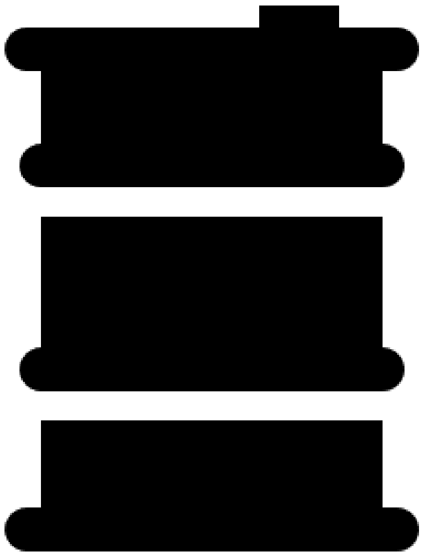
Crude oil



L1 Hydrocarbons

Crude oil is a term you've probably heard before, but what exactly is it, and why does it matter so much? Let's break it down in a way that's easy to understand.

What Is Crude Oil?

To understand crude oil, we have to travel back in time millions of years to a world that looked very different from the one we live in today. Back then, the oceans were full of tiny living organisms called plankton. Plankton are microscopic plants and animals that drift in the water. When these plankton died, they sank to the bottom of the sea, where they were covered by layers of mud and sand.

Over millions of years, more and more layers of mud and sand piled on top, burying the plankton deeper and deeper underground. As they were buried, the heat and pressure increased, causing the dead plankton to gradually transform into something new. After millions of years, these ancient remains became a thick, dark liquid known as crude oil.

Today, crude oil is found deep underground in rocks, often beneath the ocean floor or the Earth's surface. It's considered a "finite resource," which means there's only a limited amount of it available. Once we've used up all the crude oil, it won't come back, which is why people are constantly searching for new reserves and looking for alternative energy sources, like solar or wind power.

What Makes Up Crude Oil?

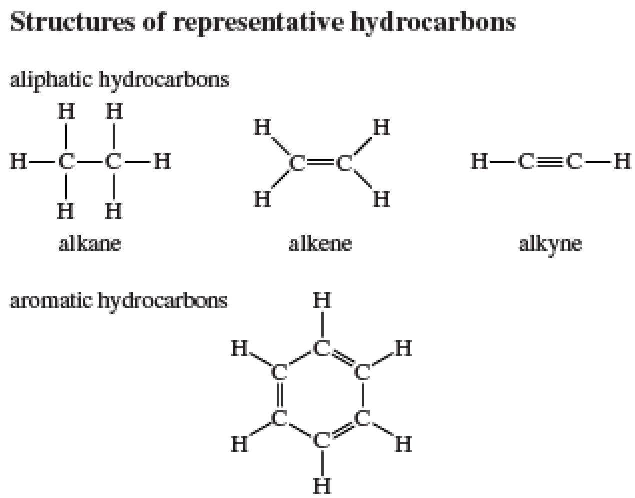
Crude oil isn't just a single substance; it's actually a mixture of many different chemicals. Most of these chemicals belong to a group called hydrocarbons.

So, what are hydrocarbons? The name gives us a clue: "hydro" refers to hydrogen, and "carbon" refers to carbon. Hydrocarbons are molecules made up of just hydrogen and carbon atoms.

These molecules can vary in size. Some hydrocarbons are made of only a few carbon and hydrogen atoms, while others consist of hundreds or even thousands of them. The different sizes and arrangements of these atoms give hydrocarbons a wide range of properties, which is why crude oil can be separated into so many different products.

Why Are Hydrocarbons Important?

Hydrocarbons are crucial because they are the primary components of crude oil, which is used to produce many things we rely on every day. After crude oil is extracted from the ground, it is transported to refineries. At the refinery, the crude oil is processed and separated into different parts based on the size and structure of the hydrocarbons it contains.



For example, some hydrocarbons are used to make gasoline, which fuels cars, trucks, and buses. Other hydrocarbons are turned into diesel fuel, which powers larger vehicles like trucks and some trains. Even the fuel that airplanes use comes from hydrocarbons in crude oil.

But that's not all. Hydrocarbons from crude oil are also used to create plastic. Look around you, and you'll likely see many plastic items: toys, electronics, and even packaging. All these plastic items originate from hydrocarbons found in crude oil.

The Impact of Crude Oil

While crude oil is incredibly useful, it does come with some challenges. First, remember that crude oil is a finite resource, meaning that once we use it all up, it's gone forever. This could become a significant issue if we don't find other ways to produce the energy and materials we need.

Additionally, burning hydrocarbons to produce energy releases carbon dioxide (CO2) into the atmosphere. CO2 is a greenhouse gas, which means it traps heat in the Earth's atmosphere, contributing to global warming and climate change. This is why there is a growing effort to find cleaner, more sustainable energy sources that don't harm the environment.

Conclusion

In summary, crude oil is a thick, dark liquid formed from the remains of ancient plankton that died millions of years ago. It's a mixture of many different chemicals, most of which are hydrocarbons—molecules made up of hydrogen and carbon atoms. Crude oil is incredibly important because it's used to produce fuels like gasoline and diesel, as well as plastics. However, because it's a finite resource and contributes to environmental problems, it's crucial to find alternative ways to meet our energy needs.

Now you have a better understanding of what crude oil is, how it was formed, and why it's so important—along with the challenges we face in using it responsibly.

Independent practice

Comprehension Questions

1. **What is crude oil, and how was it formed?**
2. **Why is crude oil considered a finite resource?**
3. **What are hydrocarbons, and what elements are they made of?**
4. **Name two products that are made from hydrocarbons found in crude oil.**
5. **What environmental impact does burning hydrocarbons have?**

Understanding Questions

1. **Explain why crude oil is important in our daily lives.**
2. **Describe the process that happens to plankton over millions of years to form crude oil.**
3. **Why is it important to find alternative energy sources to crude oil?**

Sentence Completion Questions

1. **Crude oil is a finite resource because...**
2. **Hydrocarbons are essential to making fuels, but...**

L2 Alkane

What Are Hydrocarbons?

Hydrocarbons are chemicals made up of only two types of atoms: carbon (C) and hydrogen (H). Think of these atoms as little building blocks. When carbon and hydrogen atoms join together, they form different types of molecules, and we call these molecules hydrocarbons. Hydrocarbons are really important because they make up many substances we use every day, like gasoline, natural gas, and even the plastic in some products.

Crude Oil and Hydrocarbons

Crude oil is a thick, black liquid that comes from deep underground. It's a mixture of many different hydrocarbons. When we pump crude oil out of the ground, it's like getting a giant soup of hydrocarbons. These hydrocarbons can be separated and used for many things, like powering cars and making plastics.

What Are Alkanes?

Now, let's talk about a special group of hydrocarbons called **alkanes**. Alkanes are the simplest type of hydrocarbons, and they all follow a general pattern, or formula. This formula is C_nH_{2n+2}. Don't worry if that looks confusing—let's break it down.

The "C" in the formula stands for carbon atoms, and the "H" stands for hydrogen atoms. The "$_n$" is just a number that tells you how many carbon atoms are in the molecule. For example, if you have 1 carbon atom (n = 1), the formula for the alkane would be $C_1H_{2(1)+2}$, which equals CH_4. This molecule is called methane, the simplest alkane.

Here's how the formula works for different numbers of carbon atoms:

1. **Methane (CH_4)**: This is the smallest alkane, with just one carbon atom. Its formula is $C_1H_{2(1)+2}$ = CH_4.
2. **Ethane (C_2H_6)**: This alkane has two carbon atoms. Its formula is $C_2H_{2(2)+2}$ = C_2H_6.
3. **Propane (C_3H_8)**: This alkane has three carbon atoms. Its formula is $C_3H_{2(3)+2}$ = C_3H_8.
4. **Butane (C_4H_{10})**: This one has four carbon atoms. Its formula is $C_4H_{2(4)+2}$ = C_4H_{10}.

And it continues this way as the number of carbon atoms ($_n$) increases.

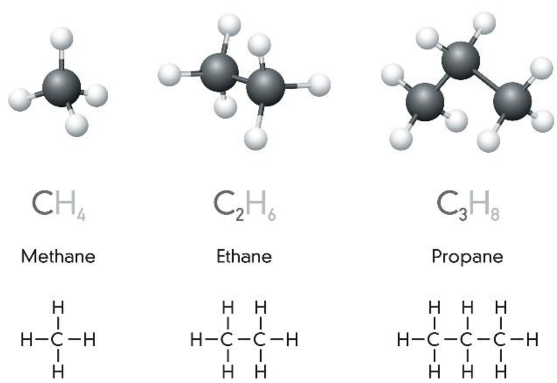
The Homologous Series of Alkanes

Alkanes form what's called a **homologous series**. This means they are like a family of molecules that follow the same pattern or formula. Each alkane in this series differs from the next by just one carbon atom and two hydrogen atoms.

For example, as you go from methane (CH_4) to ethane (C_2H_6) to propane (C_3H_8), you add one more carbon atom and two more hydrogen atoms each time. This is why we use the formula C_nH_{2n+2}—it helps us predict how many hydrogen atoms will be in the molecule based on the number of carbon atoms.

Representing Alkanes

Alkanes can be written in different ways. The most common way is by using their chemical formula, like CH_4 for methane or C_2H_6 for ethane. These formulas tell you exactly how many carbon and hydrogen atoms are in each molecule.



For example:

- **Methane**: CH_4 (1 carbon, 4 hydrogens)
- **Ethane**: C_2H_6 (2 carbons, 6 hydrogens)
- **Propane**: C_3H_8 (3 carbons, 8 hydrogens)

- **Butane**: C_4H_{10} (4 carbons, 10 hydrogens)

You can also draw these molecules, where each carbon atom is connected to hydrogen atoms by lines, representing chemical bonds.

Recognizing Alkanes

When you're given a chemical formula, you can tell if it's an alkane by checking if it fits the general formula $\mathbf{C_nH_{2n+2}}$. For example, if you see C_3H_8, you can quickly check:

- Number of carbon atoms ($_n$) = 3
- Number of hydrogen atoms should be (2 × 3 + 2) = 8

Since it fits the pattern, you know it's an alkane, specifically propane.

Why Only Four Alkanes?

You don't need to memorize the names of all the alkanes—just remember the first four: methane, ethane, propane, and butane. These are the most common alkanes you'll come across, especially in everyday life. For example, methane is found in natural gas used for cooking, and propane is often used in gas grills.

Conclusion

Alkanes are simple hydrocarbons that follow a specific pattern, making them easy to recognize. By understanding their general formula, $\mathbf{C_nH_{2n+2}}$, and the names of the first four alkanes—methane, ethane, propane, and butane—you can identify these important molecules. They're a crucial part of crude oil and play a big role in the fuels and materials we use daily.

Independent practice

Comprehension Questions

1. What are hydrocarbons made of?
2. What is the general formula for alkanes?
3. Name the first four members of the alkane series.
4. How do alkanes in a homologous series differ from one another?
5. Why is it important to recognize the chemical formula of alkanes?

Understanding Questions

1. Explain why methane is considered the simplest alkane.
2. How does the number of carbon atoms affect the formula of alkanes?
3. Why do alkanes form a homologous series?
4. What would be the chemical formula for an alkane with 5 carbon atoms? Explain how you determined the formula.

Spot the Mistake and Re-Write the Sentence

1. **Original:** "The general formula for alkanes is C_nH_{n+2}."
2. **Original:** "Propane has the formula C_4H_{10}."
3. **Original:** "Methane is the second member of the alkane series."
4. **Original:** "Ethane has three carbon atoms and six hydrogen atoms."

L3 Alkenes

Understanding Alkenes and Alkanes

To start with, let's talk about two groups of molecules called **alkenes** and **alkanes**. Both of these are types of hydrocarbons, which are molecules made up only of hydrogen and carbon atoms. But there's a key difference between them: alkenes are more reactive than alkanes. This means that alkenes can easily take part in chemical reactions, while alkanes are more stable and don't react as easily.

The Structure of Alkenes and Alkanes

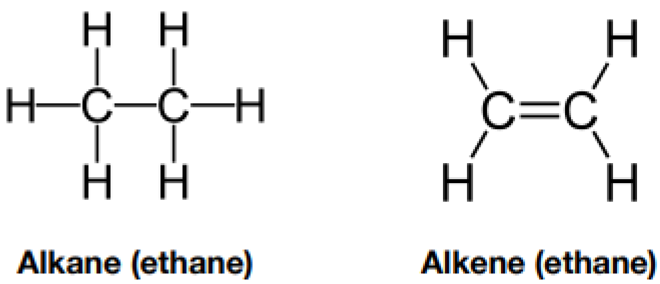


Fig 1. Comparison of an Alkane and Alkene.

Why are alkenes more reactive? It all comes down to their structure. Alkanes have single bonds between carbon atoms. For example, in methane (which is an alkane), there's a single bond between the carbon and each hydrogen atom. This makes alkanes pretty stable.

On the other hand, alkenes have at least one double bond between two carbon atoms. This double bond is what makes them more reactive. The double bond is like a loaded spring—it's full of energy and ready to react with other substances. Because of this, alkenes are more likely to take part in chemical reactions than alkanes, which only have single bonds and are more relaxed, so to speak.

Alkenes Reacting with Bromine Water

One interesting reaction that alkenes can do is with a substance called **bromine water**. Bromine water is an orange-coloured liquid that contains bromine dissolved in water. When bromine water is mixed with an alkene, a chemical reaction takes place. This reaction is super useful because it's a quick way to test if a substance is an alkene.

Here's how the test works: If you add bromine water to an alkene, the double bond in the alkene breaks, and the bromine atoms attach themselves to the carbon atoms. This reaction changes the structure of the alkene and turns the bromine water from orange to colourless. This colour change is a clear sign that an alkene is present.

So, if you ever see bromine water go from orange to colourless, you can be pretty sure that an alkene was involved in the reaction. If you were to test an alkane with bromine water, nothing would happen—no colour change—because alkanes are not reactive enough to break the bromine's bonds.

Why Alkenes Are Important

Alkenes are not just cool because they react with bromine water—they're also incredibly important in the chemical industry. One of the most common uses for alkenes is to make **polymers**. Polymers are long chains of molecules that are made by linking together many smaller units, called **monomers**. Because alkenes have that reactive double bond, they can easily be turned into monomers that link together to form polymers.

A common example of a polymer made from alkenes is **polyethylene**, which is used to make plastic bags, bottles, and many other everyday items. To make polyethylene, a chemical process called polymerization is used. In this process, the double bonds in many ethene (an alkene) molecules break open, allowing them to connect and form a long chain—a polymer.

Besides making polymers, alkenes are also used as starting materials to produce many other chemicals. For example, they can be transformed into alcohols, which are used in things like hand sanitizers and cleaning products. They can also be turned into chemicals used to make antifreeze, detergents, and even medicines.

Recap

To sum it up:

- **Alkenes** are more reactive than **alkanes** because they have a double bond between carbon atoms, which is full of energy and ready to react.
- This reactivity allows alkenes to react with **bromine water**, causing a colour change from orange to colourless, which is used to test for the presence of alkenes.
- **Alkenes** are super important in the chemical industry. They are used to make **polymers** like plastics and as starting materials for making a wide range of other chemicals.

So next time you see a plastic bag or a bottle, remember that it probably started out as a simple alkene, a molecule with a double bond just waiting to react!

Independent practice

Comprehension Questions

1. What is the main difference between alkenes and alkanes?
2. What happens to bromine water when it reacts with an alkene?
3. Why are alkenes more likely to react than alkanes?
4. What colour does bromine water turn when it reacts with an alkene?
5. Give an example of a polymer made from alkenes and explain what it's used for.

Understanding Questions

1. Explain why alkenes are used to make polymers. What role does the double bond play in this process?
2. Describe why bromine water is useful in testing for alkenes. What does the colour change indicate?
3. How would you distinguish between an alkene and an alkane using bromine water?

Sentence Completion

1. Alkenes are more reactive than alkanes because ________________.
2. Bromine water changes colour when reacting with alkenes because ________________.
3. Alkenes are used to produce polymers; therefore ________________.
4. Alkenes can also be used as starting materials for making a variety of other chemicals, ________________.

L4 properties of hydrocarbons and combustion

What Are Hydrocarbons?

Hydrocarbons are organic compounds made up of hydrogen and carbon atoms. They come in different sizes and shapes, and their properties can change depending on their molecular size. Let's break down some key properties of hydrocarbons and how they affect their use as fuels.

Properties of Hydrocarbons

1. **Boiling Point:**
   - The boiling point is the temperature at which a liquid turns into a gas.
   - For hydrocarbons, the boiling point increases as the size of the molecules increases. This is because larger molecules have more atoms and a greater surface area, which means they have stronger forces holding them together. These forces need more heat to overcome, so larger hydrocarbons boil at higher temperatures.
2. **Viscosity:**
   - Viscosity measures how thick or sticky a liquid is. Think of it like how easily syrup flows compared to water.
   - As the size of the hydrocarbon molecules increases, their viscosity also increases. Larger molecules tend to be thicker and flow more slowly because their larger size means more internal friction between molecules. For example, gasoline is less viscous than motor oil.
3. **Flammability:**
   - Flammability is how easily a substance catches fire.
   - Smaller hydrocarbons are more flammable because they vaporize more easily and mix with air better, making it easier for them to catch fire. As hydrocarbons get larger, they become less flammable because they don't vaporize as easily.

How These Properties Influence Fuels

The properties of hydrocarbons make them suitable for different uses as fuels. Here's how:

- **Gasoline** has a low boiling point and is less viscous, which makes it easy to vaporize and ignite in car engines.
- **Diesel** has a higher boiling point and higher viscosity, which helps it burn more slowly and steadily in diesel engines, providing more energy over time.
- **Heating oil** has even higher boiling points and viscosity, which makes it suitable for burning in home heating systems where a steady, long-lasting burn is needed.

Combustion of Hydrocarbons

When hydrocarbons burn, they undergo a chemical reaction called combustion. During combustion:

- **Hydrocarbons react with oxygen** from the air.
- **Carbon and hydrogen** in the hydrocarbons combine with oxygen to form carbon dioxide (CO_2) and water (H_2O). This reaction releases energy, which we use as heat or power.

Here's the general equation for the complete combustion of a hydrocarbon:

Hydrocarbon + Oxygen→ Carbon Dioxide + Water

For example, let's look at methane, a simple hydrocarbon with the formula CH_4:

1. **Write the Formula:** CH_4 (methane) + O_2 (oxygen)
2. **Complete Combustion Reaction:** $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

In this reaction:

- One molecule of methane reacts with two molecules of oxygen.
- This produces one molecule of carbon dioxide and two molecules of water.
- Energy is released in the form of heat and light.

Balancing Chemical Equations

When you write a balanced equation for combustion, make sure the number of atoms of each element on the reactant side (left) is equal to the number on the product side (right). For example, the balanced equation for methane combustion shows:

- **Left Side:** 1 carbon (C), 4 hydrogen (H), 2 oxygen (O)
- **Right Side:** 1 carbon (C), 4 hydrogen (H), 2 oxygen (O)

Balancing ensures that the law of conservation of mass is followed, meaning no atoms are lost or created in the reaction, just rearranged.

Summary

To sum it up:

- **Boiling Point:** Larger hydrocarbons boil at higher temperatures because their molecules are bigger and need more heat to turn into gas.
- **Viscosity:** Larger hydrocarbons are thicker and flow less easily compared to smaller ones.
- **Flammability:** Smaller hydrocarbons are more flammable because they vaporize more easily.

Understanding these properties helps in choosing the right hydrocarbon for different uses, from powering vehicles to heating homes. When hydrocarbons burn, they produce carbon dioxide and water, releasing energy that we use for various purposes. Balancing chemical equations for combustion reactions ensures we accurately represent the chemical changes occurring during burning.

Comprehension Questions

1. **What happens to the boiling point of hydrocarbons as their molecular size increases?**
2. **How does the viscosity of a hydrocarbon change with increasing molecular size?**
3. **Why are smaller hydrocarbons generally more flammable than larger ones?**
4. **What are the products of the complete combustion of a hydrocarbon?**
5. **Explain why diesel fuel has a higher viscosity than gasoline.**

Understanding Questions

1. **How does the property of boiling point influence the use of gasoline in car engines?**
2. **Why is heating oil better suited for home heating systems compared to gasoline?**
3. **Describe the relationship between molecular size and flammability in hydrocarbons.**
4. **What role does viscosity play in the performance of diesel engines compared to gasoline engines?**

Balancing Combustion Equations

1. **Balance the equation for the complete combustion of ethane (C_2H_6):**

$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

2. **Balance the equation for the complete combustion of propane (C_3H_8):**

$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

3. **Balance the equation for the complete combustion of butane (C_4H_{10}):**

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

4. **Balance the equation for the complete combustion of hexane (C_6H_{14}):**

$C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$

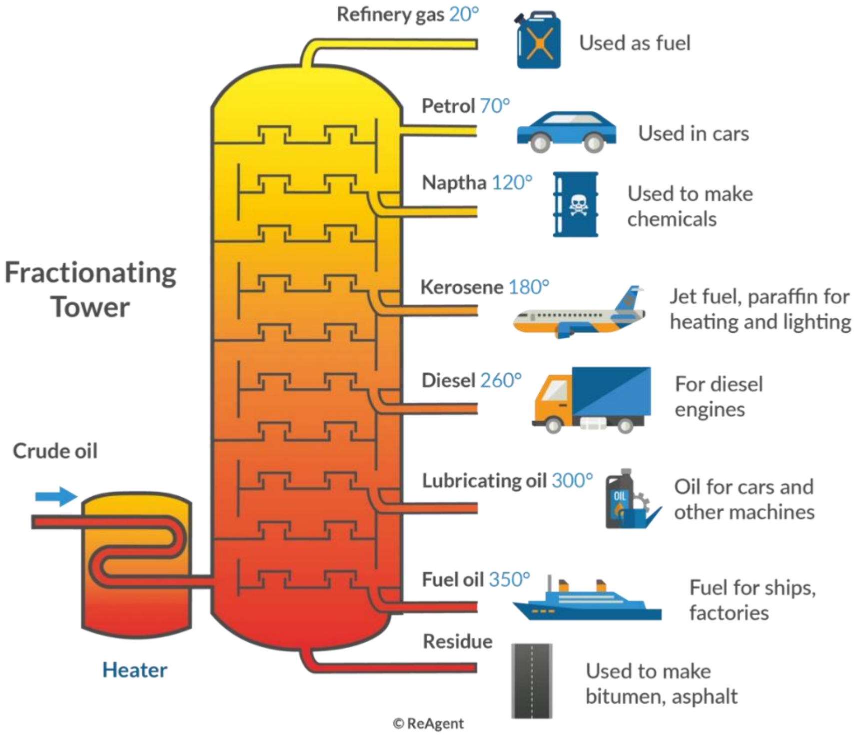
L4 Fractional distillation

Crude oil is a complex mixture of different hydrocarbons, which are molecules made up of hydrogen and carbon atoms. To make the most of these hydrocarbons, we use a process called fractional distillation to separate them based on their size and boiling points.

What Is Fractional Distillation?

Fractional distillation is a method used to sort the hydrocarbons in crude oil by heating it and separating the vapor into different groups. Here's how it works:

1. **Heating:** First, crude oil is heated in a large distillation column. As the oil heats up, it turns into vapor, similar to how water turns into steam when boiled.
2. **Rising Up:** The vapor rises through the distillation column, which has multiple trays or plates at different levels. As the vapor moves up, it cools down gradually.
3. **Condensation:** The key idea here is that different hydrocarbons condense (turn back into liquid) at different temperatures. The larger the molecule, the higher its boiling point. This means that heavier, larger hydrocarbons need more heat to turn into vapor, so they condense at lower levels in the column. Lighter, smaller hydrocarbons, which have lower boiling points, condense at higher levels in the column where it's cooler.



What Happens to These Fractions?

Once separated, each fraction of the crude oil contains hydrocarbons of similar sizes and boiling points. These fractions are then processed to create various useful products:

- **Fuels:** Different fractions are used to make fuels for various purposes. For example:
  - **Petrol (Gasoline):** Made from smaller hydrocarbons with lower boiling points, used in cars.
  - **Diesel:** Made from slightly larger hydrocarbons, used in trucks and some cars.
  - **Kerosene:** Made from even larger hydrocarbons, used in jet engines and some heating systems.
- **Petrochemical Products:** The petrochemical industry takes these fractions and processes them further to create a range of products, including:
  - **Solvents:** Liquids that dissolve other substances, like in paint or nail polish remover.
  - **Lubricants:** Oils that reduce friction in machinery, made from larger hydrocarbons.
  - **Polymers:** Large molecules used to make plastics, found in toys, clothes, and packaging.

- **Detergents:** Soaps and cleaning products, often made from smaller hydrocarbons.

Why Size Matters

The size of the hydrocarbon molecules affects their boiling points and condensation points. Smaller molecules, which are lighter, have lower boiling points and condense at higher levels in the distillation column. Larger molecules, which are heavier, have higher boiling points and condense lower down in the column. This separation allows us to sort hydrocarbons into different groups, each with its own uses.

Types of Carbon Compounds

Carbon compounds can be categorized based on their structure and the types of bonds between carbon atoms. Some common types include:

- **Alkanes:** Simple hydrocarbons with single bonds between carbon atoms, such as methane and ethane.
- **Alkenes:** Hydrocarbons with at least one double bond between carbon atoms, like ethene.
- **Aromatic Compounds:** Hydrocarbons with ring structures, such as benzene.

Each type of compound has unique properties and uses, which is why we can make a wide variety of products from them.

In Summary

Crude oil is a mixture of hydrocarbons that can be separated into different fractions through fractional distillation. The process works by heating the oil until it turns into vapor and then cooling it down in a distillation column. The size of the hydrocarbon molecules determines their boiling points and condensation points, with smaller molecules condensing higher up in the column and larger molecules condensing lower down. This separation allows us to create various fuels and other products essential to modern life. Understanding how molecule size affects boiling and condensation helps us make the most of the valuable resources found in crude oil.

Independent practice

Understanding Questions

1. Explain how the size of a hydrocarbon molecule affects its boiling point and where it condenses in the distillation column.
2. Describe the role of the distillation column in separating the different fractions of crude oil.
3. Why are hydrocarbons with lower boiling points found at the top of the distillation column while those with higher boiling points are found at the bottom?
4. How do the properties of hydrocarbons influence the types of products that can be made from each fraction?

Evaluative Questions

1. Read the following three statements about fractional distillation and choose the one you agree with the most. Explain why you agree with it.
    - a) Fractional distillation only separates hydrocarbons into two groups: light and heavy.
    - b) Fractional distillation can separate hydrocarbons into several different fractions based on their boiling points.
    - c) Fractional distillation works by cooling crude oil rapidly to separate its components.
2. Read the following three statements about the products of fractional distillation and choose the one you agree with the most. Explain why you agree with it.
    - a) All hydrocarbons from crude oil are used to make plastics.
    - b) Lighter fractions of crude oil are used for fuels like petrol and diesel.
    - c) Heavier fractions are used to make products like solvents and detergents.

Correction Questions

Correct the mistakes:

1. Fractional distillation is used to cool crude oil so that it can be used for making different products.
2. Lighter hydrocarbons have higher boiling points and condense at the top of the distillation column.
3. All hydrocarbons in crude oil condense into a single product during fractional distillation.

L5 Cracking

Hydrocarbons are compounds made up of hydrogen and carbon atoms. They are found in crude oil, which is a natural resource used to make many products like gasoline, plastics, and chemicals. Sometimes, we need to break down these large hydrocarbons into smaller, more useful ones. This process is called "cracking."

What is Cracking?

Imagine you have a giant LEGO structure, but you need smaller pieces to build something new. Cracking is like breaking down that giant LEGO structure into smaller, more useful pieces. In the world of chemistry, cracking takes big hydrocarbon molecules and splits them into smaller molecules. This is important because smaller molecules can be used to make things like fuels or new materials.

Methods of Cracking

There are two main ways to crack hydrocarbons: **catalytic cracking** and **steam cracking**.

1. Catalytic Cracking:

- **Conditions:** This method uses a substance called a **catalyst**. A catalyst is like a helper that speeds up the chemical reaction without being used up. For catalytic cracking, the catalyst is usually a solid material like zeolite (a type of mineral) and the process happens at high temperatures, around 500°C.
- **How It Works:** The hydrocarbon is heated until it becomes a gas and then passes over the catalyst. The catalyst helps break the large molecules into smaller ones.

2. Steam Cracking:

- **Conditions:** For steam cracking, very high temperatures (about 800°C to 900°C) and steam (water vapor) are used.
- **How It Works:** The hydrocarbon is heated in the presence of steam. The high temperature and steam break the large molecules into smaller ones.

What Are the Products of Cracking?

When hydrocarbons are cracked, two main types of molecules are produced: **alkanes** and **alkenes**.

- **Alkanes** are simple hydrocarbons with single bonds between carbon atoms (like methane, ethane, and propane).
- **Alkenes** have at least one double bond between carbon atoms (like ethene and propene). They are very reactive and are used in making many different products.

Why Do We Crack Hydrocarbons?

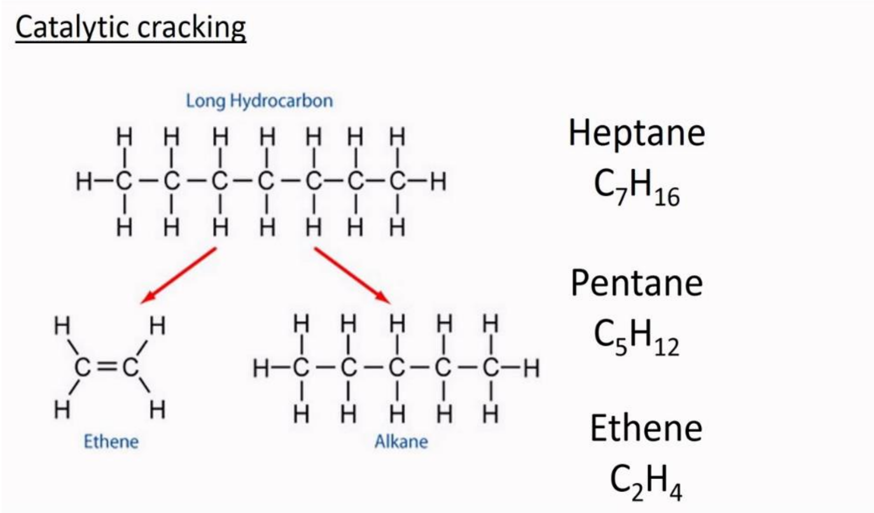
1. **Demand for Fuels:** There is a high demand for fuels with smaller molecules because they burn more efficiently and are used in everyday products. For example, gasoline and diesel are made from smaller hydrocarbons. Cracking helps produce these useful fuels from larger, less useful molecules found in crude oil.
2. **Making Polymers and Chemicals:** Alkenes, which are produced during cracking, are used to make **polymers**. Polymers are large molecules made by joining many smaller ones together. For example, polyethylene (used in plastic bags) and polystyrene (used in foam cups) are polymers made from alkenes. Alkenes are also used as starting materials for many other chemicals that we use in our daily lives.

Balancing Chemical Equations

When we crack hydrocarbons, we can write chemical equations to show what happens during the process. For example, if we start with a hydrocarbon like octane (C_8H_{18}) and crack it into smaller molecules like ethene (C_2H_4) and propane (C_3H_8), the balanced chemical equation would be:

$C_8H_{18} \rightarrow C_2H_4 + C_3H_8$ + other products

Balancing the equation ensures that the number of atoms of each element is the same on both sides of the reaction, following the law of conservation of mass.



Examples and Importance

- **Example of Usefulness:** Suppose we use catalytic cracking to produce more gasoline from a heavy oil. This helps meet the demand for fuel in cars, making transportation easier and more efficient.
- **Modern Life Dependence:** Many products we use daily are made from hydrocarbons, including fuels for cars and planes, plastics, and chemicals. Cracking helps us get the most out of crude oil, which is essential for making these products. Without cracking, we would have fewer fuels and materials, making life more challenging.

In summary, cracking is a vital process that turns large, less useful hydrocarbons into smaller, more valuable ones. It helps produce fuels, polymers, and chemicals that are crucial for modern life. By understanding and using cracking, we can make the most out of our natural resources and improve the products we use every day.

<u>Independent practice</u>

Comprehension Questions

1. What is the purpose of the cracking process in hydrocarbon chemistry?
2. Describe the two main methods of cracking hydrocarbons and mention one key condition for each method.
3. What are the two main types of molecules produced from cracking hydrocarbons?
4. Explain why smaller hydrocarbon molecules are in high demand.
5. Why are alkenes important in the production of polymers and other chemicals?

Understanding Questions

1. What happens to a hydrocarbon during catalytic cracking?
2. How does steam cracking differ from catalytic cracking in terms of conditions used?
3. Why is it important to balance chemical equations in cracking reactions?
4. How does the process of cracking benefit modern life?

Correct the Mistakes

1. Cracking uses a substance called a catalyst that is consumed during the reaction.
2. Steam cracking occurs at temperatures around 200°C and uses a solid catalyst.
3. Alkenes have single bonds between carbon atoms, which makes them very reactive.
4. The products of cracking are always alkanes and alkanes.

Complete the Cracking Equations

1. $C_{12}H_{26} \rightarrow C_8H_{18} + ?$
2. $C_7H_{16} \rightarrow C_4H_{10} + ?$
3. $C_{10}H_{22} \rightarrow C_6H_{12} + ?$