Cause and effect

Internal diesel injection deposits can interfere with the fuel injection process. Peter Weide of MarShip UK examines this growing problem

Nozzle coking has been an issue for diesel engines for many years, however, modern injectors are now suffering from deposit issues in other areas, such as inside the spray channel. What causes these internal diesel injection deposits (IDID) is a subject of much discussion.

We are all aware that while they must satisfy the expectations of the end user in terms of power and fuel economy, modern diesel engine manufacturers are subject to ever-increasing emissions regulations. To further compound the matter, fuel is changing as refiners try to be kinder to the environment, in turn driving changes in engine design in order to meet exacting emissions regulations and the needs of the end user.

The injector is at the forefront of these changes and is at the heart of fuel optimisation. Modern injection systems are now much more likely to rely on extremely high-pressure common rail systems with progressively smaller holes which, in some systems, are as fine as a human hair. These holes are finely honed into complex shapes to an exact design.

Then there are the exceptionally fine tolerances between the moving parts – often just a few microns. This development in engine design shows no signs of ending as the industry continues to meet ever-changing regulations and shifts in customer expectations. It is clear, therefore, that the IDID issue needs to be addressed, managed and solved.

Injectors are critical. They ensure that exactly the right amount of fuel is delivered at exactly the right time in the combusting cycle, and in a manner which allows it to easily vaporise and combust. Deposits at the nozzle can lead to reductions in the amount of fuel delivered and the size of the sprayed fuel droplets. This ultimately impacts on fuel emissions, power and economy.

Traditionally, coking deposits tended to build up over time, affecting engine performance so slowly that the effect on fuel economy and performance was not immediately evident.

Now it seems IDID – those inside the fuel system – can have a more abrupt impact. IDID build up between the internal moving parts. As these tolerances are extremely tight and the parts themselves often quite light, the deposits can interfere with the designed operation of the injector. They can cause binding or sticking of the moving parts which reduces the hydraulic flow, leading to a lack of power. In extreme cases, the injector parts can get stuck in an open or closed position. More commonly, the parts will move slowly and be unable to accomplish the required multiple injections with split second timing. IDID issues have reportedly developed over as little as 100 hours. In other cases, engines that operate perfectly at the end of a working day can experience issues when started again.

> ‘While they must satisfy the expectations of the end user in terms of power and fuel economy, modern diesel engine manufacturers are subject to ever-increasing emissions regulations’

Knowing that these deposits exist is one thing, understanding what they are and how they are formed is quite another. This point is complicated further as there seems to be two distinct types of deposit: ‘waxy’ or ‘soap-like’ deposits and carbonaceous or lacquered deposits – known as ‘gumming’. Combinations of fuel additives, such as mono-acidic lubricity improvers and conventional succinimide deposit control additives, have been suggested as a possible cause. In a test carried out by one of the biggest global chemical manufacturers, no evidence was found that these additives contributed to IDID deposits: when the injectors were disassembled they had completely clean internal parts.

There is, however, evidence that the use of biodiesel and ultra-low sulphur diesel could be a factor to consider. Not only does biodiesel contain trace metals that can intensify injector formation, biodiesel oxidation products can contribute to deposit accumulation. Carboxylic acid formed during biodiesel oxidation can corrode iron surfaces to yield an iron carboxylic salt layer. This salt layer can then trap other components in the fuel such as polymers that are also formed during biodiesel oxidation. When it comes to coking, temperature can also have an effect. When temperatures exceed 300°C, the thermal condensation and cracking reaction of diesel has been shown to accelerate the rate of deposition in the nozzle. This value appears to be the critical threshold for coking.

Regardless of what might ultimately prove to be the cause, the challenge is to

develop and bring an additive solution to the market that can address both the traditional coking issue and the modern IDID problem without compromising emissions, economy or performance. This would then allow any fuel used to perform optimally. MarShip UK, working with some of the world's biggest chemical additive manufacturers (which in turn supply the world's largest oil companies), has developed a solution.

DieselAid LD is targeted at addressing the problems of both coking and IDID and is coupled with an added lubricity agent which ensures the micro-tolerances are maintained for optimal efficiency. A simple single-dose bottle is enough to maintain a clean and efficient fuel system, optimising fuel consumption. DieselAid LD also contains an essential additional component to help meet emission control area (ECA) legislation after passage on heavy fuel.

Keeping fuel injectors at optimal performance is the key to maintaining fuel efficiency and maximum power, and meeting emissions regulations.

With modern designs bringing more efficient injectors, with more complex nozzle geometry and such fine tolerances on the moving parts, it is essential to keep engines as clean as possible. Many tests indicate that increasing additive treatment rates can achieve full control of deposits within a short time frame. It is therefore vital for ship operators to protect their engines and DieselAid LD presents a simple straight forward solution to this complex issue.

'Deposits at the nozzle can lead to reductions in the amount of fuel delivered and the size of the sprayed fuel droplets'

'Keeping fuel injectors at optimal performance is the key to maintaining fuel efficiency and maximum power, and meeting emissions regulations'

Peter Weide
Managing Director
MarShip UK

Tel: +44 845 287 1546
Email: sales@marship.eu
Web: www.marship.eu