

Life Cycle Assessment / Technology Assessment

Examination Wednesday 25 January 2006 : 9.00 – 12.00

- This examination has 6 questions, weights are shown in %
- You may use all course material, lecture handouts, notes, dictionaries and a calculator
- State your name and student number on each sheet

1. Goal and Scope definition (15 %)

Consider four possible methods for sending a message: E-mail, telephone, fax and letters by mail. Discuss which of these options can be used in an LCA for the following situations:

- a non-urgent message without pictures, to be sent to a colleague over a distance of 50 km
- an urgent message with pictures, to be sent to the same colleague

Also discuss how the product systems would change between situation a and b.

Introduction to questions 2-4

The pressure of the public water supply is low in many areas of Bangkok and many people install a private pumping and storage system in their own houses in order to maintain a constant water supply at a reasonable pressure. Due to an increasing environmental concern some people start to think about how the water can be delivered with the lowest environmental impact and resource usage.

Two storage tanks will be compared from an environmental point of view. Both tanks have an internal volume of 2 m³.

Storage tank A: Material: plastic (HDPE: High Density Poly-Ethylene). Weight 35 kg. Expected lifetime: 15 years.

Storage tank B: Material: stainless steel. Weight 48 kg. Expected life time 30 years.

The two types of storage tanks have been subject to an LCA study based on computer modelling of all lifecycle stages to produce the tanks. The use and waste management of the tanks are considered to have minor influence, and therefore have been left out of the analysis. The inventory of emissions is given in the next table:

Table: Inventory of emissions to atmosphere for producing one storage tank A and B

Substance	Unit	Storage tank A Plastic	Storage tank B Stainless steel
Carbon dioxide (CO ₂)	kg	117	115
Sulphur dioxide (SO ₂)	g	319	1089
Nitrogen oxides ¹ (NO _x)	g	504	458
Ammonia (NH ₃)	mg	0	0.369
Methane (CH ₄)	mg	78.5	2.07
(other) Volatile Organic Compounds ² (VOC)	g	745	101
1,1,1-trichloroethane	mg	0	384

1. To be treated as nitrogen dioxide (NO₂)
2. To be treated as propane.

2. Functional Unit (10 %)

Determine the functional unit for the water storage tanks

3. Impact Assessment (25 %)

Perform the characterization step for the two storage tank alternatives on the environmental themes: climate change, acidification (use the generic AP factors) and photochemical oxydant formation.

4. Interpretation (15%)

Can you express a (preliminary) preference for one of the storage tanks? What else do you need to know before you can draw a final conclusion? (mention at least 5 items).

5. Allocation (15 %)

The diamond mining industry also produces large amounts of grit (NL: gruis). Until recently this grit was landfilled. Now it is used by the road construction industry. Which method to solving the allocation issue in this case do you prefer, and why?

6. Environmental tools (20 %)

Discuss the possibilities for the insurance sector to apply LCA for assessing environmental liabilities (NL: aansprakelijkheid/heden) and environmental risks. Consider the application for a specific chemical company. Which other environmental tools can the insurance sector use to determine tariffs and risks to be excluded from the insurance contract?

Table: Inventory of emissions to atmosphere for producing one storage tank A and B

Substance	Unit	Storage tank A (Plastic)	Storage tank B (Stainless steel)
Carbon dioxide (CO ₂)	kg	117	112
Sulphur dioxide (SO ₂)	g	219	198
Nitrogen dioxide (NO ₂)	g	204	222
Ammonia (NH ₃)	g	0	0.289
Methane (CH ₄)	g	28.3	2.0
Other Volatile Organic Compound (VOC)	g	212	101
1,1,1-trichloroethane	g	0	2.8

1 To be treated as nitrogen dioxide (NO₂)
2 To be treated as propane