CHE5034: 石化工業程序

PETROCHEMICAL INDUSTRY PROCESS

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Teaching areas: Data Science, Machine Learning and Decision Technology. Refining and Petrochem Process.

Independent Consultant: Modeling, optimization, and simulation. Data analytics, machine learning/deep learning. Refining and chemical process optimization and control.

Consultant for:
中油 (CPC), Aveva (Europe),
Syspetro (China), Becht Eng.(US)

Also teach Data Science and Decision Technology

Jesse Chang, 2023

艾克森美孚 (ExxonMobil), 傑出工程顧問 (Distinguished Engineering Associate)

1989-2017

石化廠策劃用模式 全球技術領導

- 開發及改進各種策劃用石化程序及經濟的模式
- 模式用於每月數十億美元原油及其他進料採構最優化及石化廠操作計劃設定.
- 領導研究計劃以增進對大規模複雜決策的瞭解.

亞太地區科技及能源效率顧問. 駐新加坡.

- 促進亞太區石化廠科技運用及增進能源利用效率.

石化程序 現時優化(Real-Time Optimization) 全球技術領導

- RTO 技術開發及應用的關鍵人之一.
- 領導超過三十多個全世界各廠的 RTO 開發案. 從策劃,開發,上線,到經濟效益分析.
- 應用的石化程序包括 FCC (流體床媒裂), Reformer(重組), HDC/HDT(加氫裂),Crude(原油蒸溜), Aromatics (芳煙廠), Lubes (潤滑油程序) 等.
- 開發訓練課程並在世界各地親自教學.
- 開拓多個首次應用的 RTO. 使公司的超高解析度動力模式取得最大經濟效益.

高階程序控制(Advanced Control)及 AI 智能系統開發

- 應用模式預測控制系統(Model-Predictive Control)到各種石化程序. 包括 FCC (流體床媒裂), Reformer(重組), Crude(原油蒸溜), gas plant 等. 利用的軟件包括 DMC 及 RMPCT 等.
- 發明警報重要性及時智能重組系統. 並擔任專家系統開發小組顧問.
- 開發石化廠總合資訊系統.

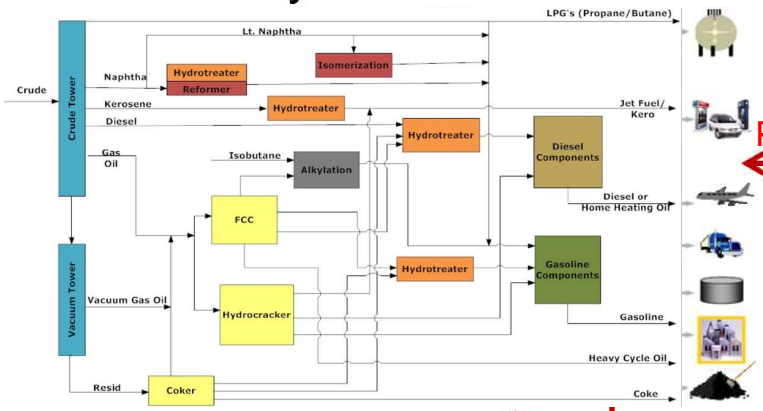
陶氏化學 (Dow Chemical), 項目領導 (Project Leader)

1985-1988：化學程序動力及生產模式開發, 專家系統(AI 及 Expert System)應用

- 開發的模式包括 LLDPE 聚乙稀製程及高分子性質, Latex 及 Acrylamide 製程等.
- 開拓專家系統及人工智慧在程序監控, 問題診斷,及操作改進的應用.

INTEGRATED REFINING AND PETROCHEM COMPLEX

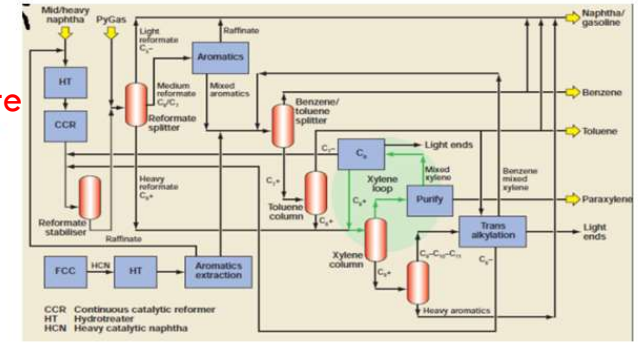
Refinery #1



Reformate

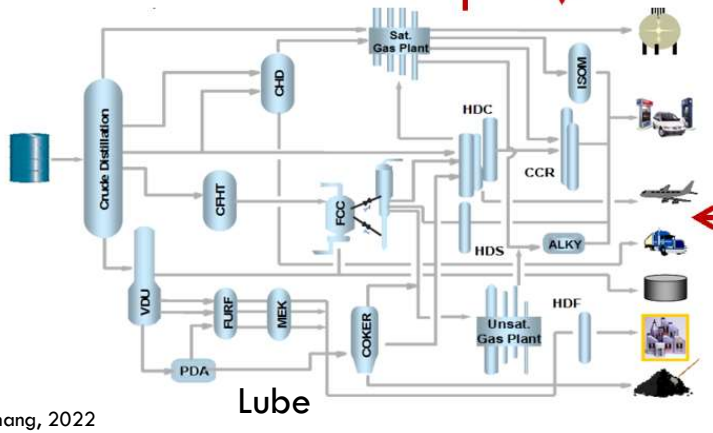
Aromatic plant → Bz/Tol/Xylene

芳香烴



C6, C7, C8

Refinery #2

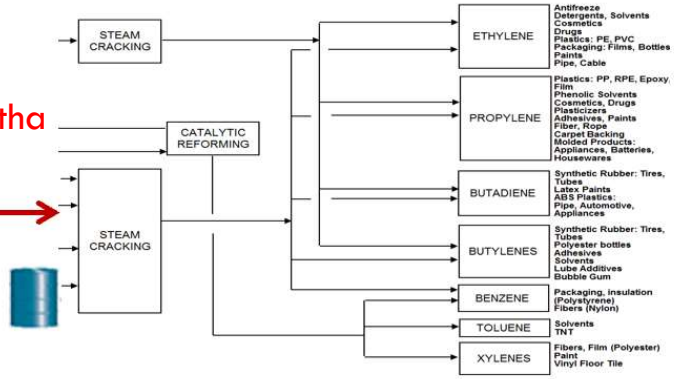


Lube

Naphtha
輕油

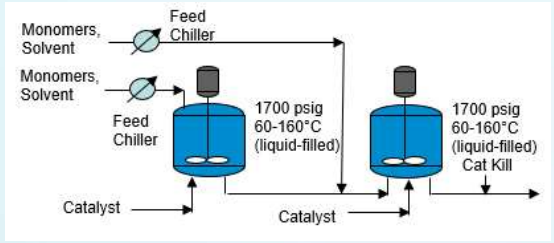
Steam Crackers → Olefins

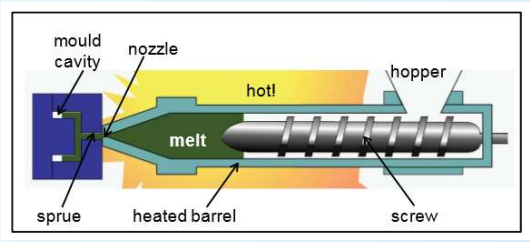
輕油裂解

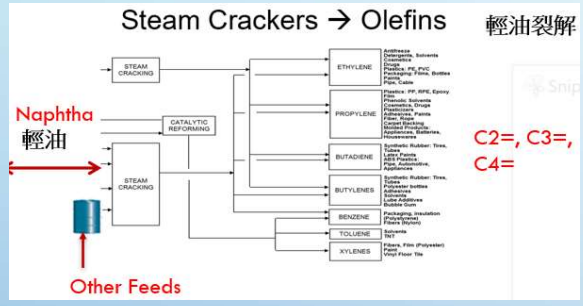


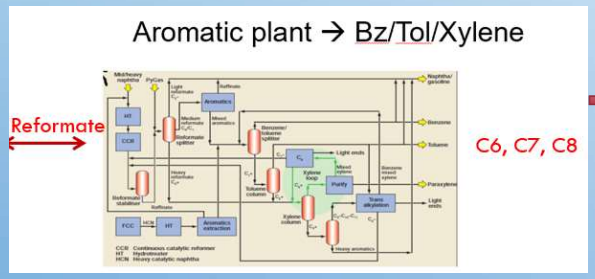
C2=, C3=, C4=

Jesse Chang, 2022









Reactions

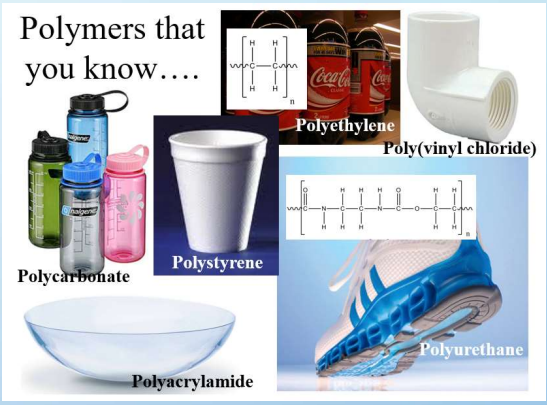
Polymerization

Other Reactions

Polymer Processing

Additional Chemicals

Non polymer products



COURSE OBJECTIVES

AT THE END OF THIS COURSE YOU SHOULD….

- Have an overview of world energy, refining, and petrochemical market
- Know the key characteristics and properties of crudes and refinery/petrochem products.
- Have a good understanding of key refinery processes. For each process you should know
  - The process' role in refinery
  - Its feed and products,
  - Reaction in the process unit,
  - Main operation parameters

When you walk into any refinery and petrochem plant in the world you should be able to look at its process flow diagram and have a very good idea what the plant does

- Understand how petrochemical plants are linked to refinery and how C2-C4 and C6-C8(Bnz/Tol/Xyl) petrochems are produced. Global COTC (Crude to Chemical) trend.
- Know the key polymers used in daily life and how they are related to the basic chemicals.
- Have basic knowledge of the pathways of Carbon Reduction in the industry

COURSE SYLLABUS

- I. INTRODUCTION, WORLD ENERGY STATUS AND OUTLOOK
- II. PETROLEUM REFINING
  - CRUDE PROPERTIES AND CHARACTERIZATION (BOOK PART II, SECTION III)
  - SEPARATION PROCESS – DESALT, DISTILLATION (PART III, SECTION V)
  - HEAVY OIL CONVERSION PROCESS – FCC, HYDROCRACKING, COKING, VISBREAKING
    - (PART III, SECTION VI)
  - DISTILLATE, NAPHTHA, AND GAS CONVERSION – REFORMING, ALKY, ISOM, HYDROTREATING (PART III, SECTION VII).
  - SUPPORTING PROCESS – H2/SULFUR PLANT, ACID GAS TREATING ETC (PART III, SECTION VII)
  - BLENDING (SECTION IV, CHAP-20) AND PROFIT OPTIMIZATION TECHNOLOGY

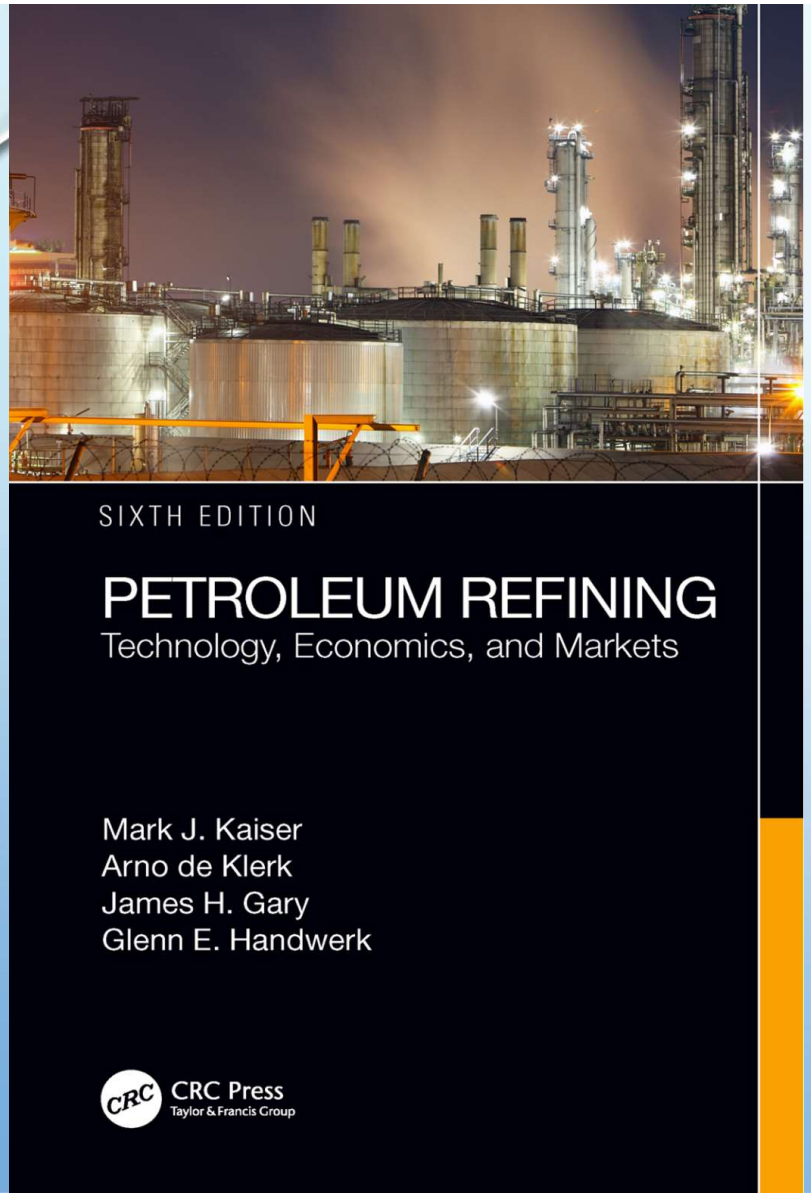
Midterm

- III. PETROCHEMICAL
  - STEAM CRACKER (C2, C3, C4) AND AROMATICS PLANT (BTX: C6, C7, C8).
  - GLOBAL COTC (CRUDE OIL TO CHEMICALS) TREND.
- IV. POLYMER ESSENTIALS AND SPECIALTY MATERIAL – KEY POLYMERS AND RELATIONSHIPS TO PETROCHEMS
  - PE, PP, PVC, PS, PU, PC, COMPOSITES, GRAPHENE ETC AND THEIR REAL-LIFE USAGES
  - KEY POLYMERIZATION REACTIONS AND POLYMER PROCESSING
- V. PETROCHEM INDUSTRY'S PATHWAYS TO CARBON REDUCTION:
  - CARBON CAPTURE AND STORAGE, ENERGY REDUCTION, CO2 UTILIZATION

Project Presentation
Final Exam

BOOKS AND GRADING INFO

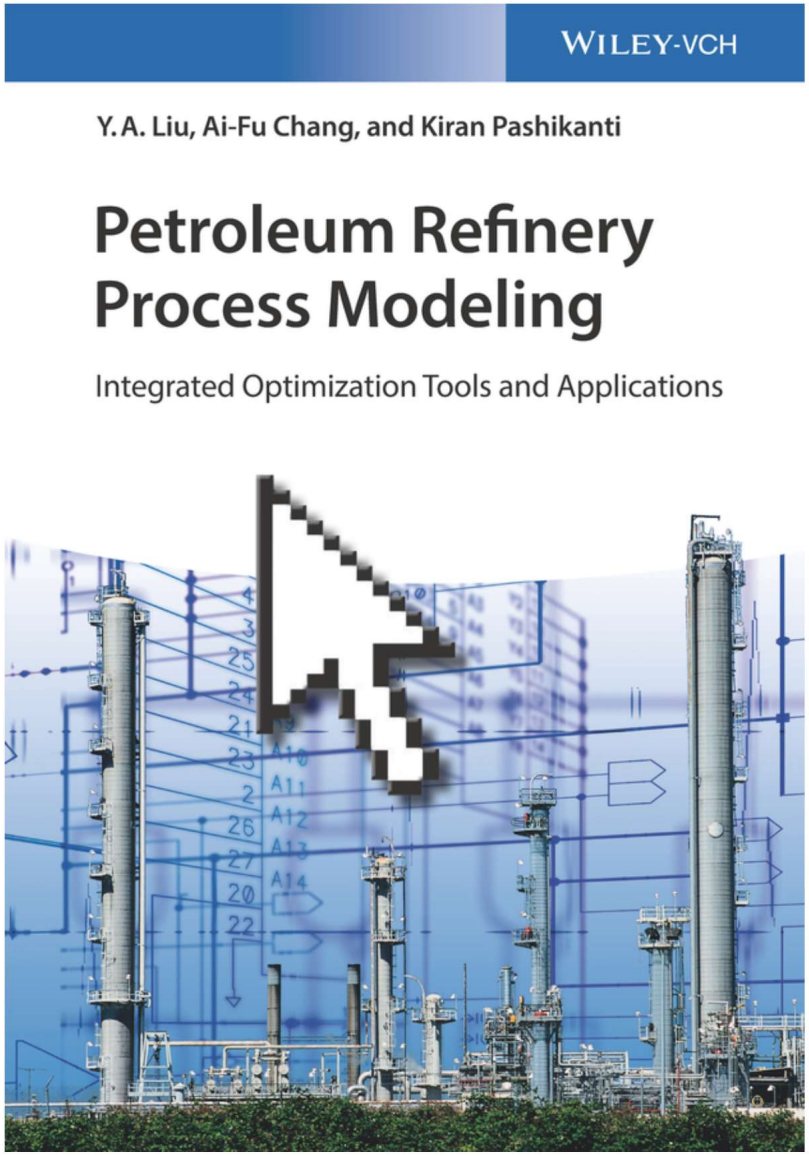
BOTH BOOKS ARE FOR REFERENCE ONLY. DO NOT HAVE TO BUY.



REFERENCE BOOK FOR PETROLEUM REFINING PART

- A WELL-KNOWN CLASSIC THAT WAS SIGNIFICANTLY UPDATED IN 2019 (WHOLE PART-I IS NEW)
- NEW 6TH EDITION, PUBLISHED IN 10/2019.
- CAN CONSIDER GETTING/RENTING E-BOOK
- COURSE WILL MAINLY USE PART II AND III
- 4/5TH ED MAYBE AVAILABLE ONLINE WITH INFO SOMEWHAT OUTDATED BUT OK.

- I will cover all important info in my slides which also include a lot of my personal experience.



SUPPLEMENTAL BOOK FOR REFINERY PROCESS SIMULATION USING *HYSYS*

- Well-written How-To book on refinery process modeling.
- Basis of our HYSYS homework
- You don't have to have the book to do the homework.

- First 2 authors are alumni of National Taiwan Chem Eng.

PATHWAYS TO CARBON REDUCTION

- USE MY OWN ARTICLES PUBLISHED IN 台大風險研究中心網頁

GRADING

- 40% MIDTERM EXAM
- 40% FINAL EXAM
- 5% CLASS INTERACTION
  - DISCUSSION, ASK/ANSWER QUESTIONS
- 15% GROUP RESEARCH AND PRESENTATION
  - PLASTICS RECYCLE TECHNOLOGY AND MARKET

- OPTIONAL EXERCISE: SIMULATION OF KEY PROCESS UNITS USING HYSYS SIMULATOR.
  - DO NOT NEED TO LEARN HYSYS IN DETAILS TO DO HOMEWORK.
  - DO NOT NEED TO SUBMIT
  - MIDTERM/FINAL WILL INCLUDES SOME QUESTIONS THAT DOING HOMEWORK WOULD HELP