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Welcome to the Infineum

PC-10 Development Notebook!

As an introduction to this notebook, we would like to offer a general description of the events shaping the development of this new category.

On September 1, 2002, API licensing commenced for API CI-4 category oils. These oils were designed to meet the needs of new engines with advanced exhaust emission controls to satisfy October 2002 emission limits. These limits were originally planned for implementation in January 2004. However, they were pulled forward for most of the OEMs offering Heavy Duty engines in the U.S. market as part of a consent decree that was agreed in 1998 between the U.S. Environmental Protection Agency (EPA) and a number of diesel engine manufacturers.

In order to meet the tightened emissions limits, most engine manufacturers implemented some form of exhaust gas recirculation (EGR) to control nitrogen oxides (NO_x). Also, oils designed to meet the performance requirements of CI-4 generally had high levels of detergents, dispersants, antioxidants and antiwear components to combat the deleterious effects of EGR on the engine hardware.

The next reduction in on-highway diesel engine emissions limits will occur in January 2007, and both NO_x and particulate matter (PM) will be reduced by an order of magnitude versus today's limits. However, while the PM reduction takes full effect in 2007, the NO_x reduction is phased-in over the years 2007-2010, and the full NO_x reduction is not implemented until 2010. The net effect is that virtually all HD OEMs are targeting a mid-level NO_x reduction for 2007-2009 and the full reduction in 2010.

Meeting the planned NO_x and PM reductions will require the use of both ultra low sulfur diesel fuel (ULSD) and some form of exhaust aftertreatment device. In response to the need for ULSD, the EPA is requiring diesel fuel suppliers to have 15 ppm maximum sulfur diesel fuel available starting in June 2006. Like the NO_x reduction, the availability of ULSD is also phased-in from 2007-2010, and this fuel phase-in has raised concerns over the backward compatibility of PC-10 lubricants.

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The reason for this concern is that virtually all OEMs plan to use some kind of diesel particulate trap to meet the target reduction in PM. Many of the lubricant components that have historically been used to ensure good engine protection may result in either the need for trap cleaning, or even reductions in trap life.

Ideally, all industry stakeholders would prefer to have some kind of performance test for an oil's impact on exhaust aftertreatment devices. However, both the short time available for PC-10 development and the poor experience of the light duty OPEST development activity have forced agreement that PC-10 will address aftertreatment compatibility by using chemical limits on the sulfated ash, phosphorus and sulfur (SAPS) content of finished lubricants. These limits will force PC-10 formulations to reduce the level of conventional detergents, antioxidants and antiwear components from their current levels in CI-4. For engines operating with ULSD, this concern is minimal, but for those engines that may continue to use 500 ppm max sulfur fuel, the concern is real.

PC-10 development activities are now well established. Although there was about a one-year "side activity" to establish a new CI-4 Plus designation, industry is now focused on delivering this new category by the third quarter of 2006. In that regard, there has been a formal request from the Engine Manufacturers Association (EMA) to the American Petroleum Institute (API) / EMA Diesel Engine Oil Advisory Panel (DEOAP) to develop a new oil category meeting the needs of engines equipped with exhaust aftertreatment devices.

The DEOAP formed a New Category Evaluation Team (NCET) to look at both the need and the feasibility of such a category, and the NCET concluded that it was both needed and feasible. The NCET was reconstituted as the New Category Development Team (NCDT) to manage the development of PC-10, and several test development task forces have been formed.

However, history shows that the development of a new diesel engine oil performance category is a formidable task – resource intensive and time consuming. While the EMA has proposed a slate of both new and carry-over engine tests to define PC-10, as of the third quarter of 2004, some of the proposed tests are not yet available. Since the API has historically required a one-year reformulation time before new category licensing, a third quarter 2006 first license timing will require all of the ASTM new test development work to be complete by the third quarter of 2005, or roughly one year from the issue of this notebook.

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Industry has certainly challenged itself, capping the matrix design funding for the proposed new tests at a new high for the automotive industry (\$3MUSD) to be funded a third each by the EMA, API, and ACC trade organizations. This staggering cost stretches what the industry stakeholders can afford, while trying to establish precision and base oil interchange guidelines in some cases for three to four new tests. The Matrix Design Task Force, established in late 2Q04, is currently working to design the most cost effective precision and BOI matrices to meet a matrix testing start date of January 2005. During the second half of 2004, the oils for the matrix must be agreed upon and blended, and the labs/stands identified for the matrix testing work.

Under these circumstances, conventional approaches to category development will not be adequate to meet the desired timing. Fundamental changes in the way we develop new tests will be required, and the EMA must identify the absolute minimum number of tests to define the performance needs of 2007 emission-controlled engines. Category development costs must be minimized, and the approval costs for PC-10 reformulation must be maintained at a reasonable level. This is not to imply that test quality can be compromised to reduce costs. In fact, quite the opposite is true. Industry needs high quality tests with excellent precision and discrimination. We should concentrate our efforts on the absolute minimum number of high quality tests to protect the 2007-2009 engine fleet.

PC-10 is expected to have a significant cost impact, adding as much as 20% to the total cost of HD oils. This is due to increases in additive costs and the cost to develop the category. Group II base stocks will likely be required due to sulfur limitations and the need for higher saturate base stocks. Some groups may be allowable, but use of Group I to meet the latest category is likely to be further limited. With 13% Noack as a base requirement, Group III stocks could also be used as correction fluids along with Group II Plus. Having the right base stocks available to meet industry demand will be something that industry must also watch.

It is difficult not to envision a repeat of the problems encountered with the introduction of PC-9. The proposed tests are not yet all developed, combined with limited availability of new engine builds for field testing and imposed chemical limits. This leads to challenges for developing oils to meet the new requirements, as

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well as ensuring the current tests being developed will be adequate to protect the final design of field engines being introduced in third quarter of 2006. It is highly likely that there will be additional – and potentially conflicting – additional OEM requirements, and that a PC-10.5 category could be needed similar to API CI-4 Plus. Longer term, an additional upgrade could be required only three years later to meet 2010 emissions. Can industry afford the cost to continue constantly upgrading oils as needs evolve?

The combination of enhanced engine protection with limitations on lubricant SAPS represents a major change in lubricant technology. Infineum fully intends to position our customers to take advantage of any opportunities that may develop during this time of revolutionary change in our industry. We are well positioned to extend our already strong diesel lubricant technology to meet the challenges and opportunities of PC-10.

As we did with the PC-9 Development Notebook, it is our intent to issue periodic updates to this document to keep you apprised of developments as they occur. Normally, these updates will follow meetings of the ASTM Heavy Duty Engine Oil Classification Panel (HDEOCP). However, any industry event that markedly has an impact on PC-10 development could also trigger an update.