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Use of FBC Ash to Stablize Dairy Barn Feedlots, Minimize Nutrient Pollution, and Develop New Utilization Outlets

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DISCLAIMER

PB.11 Use of FBC Ash to Stabilize Dairy Barn Feedlots, Minimize Nutrient Pollution, and Develop New Utilization Outlets

CONTRACT INFORMATION

Contract Number	DE-AI21-94MC31205
Contractor	USDA, Agr. Res. Ser. Bldg. 004, BARC-W Beltsville, MD 20705 301-504-5650 (telephone) 301-504-5062 (telefax)
Other Funding Sources	Ahlstrom Ash Development Corp.
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METC Project Manager	Jason Lewis
Period of Performance	Oct 01, 1994 to Sep 30, 1995

Schedule and Milestones

FY95 Program Schedule

	S	O	N	D	J	F	M	A	M	J	J	A
Site Installation								—	—	—		
Testing									—	—	—	—
Analysis										—	—	—

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OBJECTIVES

Objective #1-Dairy Feedlot Stabilization Demonstration

A dairy feedlot near Harrisburg, Pennsylvania will be selected for study using the following criteria: Site characteristics including slope and soil type, and proximity to a small stream in a defined watershed.

The selected feedlot will be split in half with half stabilized with FBC and the other half un-stabilized. Ten suction lysimeters or shallow sampling wells will be installed to a depth of 1 meter in each half of the feedlot. Lysimeters or wells will be sampled biweekly or after major rain events to determine water quality (nitrogen and phosphorous content) beneath the stabilized and un-stabilized areas.

Sampling will continue for one year. At the termination of the study the remainder of the feedlot will be stabilized.

Objective #2 - Determination of nitrogen and phosphorous leaching from feces and urine through stabilized and un-stabilized feedlot cores.

Six large (0.6m diameter by 0.6m depth) undisturbed cores will be taken each from stabilized and un-stabilized feedlot areas using 0.6m diameter steel pipe (total of 12). The cores will be fitted with a bottom cap plus a collection bottle and reinstalled at an adjacent area.

Two cores each from the stabilized and un-stabilized areas will be treated with cow urine, cow feces or left untreated.

Lysimeters cores will be sampled weekly for water quality (nitrogen, phosphorous, and metals). At the termination of the experiment, one year, density and penetration measurements will be taken and chemical analyses made for nitrogen and phosphorous.

Objective #3- Co-utilization of materials to reduce nutrient pollution potential

Samples of FBC ash, manure and straw (or bedding) will be sent to the USDA/ARS facility in Beltsville, MD in order to perform bench scale experiments under controlled conditions. Mixtures and combinations of FBC ash, manure, or straw (or bedding) will be monitored with simultaneous measurements of ammonia volatilization. After blending, the nitrogen and phosphorous content of the mixtures will be fractionated to examine the fate of these nutrients. The effect of time after blending on the fate of nitrogen and phosphorous will be examined. Moisture content and handling properties of the final materials will be evaluated.

Enhanced calcium movement into soils will be examined using PVC columns filled with soil from Beltsville. Soil columns will be surface amended with FBC ash and manure blends at ratios of 0:1, 1:1 and 1:0. Simulated rain event leaching will occur biweekly for 6 months. Leachate will be analyzed for calcium and phosphorous content. At termination, the cores will be sliced to quantify movement of calcium within the core.

Objective #4 - Co-utilization of materials to enhance value

Bulk samples of FBC ash, manure and straw (or bedding) will be sent to the USDA/ARS facility in Beltsville, MD in order to perform small field trails with blackberries and/or sea buckthorn. Blends of FBC ash plus manure and FBC ash plus manure and straw in a 1:1:1 ratio will be compared to FBC ash alone as a soil surface mulch.

Blackberries and/or sea buckthorn plants (species and cultivars used will depend upon availability) will be row planted and trickle irrigated. Treatment will consist of one of the 1:1:1 ratio mixes, FBC alone, or bare soil. Each treatment will be replicated four times with a minimum of 6 plants per treated row. The plots will be evaluated during the first year for plant growth, weed control via the surface mulch and nutritional status of the plants (essential elements plus metals).

BACKGROUND INFORMATION

Using technology developed by the USDA/ARS and USDOE, the Ahlstrom Ash Development Corporation has been successfully using fluidized bed combustion (FBC) ash from the Black River Co-Gen plant in Watertown, NY as an agricultural soil amendment. This permitted land application was based primarily on the jointly derived handbook on FBC utilization (Stout, et al., 1988). During times of the year when ash cannot be spread on crop land, Ahlstrom has been using the ash as a low strength concrete to stabilize dairy barn feedlots. The stabilized feedlots provide a place for cattle to escape from muddy conditions in the spring and fall. Farmer acceptance of these stabilized feedlots is very positive. However, there is a need to provide data on the leachates from and through these barnyard pads.

PROJECT DESCRIPTION

There are two obvious benefits to using the FBC ash to stabilize feedlots. First, ash can be used at the time of the year when fields are too wet for land spreading or there are standing crops in the fields. Second, animals on a solid surface are not subject to possible health problems caused by standing in mud and the animals are more feed efficient.

However, questions remain as to the extent of other possible benefits or detriments of the ash stabilized dairy barn feedlots.

The extent to which the ash stabilized lots keep nitrate nitrogen and water soluble phosphorous from dairy manure from reaching the ground water beneath the feedlots is unknown. Nitrogen and phosphorous in the manure retained on the feedlot surface would be available for application to cropland. Also, nitrogen would be subject to volatilization into the atmosphere. In either case, less nitrogen and phosphorous would escape to ground waters.

Soil erosion from stabilized dairy barn feedlots is anticipated to be less than that from un-stabilized feedlots. Assuming manure is removed from the feedlots on a regular basis, reduced erosion would result in less nitrogen, phosphorus, fecal coliforms, and sediment being transported to surface waters.

A possible detriment of the use of FBC ash to stabilize dairy barn feedlots would be the leaching of potentially toxic materials from the stabilized feedlots. Preliminary laboratory results indicate that leachate quality from stabilized FBC ash is not likely to be a problem under field conditions. However, field test confirmation would be desirable and would enhance the acceptance of FBC ash by regulatory agencies and the general public.

There exists some practices that could be easily adapted by the farmer, using ash stabilized feedlots, that could diminish potential nitrogen and phosphorous pollution potential and enhance the value of the field applied manure. First, spreading of straw or spent bedding material over the pad may act as an absorber of soluble nitrogen originating from the manure. The manure/straw (or bedding) mix can then be field spread. Second, intentional scrapping of the FBC pad during manure removal should result in a manure-ash mix (or manure-ash-straw mix) that will be field applied. This mix may reduce the risk of nitrogen and phosphorous pollution. The later by reaction with the high calcium ash material. Additionally, preliminary data exist that show enhanced movement of calcium through the soil profile when soluble organic materials are present.

The above practices can be simulated on a laboratory scale. This needs to be performed prior to field demonstration.

In the future, it may be necessary to increase the distribution distance of farm derived manures as well as industrial by-products such as FBC ash. Usually, the economics of distribution is the limiting factor. One way to overcome this limitation is to enhance the value of a by-product by co-utilization of two or more by-products. The dairy barn feedlot study area would be an ideal situation to explore the potential for co-utilization of materials. Co-blending of materials as a soil amendment or pelletizing blended materials could create a product which could be distributed economically.

RESULTS (PROGRESS)

There was a delay in initiating the project tests. This was due to the desire to wait for the Fort Drum power plant to convert to their normal coal source. This was accomplished in May of 1995. There was also a delay in obtaining permission to develop a barnyard ash pad in New York State. It was decided to move the ash pad site to Pennsylvania. Additionally, ash was delivered to Beltsville, Maryland for the crop field trials and column studies in late May of 1995.

To date the following have been performed at the Pennsylvania site under objective #1.

In April, 1995 a 6 by 15 m (20 by 50 feet) ash pad was constructed on a farm barnyard near Harrisburg, PA. The site is located on an intensively monitored agricultural watershed monitored by the USDA/ARS Pasture Systems and Watershed Management Research Laboratory. The site was chosen because of wet conditions during most of the year. Before the ash pad was constructed, the loose soil and manure was removed to a depth of 0.3 m (1 foot). Since the ash was hauled dry from Watertown, NY, the ash had to be conditioned on site. On site conditioning was accomplished by using a transit concrete mixer. The hydrated ash was poured on to the site, leveled out with a backhoe, and backfilled. The transit concrete mixer fully hydrated the ash and the result was a concrete-like product.

The following day, five suction lysimeters were installed in the ash pad by drilling to a depth just below the bottom of the pad and installing the sampling line to beyond the edge of the site. Five suction lysimeters were installed in the un-stabilized section of the barnyard and the site was ready for sampling.

In reference to objective #2, on the same day that the ash pad was constructed, six cores were constructed by pouring the conditioned ash into 0.6 m (2 foot) diameter by 0.6 m deep well casing welded to bottoms that had been drilled and fitted for sample collection. Next, six undisturbed cores of the un-stabilized barnyard were taken by driving 0.6 m diameter well casing into that portion of the barnyard with a pile driver and removing the undisturbed core. After the undisturbed soil cores were welded to the bottoms, both sets of cores were installed into the soil and were ready for treating and sampling.

The column study will consist of 16 columns manufactured from 10 cm diameter PVC pipe (schedule 40) as part of objective #3.. Each of four treatments will be replicated four times: soil alone, soil surface amended with FBC residue, soil surface amended with FBC residue plus dairy manure (1:1), and soil surface amended with FBC residue plus dairy manure plus bedding (1:1:1). To date the test plants, blackberry, have been planted at Beltsville. This planting site will be subdivided into replicated plot areas that will be treated with material combinations similar to the column amendments.

Currently, we are awaiting analysis of the dairy manure generated at the Beltsville farm site in order to determine the best ash/manure mixture to incorporate in the field and column studies.

FUTURE WORK

If barnyard stabilization is successful, there may be other agricultural applications for FBC ash. One such application would be to provide a pavement for the bottoms of trench silos. This application would have to stand the additional weight of farm equipment and the acidity of silage.

Results from this project may provide preliminary data on the benefits derived from co-utilization of materials which could have a significant impact on the economics of FBC residue and manure utilization.

REFERENCES

Stout, W. L., J. L. Hern, R. F. Korcak, and C. W. Carlson. 1988. Manual for applying fluidized bed combustion residue to agricultural lands, U. S. Department of Agriculture, Agricultural Research Service, ARS-74, 15 pp., Washington, DC.