

CLL728

**Biomass conversion and Utilisation**

Minor 1

Date & Time : 10/11/20, 10-11AM

MM 20

**ONLINE EXAM (Responses to be submitted at : [727CLL@GMAIL.COM](mailto:727CLL@GMAIL.COM)) before 11:15 AM.**

**Open book and Notes**

1. The ultimate analysis shows that the C, H, O, N and S contents of a biomass material are 51.9%, 5.5%, 41.5%, 0.8% and 0.3% respectively on a dry basis.
  - (i) What is the chemical formula of this biomass? (2)
  - (ii) How many kilograms of air are required to completely combusting 1 kg of this biomass? (2)
  - (iii) What is the higher and Lower heating value of the biomass. (3)
  
2. The ultimate analysis of biomass was done using CHNS analyser. The analysis of biomass is as follows C = 50%, H<sub>2</sub> = 6 %, O = 22, N = 16 %, S is 6 %.  
Following are the results are obtained during the gasification of biomass at 1000°C .  
( in mol % ).  
H<sub>2</sub> = 30 mol%  
CO = 22 mol %  
CO<sub>2</sub> = 40 mol %  
CH<sub>4</sub> = 8 mol %  
Calculate the Carbon conversion efficiency. (3)
  
3. Thermodynamic equilibrium equations have been used for modelling of the air steam gasification process which take place in the gasifier. The general form of overall chemical reaction in the gas producer may be assumed as follows :  
$$\text{CH}_x\text{O}_y\text{N}_z + w\text{H}_2\text{O} + m(\text{O}_2 + 3.76 \text{N}_2) \rightarrow x_1\text{H}_2 + x_2\text{CO} + x_3\text{H}_2\text{O} + x_4\text{CO}_2 + x_5\text{CH}_4 + x_6\text{N}_2$$
  
Here CH<sub>x</sub>O<sub>y</sub>N<sub>z</sub> indicates biomass chemical formula and w is the amount of water per kmole of biomass. Write down suitable calculation steps for the for finding out the equilibrium, composition of the product gas. (5)
  
4. A Biomass ( CH<sub>1.4</sub> O<sub>0.6</sub> ) has a heating value HHV = 16 MJ/Kg is to be converted to green H<sub>2</sub> (Heating value 120MJ/Kg). Calculate maximum amount of green hydrogen that can be produced from this biomass. Write down all the possible reactions involved along with, mass balance. Also estimate the overall efficiency of the process. (5)