Grinding back the gears

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Millers Oils claims it has come up with the next generation of motorsport lubricants

While all attention on an exciting and busy 2009 British Touring Car Championship was firmly centred on the tussle for the crown between Colin Turkington and Jason Plato, a small but significant shift in motorsport oil and lubrication technology was taking place up and down the BTCC pit lane.

Throughout the course of the season, six of the 12 competing teams, including the Carbon Zero Racing team and Team AON, used a revolutionary new transmission oil technology from motorsport oils and lubricant specialist, Millers Oils. The Nano Technology range, launched in January 2009, enjoyed a remarkable first year, exceeding the expectations of all involved in the development of the products, and went on to provide the experienced Millers Oils technical team with substantial successes, on and off the racetrack.

WEAR AND TEAR

The main problem that faces race engineers with transmission systems is coping with and managing the high level of wear and tear gearboxes suffer under racing conditions.

To this point, the oils and lubricants used have often been designed to reduce and contain the problem, with many teams being advised to use oils with high viscosity and temperature characteristics – not too viscous at low temperature, but adequate viscosity at high temperature – to protect the highly loaded gears. However, in many conventional lubricants, as the system temperature rises the oil's sensitivity to heat quickly reduces its ability to manage the effects of heavy loading and shock loading, damaging its overall efficiency and producing a secondary effect of initiating the oxidation process.

> **New developments in engineered particles has gathered pace over recent years**

The chosen oil also can also often be susceptible to shearing from the non-stop and often violent action of the gear systems. This interaction between two gear parts often leads to the oil being pushed out and away from the section it needs to lubricate.

These constant factors of changing operational temperatures and unpredictable rates of wear place great pressures on the oils chosen, and it is this inherent problem Millers Oils set out to address.

Martyn Mann, technical director at the West Yorkshire-based company takes up the story: 'Over the last two and a half years, a suitable alternative additive system had been sought to replace the existing Millers Oils' CRX range of competition gears oils. A complete upgrade had taken place on the engine oil range of motorsport products several years previously. With the incorporation of triple esters, we discovered that the previous range of gear oils relied on a two-pack system that provided chemical and physical barriers within the gearbox.

'The important objective for these new gear lubricants was that the products had to be better than our current range, offering additional benefits to users. With this in mind, we set out to find the best gear lubrication possible, which we hoped would bring long-term benefits such as improved component longevity.

'Conventional wisdom suggested that we turn to using solid lubricants, which were more resistant to higher temperatures, with a thickness that could help abate problems with gearbox friction. But when some of the early nano options we found were investigated, it became clear that incorporating this technology into driveline products would offer a distinct advantage. New developments in engineered particles has gathered pace over recent years, and this has meant that oils

can be customised to fit many different applications, with a flexible and adaptable range of differing shapes and sizes.'

This new technology offered the Millers Oils' team all the necessary requirements for a new range of oils that would improve upon what was already available. Mann: 'Our main parameters were that the finished products should be able to transmit the required power reliably, be effective in lowering transmission losses through minimal friction and, as a result, lower overall lubricant temperature as well.

'The nano particle chosen actually resembles ball bearings and falls into the size range 40-100 nanometers. The particles, when viewed under a scanning electron microscope, appear as 'onion'-type shapes consisting of nested or concentric spheres.

'Initial contact with potential suppliers of nano components revealed that, while it was still early days for mass production to be feasible, some material was available in limited quantities. 'Luckily, we eventually sourced a supplier that was able to provide commercially available amounts that we could work with.'

Mann and his team found that the comparison of existing technology to a similar viscosity product using the nano components provided a significant coefficient of friction reduction. 'We were impressed with what we found and pleased with the initial test results. In a back-to-back comparison we ran two fluids on a standard lubricants test to measure a four ball contact scar diameter, which had run in the fluid for one hour. The fluid using the nano technology showed a 50 per cent improvement. Once this discovery had been verified, the project could move forward, and a new series of fluids were formulated to cover a wide range of applications and viscosities.'

NANO TECHNOLOGY

The science is based on the chemical behaviour of extremely minute particles – a new family of additives – known as Inorganic Fullerines (IF), which are made up of structures the size of 100 nanometres or less. What these nano particles add to the overall lubricant regime is a special layer of ball bearing-shaped particle structures. Under light loads these particles work just as ball bearings would but, under higher loads and shock conditions – as found in a racecar transmission system – the particle starts to deform and then acts as a roller. Under yet more extreme conditions, the 'skins' of the concentric particles start to break apart in a similar way to chemical Extreme Pressure (EP) additives, depleting when they respond to temperature-sensitive conditions. However, unlike conventional EP additives, the nano particles are inert and operate under all temperature conditions, which gives a wider spread of protection. Mann and his team also found evidence that metallurgical issues, such as micro-pitting, can be alleviated with this type of additive system, as can potential weaknesses in compact transmissions that are close to reaching capacity.

LAT

On-track testing in the BTCC showed a marked reduction in component wear

The upshot is that the technology reinforces the oil molecules, which has the key advantage of reducing friction, heat and wear in transmission components. In extreme racing conditions, Miller Oils' new nano technology oils were shown to considerably improve performance over oils that used more 'conventional' solid lubricants, with reductions in friction of up to 25 per cent being regularly recorded in tests.

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ON TO THE GRID

During the course of the 2009 season, a pattern started to build, with feedback such as 'durability has improved', 'parts replacement is reduced' and 'gearbox cleanliness is much better', being consistently received from team engineers up and down the racing paddock.

Alan Cole, team manager of Arena International / Team AON, racing with the returning Ford marque during 2009, noted that 'the CRX 75w90NT gear oil helps to prevent overheating issues and produces very little dog damage. Before using NT gear oil, we would expect to change two dog rings per weekend, now we only change one every two races, so this is a very helpful improvement.'

This praise was echoed by team principal at TH Motorsport, Trevor Humphrey: 'It seems to cope with the heat much better than any other gear oil we have used, and retains its viscosity far longer. The oil seems to stick to the gears and dog rings much better and, by the time we approached the half-way point in the season, we had only spent about half of what we spent the previous year on replacement gearbox parts.'

Mann concludes: 'From the research to the reality in developing the nano technology oils, we have been quietly confident that we had struck upon something radical and important. The success we enjoyed in 2009 helped to prove this. The use of nano particles is still in its early stages, but with the Millers Oils' nano technology (NT) CRX range now under our belt and up and running, we are already conducting the research on further oil and lubrication applications for this type of technology. It is Millers Oils' intention to apply friction-reduction techniques to improve the problem of engine power loss in the areas of the engine systems where up to 25-35 per cent of frictional losses occur, such as piston rings and liners.

'We know that, in total, the energy loss from an engine can exceed 50 per cent,' Mann concludes, 'and that increases with engine speed to far higher figures, so there is great scope for us to develop solutions that will improve these numbers. Millers Oils will seek suitable partners to develop nano technology products further into crankcase formulations, along with other areas such as wind turbine gearboxes.'

TECH SPEC

CRX75w90NT – TYPICAL CHARACTERISTICS

SAE viscosity grade:	75w90
Specific gravity at 15degC:	0.897
Kinematic viscosity at 100degC:	17.3cSt
Kinematic Viscosity at 40degC:	n/a
Viscosity index:	n/a
Pour point (degC):	n/a
Brookfield viscosity at -40degC:	88,000 mPas