

# Powder Flow Analysis of Baking Soda

Understanding the flow properties of baking soda is critical, particularly when it is stored and handled in bulk, to ensure efficient processing and consistent product quality across various applications.

## Test Equipment:

- **Instrument:** Brookfield Powder Flow Tester (PFT)
- **Trough:** 230 cc, 6-inch diameter (Standard Volume)
- **Lid Types:**
  - Vane Lid, 33cc, 6-inch diameter
  - Wall Lid, 2B finish, 6-inch diameter
- **Type of Test:** Flow Function Test, Wall Friction Test
- **Conditions:** Room Temperature (70-72°F), Humidity: 48%



## Test Method:

A PFT equipped with Powder Flow Pro software for automated instrument control and data acquisition was used to evaluate the baking soda. The procedure included the following steps:

**Flow Function Test Duration:** 25 minutes

**Wall Friction Test Duration:** 13 minutes

1. Scooping baking soda into the trough.
2. Using a scraping tool to evenly distribute the powder.
3. Recording the sample weight and entering it into the software.
4. Conducting a standard flow function test, followed by a wall friction test.

## Parameters Measured:

- **Flowability:** Very cohesive to cohesive
- **Wall Friction Angle:** 35° to 27°
- **Bulk Density:** 1000 kg/m<sup>3</sup> (fill density) to 1100 kg/m<sup>3</sup>

**Analysis:**

- **Hopper Shape:** Conical
- **Arching Flow Factor:** 1.40
- **Critical Arching Dimension:** 90.2 mm (3.55 in.)
- **Rat-Hole Diameter:** Dependent on bin diameter

**Results:**

**Flow Function:**

Figure 1 shows the flowability of baking soda was measured across different levels of consolidating stress, revealing generally cohesive behavior. At very low stress levels (below 1.5 kPa), the baking soda became highly cohesive.

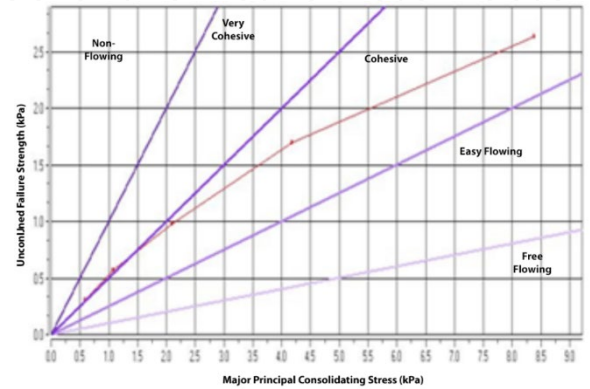


Figure 1: Baking Soda Flow Function Graph

**Wall Friction:**

Figure 2 shows the angles of wall friction were measured at varying levels of normal stress using a stainless-steel lid. The effective angle of wall friction was approximately 35° at low normal stress (0.5 kPa) and decreased to around 27° as the stress levels increased (4.75 kPa).

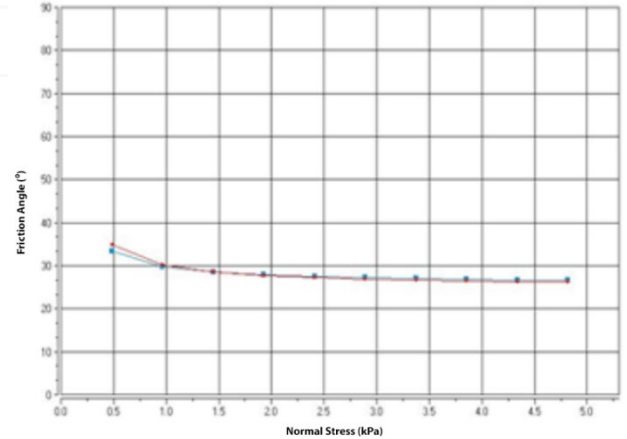


Figure 2: Baking Soda Wall Friction Graph

**Bulk Density:**

Figure 3 shows the bulk density of baking soda increased from approximately 1000 kg/m<sup>3</sup> at fill density to around 1100 kg/m<sup>3</sup> under 4.5 kPa of consolidating stress. This change highlights the significant impact of stress on the bulk density of cohesive materials like baking soda.

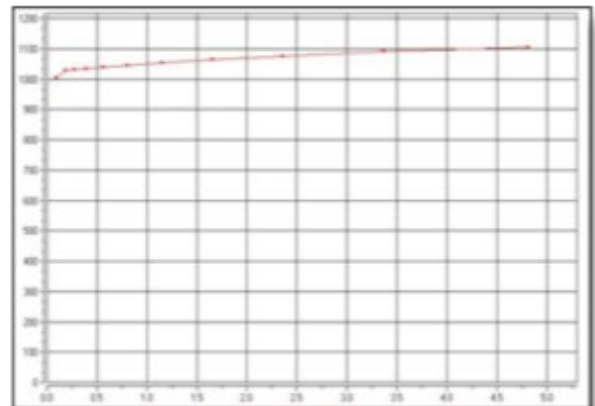


Figure 3: Baking Soda Bulk Density Graph

**Conclusion:**

The analysis reveals that baking soda is highly cohesive at low consolidation stress levels and remains cohesive even at higher stress levels. This behavior can result in potential flowability issues, such as arching and ratholing in hoppers. To prevent arching, it is essential to ensure that the hopper outlet exceeds the critical arching dimension of 90.2 mm. The rathole diameter, which varies based on the bin diameter, can be accurately calculated using the Powder Flow Pro software.