

# Powder Flow Analysis of Ground Coffee

Understanding the powder flow analysis of ground coffee is essential for ensuring consistency in production, maintaining quality control, and optimizing packaging and equipment design. This analysis helps prevent issues like clumping and uneven extraction, ultimately leading to a better-quality product and more efficient processing.

## Test Equipment:

- Instrument: Brookfield Powder Flow Tester (PFT)
- Trough: 230 cc, 6-inch diameter
- Lid Type: Vane Lid, 304 stainless steel, 33cc, 6-inch diameter
- Type of Test: Flow Function Test
- Conditions: Room Temperature (70-72°F), Humidity: 48%



## Test Method:

A PFT equipped with Powder Flow Pro software was used to evaluate the ground coffee. The procedure involved:

### Flow Function Test Duration: 25 minutes

1. Scooping the ground coffee into the trough.
2. Using the scraping tool to evenly distribute the powder and form the sample.
3. Recording the sample weight and entering it into the software.
4. Running a standard flow function test.

## Parameters Measured:

- Flowability: Easy Flowing
- Bulk Density: 308 kg/m<sup>3</sup> (fill density) to 399 kg/m<sup>3</sup> (final bulk density)



**Analysis:**

- Hopper Shape: Conical
- Arching Dimension: 0.119 m (119 mm, 4.6 inches)
- Rat-Hole Diameter: 0.567 m (for a bin diameter of 2 m)

**Results:**

**Flow Function:**

The flowability of ground coffee at different levels of consolidating stress is illustrated in Figure 1. The results show that ground coffee is generally easy flowing across various consolidating stress levels. However, at the lowest consolidating stress, the material gains strength and becomes cohesive as the feeder system empties.

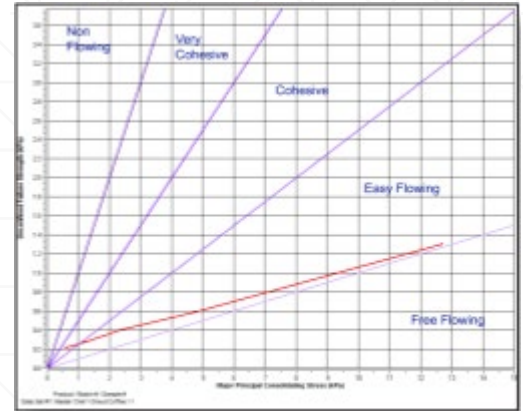


Figure 1: Ground Coffee Flow Function Graph

**Arching and Rat-Holing:**

Figure 2 provides the critical arching dimension and rat-hole diameter for a standard bin diameter of 2 meters and a bin height of 8 meters. To prevent arching, an opening of at least 0.119 meters is required. To prevent rat-holing, an opening of 0.567 meters is necessary. These values indicate that ground coffee is likely to flow easily under most conditions.

Data Set (#)	Arching Dimensions (m)	Rat-hole Diameter (m)
1	0.119	0.567

Figure 2: Arching Dimensions and Rat-hole Diameter

**Bulk Density:**

Figure 3 shows the bulk density of ground coffee at different levels of consolidating stress. The ground coffee has a fill density of about 308 kg/m<sup>3</sup>, which increases to approximately 399 kg/m<sup>3</sup> at around 12.685 kPa of consolidating stress. In general, a free-flowing powder shows small changes in bulk density, while a cohesive powder exhibits significant increases. The change in bulk density for ground coffee is relatively small, indicating that the powder is easy flowing.

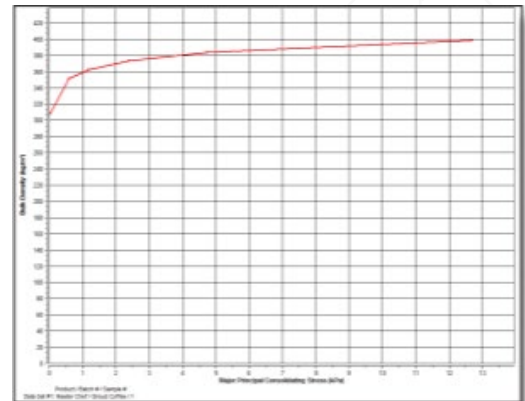


Figure 3: Ground Coffee Bulk Density Graph

**Conclusion:**

Ground coffee is an easy-flowing powder at most levels of consolidation stress. However, it becomes cohesive at very low consolidation stress levels, which may cause minor flowability issues as the feeder system empties. Despite this, the overall flow characteristics of ground coffee are favorable, indicating that it is likely to flow easily under most conditions. The critical arching dimension of 119 mm (4.6 inches) and the rat-hole diameter of 0.567 meters provide conservative estimates to ensure smooth flow in practical applications.

