

6.1

Formation of exhaust gas

Exhaust gases are caused by engine combustion. Part of these exhaust gases contain pollutants.

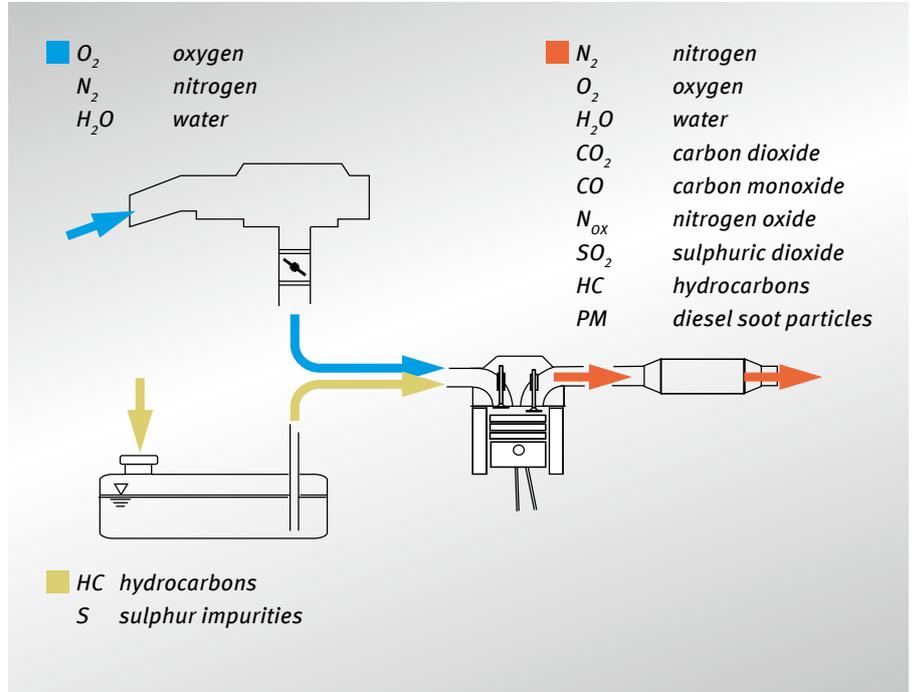


Fig. 53: formation of exhaust gas

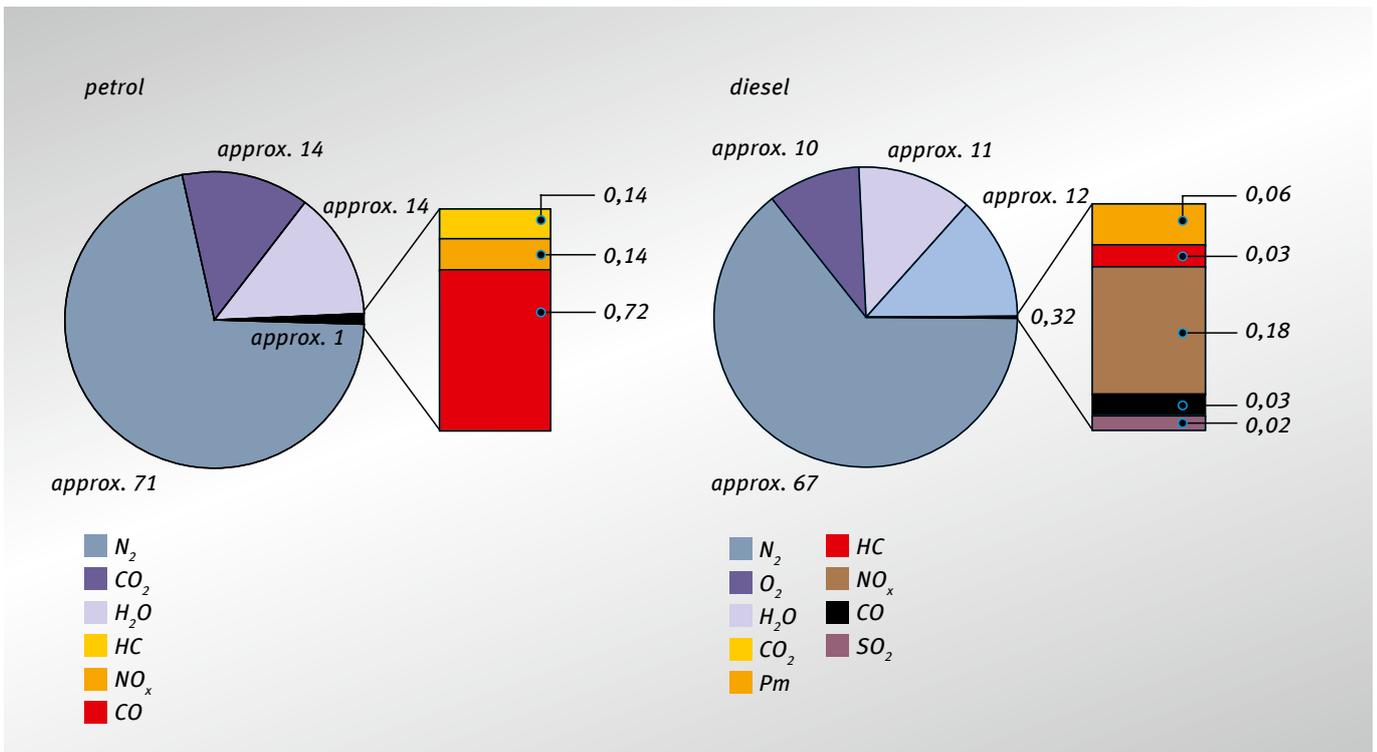


Fig. 54: composition of exhaust gas in petrol and diesel engines
The composition of the exhaust gases in petrol and diesel engines is different.

6.1.1

Essential pollutants in the exhaust gas

Carbon monoxide (CO)

Carbon monoxide occurs when fuels containing carbon are not burned completely, especial after start-up and during idling. It is a colourless and odourless, but extremely toxic gas, and can be deadly even in the smallest quantities because, as a respiratory toxic, it prevents the distribution of oxygen in the blood. Combined with oxygen it oxidises to CO₂ in a short time.

Hydrocarbons (HC)

Hydrocarbons are unburned fuel components, such as benzene, that are contained in the exhaust gas after incomplete combustion.

They occur in different forms and have different effects on the organism. They are partially carcinogenic.

Sulphur dioxide (SO₂)

Sulphur dioxide is a chemical compound of sulphur and oxygen. It is a colourless, pungent smelling gas that contributes to respiratory sickness. Sulphur dioxide is the main cause of “acid rain” because it decomposes to sulphuric acid in the humidity, which erodes natural stone structures.

Only small amounts are contained in the exhaust gas, which can be lowered more by reducing the sulphur content of the fuel.

Soot particles (PM)

Soot particles (PM – “particulate matter”) are produced from microscopic carbon beads on which the hydrocarbons originating in the fuel and grease accumulate.

They are carcinogenic.

Soot particles occur mostly in diesel vehicles.

Soot also occurs in petrol-based vehicles. But the amount is 20 to 200 times less than for diesel vehicles.

Nitrogen oxides (NO_x)

Nitrogen oxides are compounds of nitrogen N₂ and oxygen O₂. They occur in different forms such as NO, NO₂, or N₂O under high pressure, at high temperatures, and when there is excessive oxygen during engine combustion.

Measures to reduce fuel consumption, which produce more effective combustion, often cause an increase in the nitrogen oxides.

Nitrogen oxides are severe respiratory toxins. They irritate the eyes and mucous membranes and cause lung diseases. Nitrogen oxides are responsible for the “acid rain” and the “forest dieback” (death of the forests) associated with it. Furthermore they contribute to the formation of ozone, a respiratory toxic, in the atmosphere.

Carbon dioxide (CO₂)

Carbon dioxide is a colourless, noncombustible gas that is produced by bonding carbon from the fuel with oxygen from the combustion air.

It is undesirable because it reduces the earth’s protective shield against UV rays and contributes to climate changes (“greenhouse effect”).

When dissolved in water it produces carbonation, as in mineral water. Carbon dioxide is not directly toxic. Its toxic effect is based on the fact that it displaces oxygen for breathing, especially in closed rooms.

6.1.3 Emission limits

Since 1970 limits were established for the pollutant emissions of passenger vehicles. After January 1, 1971, these limits had to be met for all newly developed vehicles in the prototype testing.

The exhaust gas values were tested according to the newly introduced European driving cycle, nicknamed the "Europe test". In the Europe test, driving in purely city

traffic was simulated in 4 cycles. For the USA and other countries considerably more demanding tests were sometimes required. As this matter developed and as number of vehicles continued to rise, the limits continued to be lowered and the test criteria intensified.

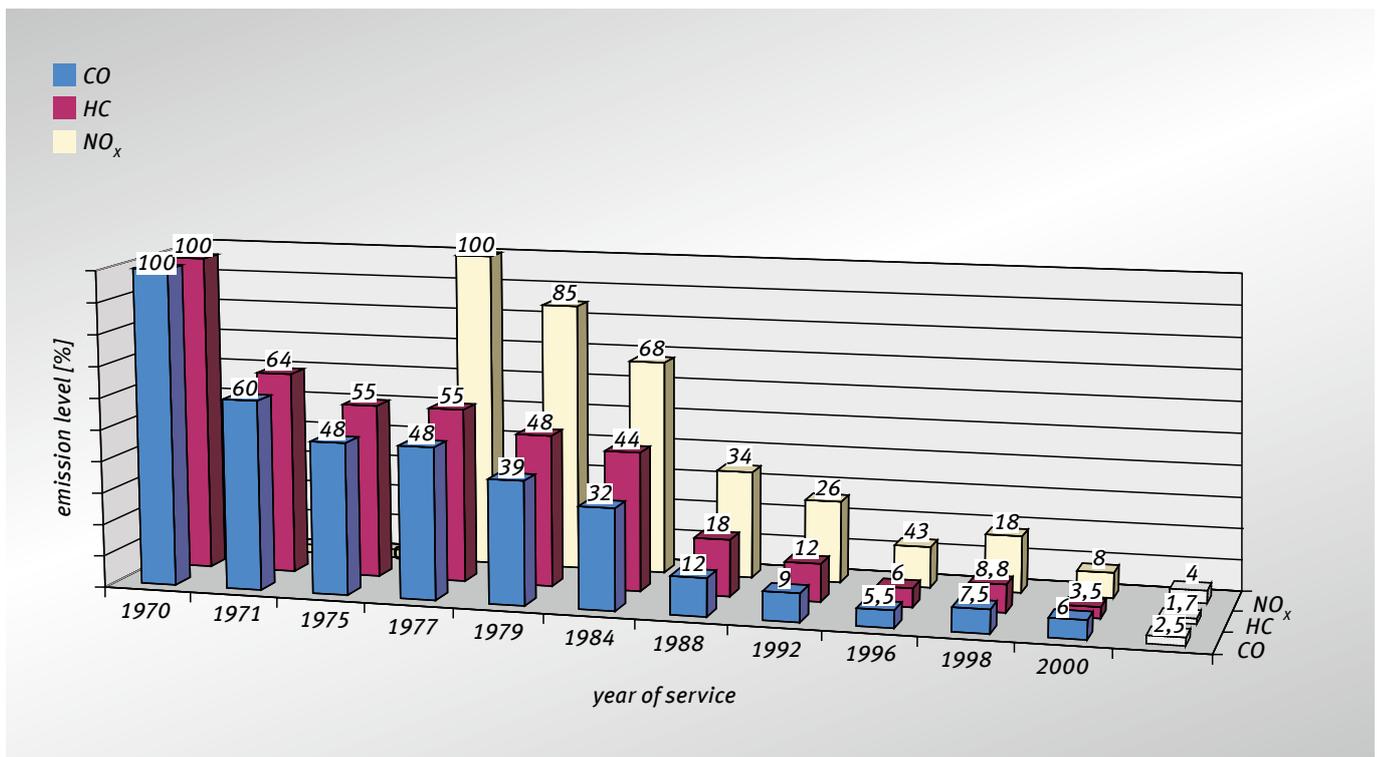


Fig. 55: development of emission limits (since 1970)