

WJEC Chemistry A-level

2.3: The Wider Impact of Chemistry

Detailed Notes

Welsh Specification

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Impacts of Chemical Synthesis

Chemical synthesis allows for the **deliberate production of different chemical products** (typically containing carbon) through several reactions. It allows a potentially economically **valuable** product to be obtained meaning processes of chemical synthesis can have much wider impacts on society, both socially and economically.

Social Impacts

Pharmaceuticals are an example of how chemistry can impact society socially. Aspirin is a specific example of a drug, a form of carboxylic acid containing a benzene ring produced from salicylic acid and ethanoic anhydride. Today it is used widely as a painkiller which provides society with many social benefits and pharmaceutical companies with economic ones too.

Polymers are another carbon compound that have had a much wider impact on society. Common examples include Kevlar, Nylon-6,6 and polyester. These materials have allowed for the development of many consumer products seen today including knife-proof vests, clothing and various plastic items.

More recently, **condensation polymers** have had an even greater impact on society, as they are able to be broken down by water, making plastic items biodegradable.

Economic Impacts

Many chemical products have great value in society as they can be used in pharmaceuticals, cosmetics and manufacturing. **Demand** for such chemical products means they have **economic value**.

It also helps to produce an industry for the raw materials involved in the chemical processes. Therefore, chemical production can be a major source of **employment**.

It is also important for manufacturers to consider the **percentage yield** and **atom economy** of reactions to ensure that as much of the desired product as possible is produced.

It is desirable to have a **high atom economy** for a reaction, as this means there is little or no waste product, only the desired product. By observing the percentage yield of the desired product, processes that lead to loss of material or excess waste can be identified and eliminated. Reactions which have by-products that can be collected and reused in a different process are significant to reducing waste.

Environmental Impacts

A lot of chemical processes can produce **by-products** that are **harmful** to the environment. Therefore they need to be monitored, or measures taken to reduce the production and effect of these products.

The majority of environmental impacts are concerned with the **combustion of carbon** containing compounds, as they release CO_2 and sulfurous compounds upon burning.





Impacts of Energy Production

Production of energy is crucial for modern society to function. It is important that in the chemical industry, future supply problems are considered, because currently the **non-renewable** resources of fossil fuels are being **depleted**. It is important that renewable resources are used as much as possible to help move towards **sustainable development**.

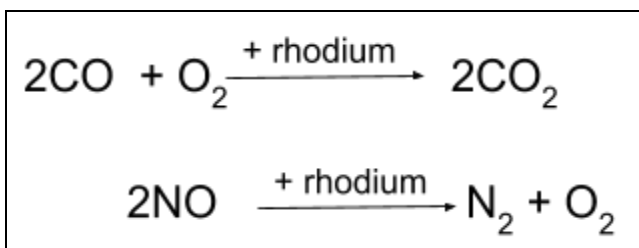
Combustion

When carbon compounds burn, they react with oxygen in the air to produce **CO₂ and H₂O**. However, if there is an insufficient supply of oxygen, **incomplete combustion** will occur. In this process, the major carbon product is instead **carbon monoxide** (CO). This is a **toxic gas** that forms alongside **nitrogen oxides** and **carbon particulates** in many modern combustion engines.

Catalytic Converters

Catalytic converters are fitted to the **exhaust system** in almost all vehicles to help reduce the amount of harmful nitrogen oxides that are released into the atmosphere. They contain a **rhodium catalyst** and use heat from the engine to convert **nitrogen oxides** into **nitrogen**, and **carbon monoxide** into **carbon dioxide**. These are **much less harmful** to the environment.

Example:



Acid Rain

The pollutant gases released in combustion, especially **sulphur impurities**, can lead to acidification of water in the atmosphere. Gases such as SO₂ dissolve into atmospheric water creating a **weak sulphuric acid** which then precipitates and falls on Earth as rain. This acidic rainfall can have major impacts on the ecosystems of Earth.

In order to combat this issue, **calcium oxide** and **gypsum** can be used in factories to remove these sulphur impurities. Pollutant waste gases are reacted with these substances to help minimise the amount of harmful gases that end up in the atmosphere.

Carbon neutrality

The concept of carbon neutrality means that the amount of **carbon produced** in a chemical process is **cancelled out** by a counter process and so there is no net increase in the concentration of CO₂ in the atmosphere.



Biofuels made from crops are a carbon neutral fuel source as the plants take in the same amount of carbon, through **photosynthesis** during growth, as is given out in the **combustion** of the fuel. However, there are issues with the methods of biofuel production as it is a very lengthy process and often only small amounts can be produced.

