Designing an Affordable Silage Wrapper for Small Farmers. FNE02-401

Final Report

Presented by:

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Background

All small farmers face a similar challenge: not spending more on equipment than earned in profit. The cost of equipment keeps rising, but the price of some crops has not risen by the same amount. In 2001, I priced silage wrappers and tubers at the Empire State Farm Days in New York. I was astonished to discover that a bare bones model sells for $10,000. Few to no used wrappers or tubers are available for sale. The concept of a silage tuber is simple: push the bale through the tube, seal the ends. My project was to design a silage tuber that can be made by any farmer who has a welder and basic hydraulics knowledge. Note that this project designed a tuber, not a wrapper. I made an error in my title.

Goals

The original goals of the project were as follows:

A. Draft plans in AutoCAD for a silage tuber. The tuber's design uses a commonly available size of silage tube.

B. Send plans to the technical advisor for approval and suggestions.

C. Buy all the metal and hydraulics needed

D. Use the metal shop at Jalko Farm to make a prototype.

E. Test the prototype. This involves tubing bales, and checking for efficiency / problems.

F. Make any needed changes to the equipment. Re-draft plans.

G. Write directions that another small farmer could follow

H. Incorporate F and G in a pamphlet for dissemination.

The only major change to the goals is that the plans are hand drafted, not drafted in AutoCAD. The preliminary sketches of the tuber indicated that our estimates on materials were low. We shifted the available funds around. Our materials budget grew and our drafting budget shrunk.

Farm History

We (my wife and I) currently operate a 214 acre farm, plus rent 80 additional tillable acres. We raise beef, laying hens, turkeys, organic grains, and timber. We are in the process of converting our entire farm to organic production. Even though we both have other jobs, we spend enough time working on the farm to consider it another full time job.

The farm has been in operation for well over 20 years by family. We have only been managing the farm for the past 5 years. Eventually, we hope to rely on the farm for 100% of our income. We are well on our way of making this dream a reality. We recently received two grants from Coastal Enterprises, Inc (CEI). The first provided assistance in writing our business plan. The second is providing financial assistance to upgrade some of our equipment and help with other startup costs. Due to the generous help from SARE and CEI, we are increasing our beef herd size and opening a mill which processes a new line of organic poultry feed.

Cooperators

Cooperators on this project included:

Tom Christensen
Associate Professor of Advanced Manufacturing Center
College of Engineering
University of Maine
Orono, ME 04469

Barret Parks
Engineer
3270 West River Road
Sidney, ME 04330

Deena Potter
Cooperative Extension
13 Hall Street
Fort Kent, ME 04743

Mr. Christensen and Mr. Parks both assisted with the design and with problem solving. Ms. Potter assisted with the dissemination of project results, and arranged a public display of our tuber and two other local tubers/wrappers.

Project Portfolio

I did my background work back in the summer of 2001. This involved looking at silage tubers that are currently being sold in the North-east. There are two basic designs: the first with a round metal tube that stretches the bag uniformly. The second has 4 to 6 arms that are inserted into the bag. The arms open and stretch the bag into a hexagon shape. The bale is then somehow pushed into the stretched bag.

My version of a bale tuber follows the second scenario: it has arms which stretch open the bag. Seeing as my baler only bales 4 ft round bales, I designed the tuber to handle 4 ft. Seeing as this is meant to be the budget model, I designed the tuber to work off the hydraulic pump of a tractor. It does not have its own motor and pump as many of the commercial versions have. The tractor is attached to the bale tuber. The hydraulics on the tractor open the arms of the tuber. The tractor is then disconnected. The arms remain open while the tuber is in use. The tractor must be reconnected in order to close the arms.

Another major difference is my version does not have wheels. It must be picked up with a loader and carried to the site where bales are to be stored. The same loader is used to load the tuber's bale carriage and to insert the bale into the bag. A special bale spear / tuber puller was built to attach to the loader. The loader stabs a bale with the spear, and places the bale on the bale carriage. The tuber-puller on the loader is then used to drag the frame of the tuber forward. A system of garage door springs and pulleys make the bale carriage push the bale into the bag as the frame is dragged forward.

I drafted the rough design, and discussed the design with my cooperators. I then purchased the needed steel and hydraulics. I used a metal band saw to cut the steel to length. I used a mig welder to weld the steel together. I obtained a silage tube for 4 ft round bales and tested the tuber to see if it could stretch the bag.

At this time, I realized that my design had two major flaws in it. First, The arms were spaced too far apart. As a result, the 4 ft bag would not fit over the arms. The frame supporting the arms was a hexagonal shape. Ideally, all 6 sides would need to have been made shorter. Due to the complexity of this feat, I ended up shortening only two of the sides of the hexagon. As a result, the tuber did not stretch the tube in a perfect hexagon. This means that no bales larger than 4 ft can fit in the bag. The second flaw was that the arms were not strong enough to stretch an entire 150 ft bag. I used 4 inch pipe for the arms. I should have used either a thicker pipe or a solid rod. I solved the problem by cutting the bag in half. This simply means that less bales will fit in a tube. Twenty (one meter wide) bales will fit in each half-bag.

I then tested the tuber with actual haylage bales. This is when I found my third flaw. I found that the bales tended to stick on the bale carriage. The carriage was not solid, and parts of the bale dragged on the ground. I remedied this by adding sheet metal to the pipes that made up the carriage. This solved the problem.

Although I had to make four modifications to my prototype to make it work, I felt that my project was a success. The tuber successfully tubed all the silage I fed in the winter of 2002-2003. I will continue to use it for the foreseeable future. If I was to make a second one, I would make all the sides of the hexagon the same length and I would use a heavier metal for the arms. The enclosed drafting plans are the plans I would use to make a second prototype, with the fixed dimensions. The enclosed pictures are of the original prototype.

Jalko Farm's Silage Tuber was displayed during the SARE sponsored Sustainable Beef Production Course. This course toured Aroostook County beef farms on September 6th and 7th, 2003. The tuber was transported to Carrol Carons Feedlot. I gave several brief presentations during the barbecue, and was available for questions. There were approximately 75 participants on the tour.

I created a brochure for Aroostook County Beef Operations Tour participants. It includes drafting plans, materials list, and basic instructions for building and using a silage tuber. It also compares our model with the available commercial models. Brochures were also disseminated this year's Common Ground Fair in Unity, Maine. Several thousand people attended the fair.

Other Misc. Info

There were no site conditions or conditions specific to my farm and this growing season that may have affected my results. I created a piece of machinery. So long as the user has a tractor with hydraulics, a loader (skid-steer or prime-mover works best), and makes bales that are 4 feet in diameter or less, s/he can easily use this tuber.

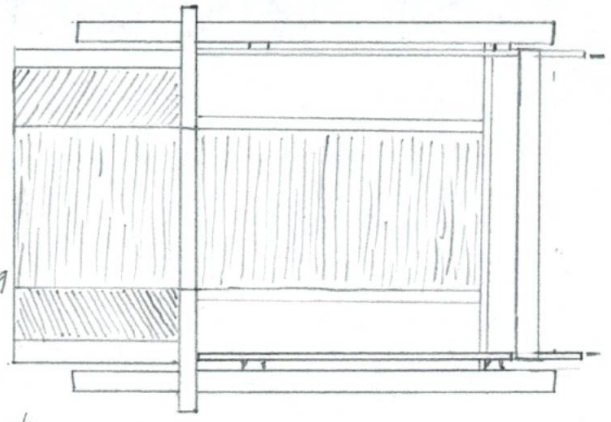
Owning a tuber greatly increased the ease of making winter cow forage. It allows me to make high quality forage when the weather is not cooperating for making dry hay. While my invention does not bag haylage any more efficiently than the commercial models, it was a whole lot less expensive. Our out of pocket expenses were less than a tenth of the cost of a new machine.

Benjamin Albert Date

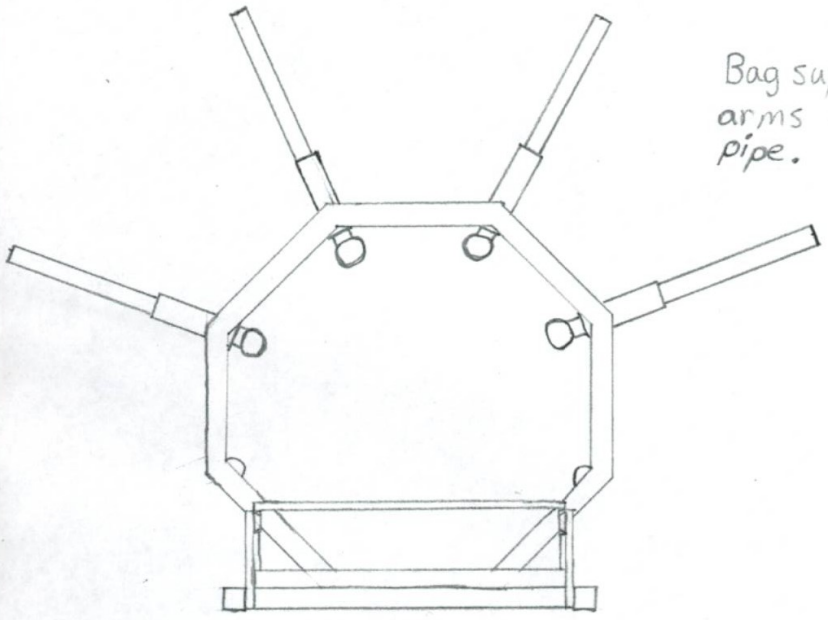
Benjamin Albert 9-25-03

FNE02-401

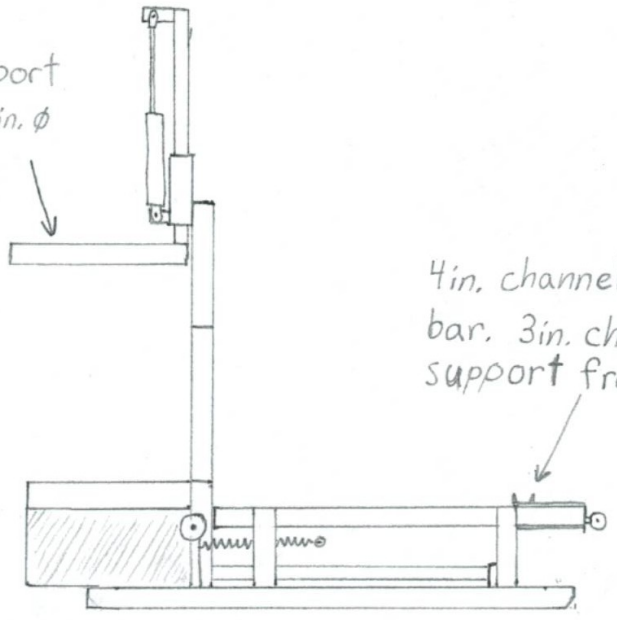
Some parts ommitted for clarity. Main frame should be constructed of 3 1/2 in. sq. minimum.



Bale support pan 1/8 in. sheet.



Bag support arms 4 in. ø pipe.



4in. channel push bar. 3in. channel support frame.

NOT ALL DIMENSIONS GIVEN. DIMENSIONS WILL VARY DEPENDING ON BAG SIZE USED. SEE BROCHURE FMI.