石油炼制实用英语教程

A Practical English Course in Petroleum Refining Technologies

陈庆宇　编著

中国石化出版社

石油炼制实用英语教程
陈庆宇　编著
中国石化出版社

石油炼制实用英语教程

A Practical English Course in Petroleum Refining Technologies

陈庆宇　编著

中国石化出版社

内 容 提 要

本书是作者根据自己长期从事科技翻译和英语教学工作的经验，为石油化工行业培养复合型实用人才编写的。全书分十五课，内容包括常减压蒸馏、催化裂化、催化重整、热加工等炼油生产工艺。每课由课文、会话两部分组成，会话以技术交流、贸易洽谈、现场参观等形式为主，其特点将石油炼制工艺、设备等知识与技术交流、洽谈等会话融为一体。

本书实用性强，深浅适中，易于上口。适合于具有一定英语基础的专业技术人员用，同时也可供有关大专院校和职工大学学生学习英语口语用。

图书在版编目(CIP)数据

石油炼制实用英语教程/陈庆宇编著．-北京：中国石化出版社 1996.12

ISBN 7-80043-663-2

Ⅰ.石… Ⅱ.陈… Ⅲ.石油炼制-英语-教材 Ⅳ.H31

中国版本图书馆 CIP 数据核字(96)第 23225 号

中国石化出版社出版发行

地址：北京市东城区安定门外小黄庄 32 号

邮编：100013 电话：(010)64241850

社长：周培荣

金剑排版厂排版

国家统计局印刷厂印刷

新华书店北京发行所经销

*

787×1092 毫米 16 开本 20.25 印张 518 千字 印 1--4000

1996 年 12 月 北京第 1 版 1996 年 12 月北京第 1 次印刷

定价：29.00 元

前　言

随着我国改革开放的深入，对外技术、贸易交流的扩大，对外语人才的数量和素质的要求日益提高。面向21世纪，急需一大批既懂外语又懂专业技术的复合型人才。《石油炼制实用英语教程》就是根据自己长期从事科技翻译工作和英语教学工作的经验，为石油化工行业培养复合型实用英语人才而编写的。本书可供石油化工工业及其相关工业的科技人员、外事工作人员以及经常参加外事活动的经理和厂长、翻译人员和有关大专院校的学生学习口语之用。

全书共15课，每课由课文、对话两部分组成。内容包括炼油工艺、工艺设备、化工仪器仪表和控制及有关技术交流、洽谈等方面的知识。其特点是将石油炼制工艺、设备等知识与技术交流、洽谈等会话融为一体。内容深入浅出，浅显易懂，实用性强。编写的目的是使学者学到一些在翻译石油化工英语科技资料和进行口语翻译时所需要的专业知识、英语表达知识，提高英语表达能力。使非专业技术人员既可以学到一些专业知识，又可以掌握这些专业知识的英语表达方法。而专业技术人员可以进一步提高专业英语水平和口语表达能力。

1993～1995年期间，锦州石油化工公司采用本教材开办了两期英语口语培训班，培训了40人，收效很好。经培训，绝大多数学员能同外宾直接进行技术交流和贸易洽谈，十几名学员在装置引进、进出口工作和出国考察中担任翻译，得到了外国专家的好评。

本书的编写工作得到了中国石油化工总公司和锦州石油化工公司的有关领导的支持，得到了周围工程技术人员的热情指教，还得到了关丽、刘新清、乔蕾、王贤跃和刘欢等的帮助，在这里向关怀、支持我的领导和同志们表示衷心感谢。

石油大学原校长杨光华教授对本书进行了认真审阅，并提出了修改意见。本书的编写参考了张建芳和山红红编写的《炼油工艺基础知识》、侯祥麟主编的《中国炼油技术》，在这里一并表示谢意。

因作者本人水平有限，内容难免有错误之处，希望读者批评指正。

陈　庆　宇

CONTENTS

附录 参考译文

Lesson One

An Introduction to Feilong Petrochemical Company

Part One Text

Since carrying out the reform and open policy, the Feilong Petrochemical Company has had more and more contacts with foreign enterprises, scientific research institutes and engineering consultant companies. They come to visit our company for trade negotiations and technological exchange. I am often assigned to be the interpreter for them. For the foreigners' better understanding of the company, our managers usually make a brief introduction to the company first when having an interview with them.

The Feilong Petrochemical Company, approved as the "First Class Enterprise of the State Level" by the State, is one of the largest modern petrochemical enterprises directly under the China Petrochemical Corporation (Sinopec).

The Feilong Company is situated in a beautiful city—— Jincheng in Liaoning Province. It enjoys a favorable geographic position and mild climate. It is 25 kilometers away from the Jincheng seaport. At the seaport, the company has built an oil dock for importing and exporting. It has a very easy access to convenient transportation facilities. The city is equipped with a complete set of infrastructure facilities.

The Feilong Petrochemical Company is a modern petrochemical comprehensive complex. It has many subordinates under her control, including 10 large-scale refineries and more than 20 petrochemical plants, and other auxiliary plants, such as a thermal power plant, a water supply plant, a gas manufacturing and processing plant and a transportation department. It employs about 30000 workers and staff members. It has a very strong technical force formed by about 2300 technicians of various discipline. It is administrated under a complete advanced management system.

Now the Feilong Petrochemical Company possesses over 30 sets of oil refining production units, such as atmospheric and vacuum distillation, fluid catalytic cracking, catalytic reforming, hydrotreating, hydrocracking, delayed coking, hydrogen manufacturing and refinery gas processing plants, alkylation, MTBE production, lubricating oil production and oil product treating, and so on. The annual processing capacity of crude oil is about 10 million tons.

The company has over 70 sets of petrochemical production units for production of 1,4-butanediol, caprolectam, maleic anhydride, ethylene, polyethylene, isopropyl alcohol, polypropylene and *cis*-1,4-polybutadiene rubber, solvent oil and various lubricant additive. Most of the production plants of the company were designed, constructed and installed by itself. Every plant can be put into operation right after the successful startup. All the operation quotas can reach the design specifications. With the development of science and technology, our company

uses advanced production technologies and up-to-date equipment imported from abroad in renovating our existing production plants continuously so that the quality products can be produced with high efficiency and low energy consumption.

Our company can produce many varieties of petrochemical products, including fuel oils, such as high octane gasoline, diesel oil, jet fuel, lubricating oil and feedstocks for secondary processing, and all kinds of petrochemical products, such as *cis*-1, 4-polybutadiene rubber, isopropyl alcohol, polyethylene, polypropylene, benzene, toluene, xylene, petroleum coke, solvents and detergents. Catalysts for petrochemical production are also manufactured.

Because the advanced production processes, the up-to-date equipment and the most advanced automatic control systems are used in our production, the products produced by our company are excellent in quality so that the application requirements of all kinds of customers can be satisfied. Now many varieties of our products have been awarded "Gold Medal Prize" or "Silver Medal Prize" by the State while many other products are appraised as "Super-quality product" by ministerial and provincial authorities. Therefore, our company enjoys great prestige from our customers. Our products are not only sold well in China, but also on the world market. Our economic efficiency increases with each passing year. Now our fixed assets are about 10 billion yuans. The annual sales revenue reaches 3 billion yuans this year. The gross industrial output is 5 billion yuans with tax and profit of 1 billion yuans.

Our policy for business is to place the product quality in the first place, upholding the principle of "quality first, customer first". Our mission is to provide best services to our customers and satisfy the needs of them. In order to achieve the goal, our company set up a complete quality control system and an after-sale service department. All the products to be delivered must be physically and chemically analyzed strictly according to the quality standards. Our company encourages the customers to put forward their comments and suggestions. We will try our best to satisfy the needs of our customers.

The development strategy of our company is to develop new technologies and new products. The developed new technologies are applied to the production for raising the operating efficiency and decreasing the energy consumption and producing quality products, and make more remarkable economic benefits. For more rapid development, our company set up a modern research institute, employing over 1000 engineers and technicians. Every year a great number of investments are made for scientific research for purchasing all the necessary instruments and facilities which can be used as modern means for scientific research. The scientific workers conduct their scientific research according to the development program of our company. Their work bears abundant fruits every year. They make great contribution to the development of our company. Our company set up an engineering design institute for undertaking designs for new production plants, technical renovation of all the production plants and periodical overhaul. The institute employs all kinds of technical personnel specialized in production processes, instrumentation, machinery, civil construction and economic analysis. The institute has a very strong technical foundation. For many years the engineers acquitted themselves of all the design tasks entrusted by the company splendidly. Several large-scale production plants for caprolectam

and 1,4-butanediol designed by them reaches the world advanced level.

Our company has a construction and installation company under her control. It employs technical personnel of all specialities rich in working experiences. The company has all kinds of up-to-date machinery and facilities for construction and installation. All the construction and installation projects contracted to it can be completed with high speed, good quality and low costs.

The Feilong Foreign Trade Company is the window of our company through which we do business and conduct technical co-operation with foreign companies. Through persistent efforts, we have established long term cooperative relations with many foreign companies. We always carry out the policy of doing business with our friends on the basis of mutual benefit and friendship. We always abide by the contracts signed with our customers. We believe that our friendship and co-operation can only be strengthened through efficient and satisfactory services to our customers.

The Feilong Petrochemical Company is interested in co-operation with foreign companies in many fields, including trade and technology. We hope that we can conduct overall technological exchange in oil refining processes and other technologies of common interest. The foreign companies are welcome to make investment here and establish joint ventures on the basis of equality and mutual benefits. The fact will prove that our company will always remain your most reliable and loyal partner for those who like to co-operate with us.

New Words and Expressions in the Text

petrochemical [ˌpetrəu'kemikəl] *a.* 石油化学的；*n.* 石油化学产品
infrastructure ['infrəˌstrʌktʃə] *n.* 基础；基础结构
thermal ['θə:məl] *a.* 热的，热量的
atmospheric [ˌætməs'ferik] *a.* 大气的，空气的，常压的
vacuum ['vækjuəm] *a.* 真空的，减压的
distillation [ˌdisti'leiʃən] *n.* 蒸馏，蒸馏法
atmospheric and vacuum distillation 常减压蒸馏
refinery [ri'fainəri] *n.* 炼油厂，精炼厂
catalytic [ˌkætə'litik] *a.* 催化的
fluid catalytic cracking 流化催化裂化
catalytic reforming 催化重整
hydro- ['haidrə] 表示“水”，“氢化的”，“氢的”
hydrotreating ['haidrətri:tiŋ] 加氢精制
hydrocracking ['haidrəkrækiŋ] 加氢裂化
delayed coking 延迟焦化
alkylation [ˌælki'leiʃən] *n.* 烷基化(作用)
MTBE (methyl-*tert*-buty ether) 甲基叔丁基醚
lubricate ['l(j)u:brikeit] *v.* 使润滑
lubricating oil 润滑油
lubricant ['l(ju)u:brikənt] *n.* 润滑剂
butanediol 丁二醇
caprolectam [ˌkæprə'lektəm] 己内酰胺
maleic anhydride 顺酐
ethylene ['eθili:n] *n.* 乙烯
poly- ['pɔli] [词头]多，聚，复
propylene ['prəupili:n] *n.* 丙烯
polyethylene 聚乙烯
polypropylene 聚丙烯
iso- ['aisəu] 表示“异构”
propyl ['prəupil] *n.* 丙基
alcohol ['ælkəhɔl] *n.* 酒精，醇
isopropyl alcohol 异丙醇

butadiene [ˌbju:tə'daiin] *n.* 丁二烯
cis-1,4-polybutadiene rubber 顺丁橡胶
solvent ['sɔlvənt] *n.* 溶剂
additive ['æditiv] *n.* 添加剂
specification [ˌspesifi'keiʃən] *n.* 规格,技术要求
octane ['ɔktein] *n.* 辛烷
high octane gasoline 高辛烷值汽油
gasoline ['gæsəli:n] *n.* 汽油
diesel ['di:zəl] *n.* 柴油(发动)机
jet fuel 喷气燃料
feedstock ['fi:dstɔk] *n.* 原料
secondary processing 二次加工
benzene ['benzi:n] *n.* 苯
toluene ['tɔlju:i:n] *n.* 甲苯
xylene ['zaili:n] *n.* 二甲苯
petroleum [pi'trəuljəm] *n.* 石油(产品)
detergent [di'tə:dʒənt] *n.* 洗涤剂,洗衣粉
catalyst ['kætəlist] *n.* 催化剂
turnover *n.* 营业额,成交量
gross industrial output 工业总产值
tax and profit 利税
put forward 拿出,提出
ovehaul ['əuvəhɔ:l] *n.* 大检修,详细检查
civil construction 土木建筑
equality and mutual benefit 平等互利

Part Two Conversation

A visit of the American guest to our company

Mr. David from Anderson Petrochemical Company in the USA paid a visit to our company at the invitation of Mr. Jia, general manager of our company last year. He flew to Beijing and went to our city by train. Mr. Jia and I went to the railway station to meet him. The following is the conversation between us.

I: Hi, Are you Mr. David from Anderson petrochemical Company?

A: Yes.

I: I am Chen, interpreter. This is Mr. Jia, general manager of our company.

J: I am very pleased to meet you. Welcome to China.

A: Thank you very much for you to meet me at the station.

J: It's my pleasure. Now let's go to the Petroleum Hotel.

(On the way to the hotel)

J: Mr. David, is this your first trip to China?

A: No. I have been to China for many times. Oh, I almost become a Chinese citizen.

J: What's your impression on China?

A: China is a great country. Chinese people are industrious and creative. Now they are marching forward in great stride for the realization of their own goal. With the implementation of the policy of "reforming and opening to the outside world", many tremendous changes are taking place from time to time. You have made great achievements in every field. Now I can say China becomes increasingly powerful and prosperous.

J: It is very kind of you to say so. By the way, how do you like the weather here?

A: Very fine. It isn't so hot. It is quite similar to that in my hometown.

J: Here we are. This is the Petroleum Hotel. Now let's go to the reception desk first.

(At the reception desk)

R: Hi. Good morning, gentleman. Welcome to our hotel. Here is the form for you to fill out. Would you please show your passport?

A: OK. Here you are.

R: OK. This is your key. Your room number is 331. Let me show you.

A: Thank you.

R: Our porter will take your luggage and suitcase to your room. Here is the elevator.

(Mr. David enters his room)

A: The room is very nice. It' s tidy and clean with all modern conveniences.

J: I am glad that you like it. We wish you have a good time here.

A: I think I will.

J: Please have a rest for one hour. Breakfast begins at 7:30. The attendants will show you the dining room where you can order either western food or Chinese food. Do you like Chinese food?

A: Yes, very much. I like Chinese dumplings and spicy Chinese dishes of Sichuan style.

J: OK. There are so many kinds of dishes for you to select. I think we can begin our meeting at 9:00. We' ll wait for you at the No. 1 Conference Room.

(At 8:50, Mr. Jia and all the Chinese attendants came to the conference room and got ready for the meeting. At 8:55, Mr. David came in. He shook hands with all the Chinese attendants and exchanged greetings with each other. At 9:00, the general manager, Mr. Jia declared the opening of the meeting.)

J: Now let' s begin our meeting.

Ladies and Gentlemen:

First I would like to express my warm welcome to Mr. David from Anderson Petrochemical Company for his visit. He is here for technical exchange and technical talks for the possibilities of the co-operation between our two parties. In the past we co-operated successfully and fruitfully in many fields. I am sure that through his visit the friendship and technical co-operation between our two companies will be greatly strengthened in the future.

There is a favorable environment for foreign investment in our city now. The city has all the necessary infrastructures. The foreign investors will enjoy all the preferential policies. I would like to make a brief introduction to our Feilong Petrochemical Company.

(It takes twenty minutes for his introduction.)

A: First I would like to extend my hearty thanks for your hospitality and considerate arrangements. You are so kind and helpful to me that I feel at home. I have been to China for many times. Whenever I am in China, I am well received. They all treat me as their good friend. So I am willing to conduct co-operations with Chinese partners. Our Company, Anderson Petrochemical Company is the second largest petrochemical complex in USA. It has over 100 years of history. Our company produces all kinds of oil products and petrochemicals which are sold well both in domestic market and world market. Your company imports our paracresol, isooctanol and triethylene tetramide from our company

every year. I am sure that the co-operation between us will be strengthened and widened. Now I am going to make a brief introduction to 1,4-butanediol process.

(Mr. David introduces the process while showing figures and drawings with a projector.) That's all for the introduction to the process. Do you have any questions? I'll try my best to give you a satisfactory answer except those confidential ones.

J: Thank you for your lecture on the process. I think we can have a detailed discussion about the process this afternoon. This morning we would like to show you around our refineries, some petroch emical plants and some utility facilities. And then we will visit the planned worksite for 1, 4-butanediol production plant.

A: OK.

(Mr. David and our people come to the No. 1 refinery. The director of the refinery, Mr. Qian, is waiting for the visitors in front of the plant).

Q: I am glad to meet you, Mr. David.

A: I am glad to meet you, too.

Q: Welcome to our refinery.

A: Thank you.

Q: I would like to make a brief introduction to our refinery. In our refinery we have two sets of atmospheric and vacuum distillation plants and three sets of fluid catalytic cracking plants. The annual processing capacity of crude oil is about 10 million tons and the production capacity of the FCC plants is about 1 million tons. In our plant, we can not only produce all kinds of fuels in different grades, such as naphtha (light fractions of gasoline, which can be used as a feedstock for catalytic reforming process), different grades of gasoline, light and heavy diesel, heavy oil for FCC feedstock or feedstocks for lubricating oils, but also produce a great amount of liquefied petroleum gases (LPG) which are very important and valuable petrochemical feedstocks.

A: Yes, I see. From Mr. Jia's introduction I can see that you have opened up a new way for making a comprehensive utilization of petrochemicals.

Q: For increasing the yield and improving the quality of our final products we have installed the most advanced control system to realize accurate and optimized process control. The system we use is TDC 3000 Discrete Control System produced by Honeywell Company in USA.

A: Most of the equipment looks quite new.

Q: Some sets of the equipment are required to be maintained periodically, say one month, half a year or one year. Let's go round the plant.

A: OK.

(After visiting all the plants, Mr. David goes back to the Petroleum Hotel for lunch. The dinner in honor of Mr. David, our guest, begins at 12:30 in the dining room of the hotel.)

J: (At the table) What would you like to drink, Mr. David? How about some Maotai?

A: Oh, no, no Maotai. I think it is too strong. I prefer Chinese wine.

J: OK. We have the best Chinese wine for you.

A: Thank you.

(Mr. Jia proposes a toast)

J: Dear Mr. David, Friends and comrades:

Now allows me on behalf of the workers and stuff members of the company to express our warm welcome to you, Mr. David. Let me propose a toast to our friendship, to the better co-operation in the future and to the success of the project.

(After everyone drank and the attendant refilled the wine glasses, Mr. David stands up, glass in hand, and responds to the toast.)

A: Dear Mr. Jia, Ladies and gentlemen:

It is a great pleasure to be here. I' d like to take this opportunity to express my hearty thanks for all the kindness and hospitality which you have shown me. I also like to propose a toast to our friendship and satisfactory co-operation.

(Everyone stands up and drinks his glass, then sits down.)

J: What about some more Chinese dumplings, Mr. David?

A: No, thank you. It is excellent, but I' ve really had more than enough.

J: Won' t you have some fruit? Just help yourself.

A: OK.

(After a while the guest is going to leave)

A: Thank you again for such a good dinner.

J: I am glad you enjoy it.

New Words and Expressions in the Conversation

paracresol ['pærəkrisəl] *n.* 对甲酚

isooctanol *n.* 异辛醇

triethylene tetramide 三乙基四胺

naphtha ['næfθə] *n.* 石脑油

liquified petroleum gas (LPG) 液化石油气

Discrete Control System (DCS) 集散型控制系统

Lesson Two

Chemical Compositions of Petroleum

Part One Text

Crude oil is petroleum explored from underground and unprocessed. All kinds of petroleum products such as fuel oils, aromatic products, asphalt and petroleum coke can be obtained by petroleum refining. Knowledge of the chemical compositions of petroleum and its products is very important for having a better understanding of all the oil refining processes, applications of the products and the comprehensive utilization of petroleum.

Usually petroleum is a fluid or viscous semifluid liquid. Most of the crude oil is black, dark green or dark brown. Small amount of it is reddish-brown, light-yellow, and even colorless.

Petroleum is basically composed of two kinds of elements such as carbon and hydrogen which form carbon-hydrogen compounds called "hydrocarbon". The hydrocarbons are the main materials for processing and utilization in oil refining processes. In addition, small amounts of sulfur, nitrogen and oxygen are contained in petroleum. Even a low content of them can also greatly affect the petroleum properties, oil processing and application properties.

In addition to the above-mentioned 5 kinds of elements such as carbon, hydrogen, sulfur, nitrogen and oxygen, petroleum also contains trace metal elements and other non-metal elements such as vanadium, nickel, iron, copper, arsenium, chlorine, phosphorus and silicon, and so on.

The above-mentioned elements can not exist in the petroleum by itself, hydrocarbons and non hydrocarbon compounds can be formed in one way or another.

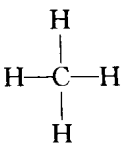
1. Hydrocarbons in petroleum

Petroleum is mainly composed of different kinds of hydrocarbons such as paraffinic hydrocarbons, cycloparaffinic hydrocarbons and aromatic hydrocarbons. Natural petroleum usually does not contain unsaturated hydrocarbons such as olefin and acetylene hydrocarbons . Different amounts of olefins can only be produced in the products obtained from the secondary processing.

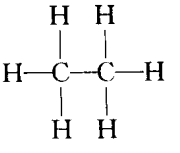
1. 1 Paraffins(alkane)

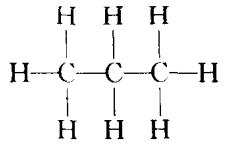
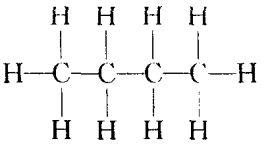
Paraffins are the main components of petroleum. All the paraffins are saturated and comparatively unreactive. C_1 to C_4 paraffins are gases, C_5 to C_{15} are liquids while normal paraffins with more than 16 carbon atoms are solid. Its generic formula is C_nH_{2n+2}. We must remember the rules for nomination.

methane CH_4



ethane C_2H_6



propane C_3H_8  butane C_4H_{10} 

pentane C_5H_{12} hexane C_6H_{14} heptane C_7H_{16}

octane C_8H_{18} nonane C_9H_{20} decane $C_{10}H_{22}$

Alkanes with branched chains are called isoalkanes: isobutane, isopentane, isooctane, isononane.

At room temperature they will not react with strong acids, strong bases, oxidants reductants. But under certain conditions the following reactions can take place: oxidation, halogenating, thermal cracking and isomerization reactions.

1.2 Cycloparaffins(naphthenes)

A cycloparaffin is a saturated cyclic hydrocarbon which is also one of the main components of petroleum. In each cycloparaffin molecule three or more carbon atoms are jointed in a ring structure. Each of these rings carbon atoms is joined to two hydrogen atoms or alkyl groups. Cycloparaffins in petroleum primarily contain more cyclopentanes comprising a 5-carbon ring than cyclohexanes composed of a 6-carbon ring.

Petroleum fractions boiling at higher temperatures contain more cycloparaffins. High boiling petroleum fractions contain bicyclic and polycyclic cycloparaffins and cycloalkanoatenes. In still heavier fractions more aromatic hydrocabons are contained with less content of cycloparaffins.

Cycloparaffins have good anti-knock property, low freezing point and better lubrication effect and viscosity-temperature properties. So it is an excellent blending component for gasoline, jet fuel and lubricating oils.

Comparing with the chemical properties of paraffins, cycloparaffins are more active. Under certain conditions the following reactions can take place: oxidation, halogenating reactions, nitrification, pyrolysis. It can also undergo dehydroaromatization under certain conditions.

The simplest cycloparaffins are: cyclopropane, cyclobutane, cyclopentane, cyclohexane.

1.3 Aromatic hydrocarbons

It is s major group of unsaturated cyclic hydrocarbons containing one or more rings; they are typified by benzene which has a 6-carbon ring containing three double bonds. Normally different kinds of alkyl groups may be joined to a benzene ring. Aromatic hydrocarbons are also one of the important fractions. Although the fractions from the same crude oil, the higher boiling and heavier molecular weights fractions contain more aromatics. In addition to the single ring aromatic hydrocarbons contained in petroleum, there are bicyclic and polycyclic aromatic hydrocarbons. The compounds of this important group are derived chiefly from petroleum and coal tar, are rather highly reactive and chemically versatile.

The simplest aromatic hydrocarbons are: benzene, toluene (methylbenzene, phenylmethane), xylene (dimethylbenzene, ortho-, meta-, para-xylene), ethylbenzene (phenylethane), styrene(vinylbenzene, phenylethylene).

1.4 Olefins

Generally, petroleum does not contain any olefins which are the products from the secondary

processing. The olefins are classified into three kinds such as alkene containing one double bond, diolefin with two double bonds and cyclic olefins. At room temperature and atmospheric pressure olefins containing from one to four carbon atoms are gases, those with from five to sixteen carbons are liquid while those with more than 16 carbon atoms are solids. The relative desity of olefins is less than 1. It is hardly soluble in water. But it can be soluble in organic solvents. They are named after the corresponding paraffins by adding "ene" or "ylene" to the stem.

Due to the double bonds contained in olefins they are chemically very active. Alpha-olefins are particularly reactive because the double bond is on the first carbon. It can undergo chemical reactions with many substances. Under certain conditions reactions such as addition, oxidation, and polymerization can take place. Olefins are easily oxidized into acidic substances or gum in the air, especially diolefins and cyclic olefins, which affect the stability of the oil products.

Some of alkenes:

ethene (ethylene)	C_2H_4	propene (propylene)	C_3H_6
butene (butylene)	C_4H_8	pentene (pentylene)	C_5H_{10}
hexene (hexylene)	C_6H_{12}	heptene (heptylene)	C_7H_{14}
octene (octylene)	C_8H_{16}	nonene (nonylene)	C_9H_{18}
decene (decylene)	$C_{10}H_{20}$		

Some of diolefins:

butadiene	C_4H_6	pentadiene	C_5H_8
hexadiene	C_6H_{10}	octadiene	C_8H_{14}

1.5 Cyclic olefins

An alicyclic hydrocarbon has two or more double bonds, for example the very active and widely used cyclopentadiene and cyclooctatetraene. The former contains five carbon atoms with two double bonds, while the latter contains eight carbon atoms with four double bonds. It is a polymer of acetylene.

2. Non-hydrocarbon compounds

The non-hydrocarbon compounds contained in petroleum are mainly sulfur, nitrogen and oxygen compounds. Their distribution in the petroleum fractions are quite ununiform. Most of them are distributed in heavy fraction and residuum. These non-hydrocarbon compounds affect greatly the oil refining processes and application properties of the oil products. Most of the treating processes are for removing these non-hydrocarbon compounds.

2.1 Sulfur Compounds

Sulfur is one of the common components in petroleum. Different crude oils have different content of sulfur. From practice we can know that higher boiling fractions contain more sulfur. Most of sulfur is contained in heavy oils. The sulfur content is one of the most important specifications for evaluation of crude oil because sulfur can have great effect on oil processing.

Sulfur exists in petroleum in the following forms: sulfur element (S), hydrogen sulfide (H_2S), mercaptan(RSH), thioether(RSR), cyclothioether, disulfide, thiophen.

The harmfulness of the sulfur compounds:

(1) Active sulfur compounds such as sulfur element (S), hydrogen sulfide, and low

molecular weight mercaptan can react with metals, causing corrosion to the equipment and the pipelines. The inactive sulfur compounds such as mercaptan and disulfides can be decomposed into highly corrosive mercaptan and hydrogen sulfide when they are heated. Although they themselves can not react with metals, hydrogen sulfide can seriously corrode the equipment in the presence of water.

(2) Some of the operational performances of oil products can be degraded by sulfur compounds. The sulfur compounds contained in gasoline can seriously affect the anti-knock properties and lead susceptibility. Therefore the sulfur content in the engine fuels should be strictly controlled.

(3) The environment may be polluted and the human health may be endangered by the harmful gases such as sulfur dioxide and sulfur trioxide from the combustion of sulfur-bearing fuels.

(4) These compounds can poison some catalysts used in the secondary processing.

These sulfur compounds can be removed from the oil products by acid-alkali treatment, hydrodesulfurization and catalytic oxidation process.

2.2 Nitrogen compounds

The higher boiling fractions contain more nitrogen compounds. Most of the nitrogen compounds exist in the residuum in the form of resin and asphaltene.

The organic nitrogen compounds can be divided into two categories: alkaline nitrogen compounds and non-alkaline nitrogen compounds.

Alkaline nitrogen compounds include pyridine, quinoline and isoquinoline.

Non-alkaline nitrogen compounds include pyrrole, indole and carbazole.

Although only a small amount of organic nitrogen compounds are contained in crude oil, they can have great effect on the oil refining processes, storage and application of the oil products. If the oil products with organic nitrogen compounds in it is stored for a long period, its color can become darker and its odor sells badly. This is caused by the gum formed by the oxidation reaction of the unstable organic nitrides in presence of air. Organic nitrogen compounds are also the poisons to the catalysts used in the secondary processing. Therefore the organic nitrogen compounds must be removed by the refining processes.

2.3 Oxygen compounds

Only a small amount of oxygen is contained in petroleum. Most of it exists in resin and asphaltene. Therefore the heavy oil with a high content of resin and asphaltene usually has a high content of oxygen.

Oxygen in petroleum exists in the form of organic compounds which can be classified into two categories: acidic oxides and neutral oxides. The acidic oxides include naphthenic acid, aliphatic acid and phenols which are referred to as petroleum acid. The neutral oxides include alcohols, aldehydes, ketons and esters.

Pure naphthenic acid is an oily liquid which has a special odor. Naphthenic acid can cause serious corrosion to the production plants and other equipment. It can affect the applications of oil products. Although it is detrimental to the oil refining processes and the operational performances