning blends—can form combustible dust clouds under the right conditions.

Spice processing systems must be evaluated for dust explosibility, minimum ignition energy (MIE), Kst, Pmax, dust concentration, potential ignition sources and equipment location.

ENGINEERING CONTROLS THAT PROTECT PEOPLE, EQUIPMENT & FACILITIES

- ATEX-compliant equipment
- Explosion venting / flameless venting
- Explosion isolation / suppression systems
- Conductive equipment, bonding & grounding
- Dust-tight construction
- Differential-pressure monitoring
- Central dust collection
- Local extraction
- Nitrogen inerting where appropriate

ENCLOSED PRODUCT TRANSFER

Closed conveying and processing systems reduce dust generation, operator exposure, product loss, cross-contamination and airborne contamination.

> *"The best way to control dust is not to create it in the production environment."*

AUTOMATION, RECIPE CONTROL & TRACEABILITY

Repeatable Products Require Repeatable Processes

1 AUTOMATION CAPABILITIES

- Ingredient selection & batch weighing
- conveying sequences
- mixer charging & discharge
- mixing time & speed
- liquid additions
- temperature & vacuum control
- sterilization cycles
- discharge & cleaning sequences
- alarm & interlock management

2 RECIPE MANAGEMENT

Recipes define ingredient identity, quantity, addition sequence, mixing duration, mixing speed, liquid-addition parameters, temperature setpoints, vacuum setpoints and sterilization hold time.

3 PROCESS RECORDS

- Actual ingredient weights
- batch and lot numbers
- process temperatures
- cycle times & alarms
- sterilization records
- operator identification

Proc-X systems can be engineered around Siemens or Allen-Bradley PLC / HMI platforms depending on customer requirements.

"Modern recipe control improves consistency, traceability and recall readiness."

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FROM PROCESSING TO FINAL PACKAGE

Finishing the Line

Reliable, end-to-end finishing solutions that protect product integrity and deliver consistent quality in every package.

1 SCREENING
Removes oversize agglomerates and foreign material.

2 METAL DETECTION
(InspeX)
Gravity-fall, pipeline and conveyorized product inspection systems.

3 CHECKWEIGHING
Verifies package weights meet specifications.

4 PACKAGING
(PreciXion)
Bags, pouches, jars, containers, cartons and bulk bags.

5 BULK PACKAGING
20–25 kg bags, drums, IBCs and FIBCs / bulk bags.

Integrated. Inspected. Packaged.

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THE PROC-X DIFFERENCE

One Engineering Partner. One Process Responsibility.

We do not start with a machine. We start with your product.

A spice process is an interaction between material properties, equipment geometry, energy input, temperature, moisture, residence time and automation.

AIS		**Automated Ingredient Systems:** Bulk material handling, conveying, storage, dosing, weighing.
DP		**Milling Technologies:** Size reduction, fine grinding, air classification, cryogenic milling.
QuantumX		**Mixing & Thermal Processing:** Ribbon, paddle, plough, conical, vacuum, sterilization, agglomeration.
InspeX		**Product Inspection:** Metal detection, checkweighing.
PreciXion		**Packaging & Filling:** Filling, bagging, packaging, end-of-line solutions.
PROC-X		**Process Engineering & Integration:** Connecting every operation into one coordinated production system.

Engineered for the products you actually process.

Spices • Herbs • Seasonings • Blends • Rubs • Flavors • Functional Ingredients