1. Given:

An anaerobic digester is used to treat the liquid waste from a 5,000-cow dairy. The dairy houses the cows in a freestall barn with compost used as bedding. Approximately 0.5 lb bedding solids per cow enters the flush stream daily along with all the manure generated. The bedding contains 83% volatile solids. The barns are flushed once daily using 40,000 gal of water recirculated from a holding lagoon for each flush. The flush water flows over a static screen to remove larger solids. Assume 25% of the entering solids are captured by the screen. Assume that on average 6 SCF (standard cubic feet) of biogas is produced per pound of VS entering the digester. The biogas contains about 60% methane and has an average energy content of 600 BTU/SCF. The biogas is used to fuel an engine-generator system which has a conversion efficiency of 23%.

Required:

Determine the total amount of biogas produced annually (SCF).

Hint: Use ASAE D384.2 Manure Production and Characteristics report.

a. Calculate the volatile solids (VS) going to the digester (lb VS/day).
   Hint: Include lost bedding.

b. Calculate the biogas production daily (SCF).

c. Calculate the biogas production annually (SCF).

Determine the average power generation when the biogas is used to fuel the engine-generator system.

   a. Calculate the daily power production (kW-day).
      Hint: 1 w = 3.4121 BTU/hr.

Determine the amount of electrical energy produced annually assuming the power generator operates 85% of the time.

   a. Calculate annual power production (kW-hr).