**Organic chemistry – review**

Around 1850, organic chemistry was defined as **the chemistry of compound from living things**  because of that arise a term called “organic”. This definition was felt ancient in 1900 at that time chemist were synthesizing new compounds in laboratory, and many of these new compounds had no relation with any living things. Today, it is defined as **the chemistry of the compound of carbon**. This definition also not too correct considering some of compound of carbon like carbon dioxide, sodium carbonate, and potassium cyanide, are considered to be inorganic. Nevertheless, this definition was accepted because all compounds contain carbon element.

Carbon is only one of bunch element written in periodic table. What is so unique about carbon that its compound justifies a major subdivision in study of chemistry? The answer is that carbon can be covalently bonded to other carbon atoms and to atoms of other element in a wide variety of ways, leading to an almost infinite number of different compounds. These compounds range in complexity from the simple compound methane (CH4), the major component of natural gas and marsh gas, to the quite complex nucleic acids, the carriers of genetic code in living system.

A Knowledge of organic chemistry is indispensable to many scientist. For example, because living systems are composed primarily of water and organic compounds, almost any area of study concerned with plants, animals, or microorganism depends on principal of organic chemistry. These fields of study include medicine, medical science, biochemistry, microbiology, agriculture, and many of other science. However, not only fields that has been writen above who depend on organic chemistry other who also depend on it are plastic and synthetic fibers which are also organic compounds. Petroleum and natural gas mostly consist of carbon compounds and hydrogen which have been formed because of the decomposition of plants. Coal is the mixture of carbon element combined with the compound of carbon and the compund of hydrogen.

**Branches of Organic Chemistry**

1. Sterochemistry

Sterochemistry is a study about molecules in three dimensions- that is how atoms in a molecule are arranged in a space relative to the other. Three aspect about sterochemistry are :

1. Geometric Isomers : how rigidity in molecule could cause isomerism
2. Conformation of molecules: the shape and how a form could be change
3. Chirality of molecules : how the structure of right or left around carbon atoms could cause isomerism

1.a Geometric Isomers of alkenes

Structural isomerism defined as compounds with molecules who have same pattern but have different orders of atoms. Structural isomerism is one type of isomerism. The second type of isomerism is geometric isomerism, which is caused of rigidity in molecules adn only found in two class of compounds : alkenes and cyclic compound.

Molecule is not a static particel, they move around, spin, rotate and bend them self. Atom and groups who only attached by a sigma bond can rotate that is the form of a molecule constantly changes. But groups who attached by double bond can not rotate without breaking the pi-bond. The energy needed to break the pi-bond around 68 kkal/mol is unavailable for the molecules in room temperature. Because of this pi-bond rigidity the attached groups attach to pi-carbon bond stays relatively to another in a space.

Usually, the alkenes structures written as if they are carbon *sp*2 atoms and atoms attached to them are all in the plane of paper. In this explanation it can be imagine one lobe of pi-bond is on the paper and other lobe locate underneath the paper covered by the upper lobe.

1.b Conformation of open-chained compounds

In open-chained compounds the groups attached by sigma bond can rotate around its bond. Because of that atoms in open-chainde could have infinite position in space relative to another. It is true that ethane is a small molecules but ethane could have different arrangement in a space which called **conformation**.

To explain conformation we use three different formula : dimensional formula, ball-and-stick formula and newman projection. Dimensional formula and ball-stick formula used to represent three dimension model of a compound molecule. Newman projection may be drawn top to toe of two carbon in a molecule. Because only two carbon can be showed in that porjection so more than one Newman projection may be drawn for a molecule. For example it can be drawn two projection for 3-chloro-1-propanol.

1.c Chirality of Objects and Molecules

Take a look on your left hand and put it near a mirror. Hand can not be superimposed with its mirror image. If that left hand is put in front of mirror the image on mirror will look like a right hand.

Any object that can not be superimposed on its mirror image is said to be chiral(greek *cheir*,”handedness”) a hand, a glove, and a shoe is all chiral, otherwise a box is achiral because box can be superimposed with its reflection. The same pinciples of right- and left-handedness also apply on molecules. A molecule can not be imposed on its reflection is chiral.

An chiral molecule and can be superimposed molecule with the molecule reflection are the same compound; they are not each other isomers. But a chiral molecule who can not be superimposed with its reflection these compounds are differen compounds which make them a couple steroisomers called **enantiomer.** A couple of enantiomer is a couple of isomer that is reflection of each other can not be superimposed.

1. Medical Chemistry

Medical chemistry or commonly known as Pharmaceutical is a multi-diciplinary mixture of oraganic chemistry, pharmacology,and various of biology branch which involves chemistry and pharmacy on designing, synthesizing, and developing pharmaceutical medicine.

Frankly speaking medical chemistry focusing on small organic molecule, encompasses synthetic organic chemistry aiming to create and develop new therapeutic agent by including synthetic and computational aspects of the study of existing drugs and agents in development in relation to their bioactivities. At the end this field is concerning about quality aspect of medicine and focusing on maintaining health not curing desease as the purpose of medicine.

1. Organometallic Chemistry

Organometallic was developed by Louis C. Cadet in synthesizing methyl arsenic compound but the ultimate recognition of organometallic as a culminated subfield was in Ernst Fischer and Geoffrey Wilkinson earned Nobel Prizes for work of Metallocenes.

Organometallic chemistry is a study about chemical compound contains at least one bond between metal and carbon atom of an organic compounds, the term metal element in this compounds includes elements like sillicon, or boron which not actually a metal but metalloids.

Organometallic chemistry combine organic chemistry and inorganic chemistry as its aspects. Organometallic compound commonly used as catalyst in life, for example in producting petroleoum and production of organic polimer.

Organometallic compound is defined as a compound in which carbon is bonded directly to a metallic atom, the examples of organometallic compounds are mercury, zinc, lead, magnesium or lithium and as mention above metalloids.

Organomettalic compounds are also found naturally, some of them are hazardous for human life such as organolead and organomercury compound

1. Physical Organic Chemistry

Physical organic chemistry term first appear as a tittle of Louis Hammet book in 1940. This study relating physic and organic chemistry which focus is using the tools of physic to find out relation between chemical structures and reactivity or in other words this study applying experimental tools of physical chemistry to the study of organic molecules.

Therefore this study has wide variety of application including electro and photochemistry polymer and supramolecular chemistry, and bioorganic chemistry, enzymology, and chemical biology, as well as to commercial enterprises involving process chemistry, chemical engineering, materials science and nanotechnology, and drug discovery.

Physical oraganic chemistry scientist use both theoritical and experimental approach in their research study such as spectroscopy, spectrometry, crystallography, computational chemistry, and quantum theory to study both the rates of organic reactions and the relative chemical stability of the starting materials, transition states, and products.

1. Polymer Chemistry

Polymer chemistry first introduced in 1777 for Henri Braconnot work which produced nitrocellulose and developed by Christian Schönbein in 1846 which led to the discovery of celluloid. Eventhough has been studied over decades it did need some longer time for universities introduced teaching and researching it until 1940 when an "Institut fur Makromolekulare Chemie” was founded in Freiburg, Germany which concentrate in study of Polymer Chemistry or known macromolecular chemistry. A year later PRI (Polymer Research Intitutie) was established in America.

Polymer chemistry it self is a multi-diciplinary study focusing on chemical synthesis , chemical structures, and macromolecule. Polymer study explain the characteristic of a material, according to IUPAC(International Union of Pure and Applied Chemistry) macromolecules refer to individual molecule chain that is domain of chemistry.

There are two major classification of polymer first is biopolymers which naturally can be found in human life such as structural protein, enzym, hormones, cellulose, DNA,RNA etc. The other one is synthetic polymer which is developed in laboratory such as thermoplastic, teflon, polystyrene, thermosetting plastic such as kevlar,bakelite, vulcanized rubber etc.

**Classification of Organic Compounds**

1. Functional Groups

Functional groups are very important in classifying organic compound as functional groups differ chemical structure to predict characteristic of one compounds. Functional groups influence the physical character and chemical character of one compounds. Molecules are differ by their functional group base. For example alcohol who has sub-unit of C-O-H this means all alcohol tend to have hydrophilic character and usually forms ether.

1. Aliphatic Compounds

Hydrocarbon aliphatic can be differ by its saturation :

1. Paraphin/alkanes which has no double or triple bonds.
2. Alkenes which contain of one or more than one double bond, for example di-olefin or polyolefin.
3. Alkyne who has one or more than one triple bonds.

Besides of classifying by it saturation it also can be differentiate by functional groups.

1. Aromatic Compounds

Aromatic Hydrocarbon contains conjugated double bonds. It means every carbon atom on the ring hybridate by SP2 , this things increasing its stability . The most common example of aromatic compounds is benzena which structure is formulated by Kekule.

1. Heterocyclic Compounds

Heterocyclic compounds characteristic will change if there is heteroatom inside which could be appear as subtitue who stick on outside of the ring (exocyclic) or inside the ring (endocyclic). Piridina and furan are aromatic heterocyclic otherwise pyperidina and tetrahydrofuran are acyclic heterocyclic.

1. Polymer

One of the most important of carbon character is that it is ready to join a chain or web through bonds. This combining process called Polymerism, in other hand chain or web that is formed called polymer. The origin compounds of polymer called monomer.

There are two major polymer as mention above bio and synthetic. Synthetic polymer created and used to fulfill industry needed thats why it is also called industry polymer otherwise biopolymer appear naturally without any human interference.

**Industry That Involves Organic Chemistry**

1. Biotechnology

Biotechnology industry involves bio or organic things as their research to create a specific product. Organic chemistry has significant role in resulting a product of biotechnology for example the cultivation plants which modify the genetic of a plant needs organic chemistry dicipline to explain chemical reaction in DNA of the plant. The result of cultivating plants are seeds that resistant to deseases, seeds coating with specific properties, and plant that drought resistant.

Biotechnology industry is classified as an advanced industry considering its works needs a lot of research and development but in other hand this industry is one of the point of human civilization development. Why? Because its basis is technology the company who involves in this industry will always have to do research and development to bolstering their competitiveness with other companies.

Examples of biotechnology company are : GenenTech, Monsanto, Dow AgroSciences, Cargill

1. Chemical

As mention above with the development in laboratory human are able to synthesize organic compound which is one of chemical industry product. Chemical products are now one of the leading role to human prosperity because of its involvement in human needs not directly but as supporter of other industry such as oil, natural gas, water, metal, mineral which create more than 70.000 different product needed by human.

Moreover over 75% industry product are polymers and plastic which is part of organic chemistry domain in its formation. Some of chemical companies that you might know are : BASF, Bayer, Braskem, Celanese, Dow, DuPont, Eastman.

1. Consumer Products

Organic chemistry has made a significant role in this industry, product such as soap, detergent, cleaning product, plastic goods, and cosmetic are made by the princip of this marvelous dicipline. Some of companies that works on this industry are : Johnson&Johnson, Unilever, and P&G

1. Petroleum

Petroleum industry is not only and mainly about finding oil in the belly of earth and explore it until it dries up. Ability only to take the black gold from the earth does not include as petroleum industry it might be include as exploration contractor.

Petroleum company works from extracting the crude oil from the belly of earth , refining the oil, transporting it and marketing the oil as a usable product. But the real question here is how to transform “useless” oil into something can be consume directly?

This called transformation process as the process means applying science in general to “cook” the oil into something consumable and has value added. Applying science in specific is applying chemistry in general , organic chemistry principal and study especially to make an excellent produt so it can meet criteria to be a consumable product.

Apparently petroleum with the appliance of chemistry not only producing gasoline as we thought before it also able to produce fertilizer for agriculture industry, pesticide to eliminate virus, and the most consumable material on earth plastic.

So, there are very wide variaty product to be made by applying organic chemistry in petroleum material , some of company who involved in this industry are : ExxonMobil, Shell Chemicals, Chevron Phillips Chemial Company, BP.

1. Pharmaceutical

As we know this industry mainly producing medicine or drugs licensed for use of medical reasons for humans or animals. As mention above one of branch in organic chemistry is medical chemistry which the focus of study is to produce drugs that has maintaining health as its orientation not curing desease as it orientation. Companies in this industry mainly has two orientation the first one is company who made drugs and sell it on its own brand or as we know branded drug and the other one is company who sell product or drug on the name of the drugs material i.e chemically equivalent, lower-cost version of a brand-name drug or as we know as generic drug.

Pharmaceutical company has many challenges one of them are some country-specific laws and regulation regarding its patenting, testing, safety assurance, efficacy, monitoring and marketing. This things happen as commitment of some countries government to protect its public from fake drugs which could lead to a desease or worse a death.

Nevertheless the process of synthesizing drugs needs organic chemistry dicipline in the creating and developing it , that is why organic chemistry consider very important in this industry.