Animal Waste Management

Animal Waste

The term “animal waste” includes both the feces and urine wastes of livestock and poultry, as well as any process water, feed, bedding, litter, or soil which can become intermingled with such materials. Animal waste contains sediment, organic solids, nutrients, salts, oxygen-depleting substances, and microorganisms including bacteria, viruses, and others.

There are a variety of uses for animal wastes including as a fuel source, animal bedding, animal feed, mulch, organic matter, and plant nutrients. Land application of animal wastes is a common method of utilization. Depending on the water content of the material, animal wastes are placed in one of four categories—solid, semi-solid, slurry, or liquid.

Manure Handling and Storage

Livestock manure is classified as either a solid, semi-solid or liquid using the following criteria:

• ***Solid*** - contains greater than 20% solids. Bedding material contributes to the solids content of the manure. It can be stacked and handled by any equipment that will move bulk materials

• ***Semi-solid*** - (also referred to as slurry) - contains 5% to 20% solids. Semi-solid manure is produced in livestock housing systems where limited bedding is supplied. The resulting semisolid does not flow as readily as liquid manure, nor can it be piled like solid manure.

• ***Liquid*** - contains less than 5% solids. The additional liquid comes from washing and spillage from watering systems. When agitated, liquid manure can be pumped or moved by gravity flow. Milkhouse washwater and other types of wastewater are often added to the liquid manure. Manure which includes bedding or waste feed will require dilution if it is to be handled as a liquid.

The moisture content of the manure determines the type of handling and storage system. Most new swine and dairy operations use liquid systems, while the majority of beef and poultry producers have solid manure handling systems.

Storage

A manure storage facility which is of sufficient size reduces the chance of pollution from spills and allows land application to take place when soil is dry, when crops require nutrients, and when work schedules permit.

• Manure storage should be large enough to store manure, bedding, wasted feed, precipitation and all liquids for at least 210 days. A one year storage capacity is optimal.

• Proper management of all liquids is essential for effective and economical manure handling and storage. Since all water which comes into contact with manure must be handled as a waste, the key to efficient management is to minimize that contact.

• Surface runoff should be diverted away from livestock and manure storage areas.

• Runoff from solid manure storage and exercise yards, milking centre wash water, silo seepage and livestock housing wash water must be stored and properly handled to ensure that groundwater, streams and other surface waters are not polluted.

Processing Manure

I. Introduction

Treatment of manure, an organic material, usually falls into three major categories:

i) Physical
ii) Biological, and
iii) Chemical.

The manure-land cycle is a large complex biological process, whereas liquid-solids separation is a physical process and odor control may involve a chemical process. A combination of physical, biological, and chemical methods are commonly used in complete treatment systems.

Livestock and poultry products (meat, milk, and eggs) provide a large portion of the protein needs of the people. Raising the large number of livestock and poultry to provide these food needs generates huge volumes of manure commonly called wastes. Manure properly collected, stored, and treated, however, can provide fertilizer, energy, and feed resources. Historically, manure has been spread onto croplands for its fertilizer and soil amendment value. While the practice will continue, alternatives are needed, especially where sufficient cropland is not readily available or when the manure is more important as a source of feed or fuel than it is as a fertilizer.

i. Physical Treatment

Physical treatment of livestock manure usually is accomplished with solid-liquid separation by sedimentation or various methods of screening. Other physical treatments include drying and incineration but increasing fuel costs have diminished interest in these methods. Solar energy, however, may help make drying economically viable.

A. Solid-Liquid Separation

Separation of solids from the insoluble fraction of animal wastewaters is becoming more important as new methods of processing manures are developed.

Sedimentation

The easiest way to remove suspended solid material from liquid manure is by utilizing natural settling or sedimentation. The sedimentation option appears to be an attractive method for removing fine solids from slurry because of the relative simplicity of the process and the low costs of the equipment involved.

Mechanical separation

A quicker separation can be obtained using mechanical screening, a technique easily applicable on farms to separate the coarse solids from the slurry. Mechanical screening is also an initial process step in many complete treatment processes.

B. Drying

Drying can be accomplished with unheated air, or with heated air at a higher rate. Assuming the rate of water evaporation capability of a manure drier remains fairly constant during operation, the output of dried manure is then inversely related to the moisture content of the wet manure going into the drier.

The conventional and most reliable type of manure drier is the rotary drum type that is charged with wet manure internally and fired internally. Drum-type driers are traditionally used for dehydration of many different biological products. Drum driers can be designed and constructed for a wide range of capacities. The rotating drum provides effective mixing of the manure and thus good exposure to the combustion energy for evaporation of water. The drum requires a minimum of power for the rotation movement and also has a minimum of moving parts. A typical drum drier is illustrated in Figure 14.

C. Incineration

Incineration is a process in which the volume and weight of organic matter is reduced by burning. The combustible fractions of the waste are burned, and the mineral matter is left as an ash. Materials having a low moisture content will support combustion, but high moisture materials will require a supplemental fuel supply.

Incinerating equipment is designed for either batch-loading or continuous-flow operations. Batch loading requires a large amount of labor. Air pollution can be generated by incineration equipment. Smoke from the incinerator can carry odors from the burning organic matter.

ii. Biological Treatment

Biological degradation of manure is a natural process that has occurred since the beginning of time, as manure is a good substrate for microorganisms. The biodegradable components of manure solids are shown in Figure 15.

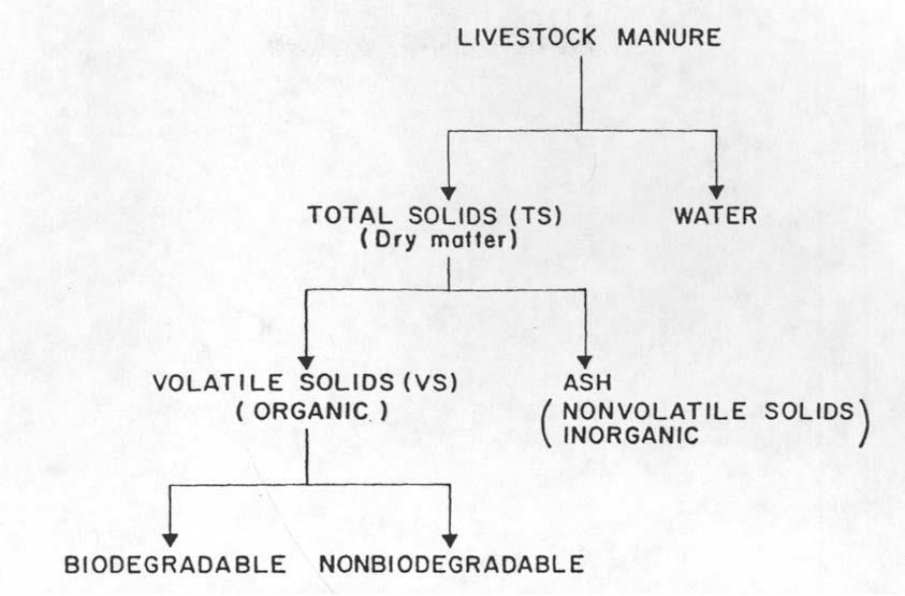

Figure 15. Solids and water in livestock manure.

Controlled and uncontrolled biological systems are commonly in use. The systems may treat liquids or solids; may be aerobic, anaerobic, or facultative; and may be in a structure or unconfined on the land. Examples of biological treatment processes include the land/crop cycle as well as anaerobic digestors, septic tanks, oxidation ponds, aerated lagoons, oxidation ditches, and composting. Biological systems may have advantages over chemical systems for purposes of recycling, since biological systems do not involve the addition of compounds that may cause toxicity problems at later stages in the cycle.

In organic degradation, manure and other sources of organic matter are utilized as a source of energy by a succession of living microbial organisms. A series of biochemical reactions are set in motion and eventually the waste materials are decomposed and returned to nature. This decomposition of organic matter is brought about by a highly complex bacterial metabolism. The bacteria break down the complex organic substances such as carbohydrates, proteins, and fats into simple organic substances. Under aerobic conditions, the bacteria carry on respiratory metabolism to reduce the organic compounds to carbon dioxide and water without giving off offensive odors. Under anaerobic conditions, bacteria break down the complex organic substances into simple organic acids and then ferment those acids to ultimately form methane and carbon dioxide

Chemical Treatment

Chemicals are used in waste treatment for various reasons such as: for pH control, for odor control, and for enhancement of biological treatment.

Acid or alkaline treatment has been used to break down cellulose and lignified fibers to make them more amenable to biological digestion. Sodium hydroxide and sodium peroxide have been used.