

Application Note: Turmeric Cleaning & Grinding Plant using ACM System

1.0 Introduction

Turmeric is a widely used spice and functional ingredient in food, nutraceutical, and pharmaceutical industries. It is processed from whole dried turmeric fingers and requires controlled multi-stage grinding to achieve uniform fine powder with desired color, aroma, and curcumin retention.

Due to its fibrous structure, relatively hard form, and oil content, direct fine grinding of whole turmeric in a single-stage system is inefficient and can lead to excessive load on the mill, higher energy consumption, and inconsistent particle size distribution (PSD).

To overcome these challenges, a **two-stage grinding approach** is adopted:

- **Stage 1: Coarse grinding using PII Mill (Hammer Mill)**
- **Stage 2: Fine grinding using Air Classifying Mill (ACM)**

This combination ensures efficient size reduction, stable mill operation, and improved overall system performance.

Additionally, turmeric is heat-sensitive and prone to loss of volatile compounds and color degradation if not processed under controlled conditions. Therefore, the integrated system is designed to minimize heat generation and maintain product quality.

The complete system — comprising cleaning, coarse grinding, fine grinding, classification, and efficient product recovery — provides a high-performance, hygienic, and dust-free solution for turmeric powder production.

This application note outlines the process flow, system design, technical performance, and advantages of a turmeric cleaning and grinding plant using a **PII + ACM based system**.

2.0 Design & Working Principle

The system operates in a continuous process comprising cleaning, feeding, grinding, classification, and product collection stages:

Step 1: Raw Material Cleaning

Whole turmeric fingers are fed into the cleaning system which may include:

- Vibro feeder / grader
- Destoner / magnetic separator

This ensures removal of:

- Dust and foreign particles
 - Stones and metal contaminants
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Step 2: Coarse Grinding (Pre-Grinding – PII Mill)

Cleaned turmeric is fed into a **PII Mill / Hammer Mill** for primary size reduction.

Grinding occurs due to:

- High-speed impact of hammers
- Breaking of fibrous turmeric structure

This stage reduces size from:

- Whole fingers → coarse granules (~2–5 mm)

Benefits of this stage:

- Improves ACM efficiency
 - Reduces load on fine grinding mill
 - Ensures uniform feed to ACM
 - Enhances overall system capacity
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Step 3: Controlled Feeding to ACM

Coarse ground material is fed via:

- Feed hopper
- Rotary Airlock Valve (RAL)

This ensures:

- Uniform feed rate
 - Air sealing
 - Stable mill operation
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Step 4: Fine Grinding in ACM Mill

Material enters the ACM where fine grinding occurs due to:

- High-speed rotor impact
- Shearing action
- Particle-to-particle collision

The airflow:

- Keeps particles suspended
 - Prevents excessive heat buildup
 - Maintains turmeric color & aroma
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Step 5: Dynamic Air Classification

- Fine particles pass through classifier
- Coarse particles are rejected and recirculated

This ensures:

- 95–98% < 300 microns
 - Narrow PSD
 - Consistent product
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Step 6: Pneumatic Conveying

Centrifugal fan:

- Transports material
- Maintains temperature
- Improves classification efficiency

Step 7: Cyclone & Bag Filter Collection

Cyclone Separator:

- Primary separation of product

Bag Filter:

- Fine particle recovery (>99%)
 - Clean air discharge
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Step 8: Final Screening & Discharge

- Product discharged via RAL
- Passed through vibro shifter

Ensures:

- Uniform particle size
 - Removal of oversize
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3.0 Key Components

Component	Function	Key Technical Feature
Cleaning System	Removal of impurities	Vibro feeder, destoner, magnetic separator for dust, stones & metal removal
P11 Mill (Hammer Mill)	Coarse grinding	Pre-size reduction of turmeric fingers to ~2–5 mm for efficient ACM operation
Feed Hopper + RAL	Controlled material feeding	Uniform feed, airlock sealing, prevents backflow
ACM Mill (Air Classifying Mill)	Fine grinding & classification	Integrated rotor + classifier, adjustable fineness (95–98% < 300 micron)
Cyclone Separator	Primary Powder separation	Reduces load on bag filter, improves system efficiency
Bag Filter System	Fine powder collection & dust control	>99% recovery, pulse-jet cleaning, continuous operation

Vibro Shifter	Final screening	Ensures uniform particle size, removes oversize
Centrifugal Fan (C-Fan)	Airflow generation	Maintains system pressure, cooling, pneumatic conveying
Ducting System	Interconnection of equipment	Optimized airflow, low pressure drop
Control Panel (MCC)	System control & monitoring	VFD control, interlocks, automation ready

4.0 Model Variants

Variant	Model	Capacity	Fineness
TG-500	ACM Based System	450-500 kg/hr	95% < 300 microns

△ Capacity may vary based on moisture, feed size, and turmeric quality.

5.0 Key Features & Benefits

Controlled Grinding for Heat Sensitive Product

Maintains color, aroma, and curcumin content.

Uniform Particle Size Distribution

Dynamic classifier ensures consistent fineness.

High Product Recovery (>99%)

Efficient cyclone + bag filter system.

Hygienic & Food-Grade Design

SS contact parts ensure contamination-free processing.

Dust-Free Operation

Fully enclosed system ensures clean working environment.

Energy Efficient System

Optimized airflow reduces power consumption.

Continuous Operation

Suitable for industrial 24/7 usage.

Automation Ready

PLC-based system with VFD control.

Low Maintenance

Robust design with minimal wear parts.

6.0 Applications

- Turmeric powder processing
 - Spice grinding plants
 - Food processing industries
 - Ayurvedic & nutraceutical products
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7.0 Performance Parameters

- Feed Material: Whole turmeric
 - Feed Size: 20–50 mm
 - Final Fineness: 95–98% < 300 microns
 - Capacity: ~500 kg/hr
 - Moisture: < 10% recommended
 - Product Recovery: > 99%
 - Operating Temperature: Controlled (near ambient)
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8.0 Automation & Integration

The system supports:

- Closed-loop control of airflow & classifier speed
- Load-based feed control
- Differential pressure monitoring (bag filter)
- VFD control for mill, fan, feeder
- Safety interlocks
- Integration with PLC / SCADA / DCS

9.0 Frequently Asked Questions (FAQ)

Q1: How is turmeric color and aroma preserved?

A: Controlled grinding with airflow minimizes heat generation, preserving natural properties.

Q2: Can whole turmeric be directly fed?

A: Yes, but pre-cleaning is essential to remove contaminants.

Q3: What fineness can be achieved?

A: Typically 95–98% passing 300 microns.

Q4: Is there any loss of product during grinding?

A: No, high-efficiency cyclone and bag filter ensure >99% recovery.

Q5: How is dust controlled?

A: Fully enclosed system with bag filter ensures dust-free operation.

Q6: Can the system run continuously?

A: Yes, designed for continuous industrial operation.

Q7: Is the system food-grade compliant?

A: Yes, SS304 contact parts ensure hygiene and compliance.
