

Exhaust Gas Analysis

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Aim of the Project

The aim of the project is to help understand exhaust gas emissions, explain how exhaust gasses are measured and how the technology has improved.

Background



The history of exhaust gas analysis traces back to the early days of internal combustion engines. Understanding the composition of exhaust gases is crucial for optimizing engine performance, reducing emissions, and meeting stringent environmental standards. Inputs include fuel and air, while outputs include harmful pollutants like carbon monoxide, nitrogen oxides, and hydrocarbons, which are released into the atmosphere which are shown in figure 2. With the introduction of European emission standards for cars in 1992 manufacturers must aim to design their vehicles to meet the strict regulations. As emissions legislation evolved and became more stringent manufacturers have developed new technologies to comply with these standards. These include direct fuel injection, turbocharging, exhaust gas recirculation, diesel particulate filters and catalytic converters.

On Board Control of Exhaust Emissions

In 2019, approximately 40% of nitrogen oxide emissions originated from road traffic, a notable decrease from over 50% three decades earlier. This decline is particularly noteworthy given the substantial increase in the number of registered cars.

The reduction in emissions can be attributed primarily to advancements in vehicle technology such as catalytic converters which convert pollutants into less harmful substances through chemical reactions in the exhaust and direct fuel injection which delivers fuel directly into the combustion chamber of the engine, resulting in more efficient fuel combustion and reduced emissions. To address this issue comprehensively, a thorough understanding is crucial. This is where the measurement of exhaust gases assumes a pivotal role. Accurate quantification is essential for a comprehensive understanding of their origins and enables effective strategies for reduction.

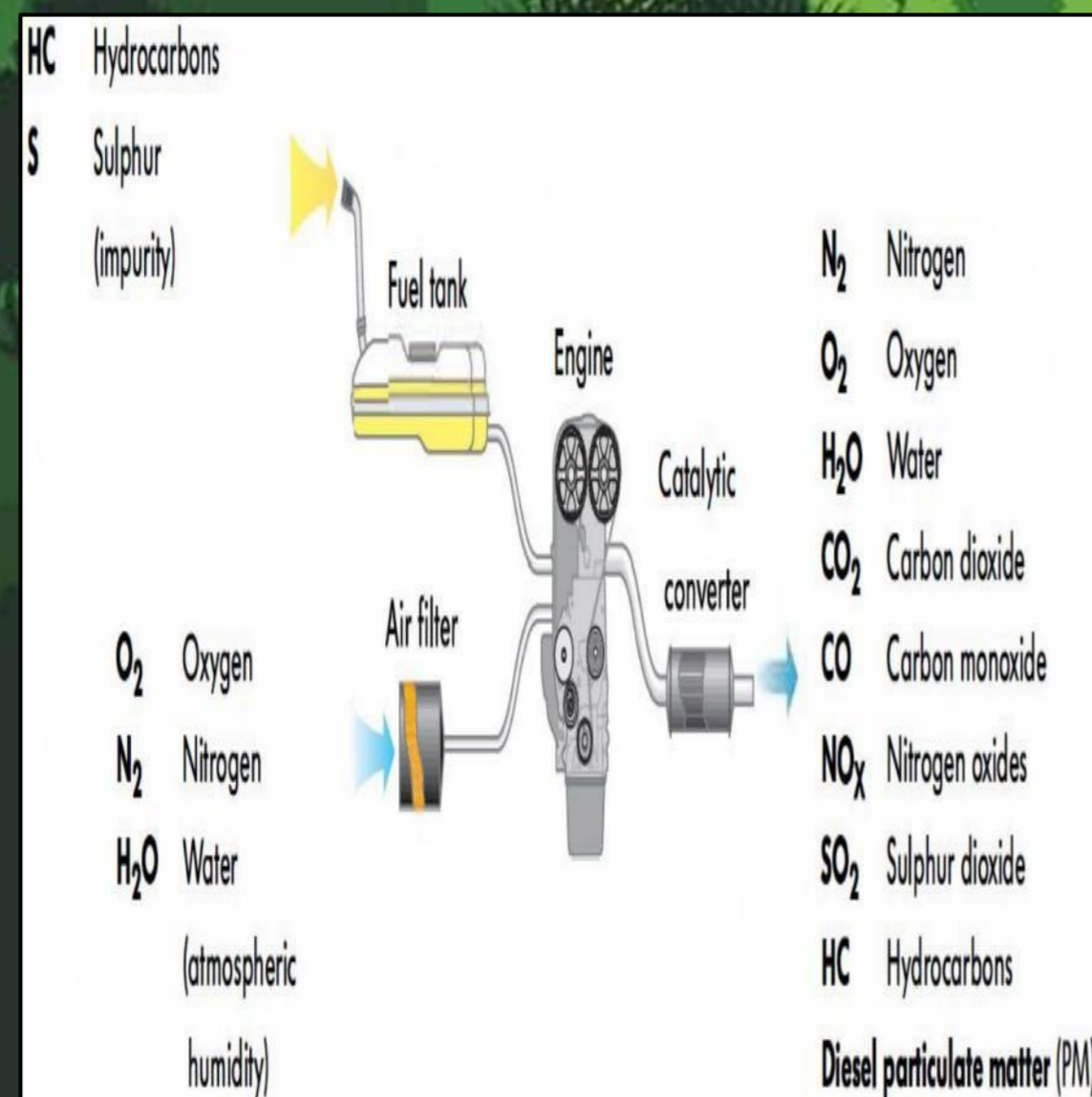


Figure 1: Combustion emissions

Emissions Testing

All types of vehicles need regular checks to measure their exhaust gas amount and makeup in Ireland we have the NCT. The NCT is a mandatory vehicle inspection in Ireland for safety and emissions and for checking the emissions to ensure they meet environmental standards they insert a probe into a vehicle's exhaust pipe to collect a sample. This sample is then analysed using specialized equipment to measure the concentration of pollutants which are shown in figure 1. Analytical methods like infrared spectroscopy or gas chromatography help identify and quantify specific gases. Modern vehicles also use onboard diagnostics systems to monitor emission control performance. The goal is to assess environmental impact, comply with regulations, and detect potential engine or emission control issues. The allowed emission levels differ based on the approval standards.

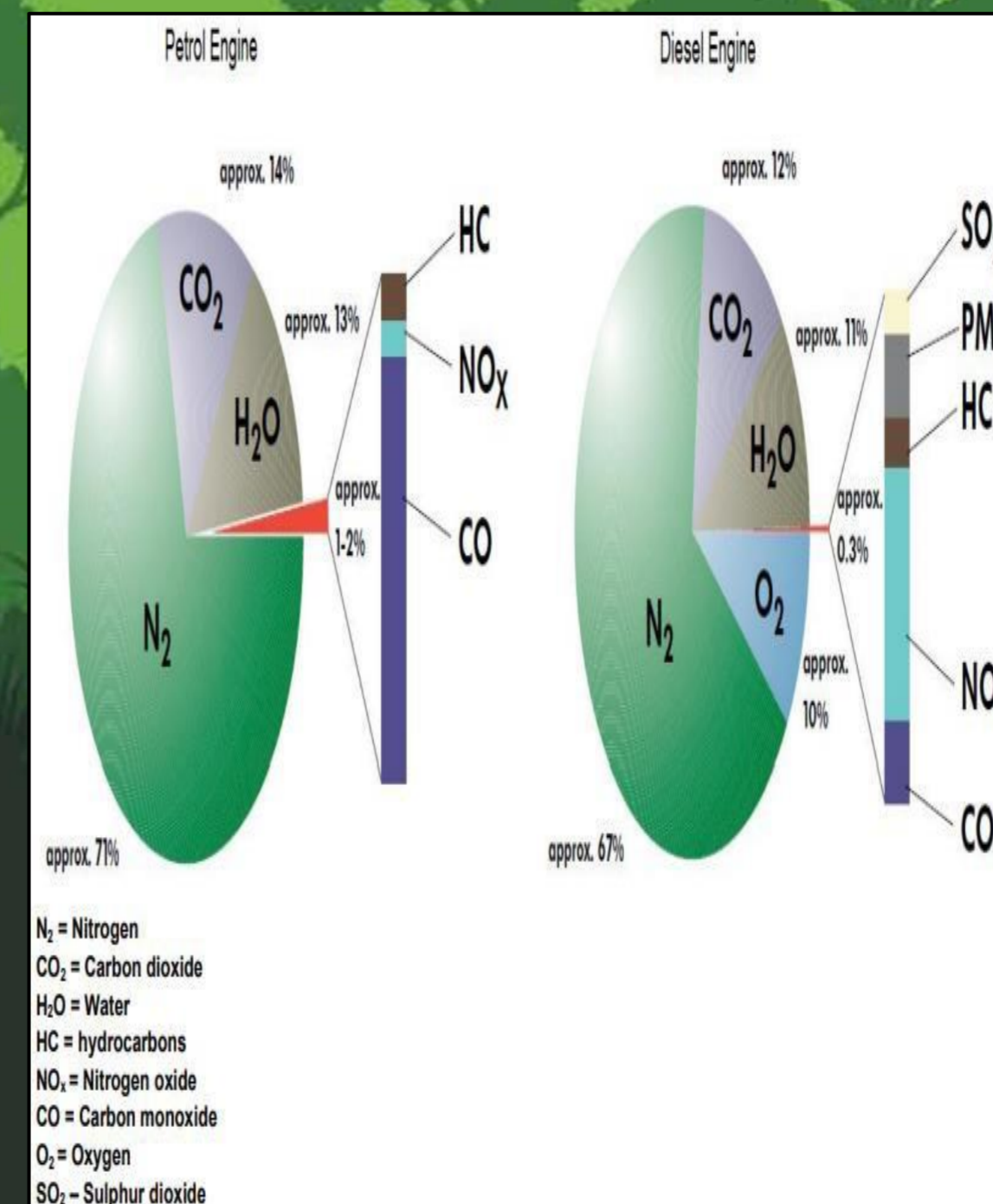


Figure 2: Breakdown of emissions petrol & Diesel

Emissions Testing

In September 2015, Volkswagen was embroiled in a major scandal when it was revealed that they had installed illegal software, known as "defeat devices," in their diesel vehicles. These devices were designed to detect when the cars were undergoing emissions tests and adjust the engine performance to pass the tests. However, during normal driving conditions, the vehicles emitted far more pollutants than permitted by regulations. This scandal affected millions of vehicles worldwide, leading to significant financial penalties for Volkswagen and damaging their reputation. This revelation brought about mutual testing methodology to screen for defeat devices in real driving conditions (Real Driving Emissions – RDE) along with enhanced laboratory testing ("World Harmonised Light Vehicle Test Procedure" – WLTP) before vehicles can be driven on European roads.

Conclusion

In summary, vehicles are continually monitoring exhaust emissions to ensure they are within specifications. The new Euro 7 standards could have several significant effects such as stricter emission limits, impact on vehicle performance and efficiency and heavy cost implications because manufacturers will have to incorporate these exhaust emissions technologies in their vehicles.

References

- Moodle notes
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