of a bottleneck than the discharge port.

Most free flowing materials the screen is usually more
through the screen much more slowly. Except for the
other ingredients, especially those that are cohesive (e.g., brown sugar) will flow
slowly.

NOTE: These are maximum theoretical capacities.

For example: If 30 lbs can do 4 lbs per minute, a 40" will do 6 lbs, and a 48" 10 lbs.

**NOTE: Spoon discharge capacity is a linear function of screen surface area.

<table>
<thead>
<tr>
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<th>5</th>
<th>7.2</th>
<th>9</th>
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<tr>
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</table>
Statement of Design Objectives

The purpose of this design study is to create an air handling system to reduce dust and airborne particulate density. The result of the design study will be utilized for picking out an existing machine system that can be purchased off the shelf for Wegmans. The design will be completed while meeting all OSHA safety regulations and Wegmans company regulations.
Performance Goals and Specifications

The performance goals are: Increasing the air quality in a given space. Reducing the air particulate density levels below an appropriate threshold of .5mg/m$^3$. Increasing the time between cleanings to 480 minutes due to the reduction of airborne particulate. A major design goal is to minimize the room the proposed design to occupy. The design should meet all OSHA standards. The unit should be compatible with the current manufacturing facilities power systems. The proposed design will meet all safety requirements of the Wegmans Corporation. The unit should not interfere with current processes at the facility. The unit should be able to be cleaned and maintained easily while meeting all Wegmans and OSHA regulations and guidelines.
Key List

1. Material must be food grade compatible
   a. No Painted Surfaces
   b. Stainless Steel 304 (Food)
   c. Stainless Steel 316 (Food/Medical)
      i. 316 is very stable and has longevity.
      ii. Can be cleaned with most chemicals
      iii. Does not rust
2. Size cannot exceed plants physical layout
   a. Must not interfere with current process
   b. Must not interfere with current workflow
   c. Cannot exceed physical building limitations
3. Safety
   a. Must minimize any safety risks with the associated design
   b. Must meet OSHA standards
   c. Grounded system
   d. Minimize Dust “explosions”
   e. Fire-retardant
   f. Closed system before filter
      i. Exhausts after filter into plant atmosphere with clean air
4. Power
   a. Must be able to use current facility power requirements
   b. Power enclosures must be NEMA 4X.
   c. Efficient design to minimize wasted energy
   d. Grounded Plug outlets required
5. Amount of work
   a. Must minimize additional work from operators
   b. Must minimize unnecessary training to be able to use
      i. Ideally just on/off needed
6. Cost
   a. Must be economically beneficial
   b. Parts must be COTS for filter
Concept Documentations:

I. MOBILE UNIT

Descriptions:
This will be a stand-alone unit that is on wheels. The fan will be located on top of the sifter to ventilate the mushroom cloud created by dumping the ingredients into the sifter. The dust will travel through the pipe and be collected at the bottom where the vacuum bag is located. The exhaust will exit through the bottom as well. The number on the picture is corresponded as follow.
1. Sifter
2. Screen
3. Fan
4. Stand (backbone of the structure)
5. Piping
6. Motor and vacuum bag
7. Wheels
8. On and off switch
9.

Good:
- Small
- Mobile
- Easy to use

Bad:
- Concept includes stagnation points
- Creates turbulence
- Noise concern
- Tip corners (unstable?)
- Weight?
Exhaust on the ground could kick up dust into the air contaminating the ingredient batch.
II. Straight Up

Descriptions:
This machine is similar to the ventilation system used in the kitchen. The dust will be collected at a central location and the exhaust will exit out of the factory. The number in the picture is corresponded as follow.
1. Filter
2. Fluid transport (piping)
3. Intake
4. Fan

Good:
- Centralized system will save space
- Could utilize more power
- Wider area of intake

Bad:
- Not mobile
- Hanging vacuum could be a safety concern
- Will need more power to operate
III. RIGHT TURN

Descriptions:
Similar concept as the previous one, but this one has a turn at the top. The number in the picture is corresponded as follow.
1. Filter
2. Fluid transport (piping)
3. Intake
4. Fan

Good:
- Centralized system will save space
- Could utilize more power
- Wider area of intake

Bad:
- Not mobile
- Hanging vacuum could be a safety concern
- Will need more power to operate
VI. DUSTPAN

**Descriptions:**
This is just a dustpan that surrounds the sifter. It will wait until the dust cloud settles and collects the dusts. The number in the picture is corresponded as follow.
1. Sifter
2. Dustpan

**Good:**
- Cheap
- Easy to use
- Simple design
- Mobile

**Bad:**
- How to attach to sifter?
- Weight (Vibrates with the machine? Change the vibration of the machine?)
- Does not actively collects the dust cloud
- Obstruct worker’s movement
V. BIG FAN

**Descriptions:**
This design uses a fan to blow the dust clouds past the sifter through the filter.

**Good:**
- Outside the box design
- Simple

**Bad:**
- Not practical to have that large of a fan blowing during process
- Obstruct worker’s movement
- No filter that large
- Creates turbulent in the air flow creates safety issue
- Will end up blowing dust everywhere
VI. BAG

**Descriptions:**
Basically this is where one worker will wave a butterfly net through the dust cloud to collect the dust.

**Good:**
- No design required
- Will be reliable (no machinery down time)
- Parts are cheap

**Bad:**
- Extra labor cost
- Slow down the process
- Safety issue
VII. Water

**Descriptions:**
The water will spray from fire hose like system. The water will cling to the dust particulates and be pulled down. The cone shaped part on top of the sifter will keep the water out and there will be a slow blowing fan to blow the dust upward. The fan will not disturb the water particles outside the cone.

**Good:**
- Will definitely clean the air
- Easy to design
- Keep itself clean

**Bad:**
- Water everywhere causing safety issue
- Disrupt workers in the area
- Waste water
**VIII. Wal-Mart**

**Descriptions:**
This is similar to the air door design at the store that keeps the outside air from entering. This design will collect the dust cloud through air intake and filter up top and sends the clean exhaust downward to create the air door.

**Good:**
- Innovative
- Isolates the area (create a clean room like environment inside)

**Bad:**
- The design will not work base on simple engineering analysis
- Cost
- Disturb more particles in the air
- Increase contamination
<table>
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<th>N</th>
<th>A</th>
<th>N</th>
<th>C</th>
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Legend:
- Konrad
- Stick
- Honeywell
- Air

Segment 1
- Air
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Segment: Mobile

Concepts: Straight up, Weighting Notes, Weighting Notes, etc.
**Quote Number: 42773**

Please refer to this quote number when placing an order.

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<tr>
<th>Line</th>
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<th>Description</th>
<th>Revision</th>
<th>Drawing</th>
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<tbody>
<tr>
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<td>W689000</td>
<td>Wegmand Squarehood1</td>
<td>None</td>
<td>Lead Time: 8 weeks</td>
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<td>W689000-001</td>
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<td>Wegmans SS Round 1, Nozzle Intake</td>
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**Quoted using 316SS**

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**Grand Total:** $8,210.00
System Level Design Review For Air Handling Equipment

The Wegman’s Bakery Facility poses a safety and allergen hazard in the work place. The dust that is generated by the scaling operation and the movement of product contaminates product and is everywhere. Wegmans must constantly clean the room floor to make it safe for employees to walk. Also many employees choose to wear a dust mask to prevent “bakers lung” which is commonly caused by the breathable dust found in the facilities air. Poor circulation allows the air to hold a visible dust cloud, which is a safety concern for both employees and their working conditions. Individuals can reduce their risk of “bakers lung” by wearing the dust masks, but the contamination of product still remain an issue as well as the cleanliness of the floor. As the floor has more products deposited on its surface it becomes increasingly easier to slip and have an accident. The implementation of a dust collection and air handling system would greatly reduce the risks of “bakers lung,” contamination and dirty floors. The optimal solution of the Shick air handling system with filter would reduce the amount of the airborne particulates. The air handling system would allow workers to work without the use of a dust mask and reducing the issue with product on the floor. While dust masks are a great solution to the “bakers lung” problem it does not address or solve other safety, allergen and contamination issues. The Shick air handling system will address safety, allergen and contamination issues resulting in an improved quality in the work area. The Shick system is expandable, so when Wegmans grows another unit can be added.
Wegman's Creeping Flow Problem

\[ p_{\text{air}} = 1.2 \, \text{kg/m}^3 \quad p_{\text{water}} = 700 \, \text{kg/m}^3 \approx \frac{1000 \text{lb}}{ft^3} \]

\[ C_0 \frac{1}{2} \rho V^2 A + \rho V^2 \frac{d}{2} \quad \text{-- Derived from FBD} \]

\[ V = \sqrt{\frac{2(p_{\text{f}} - p_{\text{air}})g \cdot V}{C_0 \rho \text{air} A}} \quad A = \frac{\pi D^2}{4} \quad V = \frac{\pi D^2}{C_0} \]

\[ V = \sqrt{\frac{2(700 - 1.2)(9.81)(0.01)}{(2)(1.81 	imes 10^{-5})(1.2)(1200 \times 0.0001)}} \]

\[ V = \frac{\rho_{\text{air}} D^2}{18 \mu} = \frac{(700 - 1.2)(9.81)(0.01)}{(18)(1.81 	imes 10^{-5})} = 0.0001 \text{ m/s} \]

\[ V = \frac{0.0001}{2.5 \text{ sec}} \left( \frac{60 \text{ sec}}{1 \text{ min}} \right) \left( \frac{60 \text{ min}}{1 \text{ hr}} \right) = 1.44 \text{ hr} \frac{s}{s} \]

Height = 2.5 m = 8.2 ft
<table>
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<th>$\text{K}$</th>
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Fluids Analysis Results Table
## Technical Information

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<th>Specifications</th>
<th>GC Series</th>
<th>GCX Series</th>
<th>Dental Series</th>
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<tbody>
<tr>
<td>Maximum air delivery *</td>
<td>260 cfm</td>
<td>100 cfm</td>
<td>260 cfm</td>
</tr>
<tr>
<td>Air delivery for all six fans speeds (in cfm) *</td>
<td>35 70 110 140 170 260</td>
<td>45 85 130 170 200 300</td>
<td>35 70 110 140 170 260</td>
</tr>
<tr>
<td>Dimensions (W x D x H)</td>
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<td>15” x 16” x 40”</td>
<td>15” x 16” x 28”</td>
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<tr>
<td>Weight (incl. filters &amp; cartridges)</td>
<td>from 39 to 46 lbs.</td>
<td>from 59 to 74 lbs.</td>
<td>from 41 to 42 lbs.</td>
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<tr>
<td>Power requirements</td>
<td>120 VAC / 60 Hz</td>
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<tr>
<td>Maximum energy consumption</td>
<td>215 W</td>
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<tr>
<td>Fan motor</td>
<td>700 cfm, 2750 rpm, centrifugal, backward curved, UL/CETL listed</td>
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<tr>
<td>Control panel</td>
<td>4 key touch pad with 32 character LCD display</td>
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<tr>
<td>Air intake</td>
<td>dual filters at base of unit</td>
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<tr>
<td>Air outlet</td>
<td>120 ° DuctFlow™ diffuser</td>
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<td></td>
</tr>
<tr>
<td>Color of main housing/housing arms</td>
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<td>Housing material</td>
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### Performance
- **Performance certification**: every system is factory certified and issued with individual Certificate of Performance.
- **Certified filtration efficiency**: greater than 99% for particles ≥ 0.3 microns (latex).
- **Certified air delivery rate**: 215 cfm (as per specified air delivery).
- **Leak tested**: yes.

### Filter / Cartridge Configuration

#### Pre-filter
- Type: High efficiency (HEPA) line dust pre-filter.
- Media type: control of coals and fine dust particles; protection of subsequent filters.
- Surface area: 30 sq ft.
- Gases and odor control: gas and odor control cartridge; control of a variety of gases and chemical concentrations.

#### Gas & odor filter
- Type: Gas & odor filter (Set of 4 cartridges)
- Media type: adsorbs airborne contaminants, odors, and chemicals.
- Chemical and odor control: adsorbs a wide range of gases, organics, and odors, including volatile organic compounds (VOCs), ammonia, and ammonia-related compounds.
- Bacteria (1 h granularity activated carbon & impregnated alumina)
- VOCs (Tricresyl phosphate)
- Aldehyde (Formaldehyde, hydrogen sulfide, sulfur dioxide, etc.)
- Chemicals (Formaldehyde, hydrogen sulfide, sulfur dioxide, etc.)

#### Post-filter sleeves (Set of 4)
- Type: Post-filter sleeve
- Media type: Activated carbon.
- Surface area: 6.5 sq ft.
- Gases & odor filter: 1 - 3 years, Post-filter sleeve: 1 - 3 years.
- Bacteria (1 h granularity activated carbon & impregnated alumina)
- VOCs (Tricresyl phosphate)

### Average Filter Life
- Based on 10 hours usage per day at speed setting 3.
- Pre-filter: 6 - 12 months
- Gas & odor filter: 1 - 3 years
- Post-filter sleeve: 1 - 3 years.
- Bacteria (1 h granularity activated carbon & impregnated alumina)
- VOCs (Tricresyl phosphate)

### Control Panel Features
- **Display languages**: English (default), French, German, Spanish.
- **Features**: intelligent filter life monitor, filter life status LED, programmable timer (hourly/day), 2 speeds, time status LED.

### Accessories
- **Standard**: remote control, battery included, set of filters.
- **Optional**: wall mount bracket, poster, negative pressure ducting, dust collect pre-filter.
- **Warranty period**: 1 year on parts and labor (excluding filters).

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**Figure 1 – Model Information from the Company**
Honeywell:
Company Name – Honeywell
Product Model – 50250-N
Price – $199.99

Honeywell
50250 Permanent True HEPA Air Purifier
Model Number: 50250 N
Owner's Manual: Downloadable from our Website
Availability: In Stock
Price: $199.99

New featuring permanent filtration!
Great for large rooms, Honeywell True HEPA air purifiers are the best choice for removing airborne particles. In fact, studies show that more doctors recommend Honeywell air purifiers to their patients than any other brand. It offers outstanding air cleaning performance with a permanent HEPA filter. The True HEPA filter removes 99.97% of common airborne pollutants as small as 0.3 microns from the air passing through it, such as dust, pollen, tobacco smoke, mold spores, and cat dander. In addition, it also helps reduce airborne viruses and bacteria.*

The Honeywell glass flow HEPA filter material removes airborne particles, viruses & bacteria. Without the use of chemicals or other treatments, it also includes an activated carbon prefilter to help remove larger airborne particles and reduce common household odors. The patented 360 degree air intake and discharge maximizes efficiency, circulating and filtering the air up to 9 times an hour.*

The permanent HEPA filter is easy to clean. Simply vacuum about twice a year (depending usage), no more expensive HEPA filters to replace. The smart Check™ electronic filter indicator reminds you when to clean the HEPA filter and when to replace the carbon prefilter. This model is most effective for large size rooms up to 374 sq ft.

- 3 speeds
- Surroundseal™ Technology helps minimize air leaks and ensures that the air passes through the filter, capturing particles
- Recommended Room Size: LARGE - 17' x 20' (374 sq ft)

- AHAM CADR Rating 750 (Smoke)
- Replacement Pre-filter 38002
- Made in the USA

*Based on tests performed in the U.S. in accordance with the test and performance standards for household air cleaners. The results of the tests should not be used as the sole basis to determine the suitability of any household air cleaner for use in any particular environment. Follow all ASHRAE precautions and manufacturer’s instructions.

Figure 2 – Model Information from the Company
Shick:
Company Name – Shick
Product Model – 9SF009A
Price – $15,000

Figure 3—Model Drawing from the Company
**Kason:**
Company Name – Kason
Price – $7277.00
Product Description – To provide the dust hood with an integral dust collector, including two filter cartridges, exhaust fan, and reverse pulse cleaning for the filters with Nema 4X control box.

![Model Picture from the Company](image-url)