REDUCING VEHICLE EMISSIONS WITH CHEMISTRY

Millions of Volkswagen cars have been found to emit up to 40 times more nitrogen oxides in normal operation than they did during emissions testing, miring the company in controversy. This graphic looks at the devices present in a vehicle to help reduce pollution, and how they work.

POLLUTING COMPOUNDS

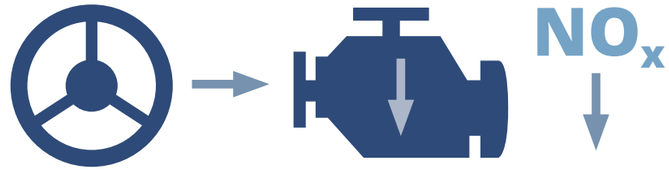
NO_x — **NITROGEN OXIDES**
E.G. NITRIC OXIDE, NITROGEN DIOXIDE

CO — **CARBON MONOXIDE**

HC — **UNBURNT HYDROCARBONS**
(FROM FUEL)

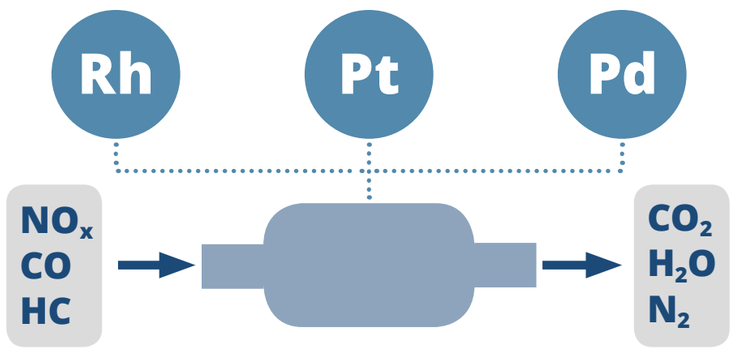
THE 'DEFEAT DEVICE'

The 'defeat device' found in Volkswagen cars is not a physical device, but a piece of software that detects when the car is being tested. When it detected this, it tuned the engine's performance reducing the NO_x emissions. In normal driving conditions they were much higher.



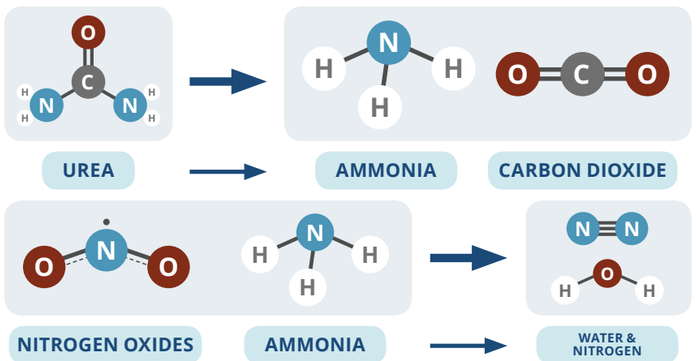
The car detected when it was in test conditions (potentially by monitoring steering wheel movement or traction control deactivation).

CATALYTIC CONVERTERS



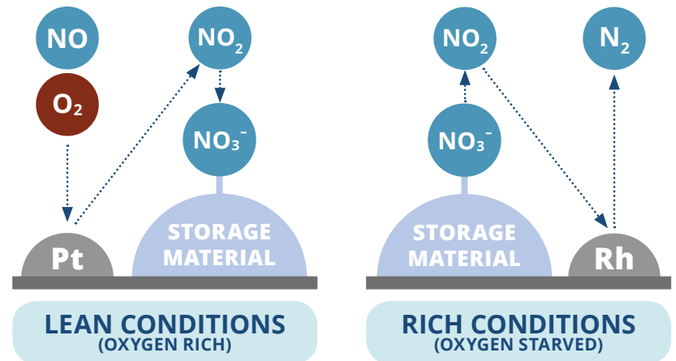
Three-way catalytic converters are present in all petrol-powered cars, and help remove carbon monoxide, unburnt hydrocarbons, and nitrogen oxides. They contain precious metals such as rhodium, platinum, and palladium to accomplish this. Three-way catalytic converters can't be used in diesel engines, as diesel's oxygen-rich exhaust gases make their removal of NO_x inefficient.

SELECTIVE CATALYTIC REDUCTION



Selective catalytic reduction (SCR) is a method for NO_x removal that is utilised in some diesel engines. It involves the injection of urea into the exhaust stream of the vehicle, where it is produces ammonia, which is adsorbed onto a catalyst. The ammonia can then react with the nitrogen oxides in the exhaust stream to produce nitrogen and water. SCR is capable of achieving NO_x reductions of up to 90%.

NO_x ADSORBERS



NO_x adsorbers can also be used in diesel engines. The majority of NO_x emissions from the diesel engines are NO, and this is converted to NO_2 by reaction with oxygen using a platinum catalyst. The NO_2 is then absorbed in the form of nitrates by the storage material (often barium oxide). Once the trap is full, the nitrate can be desorbed, converted to nitrogen over a rhodium catalyst, and released.