POLYMERUPDATE ACADEMY

EDUCATIONEM RESPONSUM EST

PETROLEUM REFINING & PROCESSING

Prepared & Conducted by

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INDEX

SUMMARY

The crude oil is, by far, the most used feedstock today in the world. Shale gas and coal can be other two feedstocks of sizable size and importance. Almost 90 % of crude is used to manufacture different type of fuels. Automotive fuel has the maximum demand. The refining process consists of separating the crude into different fractions of increasing boiling points from 40 C to 400+ C. These fractions are further treated or refined to make fuels of desired properties. In achieving this, monomers and other petrochemicals are also produced.

This course on refining operations consists of 7 lectures.

Lecture 1:

The first lecture reviews the relevant properties of crude and the basic separation into 7 or 8 fractions by atmospheric distillation. These fractions are then further treated by various techniques which are presented in remaining lectures.

Lecture 2:

Lecture 2 describes the catalytic reforming process. Catalytic reforming is a process in which light end distillates (naphthas) are reacted in presence of a catalyst at elevated temperatures and high pressures up to 35 atmospheres. The purpose of reforming is to raise the octane number of hydrocarbon feed. Hydrogen and other light hydrocarbons are also produced in the process depending upon the feed. Platinum is most widely used catalyst. The term PLATFORMING® is used many times to denote this process. The chemistry, catalyst preparation & regeneration as well as reactor parameters are described briefly.

Lecture 3:

Lecture 3 discusses fluid catalytic cracking process. The high boiling point fractions contain hydrocarbons of high carbon number. The cracking process breaks or 'cracks' the large molecules into small molecules containing smaller number of carbon atoms. The middle and higher fractions can be converted into gasoline, diesel fuel, LPG and olefins and aromatics by 'cracking' process. Essentially it is breaking down molecules having higher carbon atoms into compounds containing smaller number of carbon atoms. Although cracking can be carried out thermally without using a catalyst, fluid catalytic cracking is practiced commercially. This lecture considers the catalyst preparation & regeneration, process chemistry and reactor performance parameters.

Lecture 4:

Lecture 4 reviews the distillate hydrocracking process. It upgrades the petroleum feedstocks by cracking it to the desired boiling point range, adding hydrogen and removing impurities. The feed to this process can range from heavy vacuum gas oils and coker gas oils to atmospheric gas oils. The resulting products can range from naphtha to heavy diesels. These are designed to withstand the variation in the feedstocks, cycle times and the desired product range. Process chemistry, preparation and regeneration of catalyst, and the reactor parameters are discussed briefly and in a simple way in this lecture.

Lecture 5:

Lecture 5 reviews the hydrotreating process. The hydrotreating operation removes the objectionable materials such as sulfur, nitrogen, olefins and aromatics from the feed. The operation does not crack the feed. At times, the hydrotreating operation may follow the hydrocracking operation. Naphtha or similar lighter materials are hydrotreated prior to reforming operation. Heavier distillates ranging from jet fuel to vacuum gas oil are hydrotreated to meet the stringent quality specifications. All the relevant aspects of process chemistry, catalyst and the reactor are described.

Lecture 6:

Lecture 6 describes briefly the up gradation of fuels. Alkylation, Isomerization and olefin condensation process are described in this lecture. Alkylation of motor fuel refers to conversion of C3-C5 olefins into branched paraffinic material by reaction with isobutane. This reaction is acid catalyzed. The product of alkylation is blended with gasoline used so as to enhance the octane number of fuel. The alkylation reactions are carried out using liquid or solid acid catalysts such as, H_2SO_4, HF, HF-BF_3, $AlCl_3$ as well as ion exchange resins. The effects of base material properties influence the octane number.

Catalytic olefin condensation is similar to alkylation. However, in olefin condensation the product is higher olefins. Condensation between two different olefin molecules or with same olefin molecule can be practiced. More than two molecules of olefin can be condensed. The process yields useful products for gasoline as well as raw material for petrochemical industry.

Isomerization is a process which upgrades the light hydrocarbons (C4 – C6) for better quality gasoline. This is very useful in the light of strict regulations on minimization of benzene, phased out lead additives and also minimization of oxygenates in the gasoline. Isomerization converts paraffins into branched paraffins without changing the number of carbon atoms.

Lecture 7:

Lecture 7 discusses the up gradation of feedstock of very high boiling points generally referred as resids. Visbreaking, thermal cracking and other processes are described briefly.

PROF. (DR.) D. D. KALE

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Honorary Chancellor
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Born on November 16, 1945, Prof. (Dr.) D. D. Kale is a Chemical Engineer and has obtained his Ph. D. from University of Salford, UK.

With a teaching experience of over 40 years, Prof. (Dr.) D. D. Kale retired from University of Mumbai's Department of Chemical Technology, UDCT, Mumbai in 2005 as a Professor of Polymer Technology and as a Head of the Department of Polymer Engineering.

At present, he is a technical advisor to Giriraj Group, Mumbai and in the past has also been a consultant to several plastics industries.

He is a member of high power expert committee to Government of Maharashtra on various environmental issues and is on the expert panel for centers of excellence by DCPC. (Dr.) D. D. Kale is also a member of committee to define single use plastics set up by Ministry of Chemicals and fertilizers, New Delhi.

He has been a Visiting Professor in South Korea.

After superannuation in 2005, he has worked with Reliance Industries Ltd. for a tenure of three years.

His research interests include polymer processing, rheology, product design and recycling. He has guided 28 Ph. D. and 65 Masters Students. He has published more than 100 papers in peer reviewed journals and has one patent to his credit. He has presented papers in several International conferences such as IUPAC and has travelled widely.

He is associated with many professional bodies such as PLASTINDIA, All India Plastics Manufacturers Association, (AIPMA), IPI and SPE etc.

Prof. (Dr.) D. D. Kale has trained more than 5000 undergraduate and post graduate students in India and overseas. He has also trained more than 1000 industry personnel and has successfully authored two books. He was Honorary Editor of the journal, “Chemical Engineering Journal" published by I.I.Ch.E., India

WORK EXPERIENCE:

Jan 2018 till date - Technical Director, Euressia Polymers, Mumbai.
Feb 1, 2010 to - May 2012 - Director, Shroff S R Institute of Chemical Technology, Vataria, Taluka Valia, Bharuch, Gujarat, India
Aug 1, 2011 to Dec. 2012 - Visiting Professor, IIT Gandhinagar
Jan 1, 2006 to Dec 31, 2008 - Advisor, Reliance Industries Ltd.
Jan. 31, 1991 - Nov 30, 2005 - Professor of Polymer Technology, Head, Plastics and Paints Technology Division UICT, University of Mumbai.

AWARDS AND HONORS:

Elected as a Fellow of Maharastra Academy of Science (1998)
Received the Teaching Services Award (Best Teacher) of Mumbai University, 2003-2004
Received the Prof. K. S. Armugam National Award for Innovative Research in the Field of Engineering and Technology by the Indian Society for Technical Education (ISTE) New Delhi (2004)
Received ‘Life Time Achievement Award’ from Color Society, (2015)

OTHER INFORMATION:

- Editor 'Chemical Engineering Journal' published by I.I.Ch.E. (1992 – 94)
- Designed course work for
  Plastics for non-plastic personnel,
  Flexible packaging
  Coloration of plastics
  Chemical Engineering for plant personnel
- Headed the Knowledge Management group of I.P.I.
- Member of Board of Studies for Polymer Engg. Course of many Universities.

Has organized more than 10 Refresher Courses for Industry on behalf of Professional Bodies like IPI, SPE, Indian Institute of Chemical Engineers, Indian Small Scale Paint Association.

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