FERTILIZERS

Definition: Fertilizer is any material, organic or inorganic, natural or synthetic, that furnishes to plants one or more of chemical elements essential for normal growth.

Types of fertilizers:

Inorganic or chemical fertilizer: simple chemical compounds made in a factory

Organic fertilizer: Composed of wastes and residues from animal life

Organic fertilizers could be classified into Industrial and Non-Industrial organic fertilizers.

Industrial Organic fertilizers include waste from brewery factories e.g. molasses, waste From tobacco companies e. g. tobacco leaves, waste from fruit juice and meat canning industries e. g. orange or fruit peelings, bones hooves, blood. It also includes sawdust from sawmills.

Non- Industrial Organic Fertilizers: These include cocoa pods, rice brans, bean pod, sorted town refuse, sewage and city wastes. Animal dung, human feaces and urine are also included.

The difference between organic and inorganic fertilizers lies in the fact that inorganic fertilizers consist of relatively simple chemical compounds of known composition, they are nutritionally more concentrated and they release their nutrients immediately they are applied to the soil provided there is adequate moisture while organic fertilizers are slowly mineralized, add organic matter to the soil, they are rich in water and carbon compounds.

Common fertilizer terms:

Fertilizer Grade; Nutrient content expressed in weight percentages of N, P_2O_5, and K_2O in the order: N-P-K

Straight Fertilizer: Fertilizer containing only one nutrient

Compound Fertilizer: Fertilizer containing two or more nutrients

Granular Fertilizer: Fertilizer in form of particles sized between an upper and lower limit

Nongranular (powdered) Fertilizer: Fertilizers containing fine particles, usually with some upper limits such as 3 mm but no lower limit.

Fillers: These are materials which may or may not possess any manorial value added to compound fertilizers to make up the weight required to get them conform to a predetermined Specification in terms of percentages of the active ingredient. Examples of materials used as fillers in the past were fine river sand, powdered charcoal and kaolin while gypsum, dolomite and dried poultry manure have been more recently used.

Bulk-Blend Fertilizer or Blended Fertilizer: This refers to two or more fertilizers of similar size mixed together to form a compound fertilizer.

Coated Fertilizer: Granular fertilizer coated with a thin layer of some substances such as clay to prevent caking or to control dissolution rate.

Liquid or fluid fertilizer: This term is used for fertilizers wholly or partially in solution that can be handled as a liquid. This includes clear liquid and liquids containing solids in suspension.

Examples of N supplying fertilizers:

Carrier	%N
Urea [$(NH_2)_2CO$]	46
Ammonium nitrate (NH_4NO_3)	32- 34.5

Examples of P supplying fertilizers:

Carrier	% P	% P_2O_5
Triple Super Phosphate [$Ca(H_2PO_4)_2$	20	45
Potassium Phosphate (K_2HPO_4)	18	41

Examples of K supplying fertilizers:

Carrier	% K_2O	% K
Muriate of Potash (KCl)	60	50
Potassium nitrate (KNO_3)	44	37

Conversion table for some fertilizer nutrients

To Convert	**Multiply by**
P to P_2O_5	2.2915

P_2O_5 to P	0.4364
K to K_2O	1.2047
K_2O to K	0.8301

Fertilizer rate: The quantity of fertilizer that should be applied per unit area of farm land for a given crop.

Example of fertilizer rate calculation:

Calculate the quantity of Urea, Triple Super _Phosphate (TSP) and Muriate of Potash (MOP) needed to supply 20 kg N/ha, 15 kg P/ha and 30 kg K/ha.

Urea: 46kg N would be supplied by 100 kg urea

20 kg N would be supplied by 100/46 x 20 = 43.48 kg Urea/ha

Triple Superphosphate: 20 kg P would be supplied by 100 kg TSP

15 kg P would be supplied by 100/20 x 15 = 75 kg TSP/ha

Muriate of Potash: 50 kg K would be supplied by 100 kg MOP

30 kg K would be supplied by 100/50 x 30 = 60 kg MOP/ha

Fertilizer Manufacture:

Ammonia production is the first step in the manufacture of most nitrogen fertilizers.

Ammonia manufacture

Chemical Characteristics: Ammonia contains 82% nitrogen by weight and is 99% NH_3, it is

N content	82%

NH3 content	99%

Urea

Urea is manufactured using calcium cyanamide according to the following reaction:

$CO(NH_2)_2 + H_2O$ $CO(NH_2)_2 + Ca(OH)_2$

Urea chemical characteristics

Color	white
Nitrogen content	46.6 %
Molecular weight	60.06
Melting point	0° C

Manufacture of phosphate fertilizers

Phosphate rock and sulfuric acid are the two major raw materials for the manufacture of phosphate fertilizers

Phosphate Rock: Commercial phosphate rock refers to any rock containing a high percentage of phosphate minerals that can be used for commercial purposes such as fertilizer manufacture and direct application to soil. The term usually applies to a product obtained by mining and beneficiation.

Phosphate rocks which contain fluoroapatite as the primary and usually the only source of phosphorus are known as Apatitic phosphates while deposits in which the principal phosphate minerals are aluminous are known as Aluminous Phosphates.

Triple Super Phosphate (TSP) manufacture)

The basic chemical reaction involved in the production of TSP is:

$Ca_{10}F_2(PO_4)_6 + 14H_3PO_4 + 10H_2O$ $10Ca(H_2PO_4)_2.H_2O) + 2HF$

(Fluoroapatite) (Phosphoric acid) (Monocalcium phosphate) (Hydrofluoric acid)

Chemical Characteristics:

Color	Gray
Odor	Acid
P content	20 %

Potash Fertilizers

The principal potash evaporate minerals of commercial importance are:

Sylvinite , a mixture of potassium chloride and sodium chloride crystals. This is the easiest to process and is mined in very large quantities. Carnallite, a mixture of potassium chloride and magnesium chloride crystals. Kainite, a mixture of potassium chloride and magnesium. chloride crystals. About 95 % of all potash mined is used as fertilizers, the other 5 % is used in various industrial applications.

Potassium mineral deposits are usually the result of evaporation of water from landlocked seas that have become separated from the main oceanic body and from which the contained salts have gradually precipitated.

Potassium Chloride manufacture

Potash is very largely extracted or mined from underground deposits of sylvinite, primarily mixed crystals of potassium chloride and sodium chloride using either shaft or solution mining method. Mined sylvinite is later beneficiated or refined using any of the three principal methods namely: flotation, heavy-media separation and solution-crystallization methods.

Flotation is a method of floating off either the potassium chloride or the sodium chloride on a froth. Flotation of potassium chloride is the preferred commercial method.

Heavy media beneficiation utilizes the difference in specific gravity of sylvite (KCl) and halite (NaCl). Halite is more dense, therefore, in a liquid of intermediate specific gravity, halite will sink and sylvite will float.

Solution-Crystallization-Dissolution process is based on the solubilities of NaCl and KCl in hot and cold water, the solubility of NaCl decreases slightly as temperature increases. Thus when a brine that is saturated with both NaCl and KCl at 20ºC is heated to 100ºC, it is capable of dissolving substantial amounts of KCl but no NaCl. The KCl is then dried and marketed in several grades.

Chemical Characteristics

Potassium content:	50 %
Solubility in water	High
Chlorine content:	47 %

Methods of fertilizer application

There are three general methods of fertilizer application;

Broadcasting – Uniform fertilizer application over the whole cropped field

Placement – Inserting, drilling or placing fertilizer below the soil surface

Row, band or side dressing- applied to the sides in a band, usually 5 to 10 cm to the side and about 5 cm deep

Ring application- applied round the plant in form of a ring

Spot application: Similar to ring application, but in addition, holes are made in a ring form round the crop

Top dressing- application of fertilizer after crop emergence

Foliar application: Application of fertilizer solution on leaves of growing plants by spraying