Geomembranes as a Liner For Manure Storage Structures

WHY GEOMEMBRANES ALONE SHOULD NOT BE USED AS A LINER FOR MANURE STORAGE STRUCTURES

Due to damage that can occur during installation and operation, Geomembranes (a.k.a. flexible membrane liners, PVC liners) should not be used alone as liners for manure storage structures. The following data will illustrate the performance that can be expected to be achieved by using a Geomembrane liner as compared to other types of liners. Keep in mind that experts agree that the “Great Liner” category is unrealistic and will not be reached in most construction projects. In addition to this, the performance of Geomembrane liners in a system involving agitation and pumping has not been well researched. These factors have influenced the MPCA feedlot program’s position on Geomembrane liners. The MPCA feedlot program requires that storage structures are designed to have a maximum seepage rate of 500 gallons/acre/day.

**Good Liner**

- Soil Liner Alone: seepage rate = 120 gal/acre/day  
  ($K_s = 1 \times 10^{-7}$ cm/s)

- Geomembrane Liner Alone:
  seepage rate = 3,300 gal/acre/day  
  (1 hole/acre, $a = 1.0$ cm²)

- Composite Liner (soil + Geomembrane):
  seepage rate = 0.8 gal/acre/day  
  ($K_s = 1 \times 10^{-7}$ cm/s, 1 hole/acre, $a = 1.0$ cm²)

**Poor Liner**

- Soil liner Alone: seepage rate = 1,200 gal/acre/day  
  ($K_s = 1 \times 10^{-6}$ cm/s)

where $K_s = the \ coefficient \ of \ hydraulic \ conductivity$.

- Geomembrane liner Alone:
  seepage rate = 10,000 gal/acre/day  
  (30 holes/acre, $a = 0.1$ cm²)

- Composite liner (soil + Geomembrane):
  seepage rate = 100 gal/acre/day  
  ($K_s = 1 \times 10^{-6}$ cm/s, 30 holes/acre, $a = 0.1$ cm²)

**Great Liner**

- Soil Liner Alone
  seepage rate = 12 gal/acre/day  
  ($K_s = 1 \times 10^{-8}$ cm/s)

- Geomembrane Liner Alone:
  seepage rate = 330 gal/acre/day  
  (1 hole/acre, $a = 0.1$ cm²)

- Composite Liner (soil + Geomembrane):
  seepage rate = 0.1 gal/acre/day  
  ($K_s = 1 \times 10^{-8}$ cm/s, 1 hole/acre, $a = 0.1$ cm²)

I. Calculations for Flow Rate

II. Calculation for Flow Rate Through Geomembrane Alone

III. Soil Liner Alone
q = flow rate (m³/s)
CB=0.6 (flow coefficient)
a = area of hole (m²)
g = acceleration due to gravity (m/s²)
h = head (m)

Example:

q = CB \cdot a

h=1 ft; D=3ft;
A = 1 acre = 43,460 ft² = 4047 m²

For one hole in an acre:

q = (1 x 10⁻⁹ m³/s)(1.33)(4047 m²)

= 3,346 gal/acre/day

References:


For More Information:

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