NAU FUME HOOD CAPSTONE TEAM

BACKGROUND-CN'S-ER'S

February 6th, 2020

Northern Arizona University-Biomechatronics lab

Talal Alshammari, Zach Bell, Bryce Davis, and Shirley Hatcher

GOAL STATEMENT

- We aspire to design and build a fume hood, which works with a pre-purchased exhauster provided by the Biomechatronics lab, while increasing safety when working with carbon fiber and it's particulates.

PROJECT BACKGROUND-CLIENT

- Our client, Dr. Zachary Lerner works in the biomechatronics lab at NAU.
- In the Biomechatronics Lab, exoskeletons made from carbon fiber are built for individuals with movement impairing disabilities.
- The team is tasked with designing and building a fume hood to increase safety when carbon fiber is being worked with.

Dr. Zach Lerner

Project Background- Carbon Fiber

- Carbon fiber is a compound fiber that is used in many projects due to its high strength and its low weight
- Carbon fiber is made with thin carbon fibers and epoxy resin.
- Epoxy resin is used to finish off a machined piece of carbon fiber

Project Background – Carbon Fiber

- Epoxy resins are dangerous when sprayed or heated to a high temperature. In these two situations the epoxy creates a respiratory hazard.
- When machining Carbon fiber, many abrasive dust particulates are created which creates a hazard for exposed skin and respiratory systems.

Customer Needs

- Table Top Fume Hood
- Compatible with Existing Exhauster
- Hepa Filter
- Particulate Export
- OSHA
- Reliability
- Minimum Inlet Pressure Drop
- Filter light indicator
- Extended Hose
- Durability

Shirley Hatcher

Engineering Requirements

- Volumetric Flow Rate
- Device Maneuverability
- Dimensionality
- Combined Product Weight
- Ventilation Velocity
- Particulate Fume Capture
- Usability
- Filter Change Assessment Time
- Minimize Pressure Drop
- Durability

HOUSE OF QUALITY

Table 1: House of Quality

FUME HOOD (HoQ)	Weight	Volumetric Flow Rate (lb/ft^3)	Device manuverability/portability	Dimensional area (ft^2)	Weight (Lbs.)	Ventilation velocity (ft/min)	Particulate Fume Capture (lb/ft^3)	Useability	Filter change assessment time (seconds)	Pressure Drops across device (SPWG)	Durability/Fracture toughness (ft-lb/in^2)
Customer Needs											
1. Table Top Fume Hood	5	1	3	5	5	3	5		3	3	3
2. Compatible with Exhauster	5	3				5	5	5	3	3	
3. Hepa Filter	4					1	5	5	3	3	1
4. Particulate Export	4	5	1	1	1	5	3	3		3	3
5. OSHA	5						5		3		
6. Reliability	4						5				
7. Minimize Inlet Pressure Drop	2	1				3	5			5	
8. Filter Light Indicator	1								5		
9. Extended Hose	2	1	1		1	1		1		3	
10. Durability	3										5
Absolute Technical Importance (ATI)		44	21	29	31	72	137	59	62	70	46
Relative Technical Importance (RTI)		7	10	9	8	2	1	5	4	3	6
Target ER values		0.75	N/A	25	100	4524	0.75	N/A	N/A	5.3"	N/A

PRODUCT SPECIFICATIONS

Table 2: Exhauster Fan Manual parameters

Model No.	Motor		Max. CFM ①	Max. S.P. ②	Air Velocity (F.P.M.)	dBA @5 Ft.	Material Type		Wheel Size	Inlet & Outlet Size	Hose Size	Nozzle Opening Size	Full Load APMs ③		Approx. Ship Wt.
	HP	RPM					Housing	Wheel					115 Volt 1 Phase	230 Volt 3 Phase	
EBR-50	1/2	3450	395	5.3"	4524	72	14 Gauge Steel	Cast Alum. Radial	9 x 2 7/8	4"	4"x120"	4"x 8"	6.8	1.9	62
EBR-75	3/4	3450	660	4.5"	3360	80			9 x 2 7/8	6"	6"x120"	8"x 8"	8.8	2.4	73
EBR-100	1	3450	785	7.3"	3996	82			11 x 3 BC	6"	6"x120"	8"x 8"	11.2	3.2	77
EBR-150	1 1/2	3450	885	7.9"	4506	83			11 x 2 3/4	6"	6"x120"	8"x 8"	16.0	4.4	84
EBR-200	2	3450	985	9.8"	5015	85			12 x 2 7/8	6"	6"x120"	8"x 8"	20.0	5.6	98
EBM-25	1/4	1750	340	1.0"	1731	69	Cast Alum.	Steel Multi-Vane	6.3 x 3.5	6"	6"x120"	8"x 8"	5.4	1.3	53
EBM-75	3/4	1750	910	2.3"	2606	74			8.3 x 4.1	8"	8"x120"	8"x 8"	11.0	3.0	75
EBM-100	1	3450	670	3.7"	3411	69			6.3 x 3.5	6"	6"x120"	8"x 8"	11.2	3.2	64

① Maximum CFM with 10 feet of hose and nozzle on the inlet ***or*** discharge. ***Removing the hose and nozzle will overload the motor.*** Airflow will be reduced 5-15 CFM for each ***additional*** foot of hose or duct and about 15-20 CFM for each 90° elbow.

② Maximum additional static pressure at which point there will be no airflow. SP (static pressure) is measured in inches of water gauge (SPWG).

③ Starting amps are approximately 6-7 times the full load amps. Full load amps shown are for TEFC motors and subject to change with motor types of brands.

[1] Cincinnati Fan, "Fume Exhausters Models EBR and EBM Manual," [Online]. Available: https://www.cincinnatifan.com/manuals/PMEB1207manual.pdf. [Accessed 2 Feb. 2020].

Conclusion

- To Summarize, We plan to work closely with Dr. Lerner in the Biomechatronics lab with the goal to design and manufacture a working fume hood which complies with the already pre-purchased exhauster fan.
- This device will be capable of maintaining quality control standards given by OSHA alongside HEPA air standards.

FUME HOOD TEAM

QUESTIONS?