练 习 六

1. Crude oil in itself is a very poor fuel for internal combustion engines, and considerable chemical transformation is necessary to convert it to gasoline. Modern refineries contain, in addition to distillation columns, process units such as thermal and catalytic crackers (to make smaller molecules out of larger ones), hydrotreaters (to convert undesired sulfur compounds into sulfur-free compounds), reformers (to make aromatics for high-octane fuel), and alkylation and isomerization units (to make higher-octane molecules). Central to the modern refinery is the catalytic cracker.

2. Because the dimensions of these channels are very similar to the size of the hydrocarbon molecules that constitute gasoline, the zeolite catalysts are very efficient in converting the much larger molecules of crude oil to the desired range of small hydrocarbons for gasoline. Zeolitic cracking catalysts have had a major impact on the design and operation of modern fluid catalytic cracking units; these units were extensively redesigned to take full advantage of the higher activity and selectivity of the zeolites as well as their ability to process heavier feeds. A growing research challenge for chemists and chemical engineers is the design of catalysts that can reduce the emissions of oxides of nitrogen and sulfur during refining, and can at the same time produce cleaner-burning transportation fuels. Another major challenge is to modify cracking catalysts to accommodate the changing process needs of reformulated fuels dictated by environmental considerations.

3. The largest portion becomes gasoline. Only a very small portion is not used for combustion in transportation vehicles and in furnaces and heaters. However, from the small fraction that is not burned come thousands of chemicals--- the petrochemicals--- which we consider necessary for life today. Consider, for example, doing without plastics, some medicines, food additives, lubricants, most man-made fibers and cloth, and paints.

4. The combustion of fossil fuels provides excellent opportunities to apply chemical engineering tools under challenging conditions of high temperatures and short reaction times. Combustion for energy conversion involves chemical reactions coupled with heat and mass transfer carried out in high-temperature reactors within machines or equipment ranging from mobile engines to stationary power plants, and from small domestic appliances to giant jet aircraft. The ever-increasing demand for more efficient and environmentally acceptable fuel utilization intensifies the engineering challenges and requires the development of fundamental understanding for which the tools of chemical engineering are well suited.

5. **Alkylation.** Usually the reaction of a hydrocarbon such as an alkane or aromatic with an olefin (double-bond-containing molecule), using an acid or other catalyst.

6. **Isomerization.** Rearrangement of a molecule to a different chemical configuration (e.g., branched versus linear), while maintaining the same atomic composition.

7. **Dehydrogenation.** The process of removing one or more hydrogen atoms from a hydrocarbon structure to form a double bond (where the hydrogen leaves), or which can produce an aromatic material from a naphthene ring compound (e.g. , cyclohexane) or can form a ring compound upon removal of hydrogen. (Hydrogenation is, of course, the opposite process.)

8. **Cracking.** The process whereby a long-chain molecule or a complex mixture of longer chain molecules is broken into smaller molecules through the use of heat, with or without a catalyst. In the latter cases, the process is often referred to as pyrolysis.

9. **Hydrocracking.** Petroleum fraction cracking in the presence of hydrogen-usually under relatively high pressure-to produce smaller molecules with little or no unsaturation.

10. **Steam Cracking.** Used to describe the high-temperature cracking of hydrocarbons in the presence of steam to give fairly high yields of olefins (e.g., ethylene, propylene).

11. **Reforming.** Use of heat and usually a catalyst to transform hydrocarbons into (1) other hydrocarbons (e.g., in naphtha reforming used to make aromatics from paraffins and naphthenes) or (2) mixtures of hydrocarbons and oxides of carbon, with air or steam taking part in the reaction. Hydrocarbon reforming is used to improve the quality (octane number) of gasoline.