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MATRIC: 16/ENG01/026

DEPT: CHEMICAL ENGINEERING DEPARTMENT

1. EXPLAIN THE VARIOUS FORMS OF ENERGY WITH MATHEMATICAL RELATION

Energy exists in many different forms. Examples of these are light energy, heat energy, mechanical energy. The following explains the various forms of energy with appropriate mathematical equations:

A. MECHANICAL ENERGY:

Mechanical energy is the energy possessed by an object due to its motion or its position. It is the sum of kinetic energy and potential energy. Examples of mechanical energy is a moving car if you move the car up a mountain, it has kinetic and potential energy. Mathematically it can be expressed as,

$$M.E = U + K$$

Where potential energy,

$$U = \int_{x2}^{x1} F dx$$

And kinetic energy,

$$K = \frac{1}{2} m v^2$$

B. CHEMICAL ENERGY

Chemical energy is energy stored in the bonds of chemical compounds, like atoms and molecules. This energy is released when a chemical reaction takes place. There are different types of chemical energy, such as electrochemical energy. A good example of chemical energy is an electrochemical cell or battery. Chemical energy can also be described as the potential of a chemical substance to undergo a chemical reaction to transform into other substances. For example, at standard conditions, the combustion of 1.0 mole hydrogen with oxygen releases 285.8 kJ of energy. We represent the reaction:

$$H_2 + \tfrac{1}{2}O_2 \rightharpoonup H_2O, \qquad dH = -285.8 KJ/mol$$

where dH represents the heat (or enthalpy) of reaction, and a negative value means that the heat is released

C. NUCLEAR ENERGY

Nuclear binding energy is the minimum energy that would be required to disassemble the nucleus of an atom into its component parts. These component parts are neutrons and protons, which are collectively called nucleons. The binding energy is always a positive number, as we need to spend energy in moving these nucleons. The mass of an atomic nucleus is less than the sum of the individual masses of the free constituent protons and neutrons, according to Einstein's equation

$$E = MC^2$$

If this energy could be properly harvested, it would be a significant source of energy for our society. Nuclear energy involves the controlled harvesting of energy from fission reactions. The reaction can be controlled because the fission of uranium-235 (and a few other isotopes, such as plutonium-239) can be artificially initiated by injecting a neutron into a uranium nucleus. The overall nuclear equation, with energy included as a product, is then as follows:

$$235_u + 1_n \rightharpoonup 139_{Ba} + 94_{Kr} + 31_n + energy$$

Thus by the careful addition of extra neutrons into a sample of uranium, we can control the fission process and obtain energy that can be used for other purposes

D. THERMAL ENERGY

Thermal energy is the energy a substance or system has related to its temperature, i.e., the energy of moving or vibrating molecules. In thermodynamics, heat is energy in transfer to or from a thermodynamic system, by mechanisms other than thermodynamic work or transfer of matter Heat refers to a quantity transferred between systems, not to a property of any one system, or 'contained' within it. By transferring matter, energy including thermal energy is moved by the physical transfer of a hot or cold object from one place to another. This can be as simple as placing hot water in a bottle and heating a bed, or the movement of an iceberg in changing ocean currents. A practical example is thermal hydraulics. Mathematically;

$$Q = CpDT$$

Where Q= heat flux, Cp= heat capacity at constant pressure and DT= difference in temperature (K)

E. ELECTRICAL ENERGY

Electrical energy is caused by moving electric charges called electrons. The faster the charges move, the more electrical energy they carry. Electrical energy is energy derived from electric

potential energy or kinetic energy. When used loosely, electrical energy refers to energy that has been converted from electric potential energy. This energy is supplied by the combination of electric current and electric potential that is delivered by an electrical circuit. At the point that this electric potential energy has been converted to another type of energy, it ceases to be electric potential energy. Thus, all electrical energy is potential energy before it is delivered to the end-use. Once converted from potential energy, electrical energy can always be called another type of energy (heat, light, motion, etc.).

E=PT

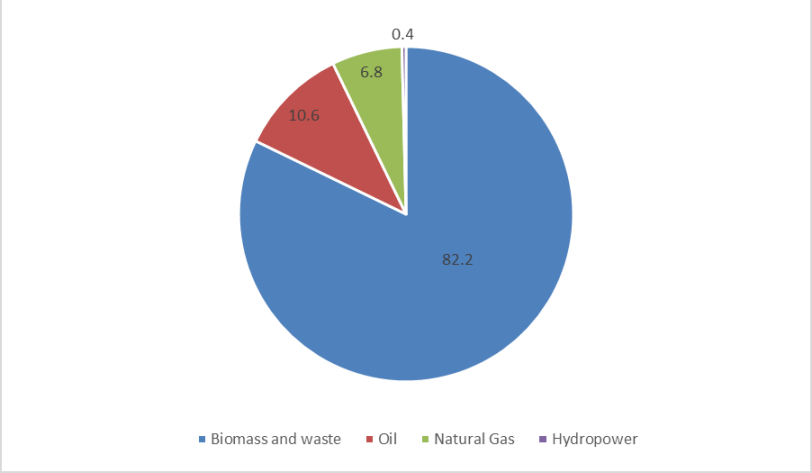
Where P=power and T=time

B. DIFFERENCE BETWEEN SUSTAINABLE ENERGY & RESOURCES AND NON SUSTANAINABLE ENERGY & RESOURCES:

SUSTAINABLE ENERGY	**NON SUSTAINABLE ENERGY**
Sustainable energy is the use of energy that meets the need of the present without compromising the ability for the future generation.	Non-sustainable energy is the energy that declines , unable to meet the needs of the future generation
Sustainable energy usually includes some aspects of renewable energy.	Usually ties with nonrenewable energy.
Technology that promotes sustainable energy include hydroelectricity, solar energy, wind energy	This includes fossil fuels such as coal, oil gas, natural gas.
Sustainable energy is more expensive to produce.	Relatively less expensive to produce.
Usually produces cleaner energy.	Energy source may pollute the environment and affect the ozone layer
Energy source can be affected by night and cloudy weather.	Energy source is not affected by the weather of environmental condition.

2. WITH THE AID OF A PIE CHART BRIEFLY ESTIMATE THE ENERGY RESOURCE MIX OF SUSTANABLE ENERGY IN NIGERIA.

Nigeria is a federal constitutional republic comprising thirty-six (36) states and the Federal Capital Territory (FCT), Abuja. The economy, heavily dependent on the export of oil products, grows at an average of 6% annually. The country enjoys a tropical rainforest and savanna climate in the south and central belt respectively as well as an arid/semi-arid climate in the north. It is blessed with enormous natural resources; crude oil and natural gas, tin, iron ore, coal, limestone, lead, zinc, arable land, solar (particularly in the north), hydropower (incl. 277 small hydro identified sites with a cumulative potential of 3,500 MW) and wind (mainly in the north and along the coastal line). According to the statistics from the International Energy Agency (IEA), total Nigerian primary energy supply was 118,325 Kilotonne of Oil Equivalent (ktoe) - excluding electricity trade. As depicted in the figure below, biomass and waste dominated with 82.2%. Renewable energy sources only accounted for a small share of the energy supply. For instance, hydropower only accounted for 0.4%. Wind and solar are also utilized, but at an insignificant level at present.



3. MONITOR THE AVERAGE AMBIENT TEMPERATURE BETWEEN MONDAY 17TH AND FRIDAY 21ST OF FEBRUARY 2020:

DAYS(17TH-21ST)	**AVERAGE AMBIENT TEMPERATURE (^{O}C)**
MONDAY	35-25
TEUSDAY	36-25
WEDNESDAY	35-25
THURSDAY	36-25
FRIDAY	34-25

$$P = \frac{dQ}{dT}$$

$$P = \frac{dKT * A}{L}$$

$$Q = P * DT$$

Where,

P=rate of heat transfer

Q= energy Transfer

A= area

L=thickness of material

Dt= temperature difference

FOR MONDAY

$$P = \frac{1.4 * 1300000 * 10}{0.991}$$

$$P = 18365287.59W$$

$$Q = P * W$$

$$Q = 1836587.59 * 21600 = 396700MJ$$

FOR TEUSDAY

$$P = \frac{1.4 * 1300000 * 11}{0.991}$$

$$P = 20201816.35W$$

$$Q = P * W$$

$$Q = 20201816.35 * 21600 = 436300MJ$$

FOR WEDNESDAY

$$P = \frac{1.4 * 1300000 * 10}{0.991}$$

$$P = 18365287.59W$$

$$Q = P * W$$

$$Q = 1836587.59 * 21600 = 396700MJ$$

FOR THURSDAY

$$P = \frac{1.4 * 1300000 * 11}{0.991}$$

$$P = 20201816.35W$$

$$Q = P * W$$

$$Q = 20201816.35 * 21600 = 436300MJ$$

FOR FRIDAY

$$P = \frac{1.4 * 1300000 * 12}{0.991}$$

$$P = 22038345.1059W$$

$$Q = P * W$$

$$Q = 20201816.35 * 21600 = 476028MJ$$

$$AVERAGE = \frac{396700 + 436300 + 396700 + 436300 + 476028}{5}$$

THE AVERAGE DAILY THERMAL ENERGY I= 420460MJ

4. HOW MUCH ENERGY IS PRODUCED IN NIGERIAN DAMS COMPARED TO CRUDE OIL ENERGY?

Energy in Nigeria is generated through thermal and hydro power sources. The main source of power generation comes from fossil fuels especially gas which accounts for **84%** of the capacity in Nigeria with the remainder **16%** generated from hydropower sources. Nigeria is bestowed with large rivers and natural falls. The main water resources that provide rich hydropower potential are the Niger and Benue rivers as well as Lake Chad basin. With an estimated 1,800 m3 per capita per year of renewable water resources available, this is not a water poor country, yet it is ranked as an economically water scarce country due to a lack of investment and management to meet demand. The total installed capacity is 12,522 MW, not including off-grid generation, of which 2,062 MW is hydropower.

however, the total exploitable potential of hydropower is estimated at over 14,120 MW, amounting to more than 50,800 GWh of electricity annually. The roughly 85 per cent of hydropower yet to be developed therefore offers solutions to address existing power shortages. Nigeria has envisioned growing its economy at a rate of 11 to 13 per cent in order to be among the 20 largest economies in the world by 2020. To meet this ambitious growth target, the government has hydropower development targets of 6,156 MW for 2020 and 12,801 MW for 2030. It has a target to reach 30 per cent renewable energy by 2030 as well as to have 70 per cent of the energy consumed produced on-grid, compared to the current 74 per cent self-generated. The Energy Commission of Nigeria aims to reach 20,000 MW of grid capacity by 2022.