Wind characteristics

Wind has two important characteristics – direction and speed. The direction of wind can be gauged using an instrument called the wind vane. It s also called winter vane. Every wind has two parts, the front and the rear. A very common shape for wind vane is the shape of an arrow.

When wind blows, it presses more on the rear part of the wind vane as it has a greater surface area. The arrow align itself such that its tip point in direction from which the wind is blowing will be marked on the wind vane.

Speed of wind is measure by anemometer.

Energy Conversion Systems

•**Energy conversion**, the transformation of energy from forms provided by nature to forms that can be used by humans.

•Many of the energy converters widely used today involve the transformation of thermal energy into electrical energy. The efficiency of such systems is, however, subject to fundamental limitations, as dictated by the laws of thermodynamics and other scientific principles.

• In recent years, considerable attention has been devoted to certain direct energy-conversion devices, notably solar cells and fuel cells, that bypass the intermediate step of conversion to heat energy in electrical power generation.

•The law of conservative energy is applied not only to nature as a whole but to closed or isolated systems within nature as well.

•Thus, if the boundaries of a system can be defined in such a way that no energy is either added to or removed from the system, then energy must be conserved within that system regardless of the details of the processes going on inside the system boundaries.

Performance and Limitations of Energy Conversion Systems

•The limitation of wind power is that no electricity is produced when the wind is not blowing. Thus, it cannot be used as a dependable source of base load power.

• Utilities and merchant generators will not invest huge sums of money into a technology that does not work when the wind is not blowing.

•Wind power will probably increase its market share when we develop a 'smart grid' that can handle multiple distributed generation input sources of electrical power.

•A wind energy conversion system is powered by wind energy and generates mechanical energy that sends energy to the electrical generator for making electricity.

•Wind energy conversion systems (WECS) are designed to convert the energy of wind movement into mechanical power.

•With wind turbine generators, this mechanical energy is converted into electricity and in windmills this energy is used to do work such as pumping water, mill grains, or drive machinery.

Bio-mass

•**Biomass** is plant or animal material used for energy production (electricity or heat), or in various industrial processes as raw substance for a range of products.

•Biomass is biological organic matter derived from living or recently-living organisms.

•Bioenergy is the energy contained (stored) in biomass.

•Two forms of biomass

•Raw: forestry products, grasses, crops, animal manure, and aquatic products (seaweed

•Secondary: materials that undergone significant changes from raw biomass. Paper, cardboard, cotton, natural rubber products, and used cooking oils.

•Biomass is considered renewable as either a feedstock or waste and due to government incentives, corporate sustainability goals and climate change initiatives, a majority of the conversion technologies use biomass to produce various forms of renewable energy.

•The type of energy includes electrical power, thermal energy, renewable natural gas, biodiesel, jet fuel, and ethanol.

•Biomass also can be used as a substitute for fossil fuels in the manufacturing of high value products including plastics, lubricants, industrial chemicals, and many other products derived from petroleum or natural gas.

•On combustion, the carbon from biomass is released into the atmosphere as carbon dioxide (CO_2). After a period of time ranging from a few months to decades, the CO_2 produced from combustion is absorbed from the atmosphere by plants or trees.

•There are four types of conversion technologies currently available that may result in specific energy and potential renewable products:

Thermo chemical conversion

Thermal conversion is the use of heat, with or without the presence of oxygen, to convert biomass into other forms of energy and products. These include direct combustion, pyrolysis, and torrefaction.

Combustion is the burning of biomass in the presence of oxygen. The waste heat is used to for hot water, heat, or with a waste heat boiler to operate a steam turbine to produce electricity. Biomass also can be co-fired with existing fossil fuel power stations.

Pyrolysis convert biomass feedstocks under controlled temperature and absent oxygen into gas, oil and biochar (used as valuable soil conditioner and also to make graphene). The gases and oil can be used to power a generator and some technologies can also make diesel and chemicals from the gases.

Torrefaction is similar to pyrolysis but in a lower operating temperature range. The final product is an energy dense solid fuel often referred to as “bio-coal”.

Thermochemical conversion is commonly referred to as gasification. This technology uses high temperatures in a controlled partial combustion to form a producer gas and charcoal followed by chemical reduction. A major use for biomass is for agriculture residues with gas turbines. Advanced uses include production of diesel, jet fuel and chemicals.

Biochemical Conversion involves the use of enzymes, bacteria or other microbes to break down biomass into liquids and gaseous feedstocks and includes anaerobic digestion and fermentation. These feedstocks can be converted to energy, transportation fuels and renewable chemicals.

Chemical Conversion involves the use of chemical agents to convert biomass into liquid fuels which mostly is converted to biodiesel.