PURDUE UNIVERSITY

# CAPSTONE/SENIOR DESIGN EXPERIENCE 2017

## Student Soybean Product Innovation Competition

Agricultural & Biological ENGINEERING

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FiltraSoy

Your World.
Your Health.
Our Filters.

### Problem Statement and Background

The Student Soybean Production Innovation Competition develops novel soy-based products that are impactful and competitive in the marketplace. The product that was created was a biodegradable HVAC air filter comprised of 91% whole soybean and 9% recycled paper; the product was also treated with cold plasma in order to extend product longevity.

### Impact & Sustainability

- Biodegradable filtration media
- Used paper was upcycled with soy to create the filtration media
- Improved indoor air quality for a lower cost
- Improved overall quality of air filtration
- Drive an demand for an additional 1.1 million bu. Soy per year

### Economic Analysis

Air Purification Equipment Manufacturing Industry: $3.2 Billion USD/year

Dust Collectors: $665 Million USD/year

FiltraSoy: $33.8 Million USD/year

### Product Discovery & Alternative Solutions/Evaluation

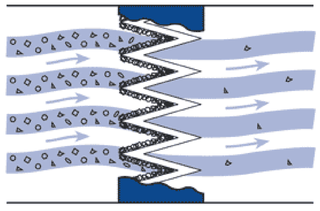
| Decision Factors | | Hair Product | Tile Drainage | Air Filter | Bath Mat | Arsenic Removal | Tampons |
|---|---|---|---|---|---|---|---|
| **Criteria:** | **Weight** | Idea 1 | Idea 2 | Idea 3 | Idea 4 | Idea 5 | Idea 6 |
| Novelty | 5 | 1 | 5 | 5 | 5 | 4 | 3 |
| Market Size | 3 | 1 | 2 | 4 | 4 | 3 | 3 |
| Soybean Content | 2 | 3 | 2 | 4 | 3 | 2 | 2 |
| Simplicity | 3 | 4 | 1 | 3 | 4 | 1 | 1 |
| Sustainability | 2 | 2 | 3 | 4 | 3 | 5 | 5 |
| Weighted Totals: | | 30 | 44 | 62 | 61 | 46 | 41 |

Filtration Media Development

- 15 alternatives developed
- Best media determined through comparative testing

### Testing Results (Dust sieved through #140 sieve to achieve suspended particle size).

| | |
|---|---|
| FiltraSoy Filtration Efficiency (%) | 76.33 |
| MERV 12 Filtration Efficiency (%) | 61.67 |
| FiltraSoy Efficiency Improvement (%) | **14.67** |

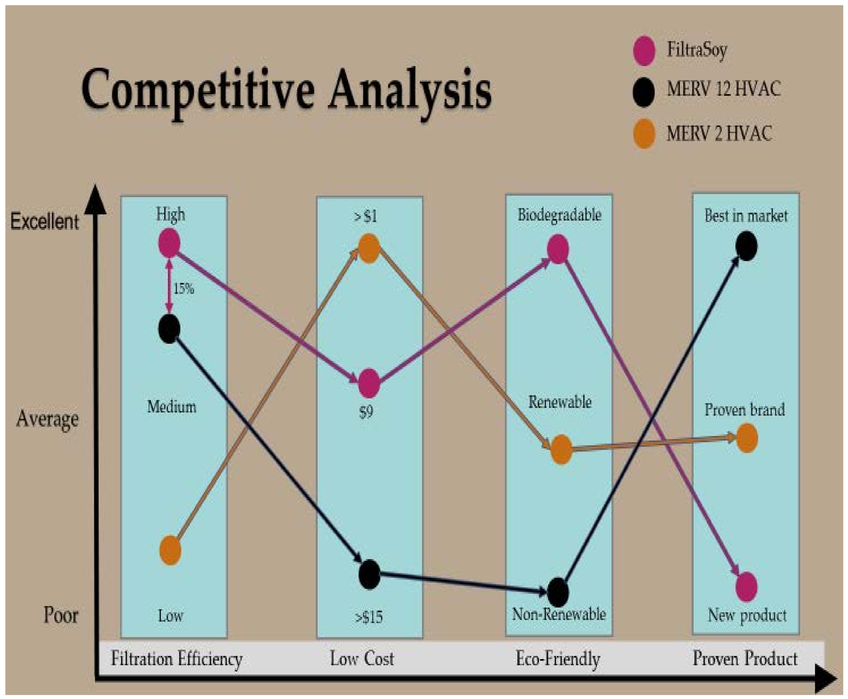


Visualization of Air Flow

### Methods

- Initial filtration media developed based on paper making principles
- Revisions to the process were made after each of the 15 trials
- Key variable parameters included:
  - o Type of recycled paper used (0% - 100% recycled)
  - o Amount of NaOH used (10%-20% by weight)
  - o Grinding size for whole soybean
  - o Boiling temperature/time for the soybean and NaOH mixture
  - o Overall ratio of soy to recycled paper (25%-100% soybean)

### Evaluation and Qualification Analysis




Testing Procedure

- ASHRAE 52.2
  - o Mass accumulation at 6 flow rates
  - o Tested against MERV 12 filter

Evaluation Criteria

- Filtration Efficiency
- Cost of Production
- Eco-friendliness
- Proven product

### Final Outcome

| Key FiltraSoy Trait | Added Benefit of Soy |
|---|---|
| 15% Higher Filtration Efficiency | • Small pore space<br>• Amino acids trap gaseous pollutants |
| 1/5th Cost of Production | • Cheap raw material, minimal processing<br>• Cheaper than MERV 12 filters |
| Environmentally Friendly | • Biodegradable and renewable |
| Cold Plasma Treatment | • High protein content within soy allows for the surface charge to be held effectively<br>• Potential for product life extension through sterilization of surface |

Sponsor:
INDIANA SOYBEAN ALLIANCE®

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