CAPSTONE EXPERIENCE 2011

Positive Drive Modified Sweep Auger

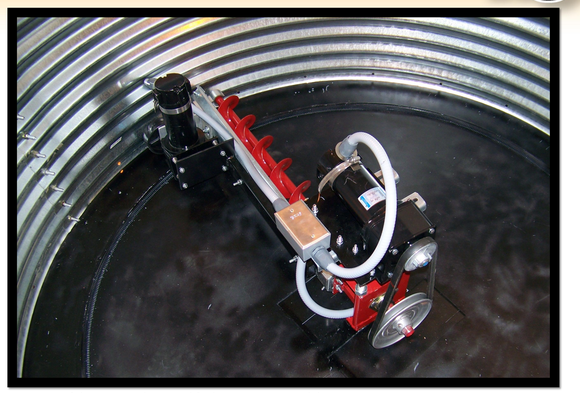
PURDUE UNIVERSITY

Agricultural & Biological ENGINEERING

Jesse Alderson (ASM), Lucas Shideler (ASM), and Eric Steidinger (ASM)

Objective:

According to Occupational Safety and Health Administration (OSHA) standards, no person may be in a grain storage structure when a sweep auger is running; this presents a problem because many existing sweep augers are unable to move themselves around the grain storage structure. Our plan to combat this problem is to retrofit existing sweep augers with an electrically driven positive drive system.



Top view of the positive drive modified sweep auger model.

Itemized Budget for Modified Sweep Auger Model

Item	Quantity	Projected Total	Actual Total
6' Grain Bin Rings	2	$500	$218.76
Grain Bin Floor	1	$100	$411.62
Track	1	$1000	$542.56
Spur Gear	1	$50	$32.50
4" Sweep Auger	1	$300	$415.16
AC/DC Transformer and Controller	2	$300	$344.00
¼ hp Explosion Proof DC Motor	2	$700	$935.63
Metal for Frame	N/A	$60	$149.51
Miscellaneous Electrical Supplies	N/A	$3500	$400.00
Miscellaneous	N/A	$500	$213.13
Total		$7010	$3662.87

Alternative Solutions:

•A possible solution to this problem that was discussed was using AC motors and gear reducers in the positive drive system. This idea was deemed inappropriate because the small-scale model would be overloaded with gear reducers.

•Another option considered was the use of a pneumatic system to positively drive the sweep auger around the bin. This idea would have brought about a big challenge in cleaning the air and also controlling the flow of air. Furthermore, there would have been operation issues associated with the colder months of the year.

•Our sponsor wanted to avoid the issues associated with a hydraulic positive drive system. Hydraulics were not desired because of the extreme modifications to the grain storage structure.

Background Information:

- In many cases, installing a new sweep auger design is difficult to complete because of serious modifications that are required. Many times these modifications are completely infeasible due to the fact that there is not enough space under the grain storage structure to install a hydraulically driven positive drive sweep auger.
- This new OSHA standard poses a problem because many existing grain storage structures contain sweep augers, which are unable of traversing the area of the grain storage structure unaided by workers or mechanical pushers. A new way of pushing or moving the sweep auger is needed to make it possible to clean grain storage structures efficiently.
- On December 24, 2009, OSHA administrators signed a "letter of interpretation" that created a new policy for operating sweep augers inside grain storage structures. This new standard states that all mechanical, electrical, hydraulic, and pneumatic equipment that may cause a potential danger to workers shall be de-energized before entry to the grain storage structure is allowed.
- This project, if implemented on a large scale, will save ADM money by saving on the initial cost of a new positive drive sweep auger. This project will also save labor costs because the auger will be able to drive itself around the rain storage structure instead of manually moving the sweep auger when it is de-energized.

Construction Process :

•The final model consists of flexible rack, a spur gear, and DC gear motors contained within one six foot bin ring.

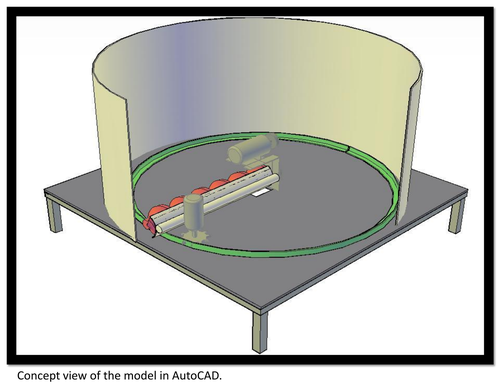
•The first step in constructing this model was to develop a design that was believed to be viable and then to express it in a series of AutoCAD drawings.

•Parts were then acquired from a variety of suppliers.

•Next the table was built, the sweep auger was modified to fit the model, and the track was mounted.

•Finally, the model was painted, wired, and the bin ring was affixed to the top of the table to contain the model sweep auger.

A close up view of the positive drive system.



Concept view of the model in AutoCAD.

Final Recommendations:

•In implantation on a full size bin, multi-phase AC motors and possibly gear reducers are recommended for the drive potion of this design.

•In larger bins a second motor and track is recommended for placement at half the radius to alleviate stress on the sweep auger.

•Instead of utilizing a flexible rack and spur gear, ADM should work with a manufacturer to specially design and build a rack suitable for this application in a full size bin. Due to this. calculating an exact cost for a full scale implementation is not possible.

Sponsor: Josh Bushue, Regional Operations Manager, ADM

Technical Advisor: Dr. Patrick Murphy

Special thanks to Scott Brand, Kyle Brooks, Carol Sikler and Gary Williams.

ADM

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Think impact.

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Objective:

The Agricultural and Biological Engineering Department offers an annual Senior Capstone Project competition concurrent with the ABE Outstanding Alumni and Outstanding Service Awards. As a service of the department, I am available to print your PowerPoint presentations on our poster printer. If you will be using a program other than PowerPoint, please check with me prior to the deadline so that printing problems can be avoided. You are not required to submit your project through me if you do not want it printed on the poster printer. A template is available on diskette or can be downloaded at: https://engineering.purdue.edu/ABE/Undergrad/ (*Note* - It is near the bottom of the page). Projects may be submitted via email (sikler@purdue.edu), on CD-ROM, or jump drive. The deadline is Monday, April 19, 2011. Check with your professor for other instructions.

Carol Sikler ABE 201, 494-1174

Helpful hints on graphics: any item that is "borrowed" off the Internet is going to be at a low (72 dpi) resolution. Increasing the size does not increase the resolution – it just makes the pixels appear bigger. Check your graphics at 100% on-screen to make sure they are clear. When possible, save in the .jpg format. Some of the poster files are enormous due to a large number of .tif or .bmp pictures – this can present problems when it is time to print.

Design and printing instructions:

- This is set to the correct size - please do not change the dimensions on the File/Page Setup menu. Finished panels must be no larger than 42" x 56". The page size is set as the paper size. The printer will not print to the edges, so please leave at least a ½" margin.
- Text on the template can be highlighted and replaced – avoid the use of too many different fonts. The printer does not support all fonts (i.e., fonts that are named "Technical"). It is best to use a 40 point font or larger (this text box is in 40 point font).
- The text boxes on the template are suggested placements only – they can be moved and changed (color, line thickness, etc) as necessary.
- Background color must be white. AutoCAD drawings need to have the black background changed prior to inserting (Under "Tools," "Options," "Display" click on the background and select a different color – preferably white or something else VERY light).
- The deadline for submitting your project is a firm deadline, independent of other activities you may be participating in outside the department. There are several groups printing projects and late submissions will be queued behind the other classes and printed on an as-available basis. Our new printer is much more efficient; things still go wrong.
- Reprints will not be available except for catastrophic disaster. Please print a scaled-down version of your project to the color printer ABE208H1 or ABE201H2 prior to submitting it to me for printing (to check for spacing, perspective, etc.). You can choose "Scale to fit paper" in the print dialogue box. Ask me if you have any questions. Please bring me a copy of the scaled version with your Dr. Murphy's signature on it as "approved." I will be delighted to print projects once I have the signed version.
- Do **not** try to print your own job on the department poster printer. The risk is very high that your job will be deleted from the queue.

If you leave an email address with me when you submit your project to be printed, I will notify you when your project is ready to be trimmed and checked. I have a place to store the completed projects in my office.
Team member and program names (ANRE, ASM, BFPE) must be on the panels, either in the title box or in the "credits" box at the bottom left-hand corner of the first panel.