Geotube® Dewatering for Lagoon Sludge

An applied research and demonstration project

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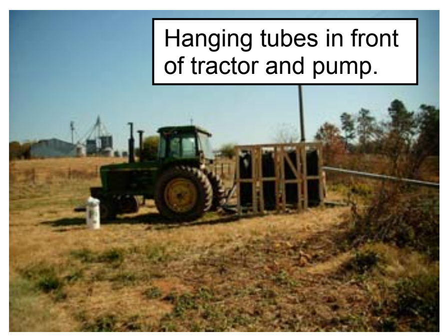
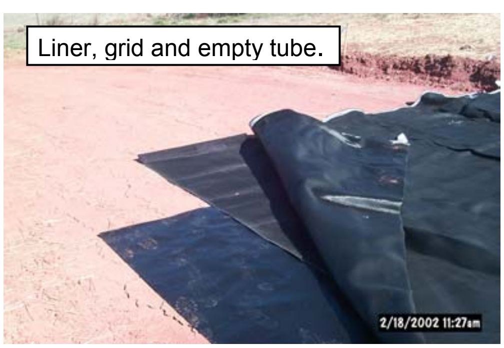
Background

In many animal waste management schemes it is desirable to separate solids from waste water and/or manures. In cooperation with the Department of Animal and Dairy Science, animal waste specialists from Biological and Agricultural Engineering are field testing a technology new to agriculture, to remove solids from lagoons. The test is currently being conducted at the UGA Dairy Science Research Center outside of Athens and is being funded by TC Mirafi, a company who manufactures geo-textile materials. The centerpiece of the research is a large porous tube made from a heavy-duty woven textile. The tube has a 45' circumference and is 100' long. Lagoon effluent can be pumped into the tube and as the liquid portion escapes the bag, solid particles are trapped inside. Solids are safely stored in the tube as water continuously leaches through the porous material. The process is repeated until the tube is full. Eventually the solids can be handled as a dry material, increasing options for transportation and land application.

Methods

Several weeks prior to the beginning of this trial a test was conducted to determine which of two weaves would be the most appropriate material for removing solids from the lagoon at the UGA Dairy Center. This was done by constructing four small scale tubes which hung vertically from a rack. The lagoon was agitated with a PTO driven propeller type agitator/pump and lagoon samples were pumped into 5 gallon buckets. The hanging tubes were manually filled. Engineers from TC Mirafi determined which material had the best dewatering characteristics, and ordered the full scale tube to be constructed.


Hanging tubes in front of tractor and pump.

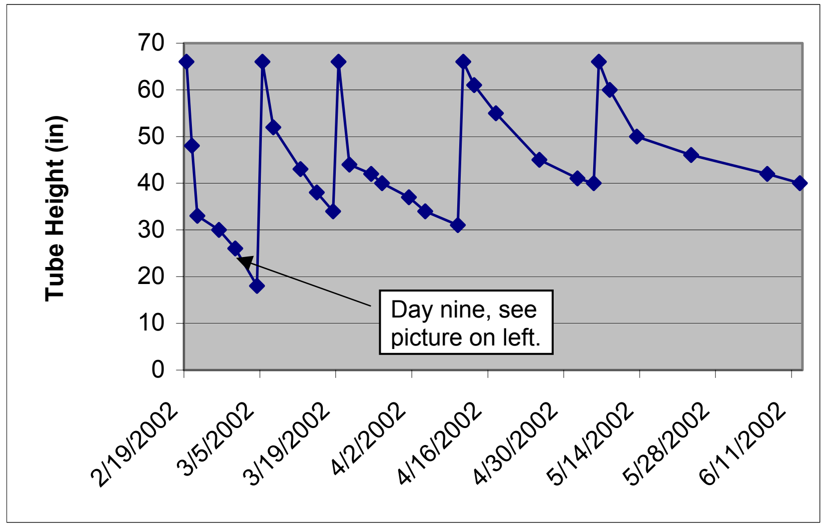


Liner, grid and empty tube.

A pad for the installation of the Geotube®, measuring approximately 25 feet by 100 feet, was graded with a 1 foot slope from end to end. It falls at the same slope into the topography of the surrounding area to prevent its rolling from the pad. The ground was lined with a heavy plastic liner and a plastic grid material to allow flow from underneath the tube. The unfilled tube was unrolled and arranged upon the pad. A berm was created to help direct flow from the bag into a culvert which returns tube effluent to the lagoon. The lagoon was agitated for several hours prior to the first filling of the tube.

Preliminary Results

Volume: A total of approximately 230,000 gal of 4% solids sludge was pumped into the tube over a two-month period. The tube was filled 5 times to an average height of 5.5 feet. (It took 87,000 gal to fill it the first time and smaller amounts for each subsequent fill.) During the first fill cycle, liquid flowed from the bag rapidly while it was being filled and for a few hours after it was filled. Flow from the bag decreased in speed as pressure decreased and as solids built up a filter cake, which partially occluded some of the pores. This process was repeated 4 more times at approximately 2-week intervals with the only difference being that the flow rate was much slower after the first fill since the filter cake already existed when filling began. Overall, approximately 95% of the solids were retained in the tube.



Nutrients: The tube retained approximately 78% of the total nitrogen (TKN was approx. 800 ppm in material entering the tube), with most of the ammonium nitrogen remaining with the liquid stream leaving the tube. Approximately 65% of the phosphorus was retained in the tube as well. An interesting observation was that the phosphorus level of the sludge (237 ppm) was about 1/3 of the nitrogen level, which indicates that we were pumping mostly surface effluent and had been unsuccessful in getting a significant amount of sludge entrained into the mix. We would expect very high phosphorus levels in sludge. Therefore, the results of the phosphorus separation may be significantly different if the material pumped into the bag contained more of the settled sludge.

Cost: The 45’ by 100’ tube in this test costs approximately $1700. A larger diameter tube would cost less per gallon of settled solids. The cost of the tube is most accurately given on a cost per gallon of settled solids (after the water has been removed) since the cost per gallon of sludge pumped into the tube is highly dependent on the solids content of the material. On this basis, the cost with this size tube is approximately 3.5 cents per gallon. If the sludge being pumped into the tube is 5% solids, the cost of the tube is approximately 1/2 cent per gallon of sludge. If it is 10% solids, the cost of the tube would be twice that much per gallon of sludge. However, since the cost of pumping per gallon is probably more than the cost of the bag, it would be more cost effective to pump material that has as high a solids content as possible. That would reduce the time needed to drain the tube and reduce the number of pumping times necessary to fill the tube. It would probably be wise to pump much of the liquid off the top of the lagoon onto nearby crop land (at agronomic rates) and then pump the sludge into the tube with as high solids content as possible.

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