

The Opportunity to Develop Cleaner Engines

An Article by Centre for Factories of the Future, the designer and developer of the clean diesel and hybrid engines

The current scandal engulfing Volkswagen (VW) regarding the falsifying of data in order for diesel cars to pass American and European emissions tests brings to light decades of deception by the company and the collusion of the research and industry bodies who failed to question and hold VW and their claims to account.

Diesel engines were being developed in the 1980's with issues relating to harmful engine emissions well known in the industry and a big cause for concern. As such there was a concerted effort to design 'Clean Diesel' engines to reduce harmful emissions, this work was carried out by many groups including companies like Volkswagen, Universities and private research companies.

One such research group was working out of Bath University where PhD student (now Professor Dr) Reza Ziarati and his colleagues, under auspices of Professor Frank Wallace, a very well-known and respected engine researcher, set up a new Engine laboratory with funding from Holset Engineering (Huddersfield, UK) and developed the first commercially viable Variable Geometry Diesel Engine. This new engine design provided a means of adding air in the engine cylinder to improve either the torque back up or to decrease the Nitrogen-Oxide (NOx) and Carbon Dioxide (CO₂) emission levels. It is worth noting that Professor Ziarati's software and engine designs were bought by many companies including Scania, Brown Boveri, Cummins of the USA and several others from Bath University without the knowledge of the Professor Ziarati. When Professor Ziarati found out it expressed no objection as he believed the humanity would benefit from these sales and Bath University would have the funds to continue its good work in Engine research.

After completing his PhD Prof. Dr Reza Ziarati was appointed at Lucas, and with his team managed to convince Lucas Bryce to let them research-discover the reason for the excessive smoke and pollutants emitted by diesel engines. Working with Ricardo in Brighton the team placed a camera on top of an Atlas single cylinder diesel engine and it was readily apparent that the cause of most of the excessive smoke was a secondary injection. This was where after the intended injection period, and due to the closure of the delivery valve, fuel returned to the pump and as there was no way for this fuel to escape the pressure waves generated returned the residual fuel back to the injector, forcing the injector to open and allow some low pressure fuel to enter the cylinder at the wrong time in the combustion cycle thus causing excessive emissions of smoke and pollutants from partially burnt diesel fuel. In response to this discovery the team, with support from Harwell laboratories, developed revolutionary new high-pressure Fuel Injection Equipment (FIE) to reduce the smoke and CO₂ emissions. Some of these findings were published by bodies including the Institution of Mechanical Engineers - http://www.c4ff.co.uk/history/papers/High_pressure_fuel_injection_system.pdf.

Following this work because of the technology developed to help reduce diesel smoke and harmful emissions Prof Dr Ziarati and his team gained the support of Lloyd's Register for their work in 'Clean Diesel', Lloyd's further showed their support, and belief in the work, by involving Prof Dr Ziarati and his team in their EU funded non-nuclear engine research - http://www.c4ff.co.uk/history/papers/Lloyds_support.pdf.

Alongside such collaborations Prof Dr Ziarati and his team continued their own lines of research to reduce diesel engine smoke and pollutants. This work resulted in the development of the first hybrid engines for buses and cars in 1994.

A further line of research being looked at in the mid 1990s advocated the use of water injection to reduce engine temperature which directly reduces the level of NOx emissions combined with specially designed filters to remove harmful particulates, tests in this area were carried out by Oxford University with the support of Prof Dr Ziarati.

All of these research initiatives, and the technologies developed, reduced the smoke and harmful emissions from diesel engines, however the reductions fell short of the claims that would be made by VW as by 1996 VW had begun claiming to have developed an engine that could give a 22% saving on fuel economy, 25% reduction in NOx and 36% reduction in CO emissions. These claims were believed by politicians, academics and

research councils around the world. In fact when individuals raised concerns about the claims and the technology behind them they were shot down. The world had chosen to believe VW's claims and not investigate further despite contradictory evidence and alternative technologies being readily available such as described above.

Yet some individuals sought to question the claims. In particular Prof Dr Ziarati raised his concerns through publishing papers such as the 1996 Scottish National Lecture on Road Transportation (http://www.c4ff.co.uk/history/papers/Emerging_transportation_system.pdf). The lecture was awarded the National Diploma for Best Paper (http://www.c4ff.co.uk/history/awards/National_Diploma-Hybrid_Vehicles.pdf) and the MacKenzie's Junner Award - http://www.c4ff.co.uk/history/awards/Design_and_Use_of_Hybrid_Vehicles_National_Prize.pdf. But without the support of the Research Councils and academics there was no way for individuals or small groups like Prof Dr Ziarati's to secure the funding to investigate and determine if what VW (and other companies) were claiming was true.

Prof Dr Ziarati, and those like him, have supported many companies to improve their diesel engines but when in 1996 the claims by companies such as VW were believed and never questioned this impeded their ability to secure crucial research funding to continue their work, for why would a funding body fund work that could prove, through evidence, a reduction of between 5 - 15% in harmful diesel engine emissions when some of the largest car manufacturers in the world are building millions of Diesel engines that they claim give a 22% saving on fuel economy, 25% reduction in NOX and 36% in CO emissions - and these claims are backed up by falsified emissions test results which are not noticed or investigated by the experts in the Research bodies? Over decades companies like VW intentionally or unintentionally belittled research into alternate methods of reducing diesel emissions and held back real developments to reduce pollution whilst making large profits by duping customers around the world.

Concluding remarks

These individuals who have always questioned VW's claims and who have wanted to investigate and learn the truth for the past 19 years have now been vindicated by the revelations of the past weeks and it is hoped that the politicians and research bodies will finally do their duty to investigate and hold VW (and other car manufacturers) to account and in so doing turn their attention and funding back to worthwhile, evidence based, research projects to improve engine efficiency and reduce emissions by means such as: water injection, use of gas fuels and novel fuels and by novel hybrid systems and perhaps to look again at whether inner cities should require engines which only run on safe pollution modes to reduce smog and pollution to safeguard public health.

But if we are never to repeat this scandal then further steps need to be taken. As well as refocusing funding and research into new ways to reduce emissions, a review needs to be carried out into how car engine tests are designed and carried out, and what influence car manufacturers have over this process. Car engine and emissions testing should be independent and rigorous. If a system can be deliberately manipulated for nearly 20 years, as is the case with the current testing systems of the EU and USA, then they are clearly unfit for purpose and need to be overhauled.

The engine technologies, for foreseeable future, are unable to produce clean engines; this applies to both diesel and petrol cars. Let us not fool ourselves; petrol is as almost as bad as diesel and the fact that it is a less efficient engine, in itself, is a cause for concern. Petrol engines also pollute and some of the pollutants are extremely harmful. The methods such as water injection, to cool the engine have been misrepresented and means to induce more air into cylinder for merely providing more air for the combustion in the past have been used to add more fuel and extract more power, this has to stop and research councils should lead the way and now promote cleaner engines and seek to support hybrid solutions more vigorously.

The most important message to the countries who manufacture diesel engines is for them to realise there are ways of burning NOXs and in fact C4FF has experimented with several new engines burning NOXs as fuel so there is no reason for these harmful by-products of diesel combustion not to be burnt as part of the exhaust gas recirculation. Furthermore, the Governments are aware that the harmful particulates of Diesel can be filtered or transformed by special catalyst. C4FF is of the view that diesel engines should be modified to burn

gas as is the case with some of gas engines developed by C4FF. In the marine world, Wartsila have already reconfigured two of the diesel engines into gas engines with a great deal of success. The future is hybrid with gas as the main source of engine fuel.