The Open University of Sri Lanka
Faculty of Engineering Technology
Technology (Engineering) Program

Final Examination- 2007

AEX6230 Environmental Control in Agricultural Structures

Date   : 07-05-2008
Time   : 0930-1230 hours

SECTION 2: Answer four (04) questions including question 1 or question 2

1. (a) What are the factors that influence the moisture diffusion through a wall?

    (b) A wall of a storage room is made of 15.9mm thick Douglas fir plywood as outside siding, 12.7mm thick structural insulating board, 88.9mm glass fiber wool, and 15.9mm thick gypsum wallboard as inside sheathing. Indoor conditions are 10°C and 60% relative humidity. Outside conditions are 30°C and 90% relative humidity.

The resistances to moisture diffusion through different materials are given in the following table. You may use the formula, $w = \Delta p/Reps$, for the rate of moisture diffusion per unit area.

Material	Reps (Resistance moisture diffusion) $Pa.m^2.s/ng$
15.9mm plywood	0.02
12.7mm insulating board	0.60
88.9mm glass fiber wool	0.0005
15.9mm gypsum wallboard	0.06

Saturation water vapor pressure at 10°C and 32°C are 1212 Pa and 4195Pa respectively.

    (i)   Estimate the flux of water vapor (mass of water vapor diffused per unit time per unit area) diffusion through the wall.
    (ii) Determine the vapor pressures at interfaces.
    (iii) Explain how you would decide whether moisture condensation occurs at the interfaces.

2. (a) Explain how the convection heat transfer coefficient is determined for natural convection
    (b) In a food processing plant cold water at 3°C is pumped through a 20mm outside diameter galvanized steel pipe. The pipe passes through a room where the temperature is 32°C and the relative humidity is 90%. To prevent the condensation on the pipe surface it is insulated with a sleeve of foam rubber

of thermal conductivity of 0.03 W/mK. Calculate the thickness of the insulation.

Assume laminar flow condition across the pipe.
Natural convection heat transfer coefficient is given by $h = 1.32(\Delta t/L)^{0.25}$
Dew point at 90% relative humidity and at $32°C$ is $27°C$.

3. Describe why ventilation is required in agricultural storage and animal housing. How will you determine heat load to be removed and the number of air changes required?

4. Describe the principle of evaporative cooling and how this could be used to cool animal housing.

5. Fencing is an important part in providing security to a farm and also to prevent damage by foraging animals.
Discuss different types of fencing used and how selection could be based on the available resources and the requirements.

6. Protected houses, similar to green houses used in cold climates, are commonly used to provide protection from extreme weather.
Describe a typical installation and how a selection of a site is done. What type of produce do you recommend to be grown in protected houses?