JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Year & Sem – B.Tech I year I Sem
Subject –Engg.Chemistry
Unit – II
Presented by – Ms.Rekha Vijay
Designation - Asst.Professor
Department - Chemistry

VISION OF INSTITUTE

To become a renowned centre of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

MISSION OF INSTITUTE

❖**Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.**

❖**Identify, based on informed perception of Indian, regional and global needs, the areas of focus and provide platform to gain knowledge and solutions.**

❖**Offer opportunities for interaction between academia and industry.**

❖**Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders may emerge in a range of profession.**

Engineering Chemistry: Course Outcomes

Students will be able to:

CO1: Explain the impurities of water (mainly hardness) and boiler troubles.

CO2: Describe processing technologies of fuel with numerical aspects of combustion of fuel.

CO3: Describe the engineering material (cement, glass and lubricant) with respect to their manufacturing, composition, classification & properties.

CO4: Explain corrosion with its controlling measures, organic reaction mechanism and synthesis of drugs (Aspirin & Paracetamol) with their properties and uses.

JECRC
Department of Applied Sciences
Lecture Plan (Session- 2020-2021)

Course Name: Engineering Chemistry **Year/Semester: 1st Year/ Semester- I**

Course code: 1FY2-03 **No. of Lecture Req. /(Avl.): /(40/44)**

Semester starting: 21 Sept. 2020 **Semester Ending: 24 Dec. 2020**

Unit No./ Total Lect. Req.	Topics	Lect. No.	Date of Delivery	Book Referred	Pg. No.
Unit-I 10	Introduction to syllabus, Common natural impurities, hardness, Degree of hardness,	1			
	Units of hardness, Determination of hardness by complexometric (EDTA method).	2			
	Municipal water supply, Requisite of drinking water, purification of water, Sedimentation,	3			
	Filtration, disinfection, Breakpoint chlorination.	4			
	Boiler troubles: Scale and Sludge formation, Internal treatment Methods	5			
	Priming and Foaming, Boiler corrosion and caustic embrittlement	6			
	Water softening: Lime-Soda process	7			
	Water softening: Zeolite (Permutit) process, Demineralization process.	8			
	Numerical problems based on Hardness, EDTA,	9			
	Numerical problems based on Lime-Soda and Zeolite process.	10			

Unit-II 10	**2.Organic Fuels: Solids fuels: Coal, Classification of Coal, Proximate analyses of coal and its significance**	**11**			
	Ultimate analyses of coal and its significance,	12			
	Gross and Net Calorific value, Determination of Calorific value of coal by Bomb Calorimeter.	13			
	Metallurgical coke, Carbonization processes; Otto-Hoffmann byproduct oven method.	14			
	Liquid fuels : Advantages of liquid fuels, Mining, Refining and Composition of petroleum, Cracking	15			
	Synthetic petrol, Reforming, Knocking, Octane number, Anti-knocking agents, Cetane number	16		Engg. Chemistry (New Age International)	
	Gaseous fuels; Advantages, manufacturing, composition and Calorific value of coal gas and oil gas	17			
	Determination of calorific value of gaseous fuels by Junker's calorimeter, Numerical problems based on Junkers calorimeter	18			
	Numerical problems based on determination of calorific value bomb calorimeter, /Dulongs formula, proximate & ultimate Analysis.	19			
	Numerical problems based on combustion of fuel.	20			

Unit-III 3	**3.Corrosion and its control: Definition and significance of corrosion, Mechanism of chemical (dry) corrosion**	**21**			
	Mechanism of electrochemical (wet) corrosion, galvanic corrosion, concentration corrosion and pitting corrosion.	22			
	Protection from corrosion; protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design.	23			

Unit-IV 10	**4.Engineering Materials: Portland Cement; Definition, Manufacturing by Rotary kiln.**	**24**			
	Chemistry of setting and hardening of cement. Role of Gypsum.	25			
	Glass: Definition, Manufacturing by tank furnace, significance of Annealing	26			
	Types and properties of soft glass, hard glass	27			
	Borosilicate glass, glass wool, safety glass.	28			
	Lubricants: Classification	29			
	Lubricants: Mechanism	30			
	Properties; Viscosity and viscosity index	31			
	Flash and fire point, cloud and pour point.	32			
	Emulsification and steam emulsion number.	33			

Unit-V 7	**5. Organic reaction mechanism and introduction of drugs: Organic reaction mechanism: Substitution; SN1, SN2.**	**34**			
	Electrophilic aromatic substitution in benzene, free radical halogenations of alkanes,	35			
	Elimination: elimination in alkyl halides, dehydration of alcohols,	36			
	Addition: electrophilic and free radical addition in alkenes, nucleophilic addition in aldehyde and ketones	37			
	Rearrangement: Carbocation and free radical rearrangements	38			
	Drugs : Introduction, Synthesis, properties and uses of Aspirin	39			
	Drugs : Introduction, Synthesis, properties and uses of Paracetamol, Revision	40			

Lecture-16(Unit-II FUEL)

- **Reforming**
- **Knocking**
- **Octane number**
- **Anti-knocking agents**
- **Cetane number**

Reforming

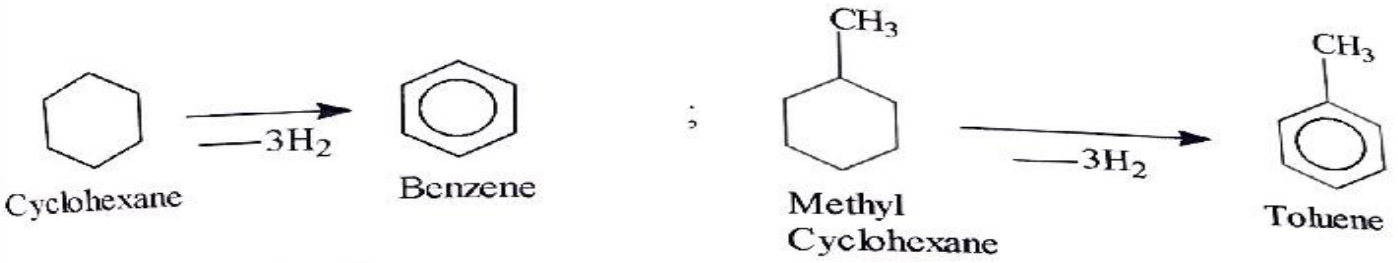
The antiknock properties of gasoline (prepared by fractional distillation of crude oil on cracking) can be improved by a special type of treatment known as reforming. Reforming brings about the structural modifications in the components of gasoline. The modifications takes place with rearrangement of molecules without greatly disturbing their average molecular weight .

- **Thermal Reforming** : C-C cleavage, dehydrogenation, isomerization, cyclization, and aromatization.
- **Catalytic Reforming :**hydrocraking, dehydrogenation, isomerization, dehydrocyclization, and aromatization.

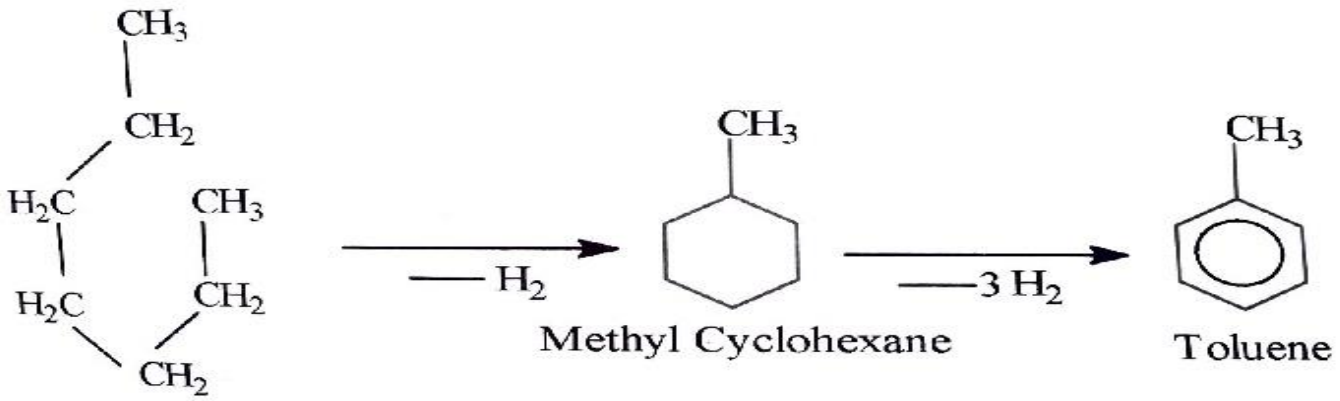
Generally gasoline is reformed to improve its antiknock characteristics.

The main reactions in the reforming process are as under:

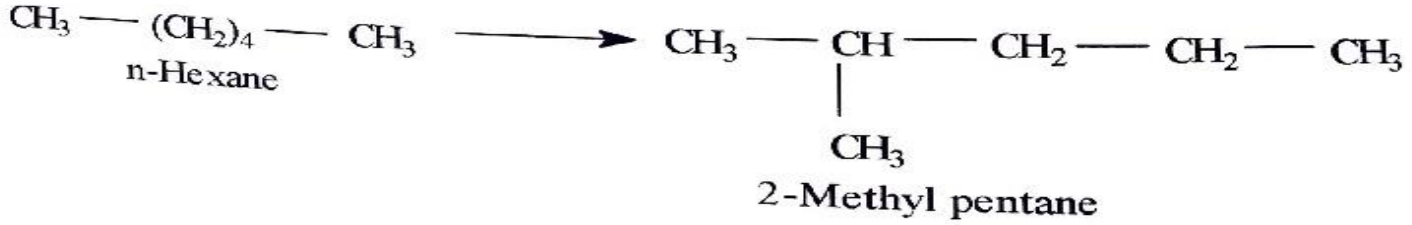
1. **Dehydrogenation**



2. **Dehydrocyclization**



3. **Isomerization**



Knocking & Octane number

Mixture of gasoline and air is used as fuel in internal combustion engine. It is highly compressed and then ignited.

The process involves four strokes :

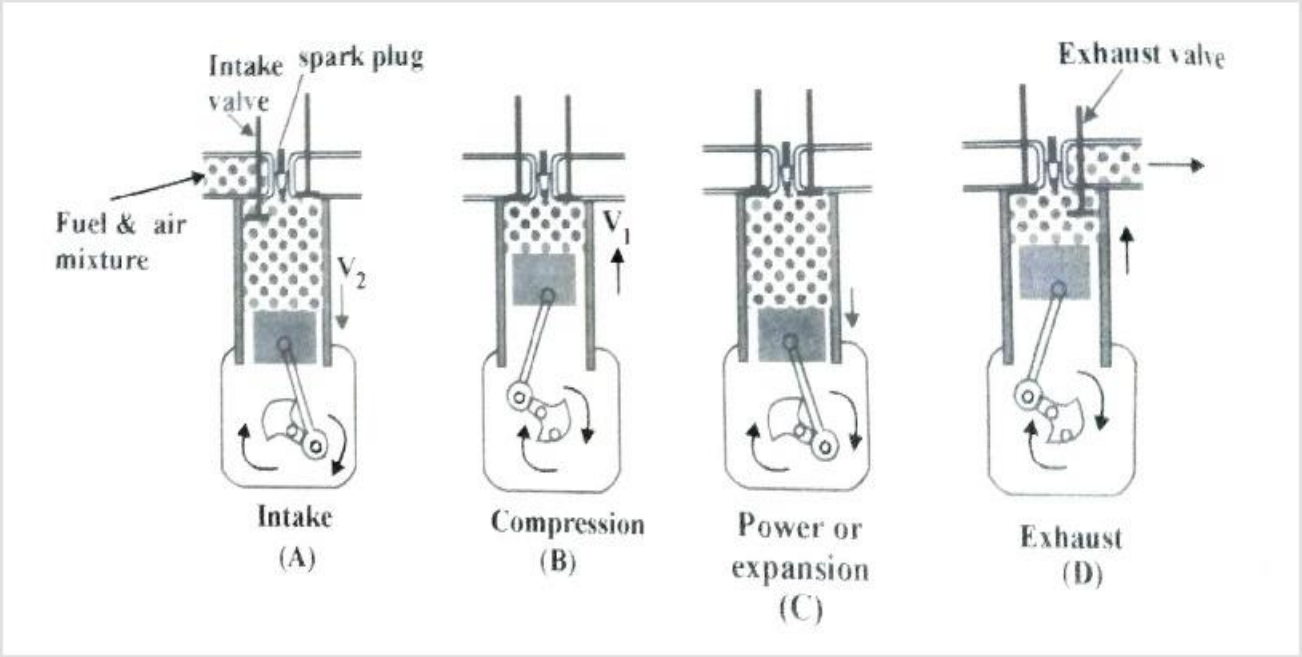
(1) The fuel air mixture is drawn into cylinder-**(suction stroke).**

(2) The fuel air mixture is compressed**(compression stroke).**

(3) The fuel air mixture is ignited by an electric spark. The gases produced due to combustion increases the pressure and push the piston down-**(Power stroke).**

(4) The piston moves up and expels the exhaust gases from the cylinder **(exhaust stroke).**

The flame on ignition should spread rapidly and smoothly through the gaseous mixture for maximum efficiency of the engine. But sometimes, due to high compression, the gasoline air mixture get heated to a temperature. so that there is spontaneous combustion before regular sparking. This is called premature ignition. There may be self ignition of last portion of the fuel-air mixture after sparking, resulting in an explosive violence. The pre-mature ignition and delayed ignition causes knocking(that is a sharp metallic sound or an explosive violence).


Intake valve
spark plug
Fuel & air mixture
V_2
Intake
(A)
V_1
Compression
(B)
Power or expansion
(C)
Exhaust valve
Exhaust
(D)

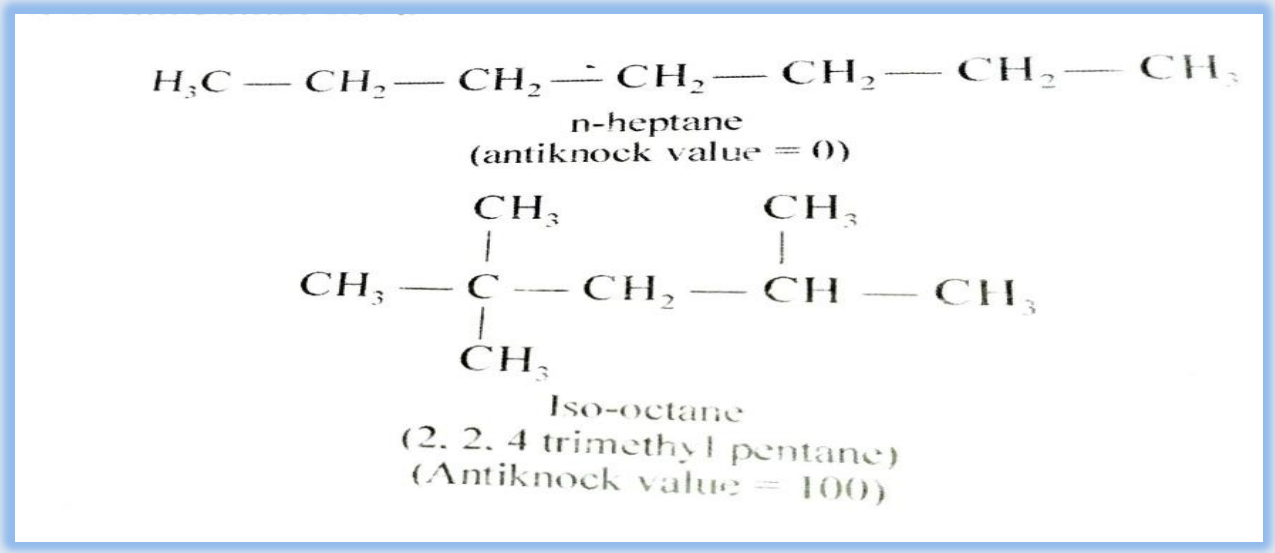
Knocking causes loss of energy and decreases the efficiency. After ignition, the expansion drives the piston down the cylinder (called suction stroke). When the combustion is complete the piston moves up (compression stroke).

$$\text{Compression ratio (CR)} = \frac{\text{Volume of gas at the end of suction stroke}}{\text{Volume of gas at the end of compression stroke}}$$

- Greater the compression ratio, more is the efficiency.
- The knocking tendency depends on the structure of constituents present
- **The order of knocking tendency is straight chain paraffins > branched chain paraffins olefins > cycloparaffins > aromatics.**
- Knocking also depends on nature of fuel, design of the engines and running conditions etc.

Octane No.

The most commonly used measure of a gasoline's efficiency, to burn without knocking is its octane number. It is found that n-heptane knocks very badly. Whereas iso-octane (2, 2, 4-trimethyl pentane) is resistant to knocking. So the octane number of iso-octane is taken as 100, and that of nheptane is zero.



The octane number of a fuel under standard conditions, is the percentage of volume of iso-octane in a mixture of iso-octane and n-heptane having the same knocking characteristics as the fuel. For example, gasoline that contain 75% of iso-octane and 25% of n-heptane are given an octane number of 75. Certain anti-knock quality is required for knock free operation of a gasoline engine. In Indias motor, gasoline have octane number 83.

Anti-knocking agents

The knocking tendency can be minimized by adding some compounds known as anti knocking

Tetraethyllead [$Pb(C2H5)_4$] and iron carbonyl [$Fe(CO)_5$) are used as antiknocking agents. The knocking agents retard the rapid combustion of gasoline vapour in the cylinder. Anyway these are poisonous compounds. Tetraethyllead is converted into lead oxide and reacts with any hydrogen peroxide **molecules formed, slowing down the chain oxidation reactions. The deposits of lead oxide is harmful** to engine life. A small amount of ethylene dibromide (20%) removes lead oxide as volatile lead bromide along with the exhaust gases.

$Pb + CH_2Br – CH_2 Br \rightarrow PbBr_2 + CH_2 = CH_2$

ethylene dibromide lead bromide

ethene The presence of sulphur compounds in petrol reduces the effectiveness of tetraethayl lead (T·E·L.). In 1 litre of petrol, about 0.5 ml and in aviation fuel about 1 ml of TE L is added. Aviation gasoline has octane number of 100 or more. It is obtained by comparing it with a mixture of iso-octane and a known quantity of TEL as reference fuel.

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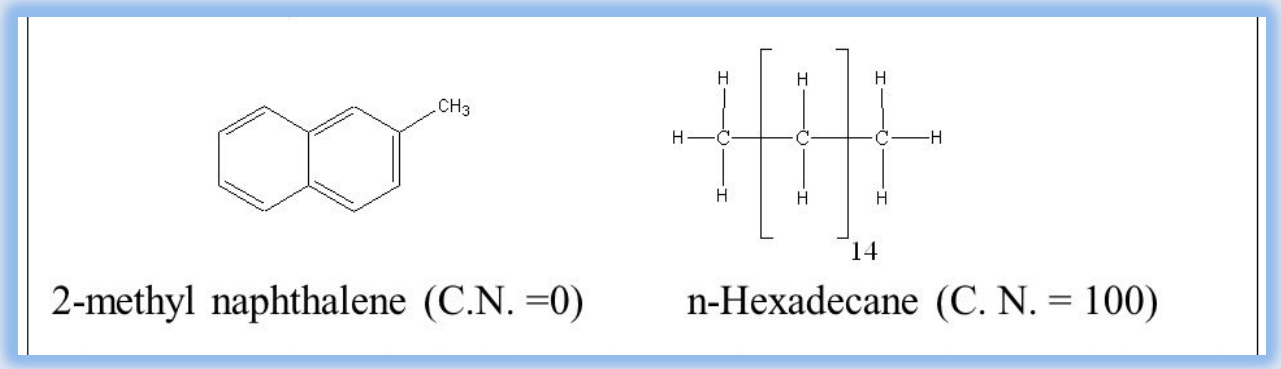
CETANE NO.

Cetane Number: The suitability of diesel fuel is defined by its cetane number. The cetane number of a diesel oil is defined as the percentage of n-hexadecane in a mixture of n-hexadecane and 2-methyl naphthalene which will have the same ignition characteristics as the fuel under test, under same set of conditions.

2-methyl naphthalene (C.N. =0) n-Hexadecane (C.N. = 100) The cetane rating of a fuel depend upon the nature and composition of hydrocarbon. The straight chain hydrocarbons ignite quite readily while aromatics do not ignite easily. Ignition quality order among the constituents of diesel engine fuels in order of decreasing cetane no, is as follows:

n-alkanes> naphthenes > alkenes > branched alkanes > aromatics



2-methyl naphthalene (C.N. =0) n-Hexadecane (C. N. = 100)

SUGGESTED LINK

https://www.thoughtco.com/definition-of-octane-number-604586

https://www.britannica.com/technology/octane-number

https://energyeducation.ca/encyclopedia/Octane_rating

https://www.captoyota.com/service/information/learn-the-common-causes-for-engine-noise-knocking-salem-or.htm

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Thank you!