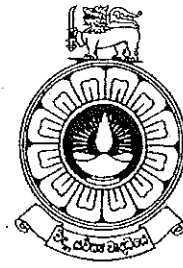


THE OPEN UNIVERSITY OF SRI LANKA
CENTRE FOR ENVIRONMENTAL STUDIES AND
SUSTAINABLE DEVELOPMENT



M.Sc. IN ENVIRONMENTAL SCIENCES- LEVEL 10- 2018/19

PHPA309/NEP2222 – Cleaner Production

Final Examination

DATE: 23rd February 2020

DURATION: THREE HOURS

TIME: 9.30 am – 12.30 pm

IMPORTANT INSTRUCTIONS TO CANDIDATES

- Write your Registration Number in the Answer Script
- This question paper consists of five (05) pages with nine (09) Essay type Questions.
Answer **06 questions only**.
- Write answers in separate papers.

M.Sc. IN ENVIRONMENTAL SCIENCES- LEVEL 10- 2018/19
PHPA309 – Cleaner Production

(1) A textile factory is processing cotton fabric to white fabric, dyed fabric and printed fabric by using the following processes.

- All the grey fabric material is inspected and any damaged material removed.
- Then the fabric undergoes a process called scouring by immersing in a hot water tank with sodium hydroxide dissolved in it to remove waxes etc.
- The fabric is then bleached using Hydrogen peroxide and TAED (Tetra Acetyl Ethelene Diamine) in a tank at 50^o C.
- The bleached fabric is then divided into 2 streams one for bleached white fabric, and other for dyeing and Printing
- The bleached white fabric is then dried in a dryer using steam.
- The fabric for dyeing and printing then goes through a process called merceirizing using caustic soda at high temperature for improving dye absorbtion capacity.
- The mercerised fabric is divided to two streams, one for dyeing and other for printing



- h) The fabric for dyeing is dyed using chemicals and a reactive dye
- i) The dyed material is washed with soap in high temperature, running water.
- j) Washed dyed fabric is dried in a steam dryer.
- k) The fabric sent for printing is printed using screen printing method using reactive printing ink
- l) The printed fabric is washed with soap in high temperature running water.
- m) The printed and washed fabric is also dried in a steam dryer.
- n) All the bleached, dyed and printed fabric are sent to finishing department for final finishing, inspecting and then packing in 30 meter rolls.
- o) The fabric is rolled on a cardboard tube and then put into a plastic bag and sealed.

In all the steps water, chemicals and dyes leaked to the ground from tanks are washed away. All operations use electricity to run the machines and steam is supplied from a boiler.

- a) Prepare a process flow diagram to show the processes in the Textile factory. (60 marks)
- b) Identify and mark all the auxiliary raw materials and waste streams on the process flow diagram. (40 marks)

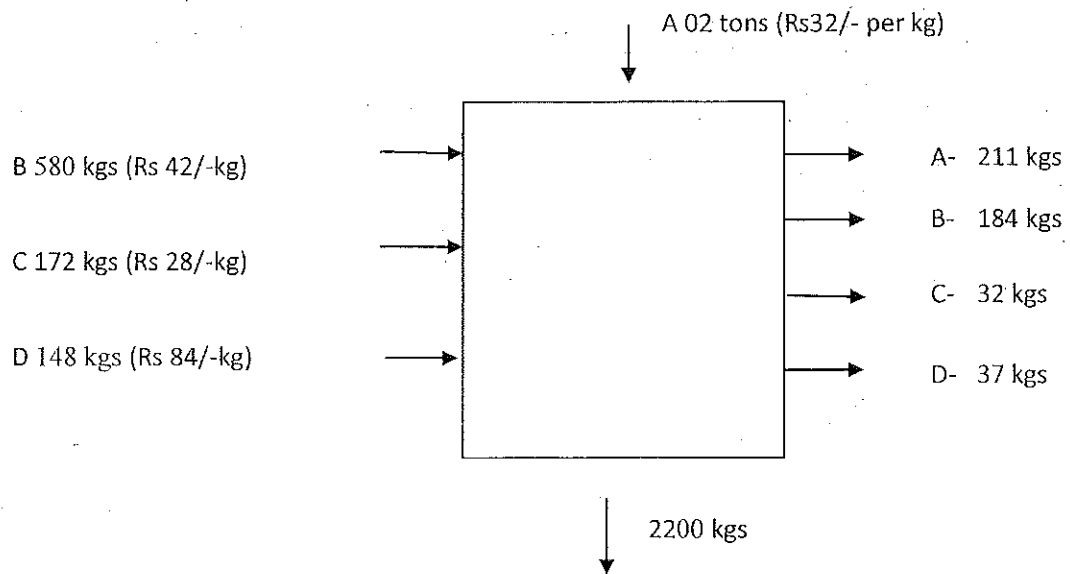
Use of correct symbols and neatness are important in the process flow diagram. Do not list waste streams separately.

2) Generating CP opportunities for minimizing waste streams is one of the major steps in Cleaner Production Assessment.

- a) Briefly explain what techniques you will use to generate CP opportunities. (50 marks)
- b) After identifying CP opportunities they are screened to select only workable opportunities. Explain how the screening process takes place. (30 marks)
- c) List the economic and environmental benefits a company can obtain by applying cleaner production to the process. (20 marks)

3) A factory producing a special mixed fertilizer uses following quantities of raw material in their production process per day. Also it was found that quantities given on the right side are the waste measured by the factory.





The raw materials are blended in a mixing plant and after that they are packed in 25 kg bags before transporting them to marketing section warehouse. For a day average of 8 bags are damaged during handling and transportation and discarded without marketing or returning to factory. The factory operates 25 day a month.

- a). What is the total material loss to the company for a day. (40 marks)
 - b) Calculate the total annual loss to the factory and the Cleaner Production Potential. (60 marks)
- 4) Answer all the questions
- a) What are the wastes categorized as hazardous wastes and what are the main Characteristics of hazardous waste. (30 marks)
 - b) How can a country manage hazardous waste to minimize the potential harm caused by these wastes? Explain using waste management hierarchy (40 marks)
 - c) Hospital waste is considered to be another special hazardous waste. Briefly explain why hospital waste is categorized as a hazardous waste and how to manage this special hazardous waste. (30 marks)
- 5) Answer all the questions
- a) ISO 14001;2015 standard has included a new topic as Leadership as its clause 5. Under leadership briefly explain the key roles and responsibilities of the top management to ensure the implementation of the standard effectively. (40 marks)



- b) In the implementation of ISO standard a key support is identified as communication. Explain what an organization is expected to do in communication and how it facilitates implementation of ISO standard. (25 marks)
- c) One of the special features in environmental management standards is emergency preparedness. Briefly explain why emergency preparedness is important in environmental management. (35 marks)
- 6) During a panel discussion on controlling plastic waste a speaker said paper bags are more environmentally friendly than plastic bags and therefore plastic bags should be replaced by paper bags. The idea was vehemently opposed by others and said without evidence from a life cycle analysis it is incorrect to take such a decision.
- What is life cycle analysis approach, which can be used to compare a paper bag with a plastic bag and briefly explain how it is used? (35 marks)
 - What are the life cycle stages in a paper bag from extraction of material to final disposal? (35 marks)
 - Suggest three common environmental impacts caused by both the plastic bag and the paper bag. (30 marks)
- 7) A tooth brush though small in size consumes 1.5 kilograms of resources to manufacture it. A suggestion has been put forward to reduce the material intensity of a tooth brush to reduce resource depletion and resulting environmental pollution.
- Suggest a tool which can be used to redesign the tooth brush to reduce the heavy resource intensity of the product. (30 marks)
 - Under the specific tool recommended by you, name three strategies which can be used to look at different aspects of the tooth brush in order to make it more environmentally friendly and resource efficient. (35 marks)
 - Suggest three ways to reduce the resource intensity of a tooth brush. (35 marks)



- 8) Food waste is a major problem prevalent all over the world.
- a) Explain how 3R can be used to reduce the food waste in a large industrial plant. (30 marks)
 - b) Even after applying the 3R principles the factory has a significant amount of daily food wastes which is not collected by any other party. Explain how the two technologies, composting and bio gas generation can be used to treat the food wastes. (40 marks)
 - c) List benefits and disadvantages of composting and biogas plants. (30 marks)
- 9) A large apparel buyer in USA has asked a local supplier of apparels the actions taken by them to change behaviour of the local down stream supply chain to make them environmentally responsible.
- a) Briefly explain What is a supply chain how can a company make their suppliers become environmentally responsible. (40 marks)
 - b) What market instruments can the company use to assess the down stream suppliers on they their responsibility towards the environment? (30 marks)
 - c) What are the advantages to the down stream suppliers in becoming environmentally responsible.? (30 marks)

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