Aerosol Whip Cream Nozzles
Engineering and Optimization of Nozzles for Least Overspray

My Motivation

When designing my engineering project, I wanted to focus on a project that aligns with my interests and talents. I have always been fascinated by the mechanics of a can of whipped cream. The propellant propels the cream to the mouth in a few seconds, yet the length of the actuator is practically negligible. On one trip to Germany, I noticed that the whipped cream dispenser did not work properly. What I took as a design flaw, I realized that the propellant propels the cream to the mouth quickly, allowing for a unique sensory experience.

Whipped Cream Chemistry

Aerosol whipped cream is composed of three main components: whipped cream, propellant, and a propellant gas that is released from the canister. The whipped cream is generated by continuous agitation of the cream and air. The propellant gas is typically a pressurized gas that provides pressure to the whipped cream. The propellant gas is usually nitrous oxide (N₂O) or carbon dioxide (CO₂), which is released from the canister when the canister is activated.

Canned Whip Cream

Whipped cream dispensers are often used in places where it is easy to access whipped cream, such as restaurants, cafes, and coffee shops. The whipped cream is dispensed from the canister by pushing the canister, which opens a valve that releases the pressurized gas into the whipped cream. The pressurized gas propels the whipped cream out of the canister, creating a cloud of whipped cream that can be used to add flavor to a variety of dishes.

Research - Nozzle Physics

The continuity equation relates the flow rate of fluid to the area of the nozzle and the velocity of the fluid. The equation is given by:

\[ \frac{Q}{A_1} = \frac{Q}{A_2} \]

where:

- \( Q \) is the volumetric flow rate
- \( A_1 \) is the cross-section area in the throat of the nozzle
- \( A_2 \) is the cross-section area at the exit of the nozzle

Bernoulli's Principle

Bernoulli's principle states that the pressure of a fluid decreases as the flow velocity increases. This principle is used to reduce the velocity of the whipped cream by widening the direct path opening inside the nozzle. When the flow velocity increases, the pressure decreases, and the whipped cream is slowed down.

Nozzle Prototypes

Several prototype nozzles were tested to determine their effectiveness in reducing the overspray of whipped cream. The nozzles were tested in a controlled environment, and the results were recorded and analyzed. The nozzles were tested with and without the propellant gas, and the results were compared to determine the effectiveness of each nozzle.

Engineering Goal

The goal of this project was to design a nozzle that reduces the overspray of whipped cream. The nozzle would be designed to confine the whipped cream to a small area, ensuring that it is only dispensed where intended. The nozzle would be designed to work with various types of whipped cream, including those that use propellant gas and those that do not.

Problem

Whipped cream dispensers are known to spray whipped cream not only on your dish but also everywhere around. While it is part of the fun, it can also be frustrating to clean up. To address this issue, I decided to design a nozzle that would reduce the overspray of whipped cream. The design was tested to determine its effectiveness in reducing the overspray of whipped cream.

Nozzle Design

The nozzle is designed to reduce the overspray of whipped cream. The nozzle is designed to have a small cross-sectional area, which reduces the flow velocity of the whipped cream and, consequently, reduces the overspray. The nozzle is designed to be compatible with various types of whipped cream, including those that use propellant gas and those that do not.

Test Setup

The test setup for this project involved the use of a whipped cream canister. In Figure 5, a chart of the canister and its parts are shown, which are connected to a pneumatic actuator. The pneumatic actuator is controlled by a microcontroller, and the actuator is connected to a push and pull position. The actuator is connected to the nozzle using a series of valves and relays.

Testing Procedure

The testing procedure involved the use of a whipped cream canister. The canister is filled with whipped cream, and the actuator is controlled by a microcontroller. The actuator is connected to a push and pull position, and the actuator is connected to the nozzle using a series of valves and relays. The testing procedure was repeated for each nozzle, and the results were recorded and analyzed.

References