Course DEEP OIL REFINING PROCESSES

Basic Information

This is a course, which contributes to MSc award in Petroleum Chemistry and Refining

Course period	1nd and 2rd semesters (20 weeks)
Study credits	6 ECTS credits
Duration	216 hours
Language of instruction	English
Academic requirements	– BSc degree in Petroleum Engineering, Engineering, Chemistry , , Environmental Sciences or equivalent (transcript of records), – good command of English (certificate or other official document)

Course Description

«Deep oil refining processes» is an extensive course where overview of the modern, integrated petroleum refinery will be analyzed. Each refining process is presented covering configuration, operating description and conditions, feedstock and catalyst selection, stream yields and properties, process parameter relationships and their effect on unit performance and yields. The impact of each process on environmental regulations and pollution control is also discussed. Crude oil properties and assays are reviewed. Current and anticipated future worldwide fuel product specifications are presented.

The effects of changes in crude oil source and supply, in particular bitumen and shale oil, as well as shifting product demand and import/export balances on future refinery operation will also be discussed.

The most important part of this course is scrutinize a schematic flow diagram of a typical oil refinery that depicts the various unit processes and the flow of intermediate product streams that occurs between the inlet crude oil feedstock and the final end products. Students will differentiate between several possible explanations of a given schematic diagrams to find the most appropriate one.

Special Features of the Course

1. Scientific, social and practical aspects of refinery industry are tightly integrated in the teaching on the course.

In addition to conventional lectures the course offers a range of other learning opportunities in which students actively participate. Moreover, students will be involved in online mini-games and tests.

2. Provides broad technical information on refining processes and petroleum products, enabling a rapid immersion in the refining industry.

Detailed course material with a glossary of the main technical terms used in the refining industry. New trends in market structure and product characteristics to European and worldwide scale. Up to date refining schemes including the production of petrochemical intermediate products.

3. Meetings with refinery employees.

In exam week refinery employees will be invited to evaluate student's knowledge. It is a great opportunity to ask professional questions and receive some advices from specialists.

Course Aims

– to explain the chemical basis of fuel production;
– to develop understanding and skills related to the recognition and interpretation of secondary refining processes;
– to acquaint with schematic diagrams of different refineries;
– to introduce environmental impacts of the petroleum refining industry.

Course Objectives

– to explain the different chemical reactions occurred during refining processes;
– to classify students secondary refining processes;
– to provide students with the explanation of refinery's basic schematic diagrams;
– to familiarize students with different kind of pollution and refining industry accidents.

Learning Outcomes of the Course

By the end of the course, students will be able to:

– to demonstrate how the composition of crude oil and feedstock may affect on products output, from chemical point of view;

– to analyze the relationship between different refining units;

– to Identify major processes' features: temperature, pressure, type of catalyst, feed, products output and etc;

– to interpret schematic diagrams and compare them;

– to understand the impact of engineering solutions in a global and environmental context.

Course Outline

week, №	Topic	Lectures/Practice session/ Lab Work	Hours[1]
1-2*	Modern energy and fuel complex overview	*Lecture* Energy industry overview. Fossil fuels geography and world oil reserves	2
		Study of additional theoretical materials, preparation for practical classes, homework on the topics Permanent Catalyst Poisons, Fresh Feed Rate (LHSV), Recycle Gas Rate, Nitrogen and Methane Content	41,4
3-8*	Oil refining industry. Increasing the primary oil refining efficiency	*Lecture* Prospects of oil refining industry development	2
		Lecture Dehydration and desalting of crude. Distillation	4
		Practice Refining industry overview. Feedstock	2
		Practice Fossil fuels geography. Classification of oil, natural gas and natural-gas condensates refining processes	2
		Practice Deep oil refining processes schematic diagrams	2
		Practice Oil treatment. Atmospheric and vacuum distillation units	2
		Practice Material balance calculation of the first refining stage	2
		Study of additional theoretical materials, preparation for practical classes, homework Liquid Recycle, Hydrogen Partial Pressure	42
9-12*	Deep oil refining processes. Improvements and the way forward	*Lecture* Thermal processes. Thermodestruction processes. Thermal oxidation processes	4
		Practice Types and meaning of thermal processes. Pyrolysis and thermal cracking	2
1-6**	Deep oil refining processes. Improvements and the way forward	*Lecture* Catalytic processes of secondary refining. Heterolytic processes	2
		Lecture Homogeneous catalytic processes. Hydrocatalytic processes	4
		Practice Visbreaker. Coking. Technical carbon production	2
		Practice Material balance calculation of a refinery with deep oil refining units	2
		Practice Types and meaning of hydrocatalytic processes	2
		Practice Auxiliary equipment calculation	2
		Study of additional theoretical materials, preparation for practical classes, homework CO + CO2 Content, Hydrogen Sulfide cleaning off	28
7-8**	Environmental impacts of the petroleum refining industry	*Lecture* Environmental Management of refining industry. Trends and current production high quality products problems	2
		Study of additional theoretical materials, preparation for practical classes, homework Claus Process, New processes of Hydrotreating	27,6

[1] Hours designed for Classroom sessions, Web-sessions, Home Assignments etc.

week, №	Topic	Lectures/Practice session/ Lab Work	Hours[1]
		Final exam (including preparation)	33,6
* - 1nd semester; ** - 2rd semester			

Lecturer and Contact Information

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Assessment

Grade policy for both home assignments and the final exam is:

– A (excellent work) 91–100 points;
– B (above average work) 81–90 points;
– C (average work) 71–80 points;
– D (below average work) 50–70 points;
– F (failed work) < 50 points.

To pass the exam students have to do all course's assignments (homework, quizzes, reports etc). The final exam is conducted orally on the questions for the exam. Students should be able to answer on 2 questions, demonstrate processes' schematic diagrams and explain them (100 points maximum).

Attendance Policy

Students are expected to attend and participate in classes and should notify trainers of excused absences in advance, where possible. Students who have an excused absence are expected to make arrangements with instructors for alternative assignment. Every topic has a home assignment work that should be done. The final mark will be made by the same grade policy as for a final exam.

Web page of the course

The webpage of the course *Deep Oil Refining Processes* is available through E-learning SibFU web site: www.e.sfu-kras.ru . You must be logged in to access this course. Course materials and required reading materials are available at the course web-page.

Core reading

The main book for this course is Handbook of Petroleum Processing (ST) Steven A. Treese, Peter R. et al (Springer International Publishing, ISBN: 978-3-319-14528-0, Vol. 964, 2015). It contains all information that is required for study in a more extensive manner. It will help students to reach a deeper understanding of petroleum refining.

The book Handbook of Petroleum Processing Steven A. Treese, Peter R. et al (Springer International Publishing, ISBN: 978-3-319-14528-0, 2015) is also recommended for studying the basic petroleum chemistry that will be used during the course.

Books Catalytic and Process Study of the Selective Hydrogenation of Acetylene and 1,3-Butadiene by Ruijun Hou (Springer, Singapore, ISBN 978-981-10-0772-9, Vol. 141, 2015) Problems and Solutions in Oil Refining and Petrochemical Industry by Alec Groysman (Springer International Publishing, ISBN 978-3-319-45254-8, Vol. 356, 2017) (Apart from Handbook of Petroleum Processing (Springer International Publishing, ISBN: 978-3-319-14528-0, Vol. 964, 2015)) will be extremely helpful in order to understand the intent of all refining processes.

Some of the course topics include material balance calculation. Although this calculation is very common, a book Structure and Modeling of Complex Petroleum Mixtures by Chunming Xu and Quan Shi (Springer International Publishing, ISBN: 978-3-319-32320-6, Vol. 182, 2016) can provide students with additional information.