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Predicting the Flow in Baby Formula Powder

This application note details the use of a Brookfield Powder Flow Tester (PFT) to evaluate the flow properties of a nutritional supplement designed for babies up to 12 months old. Understanding the flow properties of baby formula powder is crucial for ensuring consistent product quality, efficient packaging, and safe handling. Proper flow analysis helps prevent issues like clumping and uneven dosing, which are essential for maintaining the formula's integrity and ensuring accurate nutrition delivery.

Test Equipment: PFT

- **Trough:** 230 cc, 6-inch diameter
- **Lid Types:**
  - Vane Lid, 304 stainless steel, 33cc, 6-inch diameter (Flow Function)
  - Wall Lid, 304 stainless steel, 2B finish, 6-inch diameter (Wall Friction)
- **Types of Tests:**
  - Flow Function Test
  - Wall Friction Test
- **Testing Conditions:**
  - Temperature: Room Temperature (70-72° F) Humidity: 24%

Test Method:

Using the PFT with Powder Flow Pro software, the flow properties of a commercially available baby formula were assessed using the following procedure:

1. Scooping the baby formula 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 (35 minutes) and a wall friction test (20 minutes).

Parameters Measured:

Flowability: Ranged from Very Cohesive to Easy Flowing

- **Wall Friction Angle:** 16.5°
- **Bulk Density:** From 440 kg/m³ (fill density) to 620 kg/m³ (12.5 kPa)

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Analysis:

- **Hopper Shape:** Conical
- **Arching Flow Factor:** 1.40
- **Critical Arching Dimension:** 5.456 inches (136.4 mm)
- **Rat-Hole Diameter:** Dependent on bin diameter

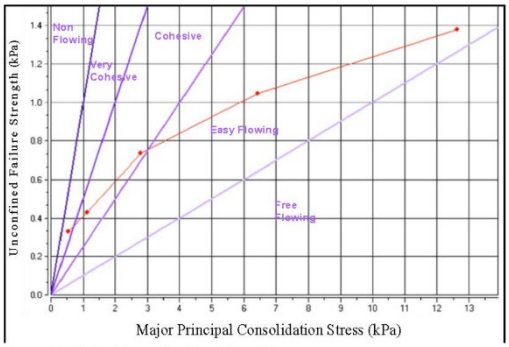

Figure 1: Baby Formula Flow Function

Results:

• Figure 1 presents the flowability of the baby formula under varying consolidating stresses. The formula exhibited easy flow but became cohesive and highly cohesive at stresses below 3 kPa.

• Figure 2 displays the wall friction angles at different normal stresses. With a stainless-steel lid, the wall friction angle remained consistently at 16.75° across all stress levels.

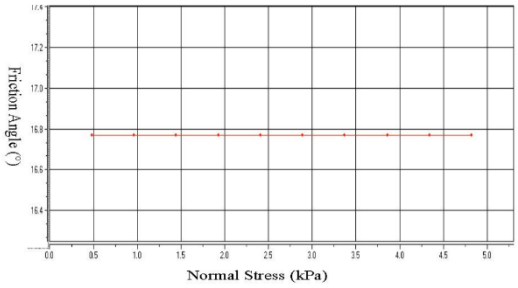

Figure 2: Baby Formula Wall Friction

• Figure 3 illustrates the bulk density at different consolidating stresses. The baby formula had an initial fill density of approximately 440 kg/m³, which increased to around 620 kg/m³ at 12.5 kPa.

Conclusion:

The flow properties of the baby formula varied with consolidation stress:

• **Low Consolidation Stress**: The formula became cohesive to very cohesive, raising concerns about potential flowability issues like arching and ratholing as the hopper empties.

• **High Consolidation Stress**: The formula exhibited easy flow, indicating improved handling and processing characteristics.

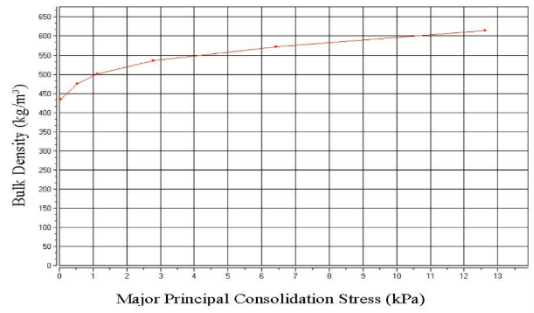

Figure 3: Baby Formula Bulk Density

To address potential flowability issues, ensure that the minimum outlet dimension of the hopper exceeds the critical arching dimension of 5.456 inches (136.4 mm). The Powder Flow Pro software can further assist by calculating the rathole diameter based on the bin diameter, aiding in the design of handling and storage systems to prevent flow interruptions.