Prior Art Review

Project 16 – Zen and The Art of Glitter Deposition

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10/10/2021	01	Initial Release
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1 Search Process

1.1 Overview

To begin the search process, it was decided that each team member would be responsible to produce a minimum of 3-5 different search terms in the search log as well as presenting the most relevant source they found to the rest of the team. Searches were to be recorded as they found them to prevent any repeating work . Each type of prior art should be reviewed (Journals/articles, Standards, Patents) to get a comprehensive understanding of the available prior art. The client indicated that there was not much prior art directly pertaining to the project, so the team focused mostly on finding ideas that could be partially implemented or create inspiration. The searching process mostly followed the pattern of finding a journal or article with some degree of relevance to the project, followed by further exploration of the relevant terms via additional journal searches as well as patent searches. This method often resulted in one search log entry leading to several more relevant terms. In the case that a search did not yield any relevant information, the terms and location of the search were still recorded to assist other group members.

1.2 Challenges

The group ran into several problems towards the beginning of the prior art process, but many of these issues were resolved by becoming more comfortable with the search process. As the client had mentioned, the prior art specifically related to the problem was limited. It took some time to find relevant information regarding the project for each search because most sources did not relate or benefit. Additionally, once a potential source was found, usually only an exceedingly small portion of the information was relevant. Many searches would begin with something that sounded relevant and ended up leading to a dead end. This was a big problem because of how challenging it was to find any information relevant to the project. The group then had a meeting to compile a list of search terms to try and help initiate the searches. These search terms were able to produce some new and relevant information which helped to progress the search.

Additionally, the group ran into some issues with the search for standards. At first it was difficult to determine what kind of terminology should be used for the search as “glitter boxes” are not a typical product. After some dead end searches the group came upon ASTM standards for additive manufacturing. While inkjet processes and powder deposition were not exactly mentioned, they do qualify as additive manufacturing and this standard was deemed relevant. The standards presented were helpful but should be further investigated. The standards specifically state 3D printing, the problem put forth by the client could certainly be considered additive manufacturing.

1.3 Effectiveness/Satisfaction

With each search, the team members were able to learn how to change key words to come across better articles, journals, or patents that related more to the project at hand. Learning what not to search was as beneficial because it narrowed down the results and gave the team a better sense of what to find that could help develop the project. The team was satisfied with our work and process of searching. We were somewhat satisfied with the results found after searching, but would have found it beneficial to find some patents or articles pertaining more to inkjet systems so the team could have a better understanding of the operation and functionality.

Once the predetermined number of searches and sources were found by each team member, a meeting was held to communicate the most relevant information found by each member and determine

if the search log should be concluded. The information shared in this meeting led to several ideas which would contribute to the development of the first sprint's increment along with the project as a whole. The most relevant sources were agreed upon and a more comprehensive understanding of each source was obtained and documented below. It was at this point that the group decided to conclude the search log due to the significant amount of information that had been found as well as the increasing difficulty in producing search terms. Even with findings that led to dead ends or did not relate to the project, these sources helped each team member become more aware of different techniques, machines, and uses for the same products we were searching. Knowing the different capabilities or systems similar help open doors to different concepts and uses that we did not know of before.

2 Search Log

Date	What are you looking for?	Where did you look?	Search Query	Evaluation of the search.
9/23	Existing solutions for the collection of particles off a surface	Professor Marshall	N/A	-Professor Marshall forwarded several of his own articles relating to the use of bounded vortex flow to collect particles from a surface. These articles gave a potential solution for the collection portion of our problem. -Along with this he sent us a document explaining the Twister Cleaning Nozzle which was designed to "create a bounded-vortex flow field to aerodynamically remove dust particles from the surface of optic filters." -While these resources are very helpful in beginning our prior art review, the client did not seem very receptive of the bounded vortex flow idea. Seemed to prefer simplified designs utilizing a single air blade
9/27	Techniques used to evenly/randomly distribute particles	Compendex	Particle deposition	-This search yielded an example of a system designed to test particle deposition based on surface roughness -The system used compressed air to blow particles into a chamber with the test surface and a fan -This system did not have any way to remove the particles -a second article demonstrated the effect of particle diameter and the use of a ribbed channel on deposition efficiency -while particle diameter could affect results in our final design, the client would not be able to disclose all possible powders that would be used
9/27	Existing patents for material deposition	Google Patents	Material Deposition	-This search showed a method of additive manufacturing, to fabricate solids -while the client is performing additive manufacturing this type of patent is for precise addition/stacking of solids which does not apply to the adhesive powder system the client needs

9/28	Potential avenues for collecting/filtering glitter	Google Scholar	Dust Removal	-This search yields an article exploring the use of an environmentally friendly agglomerant to improve dry dust removal in a filter material ("*Preparation and performance characteristics of an environmentally-friendly agglomerant to improve the dry dust removal effect for filter material" –Liu)* https://doi.org/10.1016/j.jhazmat.2020.122734 -The article described the use of a pulse filter device which would periodically inject powder into a chamber with the filter material -One of the included parts was a **pulse valve** which was controlled by a **pulse controller**, this same setup could be used to add turbulence to our glitter box. More research into pulse valve should be done -Other aspects of the device recorded wind speed as well as dust concentration, these would not be relevant in our design unless the client wants an exact measure of how much glitter is left in the box
9/28	Existing implementation of pulse valves	Google Patents	Pulse Valve	-This search provided more insight into the various applications of a pulse valve as well as how they operate -One interesting patent was for a Variable orifice pulse valve; this could be useful when it comes to calibrating the turbulence in the glitter box. Too much turbulence could interfere with the adhesive and potentially disrupt the deposition process https://patents.google.com/patent/US6032667A/en?q=pulse+valve&oq=pulse+valve
9/28	Standards for this kind of product	ASTM	Additive manufacturing	-This search led to several patents regarding the general principles, guidelines, and recommendations for any additive manufacturing -While the standards specifically state 3D printing, the problem put forth by the client could certainly be considered additive manufacturing. These standards should be further investigated
10/01-10/03	Techniques to Apply powder	Google Patents	Powder Application	-This search led to many patents that are very similar to some of the sketches we made. Showing many different ways powder can be applied to a surface. -Many new search terms search terms came from this search and each one needs to be searched. -More research into powder applications needs to be done, lots of good information here. -https://patents.google.com/patent/US10548695B2/en?q=Powder+Application here in this patent, we can find information similar to what we are

				trying to find a way to design. Laying down powder or material layer by layer in order to produce 2D or 3D components.
10/01	Techniques to Apply powder	Google Patents	Contour Crafting	-Many patents were found regarding many other applications of contour crafting; this term seems to provide some very broad results. But there are a few patents that were found relating to 3D printing. -Most of the 3D printing was material was not generally focused on a material/powder deposition. -Another search here may yield some better results, but this is a very broad search term in general
10/01	Techniques to Apply powder	Google Patents	Fused Deposition Modeling	-At first glance almost every single one of the patents are related to 3D printing, more specifically focusing on print heads -After some more in depth searching. These search terms do not produce many results related to any sort of powder application. Results may vary, but most of them are related to 3Dprinting using other materials and methods that may or may not help with inspiration.
10/01	Techniques to Apply powder	Google Patents	MultiJet Modeling	-This was a very successful search. Lots of information regarding 3D printing and a few articles more focused on a form of powder deposition similar to what we have been looking at some also very different which could inspire some new ideas. Some Keywords found were inkjet and powder deposition... directly related to what we are doing. -Some of the patents on this search Could provide further insight and more research here could be very beneficial.
10/03	How to disperse the powder over the entire surface	Google patents	Dispersion of powder	-There are multiple patents that show up when using this search term. Lots more can be found here - https://patents.google.com/patent/JP5646341B2/en?q=~patent%2fJP6735012B2 was a specific patent that stood out. Its focus is to pick up powder using air flow. This could be very useful in helping us find an effective way to turn the powder particles into projectiles pointed at the adhesive.
10/04	How air knives operate	Google Scholar	Air knife application	The search was somewhat effective. There are countless studies on how air knives apply a substance and those processes, but I was able to confine the search to see how it cleans and can allow the cleaning process of substances to be more efficient. In this study, air knives were utilized to propose a new methodology for semiconductor wafer drying using the concept of high-pressure gas flow. It uses high-speed drying and a lower count of additional drying defects. Articles were identified to use for further

				investigation in this process. Refining the search to specifically air drying, or cleaning will help instead of them being used to apply product.
10/04	How to remove the excess glitter for reuse	Google Patents	**Glitter reuse**	This search is an invention patent example for removing the excess glitter for reuse. I found this patent inspiring because it is similar to what problem we are trying to solve. In this invention, the glitter is applied to a succession of cylindrical articles by forcing them through a pot of clear lacquer. Squeegeeing the coating to a desired thickness, and then immediately passing the article through a vacuum tube, which removes the excess glitter for reuse. The client wanted us to keep the design as simple as possible, a vacuum tube is maybe something we are adding to the design for the next step, rather than a whole vacuum section. https://patents.google.com/patent/US6599567?oq=glitter+reuse
10/04	Removing dust levels on conveyer belt	Google scholar	Bag and Belt Cleaner Device	This search was more specific in seeing how others have removed dust particles specifically on a conveyer belt, a similar system to ours. There are a few sources here, but one in particular stood out. The US Bureau of Mines designed and tested a system to reduce dust levels in and around bags on a conveyor belt in airports. It has a chamber that the bags enter so that the dust does not enter the environment of those working or around, which is essentially a goal of ours as well. This was done with brushes and air jets, something we may consider.
10/04	Air knife efficiency	Engineering Village	Air knife application	This research explains the application of air knives in terms of computational fluid dynamics. I found this research inspiring because in this work, a novel configuration of a multiple-slot jet air knife is investigated through numerical simulations as an alternative to the traditional single-slot air knife. It might be too complicated to apply in our design, but it could be a good inspiration at some point.
10/04	How to clean excess glitter with an air knife	Google scholar	Air knife system	This search had many articles regarding the system of air knives and how they are used and in what experiments they have been beneficial, but nothing in this search was useful regarding our project. This search could be improved by being more specific and using key words pertaining to this project, not so general because there were too many options that were unrelated.
10/06	Glitter transfer process	Inspec	Particle transfer	This search explains how the glitter transfers in microcosmic. It somehow helps the project with theoretical support since the glitter is tiny enough to be viewed as particles. The research on particle motions is too complex for the project, but it's helpful for us to understand the influence

				of fluid flow for the glitters in the design. https://www.epj-conferences.org/articles/epjconf/pdf/2020/03/epjconf_enas2020_01019.pdf

3 Concluding The Search Process

3.1 Rationale for Stopping

Before the search process began it was decided that a minimum of 3 to 5 different search terms should be added into the search log by each team member. This was easily accomplished, however, initially, the quality of the results did not meet the standard of what was required. As already mentioned in the challenges section, the team kept running into dead ends, so a team meeting was held to come up with search terms, and a higher quality of results was found because of this prompting the team to wrap up the search process and move on to the next task. The team did more searching than initially planned and this resulted in search results much more relevant to the project than initially found. The prior art relevant to this project is indeed out there in small amounts if one is willing to think outside of the box, but no direct solutions to our problem have been found. Had it not been for going above and beyond with extra searching the team may not have produced much relevant prior art material. The information that has been found provided valuable information for the group to begin working on preliminary design solutions. The team continued to search, but no other journals or articles provided sufficient material for them to utilize. The plan moving forward is to continue iterating the designs that the group has already produced and conduct further research as necessary.

3.2 Potential Further Research

After some discussion with the group's mentor Dr. Marshall, the group determined that a greater understanding of theoretical particle flow was needed to fully understand the problem and potential solutions. This is what the next phase of research will be focused on with the help of Dr. Marshall. Some suggestions from Dr. Marshall were that the group investigate settling velocities and settling rates for air borne particles. It was stated that these factors were critical in determining the minimum shear force required to induce turbulence in the glitter box as they control how the glitter would react to different air velocities. It is expected that these initial searches will lead to more relevant research on particle flow.

Additionally, the group concluded early on that a CFD model to better understand the airflow inside of the box would be beneficial. Having a valid CFD model would cut down on the amount of time invested in invalid solutions and increase the group's efficiency. Research into the various potential models should be conducted to ensure the fluid simulation is as accurate as possible and to make sure that the methods being used meet standard practices.

Another step to take in the search process would be to investigate systems with negative air pressure and try to find some sort of dust containment system with holes open to the atmosphere where the particles can be contained inside. The latest design the team has put together is a cylindrical chamber with particles blowing around in the air inside. Finding a way to incorporate negative air pressure could be useful if the design were to remain an open system. The negative air pressure inside created by something like a vacuum could be an easy way to ensure that powder wants to stay inside

the system while it's running. However, this may not be the answer to the problem. Integrity did not say that a vacuum is out of the question but wanted other research to be done on how to start from the simplest design possible; perhaps not involving a vacuum unless it was proven to be required. There may be some ways to proceed without a negative pressure inside the chamber.

4 Prior Art Summary

4.1 Journal Article: Preparation and performance characteristics of an environmentally-friendly agglomerant to improve the dry dust removal effect for filter material

This article discusses the effect of an agglomerant on the dust collection efficiency of a pulse filter. The article begins by establishing how coal plays a large role in China's energy industry. The coal miners are often exposed to dangerous coal and rock dust and various methods to remove the dust from the air are implemented. The methods mentioned include inertial dust removal, bag dust removal, electrostatic dust removal, filter cartridge dust removal, and pulse filter dust removal. The article focused on pulse filter dust removal, which consists of sucking in dust laden gas which is cleaned through several filters and blown out as clean air. The filter is then blasted with short bursts of compressed air to knock all the dust loose which is then collected in a hopper below the filter. The article goes over several ways that pulse filter had been optimized through changing the components of the filter and focuses on how adding a small amount of water mist had been proven to increase filtering performance. In response to this, the authors produced a high efficiency agglomerant to be compared to the use of water. The article discusses how the researchers tested the agglomerant and compared changes in viscosity, surface tension, absorption, and dust removal performance to that of water.

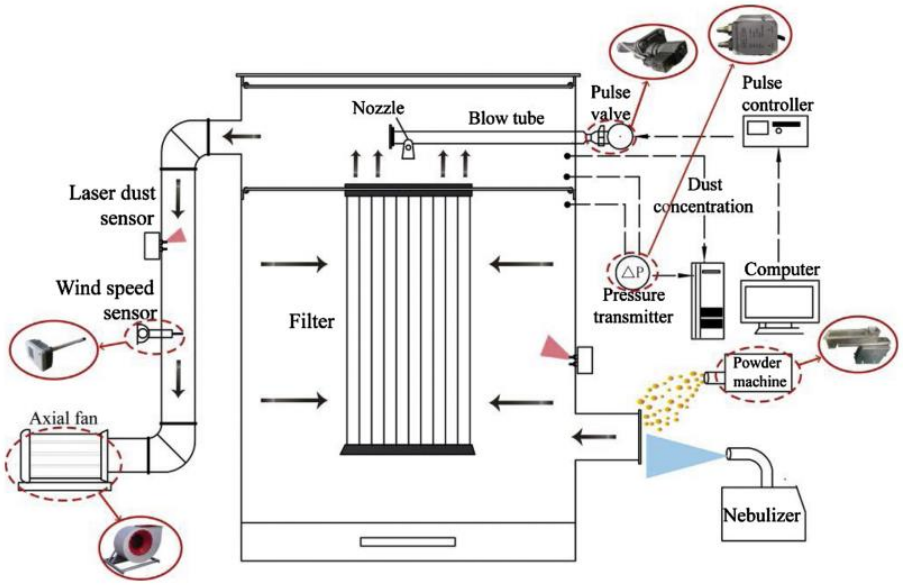

Figure 1: Experimental Setup

The part of this article that was most relevant to the group's problem was the experimental setup, shown in Figure 1. When reading this article, parallels were immediately drawn to the

mechanisms that the group needs to design. The experimental setup consisists of a container that will have dust blown around inside of it until it has stuck to a surface, then the excess is removed. In the most basic terms, this is exactly what the group is trying the accomplish and the methods used here have been considered when working on the design of the groups solution. The pulse valve has been considered as a potential avenue for disrupting the glitter and getting it to completely coat any adhesive. The pulsing would prevent piles of glitter from forming at the edges of the glitter box as well as reducing the ammount of pressure introduced to the box. Additionally, the idea of a filter was considered for preventing glitter from escaping through any venting holes in the glitter box. However, the client expressed that they did not want to have to replace or clean any filters after use if possible so that idea was not explored any further.

While some of the mechanisms presented in the experimental setup are relevant to our problem, many are not. For example, the wind speed and laser dust sensors are not neccesary for our design and would over complicate what the client wishes to do. Additionally, the article does not describe the “Powder machine” that is present in the experimental setup, this information could have been valuable in choosing the deposition method used in the groups design. overall this article provided some key ideas that helped to jump start the design process as well as pointing the group in a good direction for further research.

4.2 Journal Article: Reducing Respirable Dust Levels During Bag Conveying and Stacking Using Bag and Belt Cleaner Device

The U.S. Bureau of Mines designed and tested a system titled the Bag and Belt Cleaner Device (B&BCD) so that dust levels may be reduced in and around the conveyer and stacking process of bags at mineral processing operations. This system is necessary due to the high exposure to dust in the mining metal/nonmetal industry. This is done using the combination of both brushes and air jets. The bags travel through the device on a chain conveyer, which allows any product, dirt, or dust, to be cleaned from the bags and fall into a hopper at the bottom of the device, which is then recycled back into the process with a screw conveyer. The results were successful, with evaluations showing the amount of product removed from the exterior of the bags between 77-93%. This concept correlates with our problem to solve because we too are looking to design an enclosed area that is able to control the flow of particles, glitter in our case, dust in theirs, and cleaning and maintaining those particles without them escaping the encasement.

The final design, as shown in Figure 2, consisted of a push-pull ventilation technique to capture dust generated during bag stacking, which was a low-volume but high-velocity system creating a 4.3 m^3/min stream of air over the top layer of bags on a pallet. Once this was “pushed”, it was “pulled” into an exhaust ventilation system at 70.8 m^3/min. This was then filtered through a baghouse or another device before leaving the mill. Results were seen to be a 70% reduction of dust exposure in laboratory testing and 76% reduction in the field for the first evaluation. This system has proven to be reliable and effective.

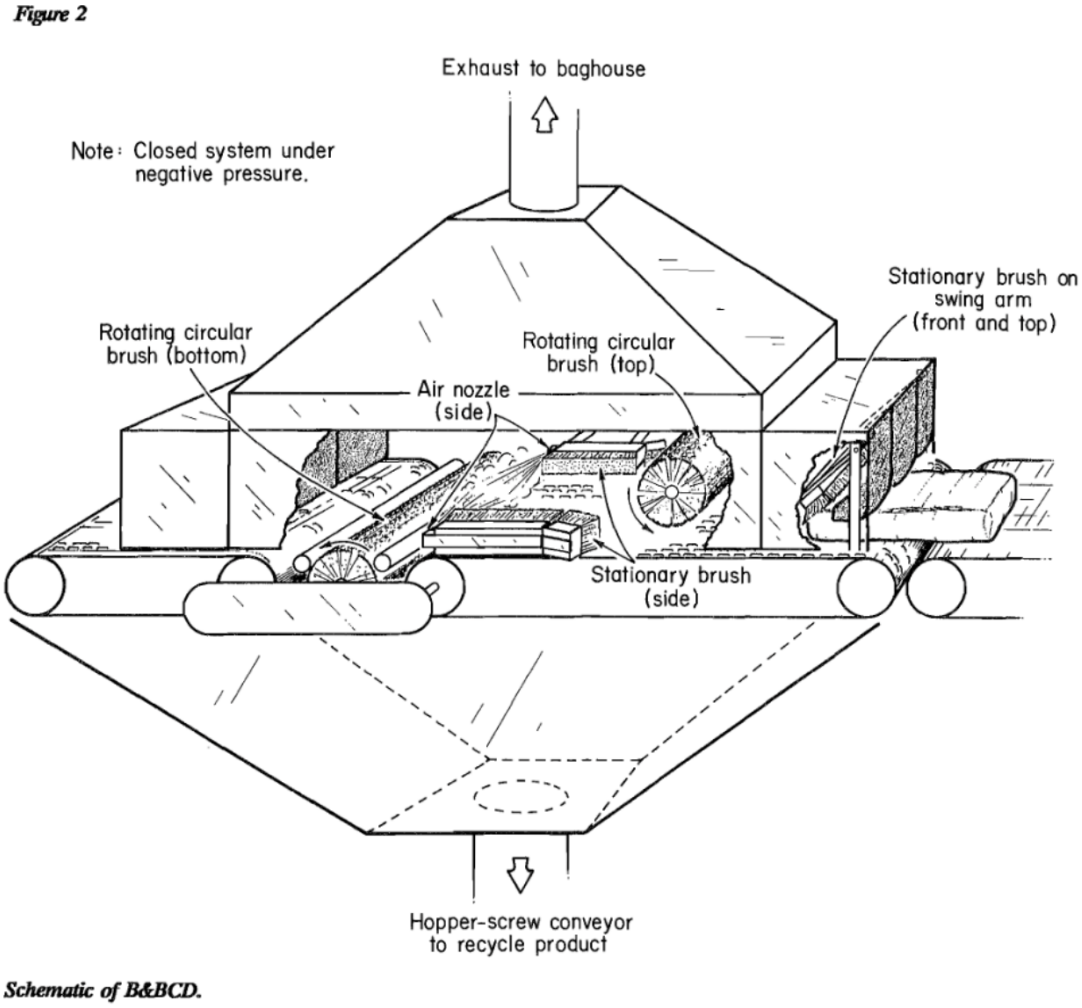

Figure 2: Machine Design [2]

Although this project is not involved with reducing dust exposure to people working in mines, the concept of the design is like the Glitter Deposition device. There is the idea of the push-pull method to manipulate flow in certain directions and remove the particles within the system without them circling back [2]. At the bottom of Figure 2, there is a hopper-screw conveyer that recycles the particles/product. The team can use this concept of recycling the particles after the particles have been applied to the adhesive so they may be reused. A hopper was implemented into the increment in the SolidWorks model to deposit the glitter particles into the system, so there are multiple similarities between both devices, with the same goal to retrieve the unneeded particles with the use of manipulating air flow.

4.3 Journal Article: Dosage device and method for mixing powder in airflow 537

From this research article, the design is to be used in the medical field as a method to mix drug powder into an air flow. It is used to deliver the powder form of certain medical drugs directly to the lungs. It works by sending an air flow over a small reservoir perpendicular to the flow tube that contains powder. As the air travels through the tube, it picks up powder into the air flow by creating a small vortex which then flows back through the upper tube into the lungs. This technique of picking up powder is called a shear driven cavity flow. The invention is like an inhaler in theory and comes with a mouthpiece or nasal adaptor in order to allow for the ingestion of the drug. In Figure 3 below is a sectioned image of the tube connected to the reservoir showing the air flow patterns inside. The arrow inside of the reservoir represents the vortex that is being generated inside of the reservoir picking up the drug powder particles. The arrow above the reservoir in the tube shows the direction of the air flow relative to the formation of the vortex.

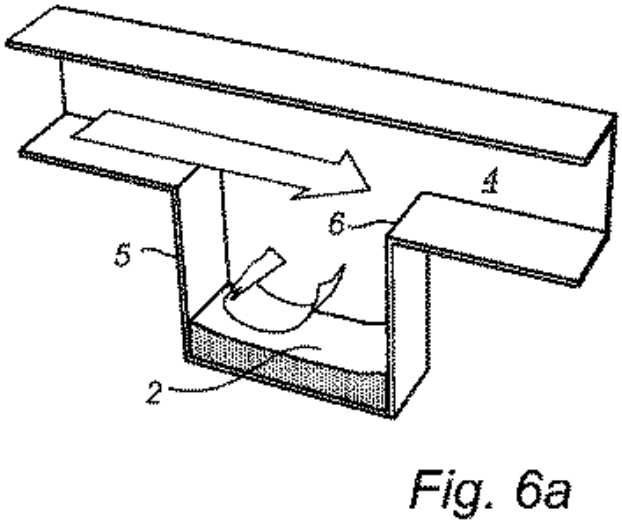

Figure 3: Vortex Generation [3]

This could be relevant to our project regarding the addition of powder into the system. With the current system that is in place, powder is dropped in from the top of the chamber, however, if this method proves to be difficult to work with, this could potentially be another method of introducing powder to the system that may be more efficient. Although this could work, it does present some limitations. The amount of powder that is in the reservoir will run out eventually. In the context of the original invention this is not a big deal, but our system is being designed to operate 24/7 so the reservoir will not hold up and will run out eventually. There needs to be some sort of method to actively add powder. It is also limited to the same problem as the current design that our group has made; if there is going to be air flowing in, there will need to be air flowing out. The group still needs to come up with a way to effectively remove air from the system that will not make a mess. Overall, this is another method

of powder addition to the system that may work surprisingly well and more research on this could benefit the project.

4.4 Journal Article: Method for Glitter Coating a Cylindrical Article

This research is in the field of the application of decorative coating to small articles, such as pencils and other writing implements. Decorative printing is one of the most popular and critical parts in the manufacturing industry nowadays. Cylindrical articles, such as pencils, to which the present invention applies, have been coated with decorative coating by methods such as dipping, spraying, and by forcing the articles through a pot of coating liquid and squeegeeing off excess liquid, followed by a drying or curing Step. deposition of glitter on cylindrical writing instruments by an electro-flocking process involving application of an electrostatic Voltage between the writing instrument and the glitter dispenser is disclosed in multiple designs. In this invention, glitter is applied to a succession of cylindrical articles by forcing them through a pot of clear lacquer, squeezing the coating to a desired thickness, and then immediately passing the article through a pot of glitter. The articles then pass through a vacuum tube, which removes the excess glitter for reuse. The glitter particle swirling in the tube and adheres to any areas of exposed lacquer, then drops onto a conveyor that is long enough to permit them to dry before being collected for curing.

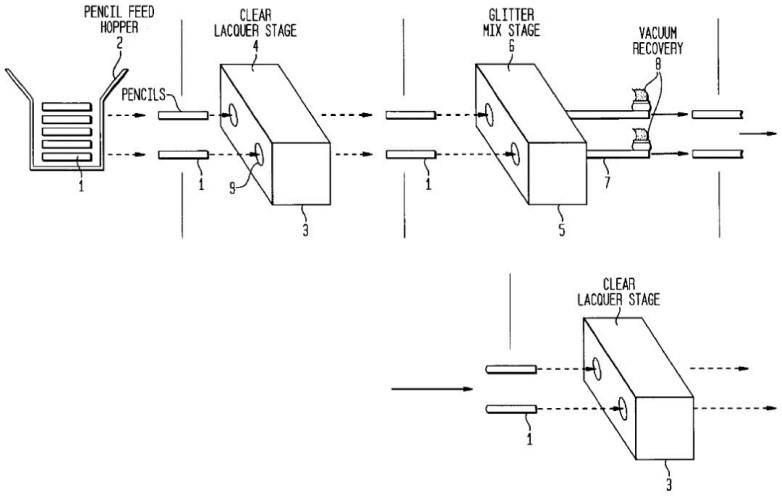

Figure 4: drawing sheet of the glitter reuse invention

The part of this design that was the most relevant to the group's problem is the process of applying glitter to the adhesive and reuse the glitter. When reading this patent, it applies the glitter on the item adhesive surface and then vacuums the surface to reuse glitter, it is like our idea at the very beginning of the design process. The team had a design which had two sections that one is for glitter print and the other is for vacuum section. After communicating with the client, they said that they would prefer us to keep the design small and simple, so we deleted the vacuum section, instead, replaced it with an air knife application. It is the same theory that by adding the air flow to let the excess glitter swirl in the glitter box and collect the glitter. The glitter reuse is the part that the group will research and improve on for the next step.

4.5 Journal Article: Numerical Investigation of Multiple-Slot Jets in Air-Knife Wiping

This study is relevant to the application of air knife, which is one of the most critical parts of the project for glitter reuse. This study shows that Gas-jet wiping using an air knife is an effective hydrodynamic method to control the coating thickness of zinc on a moving steel substrate in the continuous hot-dip galvanizing process. The current generation of single-slot air knives is widely used in the galvanizing industry but has limitations in producing low coating weights at the higher line speeds desired for the current generation of automotive sheet steel products. The molten zinc coating thickness on the sheet substrate is usually controlled just above the bath using a planar turbulent gas jet or air knife, typically in a single-slot configuration (Fig. 5)

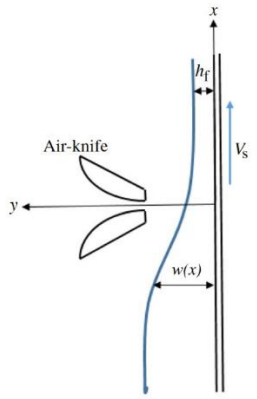

Figure 5: Schematic of the gas-jet wiping process

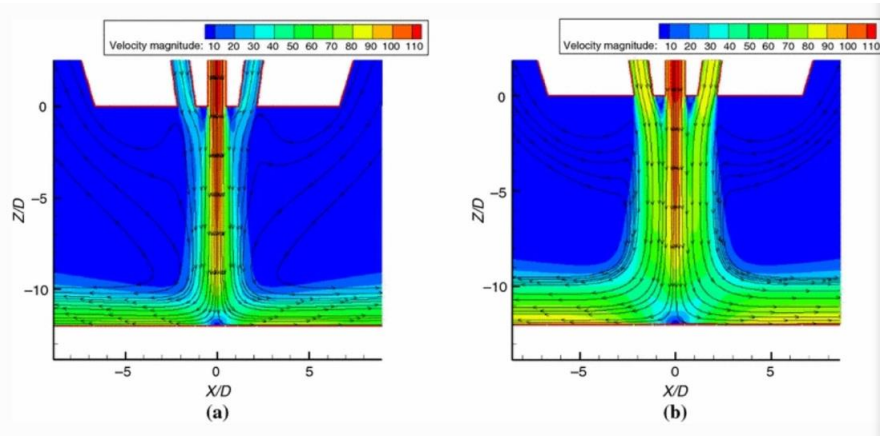

Figure 6: Pressure contour and streamlines for air-knife Re=3000 and Re=9000

The study concluded that a novel configuration for a multi-slot air knife which can be applicable for the continuous hot-dip galvanizing process as an alternative for the conventional single-slot jet was investigated numerically. As seen in figure 6, there are pictures of different Reynold numbers, and the figure is a comparison. This study is leading to the next step of our research that we are going to run some Computational Fluid Dynamics simulations to test the feasibility of our glitter box design, which helps the design have a strong theoretical support of fluid dynamics.

5 Novelty of Project

This project involves innovating the glitter box design and recollecting excess glitter after deposition. After research and discussion with Dr.Marshall, he introduced the group to the bounded vortex theory which helps with the glitter recollecting. After the team communicated with the client about this idea, the client preferred the team to start simple. To avoid the complex solution, an air knife has been applied to the design.

Through the collection of research, the team found ideas that could be applied or were related to this project, leading to inspiration for other paths for the team to explore. The team was inspired by the gumball machine and designed the rotating gumball deposition mechanism for glitter deposition. This is a bold and innovative design idea that the team came up with. The mechanism is designed in a cylindrical shape and there is an open section to scoop glitter with the rotating cylinder, when it is facing down to the bottom surface, the glitter will drop due to gravity. Air knife idea is another innovative design idea in this project. An air inlet is designed on the side of the glitter box to connect with the air pump and provide air flows to the channel to create a laminar flow, which enables the glitter to circulate inside the box. The search log research provided a lot of theoretical support for this design idea. Last not least, air vent holes are designed on the side of the chamber, these holes are there to balance the pressure inside the box by letting air escape while air is being pumped into the chamber.

As stated before, the prior art correlated to this project was scarce, for not many sources have researched glitter deposition. With this project goal being unique, the team had to be creative in how to find research that applied to any concepts or designs that related to the project. Seeing how manipulating air flow a commonality was, that subject was further investigated. Also, seeing how manufacturers need to clean up particles or remove them from a working site proved useful in understanding the concepts and thinking of designs on a smaller scale that could vacuum, sweep, or blow the particles into a chamber to recycle the particles, one of our requirements.

6 References

[1] R. Liu, G. Zhou, C. Wang, W. Jiang, and X. Wei, “Preparation and performance characteristics of an environmentally-friendly agglomerant to improve the dry dust removal effect for filter material,” *Journal of Hazardous Materials*, vol. 397, Oct. 2020, doi: https://doi.org/10.1016/j.jhazmat.2020.122734

[2] E. Heinonen, “Variable orifice pulse valve,” US6032667A, Mar. 07, 2000 Accessed: Oct. 08, 2021. [Online]. Available: https://patents.google.com/patent/US6032667A/en?q=pulse+valve&oq=pulse+valve

[3] Astrazeneca Aktiebolag, “JP5646341B2 - dosage device and method for mixing powder in airflow 537,” *Google Patents*, 25-Dec-2014. [Online]. Available https://patents.google.com/patent/JP5646341B2/en?q=~patent%2FJP6735012B2. [Accessed: 10-Oct-2021].

[4] A. B. Cecala, R. J. Timko, and A. D. Prokop, “Reducing respirable dust levels during bag conveying and stacking using bag and belt cleaner device,” *Centers for Disease Control and Prevention*, 1995. [Online]. Available: https://stacks.cdc.gov/view/cdc/10225. [Accessed: 10-Oct-2021].

[5] William P. Whitehorn, “Method for glitter coating a cylindrical article”, US6599567B2, Dec.20, 2001, Accessed: Oct.05, 2021 [Online]. Available: https://patentimages.storage.googleapis.com/ca/c6/98/31f78e5cf42cc2/US6599567.pdf

[6] A.Yahyaee Soufiani, J.R. McDermid, A.N.Hrymak & F.E.Goodwin. “Numerical investigation of multiple-slot jets in air-knife wiping”, Journal of Coatings Technology and Research, 2017, [Online]. Available: https://link.springer.com/article/10.1007/s11998-017-9963-0#Sec14