Summer Examinations 2016

ENV203416N

Module Title Mechanical, Biological & Thermal Treatment of Wastes
Level Five
Time Allowed Two hours

Instructions to students:
• Enter your student number not your name on all answer books.
• Answer all questions from Section A and two questions from Section B.
• Section A carries 40% of the overall marks.
• Section B carries 60% of the overall marks.
• You do not need to use separate answer books for the questions in Section A, but use a separate answer book for each of the questions in Section B. Label each answer book with the number of the question you are answering.
• Neither books nor notes may be taken into the examination.
• The use of electronic calculators of an approved type is permitted.
• Erasmus/overseas students are permitted to take a bilingual dictionary into the examination room but will not be permitted any extra time.
• Students are permitted to remove this examination paper at the end of the examination.

No. of Pages 4
No. of Questions 14
Section A

Answer all questions.

1. One of the parameters which needs to be closely controlled in a compost system is temperature. If the compost temperature goes above 70°C, the beneficial microbial populations can be killed. Explain and briefly illustrate how temperature can be controlled by turning the pile.  

(5 marks)

2. Discuss the requirements/importance of the following in the composting process:
   - Nutrients
   - Particle size
   - Moisture
   - Oxygen
   - pH

(5 marks)

3. Explain why lignin is the slowest degrading organic material in a compost system.  

(3 marks)

4. With respect to the anaerobic digestion process:
   a. Complete the equation to demonstrate the idealised process of anaerobic digestion.

\[ C_6H_{12}O_6 \rightarrow \]

(2 marks)

b. Identify two methods of mixing within the reactor vessel.  

(2 marks)

c. What are the three distinct temperature ranges used in commercial anaerobic digesters?  

(3 marks)

d. State two factors which may cause increased volatile fatty acid (VFA) concentration and reduced pH.  

(2 marks)
5. Differentiate between exothermic and endothermic reactions. (2 marks)

6. List the principal products of the EfW process. (4 marks)

7. What purpose do “stacks” serve in an EfW plant? (2 marks)

8. Identify two advantages and two disadvantages of EfW. (4 marks)

9. Differentiate between gasification and pyrolysis. (2 marks)

10. Using diagrams, differentiate between i. wire plate and ii. wire pipe electrostatic precipitators (ESP’s). (4 marks)

Total: 40 marks
Section B

Answer two questions.

11. You have been asked to explain the differences between open windrow, in-vessel and vermi composting to a community group who are considering implementing a biodegradable waste treatment scheme. Explain each type of composting method with examples of commercial application where applicable, and discuss the inherent advantages and disadvantages for each type of system.

   (30 marks)

12. Successful anaerobic digestion of MSW requires careful control of operating and environmental conditions. Describe the principle factors that influence the anaerobic digestion of solid wastes.

   (30 marks)

13. a. With reference to incinerator design discuss the role of time, temperature, turbulence and oxygen.

   (12 marks)

   b. The majority of incinerators in Europe have a moving grate as part of the combustion chamber feed chain. Summarise, using diagrams where appropriate, three different grate designs.

   (18 marks)

   Total: 30 marks

14. Discuss the various methods of pre-treatment available for MSW with regard to the biological and thermal treatment of wastes.

   (30 marks)

End of Section B
End of Paper