LUBE-TECH
NO.23

INFINEUM TRENDS

Edited by Rod Parker

This article is a synopsis of the trends and implications for the European lubricants industry, highlighted at the latest Infineum Trends showpiece events held earlier this year around Europe. The Infineum Trends presentation covered the impact of legislation driven changes/developments on motor manufacturers, and the fuels/lubricant arena. For those who were not present at Infineum's bi-annual event, there is much to take in. Infineum highlighted a considerable number of potential industry developments; many just over the horizon and most will have significant implications for lubricant sales in our sector. Those readers, who also attended, may find this 'hard copy' article a useful reference in addition to their copy of the CD-ROM presentations.

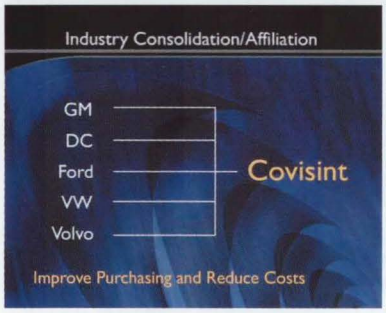
INDUSTRY GLOBAL OVERVIEW

MOTOR MANUFACTURERS CONSOLIDATION.

Today four vehicle manufacturers dominate world vehicle production. **General Motors'** interests comprise the following companies: Chevrolet, Buick, GMC, Oldsmobile, Pontiac, Saab, Cadillac, Allison Transmission, Opel, Vauxhall, GM Locomotive Group, Fiat, Fuji Heavy Industries, Isuzu and Nummi. **Daimler Chrysler** has the brands of the historic Chrysler Group as well as Mercedes, Smart, Freightliner, and Detroit Diesel, but part ownership investment in both Mitsubishi and Hyundai. **Ford** now owns the Jaguar, Aston Martin, Landrover and Volvo brands along with their historic international Brand names. **The Volkswagen Group** comprises Audi, SEAT, Skoda and even Rolls Royce until 2003, plus the upmarket Lamborghini brand.

In the heavy truck market **Volvo Heavy Truck** has acquired Renault (RVI) and MACK trucks, siblings in their growing empire of heavy truck brands.

Whilst the above is certainly not by any means an all-inclusive list of automotive industry consolidations, it serves to illustrate the trend which has been ongoing for the past several years, with more consolidations and fewer but larger auto marketers. In addition to these formal consolidations auto marketers are also forming other business arrangements to help reduce costs. One of these business arrangements has been used by several major companies, General Motors, Daimler Chrysler, Ford, Volkswagen and Volvo who have joined together to form a B to B e-mail business named Covisint which has a specific goal of improving purchase and reducing costs.



OIL INDUSTRY CONSOLIDATION

On the oil company side, as many LUBE readers will know, numbers of companies have dropped over the last five years from 20 to 7. Cost effective regrouping is the name of the game. **The market oil-majors list now includes Exxon Mobil, Chevron Texaco, Shell/DEA/Pennzoil-Quaker State, BP, TFE, Repsol YPF and Conoco Phillips.**

ADDITIVE INDUSTRY CONSOLIDATION

Moving from oil companies to additive companies, we have seen a similar consolidation with 8 additive suppliers in 1990 reduced to just 4 in the year 2000. **Alphabetically, the additive companies are Ethyl, Infineum, Lubrizol and Chevron Oronite.** Unfortunately, as far as the additive industry is concerned all of these corporate consolidations have not produced the hoped for improvements in profitability from any of the industry participants.

Looking specifically at the returns in the additive industry they can see that both return on capital and return on sales have continued an unsustainable downward trend. The reasons for this situation are complex, but at least one major portion of the problem is the cost of technology development for the additive industry. **Over the past 10 years the additive industry has spent upwards of 8-10% of its sales revenue on technology development. This is over twice the average technology investment of other specialty chemical businesses** and roughly four times the spending rate of commodity chemical businesses.

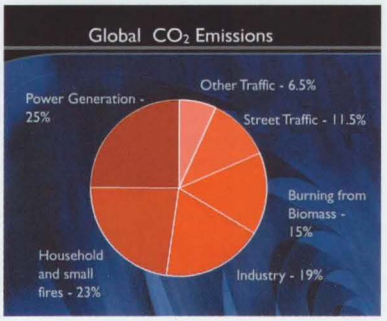
The additive industry claims it cannot continue at the current rate of technology spending with today's overly short life-cycles of each additive development, i.e. insufficient time between rollouts of new specifications and technology, to recoup the investment. As an industry, we must develop processes and working relationships to ensure timely delivery of new technology, but still allow additive companies to have sufficient return on their technology investments to allow them to continue investment in their business, thus delivering true value to the end-users.

This is no surprise, as we all know. With the poor prognosis on the health of the industry as a whole, it is increasingly important to acknowledge that there are valid stakeholder needs, such as affordability, representation and active participation in the debating chamber. Concerns have been aired collectively and needs addressed in the same way.

THE ENVIRONMENT: EMISSIONS

Most people tend to take air quality for granted, until something goes wrong. One culprit among many is Ozone (O_3). Around 80 years ago, enterprising seaside resorts publicised their ozone rich air, as a source of health and well-being. Try promoting that view today in places like Los Angeles or Athens. A few decades on, opinions are completely opposite.

O_3 is generated on our streets when vehicle exhaust fumes, with their high content of Nitrogen Oxide (NO_x) react to strong light intensities. When the right conditions prevail other cities like London, Paris, Milan, Madrid and Hamburg also don't escape. Now the debate has moved strongly to the significant percentages of microscopic air borne particles, long associated with road vehicle exhaust. In the UK, the Institute of Lung Health at Leicester University has also reported that ultra-fine vehicle particulates can enter the lungs of young children. Other researchers are also investigating the problem, but despite our increasing awareness of emission control it is clear there is no easier solution to combating emissions. Maintaining air quality is going to tax the concerted brains of government, scientists and engineers for a long time to come.



Over the last 20 years or so, emissions regulations in Europe and the US have got CO, HC and NO_x emissions from petrol powered cars and trucks down by over 95%. Similar reductions are on record for particulates and nitrogen compounds produced by diesel vehicles, although emissions of ultra fine particulates remain a very real concern. In the European Union research is under way to determine whether current particle limits needs revising to take into account particle surface area. It is widely expected that future emission

(Continued from Page I)

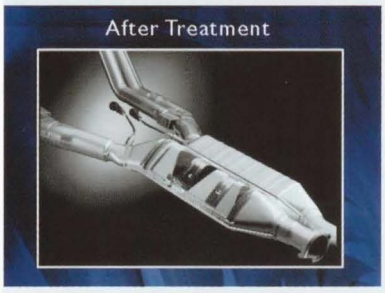
standards will cite not only their mass, but the number and size of particulates.

In the EU road transport produces over 20% of the total manmade CO_2 emissions and this figure clearly increases with the vehicle population. CO_2 can be limited only be reducing the amount of carbon-based fuel used, which is why in the long term, cutting frictional losses and raising thermal efficiency is so important. In Europe, target CO_2 emissions per car have been set and automotive manufacturers' associations in the UK, Japan and Korea are working towards these limits. In North America as far back as the mid-70s, the US EPA introduced Corporate Average Fuel Economy (CAFE) standards to encourage greater fuel efficiency and reduce CO_2 from the tail pipe.

TECHNOLOGY SOLUTIONS

For gasoline-powered cars the key invention was the catalytic converter. The catalyst has achieved greater reductions in vehicle emission than any other single invention to date.

Particulates may prove to be a further challenge, if and when direct injection engines power the majority of gasoline cars. Then there is the totally separate issue of how to get the fuel-air mixture to combust: compared with spark ignition systems, homogenous charge compression-ignition (HCCI) engines running on natural gas or gasoline offered significant additions in future economy, thermal efficiency and NO_x reduction. Work, as they say, is in progress.



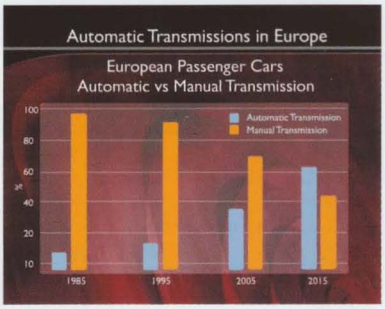
The latest diesel powered units are carving out an ever-greater slice of the passenger car market, especially in Europe whilst the heavy-duty sector is growing as more and more goods are transported by road. But the onward march of the diesel is tempered by the need to reduce both NO_x and particulates - the well-known trade off.

Meanwhile, concern over particulate emissions has prompted the widespread use of oxidation catalysts (oxcats) on diesel passenger cars and some heavy-duty vehicles. In all cases low-sulphur fuel is essential for effective operation. The catalysts effectively cut Carbon Dioxide and Hydrocarbon emissions and oxidise the organic fraction of diesel particulate matter, lowering particulate mass by 50%

The use of particulate trap-based after treatment doesn't only reduce the number of particles, including the ultra-fine, but they achieve over 99.9% filtration efficiency over a wide range of operating conditions.

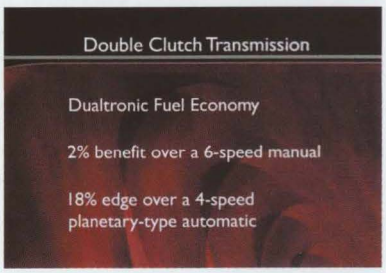
TRANSMISSIONS

Ever since motor vehicles took to the road, they needed some previously unknown solution to help them climb hills without stalling. The gearbox was the obvious answer. The next invention was mass produced automatic transmissions (AT), which their inventors claimed would bring widespread happiness. Not entirely so, as whilst many American drivers might have forgotten what their left legs are for, do-it-yourself gear changes are still the norm in more than 80% of European cars. ATs are in general less fuel-efficient than manual transmissions, but this looks like changing. Today, in one form or another, automatics are gaining more ground and are expected to gain more than 60% of the European passenger car market by 2015.



Continuously Variable Transmissions (CVT) are today grabbing a larger market share, but surprisingly they have a long history and Gottlieb Daimler and Carl Benz fitted a form of CVT to their first cars as far back as 1886. CVT transmissions provide better fuel economy than conventional automatics. Globally CVT production is expected to exceed 2 million units by 2005. Another fuel efficient way of getting power from the engine to the wheels is the use of automated manual transmissions (AMT), logically the easiest way to remove the hard work which some people associate with changing gears. AMT capitalises on existing technology and fluids and requires no radical changes in production lines.

In the quest for competitive advantage, vehicle manufacturers leave no stone unturned and among the future options being scrutinised is Double Clutch Transmission (DCT). DCTs offer a fully automated transmission and surprisingly better fuel economy than a manual gearbox, a prize, which the motor manufacturers will be quick to explore. DCT will be in European production vehicles by 2003 and expect to gain a 20% share of the European market by 2010. Borg-Warner are introducing the Dualtronic DCT.



But, whatever form these next generation units take, their future will depend on the transmission fluids inside them. In an industry littered with acronyms, MT, AT, AMT, CVT, DCT, the nature of ATF is changing too.

The service fill market is still dominated by Dextron and III/Mercon quality claims. Mercon V now accounts for 7% of the international market.

The challenge for transmission-lubricants is to extend drain intervals, coupled with higher gearbox temperatures, have better foam suppression and increased shear stability.

CRANKCASE LUBRICANTS

It is common knowledge that for passenger cars there was a recent ACEA update back in January. The first point to note is the complexity of the A sequence is increased with the arrival of ACEA A5, a new category for high quality, low viscosity oils combining fuel economy and extended drain intervals. The usual premise applies - low viscosity equals reduced friction, giving better mechanical efficiency and greater fuel economy, which in turn means lower emissions.

No one queries that the real issue centres on the words 'low viscosity'. Without careful formulations, the lower it goes the greater the risk of wear and some manufacturers have long had reservations to exclude it from their engines and do not support A5. Unlike Ford, say, who are happy to specify a 5W-30 oil in the gasoline power units fitted to the new Mondeo and Fiesta. They, amongst others, have no concerns - and were the main supporters of A1, which likewise defines a low-viscosity oil. Ford are now pushing for a 5W-20 oil in this category.

ACEA A1 is aimed at low viscosity and fuel economy is now more severe because of a new and different oxidation test in the Peugeot TU5 engine 1.6-litre injection unit run at high rpm and high oil temperatures.

ACEA A4 is absent and is reserved for a future sequence on direct injection gasoline engines. The same overall trends are visible with the B sequence, for passenger car diesels where again the newcomer is ACEA B5. Effectively the counterpart of A5, B5 is an attempt to define a fuel economy oil for compression-ignition engines - again with the high quality demanded by extended drain intervals. The fuel economy test is base on a gasoline engine, but a diesel fuel economy test is under development based on the Ford Puma unit.

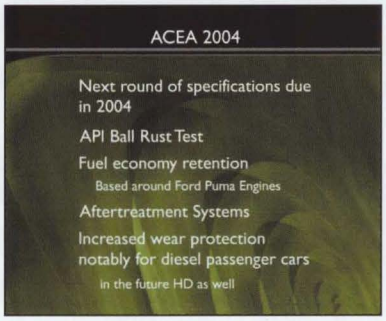
Again ACEA B1 now reflects the tighter levels applicable in the Peugeot XUD11 BTE. B4 is likewise more severe and written in such a way that the fluid will almost certainly have to contain high amounts of non-conventional base stock.

With the ACEA E sequence for HD diesels nothing much has changed.

On a more general basis there is still the perennial concern about chemical limits in oil.

For now, the only sensible deduction is that formulating oils able to meet a number of ever tighter performance specifications is tough enough without adding a plethora of chemical limits which may compromise optimum performance and for which there is no proven technical justification.

ACEA members are already planning the next round of specifications due in 2004. They have identified several requirements they would like to see for which no tests are currently available. ACEA have also shown the desire to put existing aftertreatment systems under the microscope for compatibility. Firstly, the alleged poisoning of three way catalysts by phosphorous. Next, the progressive blockage of particulate filters by ash, accompanied by higher exhaust back-pressure and lower engine performance. Thirdly, the effect on diesel oxidation catalysts.



ACEA are running a test programme designed to highlight lubrication effects on oxcats, notably for sulphur and phosphorous.

ACEA's future specifications also include the provision of increased wear protection, notably for diesel passenger cars. We might also see a similar test for the HD truck sector as well. With increased performance and longer drain intervals, tighter limits are on the way, requiring higher quality oils, higher additive treat rates, better base stocks and increased costs. At the moment there is no test specification designed for GDI powered units, so the ACEA A4 gasoline direct injection sequence is missing at present. There are concerns about deposits in inlet ports, compression chambers and on inlet valves. Identifying the cost is key to this issue. It could be the fuel, the lubricant, or engine design.

Of more pressing urgency is the fact that many of the engines used in the present tests are nearing the end of their life.

In the world of truck manufacturers the VDS-3 is Volvo's latest level conceived to meet the needs of Euro 3 engines. This is a tough specification, requiring oil drain intervals of 100,000km. While at Volvo there has been considerable activity, there has been no new specifications from Mercedes Benz - an unusual situation from one of the most energetic players in OEM-tailored specification.

DAF who now pass for use ACEA specifications, now recognise the benefit of having their own specifications - the new HP1 and HP2 specifications. These are designed for maximum wear protection and minimum drain intervals. With 150,000 Kms between drains, it will be the longest interval for a standard field trial and allow them to specify similar figures for vehicles in service. Good news for DAF operators. Both Renault VI and Volvo are seeking to harmonise their specifications, but each will retain their own approval systems. A Volvo truck will continue to require VDS-3, a Renault truck RLD or RXD - even if the two specifications turn out to be virtually identical.

A different kind of approach prevails at Scania, who with their LDF specification, allow very restricted read across. For their trucks, Scania approve only the exact oils decided in the field trials.

MAN are busy defining new specifications to supplement their current tests. MAN plan to use this new D2876 engine test to qualify regular M3277 Euro 3 engine oils, but also wish to introduce a more severe M3277 Plus specification based on this test. MAN hoped to be able to extend the oil drain interval of M3277 Plus oils from the current 80,000 Kms to 120,000 Kms.

For the next round of emissions legislation, due in 2005, there are two principal aftertreatment routes open to the HD diesel sector. Selective Catalytic Reduction (SCR) and Exhaust Gas Recirculation (EGR), the latter with some sort of particulate trap. Following the SCR route imposes relatively few performance demands on the oil but it does potentially require lower levels of sulphur and phosphorous. The EGR-Plus-trap route means the oil quality has to be significantly higher to maintain current drain intervals and protect against the corrosive gases. At the same time adding a particulate trap restricts the amount of ash permissible in the oil stock. High quality plus low ash equals high complexity.

The outcome is TWO radically different lubricants required for engines coming on to the market at the same time. The difficulty is clear: Do ACEA set two different specifications - one for the SCR truck, one for the EGR, or do they attempt a one-size-fits-all approach, which will always be a compromise?

Indeed, could ACEA's specs' start to lose their relevance with Euro 4 trucks? Or does the situation get resolved when the whole sequence system collapses and each engine manufacturer goes for his own unique specification?

The questions may be theoretical now, but for the HD diesel sector they won't go away - and that applies to everyone who makes trucks, tests them, markets them and formulates their lubricants. Finding the answer will not be easy, and in the mean-time informed debate must prevail.

At any one time, currents of opinion on all manner of developments can sweep the industry. One of current importance is the continual move towards extend drain intervals on commercial vehicles. With truck downtime a major cost for operators, the pressure to increase oil drain intervals is growing on those who build the vehicles, to boost their reliability and durability and on those who promote the long-life capabilities of the oils.

All European OEMs, together with companies like Mach and Cummings in the US, use the service interval as a marketing tool to sell engines. For all the latest European models, intervals of 60,000 to 80,000 km are now around: many are pushing towards 100,000 km whilst Mercedes Benz are promoting oils meeting their Page 228.5 specification. MB have also claimed intervals of up to 160,000 km provided other vehicle modifications are made. Drain intervals can no longer be the factor that determines major service intervals. What about a vehicle's other consumables: brake pads/shoes, hydraulics etc. Equating the downtime schedules for both is going to require some careful calculations by manufacturers and operators alike.

(Continued on Page IV)

(Continued from Page III)

PASSENGER CARS

Life gets no less complicated for the passenger car manufacturer. Daimler Chrysler's current Page 229.1 specification is long established. This Mercedes Benz quality level is no longer adequate for the latest direct-injection passenger car diesels released this year. To maintain the current oil drain interval Mercedes Benz are now recommending, as a minimum, its successor Page 229.3, first released in August 1999.

The latest MB 229.3 list contains some 91 approved oils and is likely to become the base quality level for Daimler-Chrysler passenger car engines. It targets better fuel economy, reduced sludge and greater component durability. It also continues the universal move towards low viscosity. Mercedes Benz's Service Fill specification, Page 229.5 was released in mid 2000. Applications by the oil companies had to be submitted by the end of February 2002, with the first approval list due for issue before the end of the 2nd quarter. Costs for MB Page 229.5 and its field test package, based on in-house trials are around 600,000 euros, with the total programming costing some 1 million euros. Mercedes Benz's drive for reduced sulphur and phosphorous takes a further step with the introduction during 2002 of the new Mercedes Benz direct injection gasoline engines fitted with $DeNO_x$ storage catalysts. These will probably first appear in the updated C-class and E-class.

Volkswagen have worked closely with selected partners to produce their latest specifications - 4 factory fill and 5 service fill since 1999. These comprise just a fraction of VW specifications and the market has commented on the confusion that the number of specifications is producing. This 'spoiled-for-choice' situation is affecting everyone - end users, service based staff and oil companies' marketing departments striving to create 'differentiating' stages.

One characteristic which some of these VW specifications share is their reliance on a large number of complex, expensive in-house tests. Amongst others, this is the case with the 503.00 and 506.00 sequences. These cover the 2000 model year gasoline and turbo diesel direct injection engines whose oil drain intervals, with LongLife service system, now stretched to 30,000 km or two years. The extended testing at the heart of the specifications includes a radio nucleotide test - using a TDi engine - to detect minute levels of wear on these services all components such as cams, tappets, bearings and rings. The updated 506.01 specification for direct injection turbo diesels, was released during the 3rd quarter of 2001. For oils between 2.9 and 3.4 HTHS, this allows drain intervals extended to 50,000 kms or two years. The extension of RNT wear test to 650 hours will cost around 100,000 euros.

The new 503.01 specification is for the high performance gasoline engines in the Audi TT and S3 and in VW's latest W configuration units fitted to the W8 Passat - W12 top of the range Audi A8. 503.01 requires HTHS above 3.5, no surprise given the wear requirements of these high performance engines. The W12 will be one of the units available in VWs luxury S-class rival, the all new Phaeton, which will be the first car to be serviced over the Internet and by video. Amid all the other items on the service schedule, engines will now be able to conduct remote oil checking.

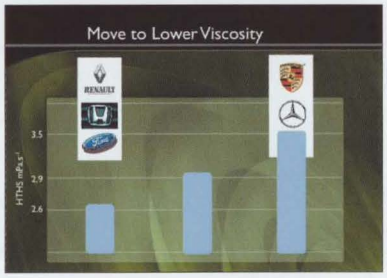
But what might the future bring for VW's oil requirements? The initial answer must be 'more of the same'. Depending on models VW has no short to medium term plans to extend its drain intervals. This also applies to future VW gasoline direct engines such as the Golf I.6 and Polo 1.4 FSI. These all-new engines will take VW future into the GDI market: in terms of their oil specification, and the learning curve will probably be steep.

At BMW things appear somewhat simpler and involve two new oil specifications. The first is BMW LongLife-01, with drain intervals of 30,000 kms or two years. This is the Service Fill approval list for all lubricants meeting the M52 test (or in the future the M54) and the BMW aeration test. With the HTHS above the figure 3.5, the oil can be used in all BMW engines including those fitted with Valvetronic Variable Valve timing. These new 4 and 8 cylinder engines are used across the BMW range.

The same high performance demanded by long drain intervals is required for BMW LongLife-01 FE (fuel economy). The HTHS is slightly lower but still greater than 3. In the BMW fuel economy test the target is an improvement of 1.2% over the 5W-30 reference oil. One major difference in this category is that the oils defined can be used only in valvetronic engines.

There is no shortage of challenges at Ford. Their 913B specification was released in December 2001 as an upgrade to 913A. Covering the newer engine oils including those produced under the storage allowance with PSA - this is aimed at reducing the problems associated with increases in temperature and soot levels. Protection against higher temperatures demands more severe oxidation performance at the ACEA A3-02 level. For soot handling the requirement is the severe B3 viscosity increase limit.

Ford continues with their drive for lower viscosity oils with a potential move within one or two years to 5W-20 oils with low HTHS - typically 2.6. According to Ford none of their current passenger car diesel engines is compatible with these oils apart from Puma and V6 Lion units. However, they claim that many of their existing gasoline engines are fully protected although several of their competitors fail to share their enthusiasm for this low level. Meanwhile, even for Ford, anything below 2.6 is uncharted territory. Ford will probably look to the US and follow the GF4 recommendation of an 0.05% limit of phosphorous in oil. Ford currently has little to say about chlorine except to declare their support for ACEA.



Ford has forged a commercial partnership with PSA, now commissioned to develop all Ford's passenger car diesel engines worldwide. The first fruits of this long-term association were the DV4 and DV6 engines, these common rail direct injection diesels feature significant improvements in weight reduction and fuel economy. The new engines will be used under the Ford, Peugeot and Citroen brands.

GLOBALISATION

The main motor manufacturers are all global; so are their structures, their supply chains, their production facilities and the strategic alliances they foster. The question is will the result be global lubricant specifications. On the heavy-duty diesel side the process has begun and as previously reported in LUBE this initiative has produced the DHD-1 specification, a joint initiative by EMA in the US, ACEA in Europe and JAMA in Japan. These organisations have also committed to creating its successor DHD-2 in 2007.

In the passenger car sector, things are less clear-cut and there are currently major international differences of opinion. US fuel economy demands appear incompatible with European performance requirements. This, coupled to worldwide differences in driving conditions and traffic densities indicates there is still some way to go to an international specification. But, the inevitable will happen given sufficient time (5-10years?) - an example of globalisation is that today people are starting to talk about the possibilities of diesel cars in the US, something unheard of a few years back, but there is some way to go.

In the long run Infineum believes that global tests are more important than global specifications.

Infineum's final maxim at the presentation was "Change is Constant".

Lastly, I would like to thank Infineum for all the help they provided for this feature.