Application Note: High-Performance Sugar Grinding System

Sugar grinding is a critical process for the bakery, confectionery, and beverage industries, requiring precise particle sizes ranging from coarse "Castor Sugar" to ultra-fine "Icing Sugar."1 However, processing sugar presents two major challenges:

- **Hygroscopic Nature:** Sugar readily absorbs moisture from the air, leading to lumping, caking, and potential blockage of the grinding system.
- **Explosive Dust:** Fine sugar dust is highly combustible (St1 Hazard Class), posing significant safety risks.

RIECO Industries provides a specialized **Sugar Grinding System** designed to overcome these challenges. By integrating **Controlled Atmosphere Grinding (Dehumidification)** with **Explosion Protection** technologies, our systems ensure continuous, safe, and dust-free operation while delivering the precise fineness required for applications like chocolate, icing, and instant mixes.

1.0 Design & Working Principle

The system is designed to operate in a "Cool and Dry" environment to prevent the sugar from melting or caramelizing.

- **Feeding:** S30 sugar is fed into the mill via a screw feeder mounted on the mill hopper — or via an externally controlled feed that feeds directly into the mill hopper. The feed arrangement provides a steady, metered input to the pulveriser.
- **Grinding:** The micro pulveriser reduces feed to the target fineness (95% < 250 micron). The grinding chamber is arranged vertically so material discharges downwards by gravity.
- **Gravity discharge & buffering:** Ground material falls into a discharge hopper located directly below the pulveriser. This hopper acts as a buffer to ensure even downstream discharge.
- **Sealed discharge:** A Rotary Air Lock (RAL) mounted below the discharge hopper provides an air-sealed, controlled discharge into collection drums/bins.
- **Dust control / breathing:** Air and entrained dust from the mill are drawn (or vented) through stainless ducting to the Vent Bag Filter. The C-Fan provides the required air movement for mill “breathing” and ensures dust is carried to the filter.
- **Filtration & collection:** The bag filter captures fine dust; filtered air is released (or recirculated as required). Filtered product in the filter hopper discharges into the RAL / collection drum as part of the product recovery path.
- **Control & safety:** The basic control scheme interlocks feeder, mill, fan and RAL to prevent overfeeding and to ensure the filter/fan is running during mill operation.

For Universal Mill Case

Step 1: Feeding Section

Sugar S30 is introduced into the **Feed Hopper** located at the upper level of the system.
A **Rotary Air Lock (RAL)** mounted directly below the hopper meters the sugar into the mill at a controlled rate.
This arrangement ensures smooth and choke-free feeding into the BT-450 mill.

Step 2: Grinding Section – Universal Mill BT-450

The metered sugar enters the **BT-450 Universal Mill**, where size reduction occurs through impact and milling action.
The mill is centrally positioned so that ground product falls vertically downward.

Step 3: Gravity Discharge & Product Buffering

Ground sugar drops by gravity into the **Discharge Hopper** placed directly below the BT-450.
The hopper stabilizes product flow and prevents surging during downstream discharge.

Step 4: Sealed Discharge to Collection

A second **Rotary Air Lock (RAL)** is located under the discharge hopper.
This RAL provides air-sealed discharge into a small collection drum or product handling bin.
This ensures clean, dust-free collection of finished sugar powder.

Step 5: Dust Collection & Mill Breathing

A **Vent Filter** is connected to the mill through ducting to handle air displacement ("breathing") during grinding and discharge.
Dust-laden air from the mill is drawn into the vent filter for separation.

- The **C-Fan** provides the required suction.
- A **Knife Gate Valve (KGV)** is provided for isolation of the filter line during maintenance or cleaning.
- Separated fines fall into the **dust collection drum** below the filter.

This ensures a **clean, dust-free plant environment** and prevents sugar dust escape.

2.0 Key Components

Component	Function	Technical Feature
Feed Hopper	Holds and regulates the incoming S30 sugar before entering the mill	Designed for steady gravity flow; food-grade SS construction; allows integration of controlled feeding devices
Screw Feeder / Feed RAL	Provides controlled, uniform feeding into the mill	Adjustable feed rate; avoids overloading; acts as air-seal when RAL is used
Micro Pulveriser / Universal Mill (BT-450)	Primary size reduction of S30 sugar to required mesh	Impact + milling action; low-heat grinding; suitable for 250 micron in Pulverizer & 75 Universal mill output; robust rotor/liner configuration
Gravity Discharge Hopper	Collects and buffers ground sugar directly below the mill	Vertically aligned design; prevents surging; smooth flow of fine powder
Product RAL (Below Discharge Hopper)	Ensures sealed, controlled discharge of final product	Prevents air leakage; maintains consistent product flow; supports dust-free operation
Vent Bag Filter	Handles mill breathing, separates air–dust mixture, and recovers sugar fines	Pulse-jet cleaning; high filtration efficiency; hygienic dust control; food-grade internal surface
Centrifugal Fan (C-Fan)	Creates suction for dust collection and airflow through vent filter	Maintains required negative pressure; stable airflow; ensures clean plant environment
Knife Gate Valve (KGV)	Isolates duct line during cleaning or maintenance	Quick shut-off; SS construction; prevents backflow of dust-laden air
Dust Collection Drum	Collects dust/fines separated from the vent filter	Compact design; easy handling; recovers fine sugar that would otherwise be lost
Ducting & Interconnections	Connects mill, hopper, C-Fan & vent filter	SS304/food grade material; smooth internal finish; leak-proof airflow paths

Control Panel / Local Control Box	Controls operation of feeder, mill, fan, and RALs	Basic interlocks; overload protection; feeder speed control; ensures safe & synchronized operation

3.0 Model Characteristics

RIECO offers scalable systems for various production needs:10

Variant	Model	Capacity (Approx.)	Target Fineness
SU-2DH-SS304	**2DH SS 304**	250-300 Kg/hr	95% 150 Microns
SU-2DH-SS316	**2DH SS 316**	250-300 Kg/hr	95% 150 Microns
SU-2W-SS304	**2W SS 304**	500-600 Kg/hr	95% 250 Microns
SU-2W-SS316	**2W SS 316**	500-600 Kg/hr	95% 250 Microns
SU-BT-SS	**UM 450 SS 304**	1000-1200 Kg/hr	95% Pass 75 microns

**Capacities depend on feed sugar crystal size and moisture content.*

4.0 Key Features & Benefits

- **Anti-Caking Operation:** The integration of dehumidified air prevents the sugar from absorbing moisture, ensuring a free-flowing final powder that doesn't lump in the bag.
- **Explosion Safety:** Fully compliant with **ATEX / NFPA** standards.[12] Features include 10-bar shock-resistant construction (optional), chemical suppression systems, and mechanical isolation valves.
- **Cool Grinding:** High airflow design keeps the temperature rise low (< 10°C), preserving the whiteness and quality of the sugar.
- **Hygiene: SS304/316L construction** with food-grade polishing and easy-clean designs (CIP capable) ensures compliance with FSSAI and FDA standards.
- **Low Dust & Hygienic Operation** Vent bag filter with C-fan maintains dust-free environment, essential for food-grade applications.

5.0 Applications

- **Bakery:** 150–250 micron sugar for biscuits and cookies.
- **Confectionery:** "Icing Sugar" for dusting, cream fillings, and fondants.
- **Beverages:** Fine dissolving sugar for instant drink mixes.
- **Pharma:** High-purity sucrose powder for tablet coating and syrups.

6.0 Performance Parameters

- **Feed Material:** Crystal Sugar S 30 grade
- **Fineness:** Adjustable from 150 microns 250 microns.

- **Feed Moisture:** Recommended < 0.05%.

7.0 Automation & Integration

- **HMI/PLC Control:** One-touch recipe selection for different grades (e.g., "Fine Flour" vs. "Grits").
- **Load Balancing:** Automatic feed rate adjustment based on mill motor amp load.
- **Safety Interlocks:** Prevents operation if air pressure is low or doors are open.

8.0 Frequently Asked Questions (FAQ)

Q1: Sugar dust is explosive.18 How do you guarantee safety?

A: We treat sugar dust as a serious hazard (St1). Our systems come standard with explosion relief vents (rupture discs) on the bag filter. We also offer explosion isolation valves to prevent flame propagation back to the feed bin.19 All electrical motors are flame-proof (FLP) if required by the hazardous area classification (Zone 21/22).

Q2: Why does my sugar turn into a solid block after grinding?

A: This is due to moisture absorption and the "glass transition" of amorphous sugar. Our system uses a Dehumidifier to grind in a dry atmosphere, and we recommend using moisture-barrier packaging immediately after grinding to prevent caking during storage.20

Q3: Can I produce both Bakery Sugar (coarse) and Icing Sugar (fine) on the same machine?

A: If you choose the Air Classifying Mill (ACM), yes. The ACM allows you to adjust the particle size by changing the classifier speed.21 A Pin Mill is typically fixed at a certain fineness range and is better suited for dedicated coarse/medium grinding.

Q4: Do I need a chiller?

A: For standard applications, the high airflow of the mill provides sufficient cooling. However, for ultra-fine icing sugar or operation in very hot climates (>35°C ambient), we recommend a chiller to keep the process air cool and prevent sugar melting inside the mill.

Q5: What is the maintenance requirement?

A: The main wear parts are the pins (in Pin Mills) or the hammers/liner (in ACM).22 These are made of wear-resistant steel and typically last for thousands of hours. The bag filter sleeves need periodic cleaning or replacement, which is indicated by the differential pressure gauge on the control panel.

Q6: Can you add an anti-caking agent (like TCP) during grinding?

A: Yes. We can provide a dosing system (screw feeder) to add anti-caking agents like Tri-Calcium Phosphate (TCP) or corn starch directly into the mill. The mill acts as an excellent mixer, ensuring the agent is evenly coated on the sugar particles.

Q7: How do you handle "tramp iron" or metal in the sugar?

A: We install high-strength Magnetic Grills (10,000 Gauss) at the feed inlet to catch any ferrous contaminants.23 For final safety, a metal detector can be installed on the discharge line.

Q8: Is the system suitable for "Pharma Grade" sugar?

A: Yes. For pharmaceutical applications, we offer a GMP model featuring SS316L contact parts, high-quality surface finishes (Ra < 0.4 micron), and crevices-free design for easy validation and cleaning.