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Whilst markets are recovering from the global decline of fluids sales in 2009, the metalworking fluids industry is facing unprecedented new challenges. The future key drivers of the market come in three major areas: regulation, application and innovation.

**Regulation in the metalworking fluids market**

The ever-increasing regulation is a growing burden to our industry, but should be seen as an opportunity for innovation and differentiation in the highly competitive market place.

Further to this, a number of cases have been reported, where metalworking fluid problems were highlighted to the Public and Governmental bodies. The two best known being the outbreak of lung disease at Powertrain UK in 2004, and the MWF mist exposure leading to court fines being imposed to Koyo UK in 2009.

What are the key regulations we can expect to have an impact on our industry?

REACH (Registration, Evaluation and Authorisation of Chemicals) is probably on everybody’s agendas and when you are reading this article, a number of deadlines will have just passed or need to be respected in the near future.

CLP is the European Regulation on Classification, Labelling and Packaging of chemical substances and mixtures. The legislation is based on the United Nations’ Globally Harmonised System (UN GHS). This came into force on 20th January 2009 and applies across the European Union. CLP is replacing the Dangerous Substances Directive (DSD) and the Dangerous Preparations Directive (DPD) in a step by step approach.

Within REACH an authorisation procedure is in place. During October 2010, 79 substances (among others formaldehyde) were intended to be submitted either by the ECHA (European Chemicals Agency) or EU member state authorities. 38 substances (e.g. boric acid) were on the candidate list, and 7 substances (e.g. SCCPs) are on an ECHA recommendation list for authorisation.

Biocides currently in use must be extensively tested for any dangers they present to humans or the environment or both. Since 2006, no biocide may be sold which has not been extensively evaluated. A new Biocide Directive will enter into force on 1st January 2013, and will incorporate the active involvement of the ECHA. The two-step authorization process will be retained; biocidal products based on new active substances and low-risk biocidal products will have access to an EC authorisation, instead of current authorisation at EU member state level. Data collection should become easier, and test results may be shared. Environmental criteria still need to be added to the new directive.

By 2020, the OECD estimates, we could be generating 45% more waste than in 1995. The EU’s Sixth Environment Action Program identifies waste prevention and
management as one of four top priorities. The European Union’s approach to waste management is based on three principles: waste prevention, recycling/reuse and improving final disposal/monitoring.

All of these regulations have an impact on the MWF market, such as:

- Reduced variety of fluids in the market
- Higher cost of raw materials, higher finished product prices
- Apparently ‘more dangerous’ labelling of products, although compositions unchanged
- New product formulations are triggered by replacement of raw materials due to standardisation
- Real innovation needs to be ‘out of the box’

Challenges from the application
What are the key trends in metalworking applications and their impact on the fluids?

The automotive industry is forecast to grow significantly in this decade. A recent study indicates an increase of global light vehicle sales by +46% (2015 vs. 2009), where most of the growth is expected to come from Asia and the Americas. The engine type in new cars will move away from solely combustion to hybrid and electrical. The Institute CAR of the University of Duisburg-Essen forecasts a 31% share of hybrids and electrical engines in global new cars by 2020, increasing to 65% by 2025. This will obviously have a great impact, as today 80% of automotive metalworking fluids are in engine and powertrain production.

In 1995, there was an average of 73 kg aluminium in a car. This has more than doubled to 157 kg in 2010. More alternative materials such as plastics and ceramics will replace metals where possible. Even so, more exotic materials will be used such as Platinum (fuel cell), Zinc, Palladium, Gallium, Copper, Magnesium, Aluminium, Titanium and Carbon.

In the aerospace industry a move towards composite ‘intelligent’ (transparency on command!) materials and lightweight carbon fibre for increased fuel efficiency can be observed. Fabrication of Titanium fan/compressor structures and Nickel-based turbine structures, realised through advanced computer weld modelling, makes them 10%-15% lighter than conventional single-piece castings. Smaller castings can be more ‘near net shape’, which means less machining and smaller machines. Productivity will increase due to use of high pressure and ultra high pressure fluid delivery systems. When machining turbine casings, you normally have to remove large quantities of difficult-to-manufacture materials (Inconel and Waspalloy) through a rough milling process. Ceramic turn/milling inserts offer opportunities to run 20 to 30 times the speed of Carbide, although at lower feed rates, resulting in productivity gains.

More generally, in metalworking manufacturing a number of trends are visible already today. New and to a certain degree existing processes may be done by dry machining where possible, this is, however, limited by chip removal and tool life. Microlubrication can also significantly reduce fluid consumption, but is limited to certain applications. Near net shape casting will allow producers to reduce cycle time and save on waste as well as fluids. High-speed cutting in order to increase productivity, at the same time machines and metalworking fluid systems are getting smaller, and the coolant pressure higher. These will present key challenges to future fluids. New processes such as flow forming and hydro forming are gaining ground. Flexible multi-tooling machines (vs. fixed production lines) are going to be the picture of future shop floors. Low carbon manufacturing (to minimize CO2 emissions) is on the manufacturers’ agenda. The machine tools industry’s commitment to ‘eco-design’ from 2012, aims to make machine tools more energy efficient. Last but not least, MWF users will probably have closer monitoring schemes and/or full fluid management programmes in place, as fluids and their related cost are representing an ever-increasing cost and Health, Safety, Environment impacts.

Water represents 90 to 95% of the fluid mix in a water-soluble metalworking application. It is already today a critical resource, especially in coastal areas, developing countries, but increasingly in industrialised countries. Increasing fluctuations in water quality, for example after floodings, can pose an obstacle in the manufacturing process. MWF users may be more reluctant to invest in water treatment facilities in the future, this would allow them to benefit through the increased quality of fluids and a more stable manufacturing process, resulting in a lower total cost.
What do all these trends mean for metalworking fluids?

Obviously, future fluids need to be even better performing in all aspects. New approaches, such as multi phase product systems, in use especially in the automotive industry, will probably evolve further. There will also be an increasing demand for new technology synthetic products. Due to the productivity gains and other trends, an overall lower market volume will be observed. This will partly be compensated by increasing output in some regions and industries.

Innovation as key driver

The above trends in regulation and application will make innovation in the metalworking fluids business essential in this decade. Only looking at two raw material areas, base oils and biocides, reflects well the challenges our industry is facing.

As to mineral base oils, reduced API Group I capacities are already leading to higher prices and substitution by API Group II or III oils, but having lower sulphur content, thus triggering complete reformulation of products. On the other hand, new engine oil specifications make it more problematic to still include Group I oils. And new capacities (Group II and III) in Asia and the Middle East are in place, reducing these regions’ need to tap Group I exports from Europe. Europe today is still home to 44 base oil plants, that primarily make Group I. It has zero Group II capacity (aside from a few re-refiners), and some Group III volumes only.

Re-refined oils are on the rise. The global supply in 2009 was 1.6 million tons, whereas according to Kline and Co. this will increase 3 million tons by 2019, and the potential market today is 7 million tons. The current regeneration technologies allow re-refiners to produce high quality API Group I base oils and in some instances Group II quality base stocks.

Biocides are undergoing ever-stricter regulation. In order to guarantee satisfactory bio-stability levels in water-miscible metalworking fluids, definitely, new ways of working need to be found. A recent study on endotoxins in MWF conducted by the HSE in the UK compares the biocconcept fluid technology with conventional (i.e. using biocides) technology. It concludes that in biocconcept fluids regular adjustment of concentration and pH is needed, and the ‘lead germ’ is only dominating, when the fluid is well managed. High concentrations of endotoxins were found, even when the fluid is well managed. Conversely, conventional MWF remained stable even when badly managed, a significant contamination by bacteria was observed only after a longer period and after adding excessive levels of tramp oil and swarf. Very low endotoxin levels were detected in the stable period.

An entirely new approach might be to use bacteriophages. They are small viruses that infect bacteria and kill them by multiplying and essentially filling the bacterial cell to bursting. They have been used for over 60 years as an alternative to antibiotics in the former Soviet Union and Eastern Europe and are seen as a possible therapy against multi drug resistant strains of many bacteria. In August 2006 the US Food and Drug Administration (FDA) approved using bacteriophages on cheese to kill a specific bacteria, giving them GRAS status (Generally Recognised As Safe). In July 2007, the same bacteriophages were approved for use on all food products.

Other methods being looked into are, silver coatings and nanotechnology. Currently, research is being conducted into biocides using nanomaterials that prevent biodeterioration when employed on the machines, these may be removed easily so they are compatible with subsequent biotreatment. There are novel nanomaterials which enhance the kill performance of conventional biocides. Hybrid methods which combine microbial biodegradation with advanced oxidation methods might be future options too.

Conclusion

Whether it will be triggered by new regulation, evolving manufacturing applications or new fluid technologies, the metalworking fluids industry is facing a decade full of changes and challenges. Fluids manufacturers have to follow closely the trends, and adapt their strategies accordingly. No doubt, it is time for ground-breaking innovation, and those who go first will probably finish first.

Christian Eyler
General Manager France & NW-Africa, Cimcool Europe BV

Sources and useful links

CAR (Center Automotive Research)
University of Duisburg-Essen - http://www.uni-due.de/car
HSE (Health and Safety Executive) UK - www.hse.gov.uk/metalworking
UEIL (Independent Union of the European Lubricants Industry) – www ueil.org

Biography

Christian was born in Germany and has a background in Production Engineering & Management. Following his early education in Germany he now holds an MBA in International Business, following studies at the Universities of Hamburg, Nuernberg and HEC Paris.

During this period of study he gained first hand experience in the petroleum industry with Shell Aviation and Shell Upstream in Central Africa. Following his studies he started his full time with Castrol Industrial, where he held a variety of positions in local and international sales management.

Since 2005 he has been working for Cimcool Europe as General Manager France & NW-Africa. Christian is the Chairman of the HSE&REACH commission of the French Lubricants Association CSNIL, and a member of the UEIL H&E Committee.

Christian is married with two young children and is 41 years old.