MANURE TREATMENT

THIS CHAPTER EXPLORES:

the many benefits of manure treatment

the pros and cons of three Ontario-appropriate treatment technologies, namely mechanical solid-liquid separation, anaerobic digestion, and aerobic composting.

Raw manure should be managed to make it easier to store, handle, apply, and dispose of. You can do this by changing its physical, chemical and biological properties. That may sound challenging. But as best management practices, the on-farm manure-treatment technologies in these pages must also be simple, reliable, suit your operation, and be economically feasible.

Manure treatment can perform some combination of the following functions:

- reduce manure volume for land application
- reduce or increase nutrient content of manure for land application
- recycle a product for reuse (e.g., water for flushing systems)
- reduce environmental impact (e.g., surface water and groundwater contamination)
- reduce odours and other nuisances
- reduce pathogens
- produce useful byproducts for on-farm use or off-farm sales
- produce clean discharge
- produce renewable energy
- reduce emissions of greenhouse gases.

Unfortunately, no treatment developed to date can address all of the above functions. In fact, the challenge is to avoid a technology that reduces the impact of one potential pollutant (e.g., nitrate-nitrogen) only to cause a problem with another (e.g., manure phosphates).

There are dozens of technologies being developed for the treatment of manure. Many of them are simply unsuitable for Ontario conditions or require more practical research to resolve technical flaws.

The following technologies show promise for Ontario livestock farms:

- mechanical solid-liquid separation – particularly screw presses
- anaerobic digestion
- aerobic composting of manure.

MECHANICAL SOLID-LIQUID SEPARATION

The process mechanically divides manure into solid and liquid fractions. The solid component contains most of the fibre and some of the N + P.

The liquid component can be used for flushing the barn, land-applied, treated in a vegetated filter strip or stored with other dilute liquid wastes.

The screw press separates solids from liquid more efficiently than other technologies (e.g., belts and screens).

The process is more effective with fresh rather than stored manure.

Advantages

- less solids in liquid fraction makes handling, pumping and application easier
- phosphorous is concentrated in the solid fraction – improving the ability for more site-specific nutrient management or more valuable compost material
- more economical to transport the concentrated solids fraction offsite versus the raw liquid manure
- may reduce land base required for spreading manure onsite

Disadvantages

- creates two "streams" of manure to store, handle and apply
- increased capital cost, labour and maintenance

Solid-liquid separation makes the liquid fraction easier to pump and apply.

ANAEROBIC DIGESTION

The biogas produced by anaerobic digestion units can be burned for heat or used to generate electricity.

Liquid manure high in organic material is transformed by anaerobic bacteria into several end-products – including "biogas" (carbon dioxide and methane). Biogas can be burned for heat or used to generate electricity.

Digesters function over a range of operating temperatures. Most operate efficiently between 35 and 40 °C (35–104 °F). If operating temperatures exceed 48 °C (120 °F), more methane will be produced. However, the methane-producing microbes may shut down at these higher temperatures.

Components include storage tanks, manure-handling equipment, digester tank, gas-handling equipment and electrical generation equipment.

Remaining outputs may require further processing prior to disposal or application.

Generally speaking, there are two anaerobic digestion system configurations suitable for Canada.

Completely mixed

A completely mixed system, as the name implies, consists of a large tank in which new and old material is mixed. These systems are suitable for manure with lower dry matter content of 4–12%.

Plug flow

Typically a plug flow system consists of long channels in which the manure moves along as a plug. These systems are suitable for thicker liquid manure (11–13% dry matter).

Advantages

- odour reduction
- pathogen reduction
- energy production
- nutrient retention for fertilizer use

Disadvantages

- increased capital cost, labour and maintenance
- most suitable for very large operations
- utility connections may be difficult
- no decrease in the nutrient content of manure, so the same land base is required for spreading unless further treatment is done

AEROBIC COMPOSTING

This transforms solid manure and bedding materials into stable, soil-like material using accelerated aerobic decomposition by microbes. The process requires regular mixing and careful management of air flow, temperature, moisture, and C:N ratio.

Ideal conditions include a moisture content between 40–65% and a C:N ratio of 20:1–40:1.

Advantages

- pathogens and weed seeds are killed
- volumes are reduced
- material can be land-applied or sold
- land base for spreading reduced if compost sold

Disadvantages

- poor management can lead to runoff, offensive odours and greenhouse gas emissions
- improper site selection can lead to water contamination (field windrow composting in sensitive areas)
- most practical for large operations
- concentrates the nutrients in a reduced volume, and the same land base is required for spreading material

Windrow composters can be used to accelerate the composting process.