Autonomous Smoke Mister

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Introduction

While smoking meats, they can become dry over long cooking times. To mitigate this, cooks generally have to keep constant watch over their meat; this can prove inconvenient and problematic for cooks, as cooking time can range from 4-20 hours. This Autonomous Smoke Mister replaces the need to tend to these slow-cooked meats by automatically basting their surfaces. This device delivers a finished product that is tender, moist, and flavorful.

Objective / Metrics

Objective	Metric	Scale
Deliver Fluid to Meat	Variety of different viscosities able to pass through unit Surface area of meat that can be covered	1 – water 2 – sugar water, thin syrup 3 – thick syrup, buttery solution 1 – dispersed over negligible area 2 – dispersed over adequate area 3 – dispersed over excessive area
Automatic Operation	Level of automatic operation achieved with final product	1 – pumps automatically, continuously when powered 2 – pumps automatically at set intervals 3 – pumps automatically at set intervals for set duration
Universally Installed	Number of smokers or grills that units can be installed upon	1 – limited smoker/grill adaptability 2 – almost total smoker/grill adaptability 3 – total smoker/grill adaptability
Easy to Clean	Ease of cleaning following use inside smoker/grill	1 – difficult to disassemble unit, difficult to clean thoroughly 2 – moderately challenging to disassemble & clean thoroughly 3 – very easy to disassemble unit and clean thoroughly
Cost to Manufacture	Cost per unit in parts, manufacturing, and labor	1 – $100+ 2 – $50 - $100 3 – <$50

Analysis

This analysis' main focus was the viscosity of the fluid. Based on user input, a range of viscosities were selected for this calculation. Calculations were performed on a worst case scenario basis and a value for pressure loss was achieved with the use of Bernoulli's Equation.

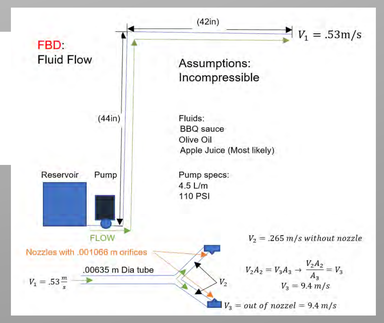
$$Reynolds\ \#\ (Re) = \frac{Density\ (\rho) * Velocity(V) * Diameter(D)}{Dynamic\ Viscosity(U)}$$

$$Friction\ factor Laminar\ (F) = \frac{64}{Re}$$

$$frictional\ Head\ loss\ (F_{l}) = \frac{Length(L) * F * (V^2)}{Grvity(G) * 2 * D}$$

$$Change\ in\ Pressure\ \ head\ loss\ (\Delta P) = P * G * F_l$$

$$Pressure\ \ head\ loss\ \ (\Delta P) = P * G * (height\ change\ (Y) + F_l)$$



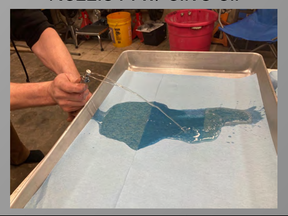
Final Product

Results

Nozzle A w/ apple juice

Nozzle A w/ BBQ

Nozzle A w/ olive oil



Substance	Pressure
BBQ	9.9E5 Pa (144 PSI)
Olive Oil	4..2E5 Pa (61 PSI)
Apple Juice	1.3E5 Pa (19.5 PSI)

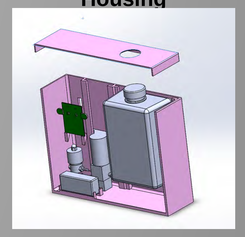
Nozzle	Material	Coverage (sq ft)	Max Temp	Cost
A	Stainless Steel 90 Degree Fan	3.25	2500 °F	$8.69
B	PLA Filament Cone Shape	1.75	315 °F	$1.15
C	Stainless Steel with 3mm Hole	0.14	2500 °F	$30.72
D	Silicone John Guest Fitting	0.75	400 °F	$5.75

Hose Material	Max Temperature	Cost per Foot
Silicone (High Temp)	500°F	$1.099
Stainless Steel	1200°F	$79.49
Silicone (Low Temp)	428°F	$2.60

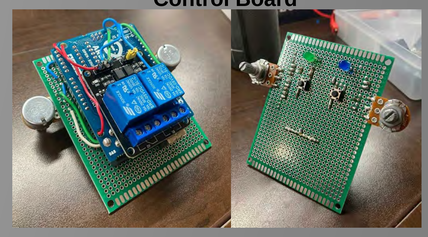
Pump Part #	Pump Type	Pressure [PSI]	Voltage	Cost
TOPINCNn0x73v4wkb	Peristaltic	15	12	$44.99
XP033LV3X	Peristaltic	50	12	$800.59
DP4004	Diaphragm	110	12	$18.47
XP017LVHXG19	Peristaltic	110	12	$1,278

Sub Prototypes

Housing



Control Board



Tubing

Tank

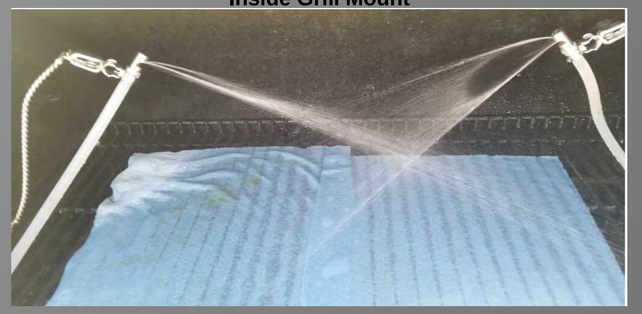
Pump

Nozzle

Solenoid

Clips/Mounts

Inside Grill Mount



Conclusion

The prototype was used to identify the feasibility of the nozzle and pump combination. These pumps and nozzles were originally chosen based on the calculations we performed and the desire to have a higher functioning system. The final design testing showed that our design could withstand the conditions of the smoker. It could also produce a meat that was identical to one prepared by hand.