Application Note: High-Curcumin Turmeric Processing Plant

Turmeric (Curcuma longa) is a "Golden Spice" valued for its Curcumin content, aroma, and colour. However, processing it presents unique challenges:

- **Hardness:** Dried turmeric rhizomes (gattha) are rock-hard and abrasive, requiring heavy-duty pre-crushing.
- **Heat Sensitivity:** The essential oils and Curcumin are highly sensitive to heat. Standard grinding can generate temperatures >90°C, causing volatile oil loss (aroma depletion) and colour degradation (darkening).
- **Staining & Hygiene:** The fine yellow dust is staining and requires strict containment to maintain a clean plant environment.

RIECO Industries provides a specialized **Single Stage Grinding Plant** designed to address these issues. By using its Air Swept Mill we ensure high capacity, precise fineness, and "Cool Grinding" temperatures (< 45°C) to retain the maximum Curcumin value.

The **Air Swept Mill (ASM)** provides a high-efficiency, low-heat grinding solution for producing fine turmeric powder (300–400 microns). Continuous air movement prevents heat build-up, preserves product quality, maintains natural oil content, and ensures a consistent, flowable product.

1.0 Design & Working Principle

The Air-Swept Turmeric Grinding system operates in a continuous closed-loop circuit with controlled feeding, impact grinding, air conveying, and filtration.

Step 1: Vibro Feeder Feeding

Turmeric fingers/bulbs are dosed uniformly via a **Vibro Feeder**.
• Provides smooth material flow
• Controls feed rate to avoid mill overload

Step 2: Inclined Belt Conveyor

Transfers material from feeder to mill inlet.
• Designed for continuous, choke-free feeding
• Ensures stable loading to Air Swept Mill

Step 3: Grinding in Air Swept Mill

Inside the mill, turmeric is reduced by:
• High-speed impact
• Shearing between rotor & liner
• Turbulent airflow carrying material through chamber

- Key advantage:
  Air acts as cooling medium → prevents colour loss & volatile oil loss

Step 4: Pneumatic Conveying to Cyclone

Fine material is picked by conveying air and carried to the cyclone separator.
• Air stream keeps product temperature low
• Ensures uniform particle size

Step 5: Cyclone Separation

Cyclone separates powdered turmeric from conveying air.
• Heavy particles fall into Rotary Air Lock
• Minimizes dust load to bag filter

Step 6: Bag Filter Dust Collection

Remaining ultrafine particles are captured.
• Ensures < 20 mg/Nm³ emissions
• Provides > 99% product recovery

Step 7: Product Discharge

Powder collected below cyclone and bag filter through **two RALs** into collection bins/packing line.

Step 8: Central Control Panel

Controls all motors, interlocks, feeders, and safety parameters.

2.0 Key Components

Component	Function	Key Technical Feature
Air Swept Mill	Responsible for grinding turmeric into fine uniform powder	Screenless design, low-heat operation, impact + air sweep grinding, 300–400 µm fineness
Bag Filter System	Separates fine powder from air & controls dust emissions	Pulse jet cleaning, >99% product recovery, hygienic operation
Centrifugal Fan	Provides required airflow for conveying & cooling	High-volume airflow, ensures <15–20°C temperature rise
Vibro Feeder	Doses turmeric fingers evenly into conveyor/mill	Controlled feeding, avoids mill surges
Inclined Belt Conveyor	Transfers turmeric to mill	Stable, continuous feed, food-grade belt option
Cyclone Separator	Separates powder from conveying air	High separation efficiency, reduces bag filter load
Rotary Air Lock (Below Cyclone & BF)	Air-sealed discharge of product	Ensures steady discharge without air leakage
Control Panel (PLC/HMI)	Controls complete system	VFD-based feeder & fan control, safety alarms, interlocks

3.0 Model Selection & Capacities

Variant	Model	Capacity (Approx.)	Target Fineness
TP-15-SS	**ASM 15 SS 304**	80-100 Kg/hr	95% 400 Microns
TP-25-SS	**ASM 25 SS 304**	150 – 200 kg/hr	95% 400 Microns

4.0 Key Features & Benefits

- **Curcumin Retention:** The "Cool Grinding" airflow design minimizes temperature rise, preventing the oxidation of Curcumin and preserving the bright yellow-orange colour.
- **Low-Heat Grinding:** Preserves Curcumin & Volatile Oils
- **Uniform Powder** Fineness (300–400 microns)
- **Dust-Free Operation:** The entire line is negative-pressure sealed. No yellow dust escapes into the factory, ensuring operator health and hygiene.
- **Wear Protection:** Critical wear parts (hammers, liners) are made from **Hardened Alloy Steel** or **Tungsten Carbide** tipped to withstand the abrasive nature of turmeric.
- **Continuous Industrial Duty:** 24/7
- **Automation:** PLC-controlled feed rates ensure the mills are never overloaded, maximizing uptime.

5.0 Applications

- **Culinary:** Standard 60–80 mesh powder for curry mixes and retail packs.
- **Extraction:** Coarse grits (20–40 mesh) for Oleoresin/Curcumin extraction plants.
- **Nutraceutical:** Ultra-fine (100+ mesh), high-Curcumin powder for capsules and supplements.
- **Natural Colorant:** Super-fine powder for food colouring applications.

6.0 Performance Parameters

- **Input Material:** Dry Turmeric Fingers (< 8% Moisture).
- **Output Fineness:** D95 400 microns
- **Grinding Temp:** Standard: 40–50°C | Cryogenic: -20°C to 10°C.
- **Yield:** > 98% Recovery.

7.0 Automation & Integration

- **Smart Interlocks:** The feed stops automatically if the mill amp load exceeds the set point.
- **Temperature Monitoring:** Sensors in the grinding chamber trigger an alarm if the temperature rises above the safety limit (e.g., 60°C).

- **Metal Detection:** Integrated magnetic separators (10,000 Gauss) and metal detectors ensure the final powder is free from tramp iron.

8.0 Frequently Asked Questions (FAQ)

Q1: Why do you recommend a 2-stage process instead of a single grinder?

A: Turmeric fingers are extremely hard. Using a single machine to go from "Finger to Powder" causes excessive wear and heat. Splitting it into "Crushing" (Stage 1) and "Fine Grinding" (Stage 2) reduces wear, saves power, and keeps the product cooler.

Q2: Will the heat generated during grinding darken my turmeric powder?

A: In a standard hammer mill, yes. But our ACM (Stage 2) uses a high volume of air to cool the product continuously. For extremely critical applications, we can add a Chilled Air System to guarantee the colour remains bright yellow.

Q3: How do you handle the dust? Turmeric dust is very messy.

A: Our system is a Closed-Loop Pneumatic design. From the feed hopper to the packing machine, the material is conveyed inside pipes under vacuum/pressure. The air is filtered through a high-efficiency Bag Filter, so the plant environment remains clean.

Q4: Can I grind other spices on this same plant?

A: Yes. The same system can effectively grind Coriander, Cumin, and Mixed Spices (Masala). However, for very high-oil spices like Chili or Nutmeg, operation parameters (speed/feed) will need adjustment.

Q5: What is the maintenance life of the wear parts?

A: Turmeric is abrasive. Typically, hammers need rotation/replacement every 300–500 hours depending on the material hardness. We use special carbide-tipped hammers to extend this life significantly.

Q6: Does the system include cleaning of the raw turmeric?

A: Yes, we highly recommend our Pre-Cleaning Section (Destoner + Classifier) before grinding. Removing stones and mud balls protects the mill from damage and ensures a hygienic final product.

Q7: Can I get "Agmark" grade powder with this machine?

A: Yes. The system is designed to produce powder that meets Agmark and Export quality standards in terms of fineness, cleanliness, and low temperature processing.

Q8: Is Cryogenic grinding necessary for Turmeric?

A: Not always. For standard food-grade turmeric, our Air Classifying Mill provides sufficient cooling. Cryogenic grinding (using Liquid Nitrogen) is only required for premium pharmaceutical grades or when absolute maximum essential oil retention is critical.