Simultaneous reduction of particulates and nitrogen oxides

Emitec's SCri® is a perfect retrofit solution

Increasingly tougher standards for the reduction of diesel engine emissions have led to a steady rise in fuel consumption. The SCR process (selective catalytic reduction), which involves the injection of a urea solution into the exhaust gas, makes it possible for the first time to reduce fuel consumption whilst still achieving the EU V emission limits. Car manufacturers report a 4 to 5 per cent improvement in fuel economy. This advantage can also be applied to non-road diesel engines.

Increasingly stricter emission limits forced engine manufacturers to move the timing of the injection to a “late” point further and further beyond top dead centre. While this reduced the combustion temperature and the amount of nitrogen oxide it also raised fuel consumption. The SCR process that reduces nitrogen oxides in the exhaust system allows the injection timing to be moved back to an “early” point of minimum specific consumption. This also reduces the production of particulates. Emitec’s SCri® system combines particulate and nitrogen oxide reduction and eliminates nitrogen oxides and particulates almost completely.

Diesel engines in tractors, mobile agricultural machinery and stationary applications are particularly durable, which makes the retrofitting of an SCR system economically viable. The SCri® developed by Emitec not only reduces nitrogen oxides but also particulates in the same process (Pict. 1a/b). The SCri® contains a PM-METALIT® (Pict. 2) that reduces particulates and an SCR catalyst that reduces nitrogen oxides. The two components are fitted behind each other in a single housing. An aqueous urea solution is injected into the hot exhaust gas in front of the PM-METALIT®. The storage tank for the urea solution (AdBlue), the dosing module and the electronic control unit including every sensor necessary for the precise dosing of the urea solution were also developed by Emitec and together form an integrated, self-contained system (Pict. 3).

Conventional SCR systems consist of several components that have to be arranged in series in the exhaust system: oxidation catalyst, particulate filter, urea mixer, SCR catalyst and ammonia trap. Emitec's SCri® combines all these individual components – except for the oxidation catalyst – in a single housing where they support each other’s functions. The PM-METALIT® is given a hydrolysis coating to improve its capacity to reduce particulates and evaporate the urea solution while ensuring optimum decomposition of urea to ammonia. This is extremely important to facilitate the instant conversion of nitrogen oxide across the full volume of the SCR reactor. There is no other system that is able to harmonise the individual functions so perfectly and requires so little installation space.
Emitec uses only extremely thin, high-temperature-brazed steel foils for its substrates, which makes the system described here practically indestructible. This is particularly important for non-road machines. Any shock or impact may dent the outer housing but cannot compromise the function of the SCRI\textsuperscript{®} and the metal substrates cannot be destroyed by vibrations. The corrugated and flat foil layers are manufactured in a special process and permanently joined to the steel housing using a high-temperature brazing process originally developed for the nuclear industry. Both flat and corrugated foils contain perforations, which force the exhaust gas into a turbulent flow pattern. They also fill the catalyst across the direction of the flow to make maximum use of the catalytic coating. This is one of the reasons why the SCRI\textsuperscript{®} is smaller than conventional designs.

Another important feature is the fact that steel foils heat up more quickly than ceramic components after the engine has started so that emissions are reduced at a much earlier stage.

Emitec developed a heated catalyst (Pict. 4) that preheats the exhaust gas in particularly difficult applications where engines have to run idle for long periods. The heated catalyst is installed in front of the SCRI\textsuperscript{®} and receives signals from the SCRI\textsuperscript{®} control unit to start or stop the heating process.

Emitec’s SCRI\textsuperscript{®} can be used as a retrofit system or in new vehicles and machines. The system is an innovation that represents real progress in emission reduction at the right time.