A platform for reduction

Ford is minimising environmental impact while maximising cost efficiency and performance at its Dagenham plant thanks to collaboration with BP. By Edmund Meyer and Jacque Cervantes

Reducing manufacturing costs, whilst simultaneously minimising the effect automotive production activities can have on the environment, seems like an impossible task.

Ford and BP have worked together for the last four years in a strategic cooperation primarily focused on being good corporate citizens. Both companies share a firm belief that energy providers and automakers working together, rather than independently, can develop better products to satisfy our customers' want for responsible, personal mobility. By leveraging each other's technology and innovations, each company can more quickly deliver greener products to market while at the same time minimising the footprint that their operations have on the environment.

With this in mind the Ford Engine Plant in Dagenham, UK approached the Castrol part of the BP Group to begin working on a joint initiative aimed at reducing the volume of lubricant, process wash and metalworking fluid waste generated from its manufacturing operations.

Zero waste

Joint teams from both Castrol and Ford were challenged with developing a new technology platform that would enable:

- Zero waste
- Zero depletion i.e., to be formulated largely from renewable resources
- Zero health and safety incidents
- Improved manufacturing performance (improve quality while reducing total cost).

To add to the challenge, this new technology platform had to ensure that on completion it:

- Could be deployed as a common solution across all of Ford's global powertrain operations
- Would at a minimum, not compromise but improve the performance of traditional lubricants, metalworking fluids and process wash chemicals
- Would not adversely affect the capability or performance of machinery and any associated sub-componentry.

Working closely together, Castrol and Ford have developed and optimised a total lubricants and coolants system suited to Ford's manufacturing processes. Castrol's total system approach focuses on ensuring the compatibility of the chemistry between interacting metalworking, honing, wash fluid and machine tool lubricants. This approach makes it possible to achieve a closed-loop system that significantly reduces chemical usage and any waste generated.

The success of the total system approach has been proved in a 12-month production trial at Ford's Dagenham plant. The Dagenham trial demonstrated that significant cost savings can be achieved by significantly reducing the volume of waste generated. This represents an important achievement given the nature of rapidly rising waste disposal to landfill costs.

The inter-compatible nature of the chemistry deployed has further added to savings by reducing the total volume of metalworking and allied products used in the manufacturing process. Annual savings totalling $200,000 have been achieved using this unique approach without affecting manufacturing performance and health and safety needs.

Stuart Burns, Technical Specialist, Manufacturing Engineering, at Ford says: "By working together Ford and Castrol have been able to develop a "zero-effluent" philosophy for the new 1.4/1.6 diesel engine facility at the Dagenham Engine Plant. By focusing on every area that fluids are lost in the system, and using advanced chemistry, it has been possible to recycle and reuse enormous volumes of fluids traditionally sent to waste.

"This philosophy is both cost and environmentally superior to any traditional fluid management system."

Total system approach

At the heart of the total system approach is the need to mitigate the negative impact of tramp oil on the performance of water soluble metalworking fluids. Hydraulic and slideway oil and other machine tool lubricant leaks will eventually find their way into metalworking fluids and are commonly known as tramp oils. By virtue of their incompatibility with metalworking fluids, tramp oils can have a significantly adverse effect on the life and performance of a metalworking fluid.

Products for efficiency and the environment

Castrol offers a wide range of environmentally-friendly products contributing to reduced mist, Volatile Organic Compound (VOC) emissions and waste (see table). Reduction in the total fluid usage in manufacturing is made possible through dedicated on-site condition monitoring equipment, employing compatible lubricant technologies and tailored service plans designed to extend the machining fluid life.

ENVIRONMENTAL ATTRIBUTES	BENEFITS
Chlorine-free	Reduces waste-related issues; easier SARA 313 reporting; reduces corrosion potential
Boron-free	Improves waste stream
Biodegradable base oils	Sustainable technology, biodegradability
MQL technology	Reduces VOC, waste stream volume
Low odour honing oil	Improves working environment
Dry-film lubricants	Reduces VOC, waste stream volume
Water reducible lubricants	Reduces VOC, reduces risk of fire hazard
Polymer quenchants	Reduces risk of fire hazard
Barium-free	Improves waste stream, heavy metal elimination
Water-based	Reduces VOC, reduces risk of fire hazard
Low VOC	Reduces emissions
OPERATOR-FRIENDLY ATTRIBUTES	**BENEFITS**
Secondary amine-free	Prevents the formation of nitrosamines in the presence of nitrites
Formaldehyde-free	Provides an alternative to formaldehyde condensate biocides
Neutral pH	Prevents staining of pH sensitive metals, reduces dermal (skin) issues
Zinc-free, heavy metal-free	Reduces dermal (skin) and waste stream issues

Systems subject to high levels of tramp oil create a number of problems. Tramp oils strip out the oil soluble components of water-soluble metalworking fluids; this ultimately leads to poor machining performance and excessive product usage. Typically tramp oil can de-stabilise a water-soluble metalworking emulsion or degrade it, creating an environment ideally suited to accelerating bacterial and fungal growth. Such conditions significantly reduce the performance of the water soluble metalworking fluid leading to increased oil misting, an increase in the emulsions average oil droplet size, and ultimately driving increased fluid losses via drag out in chips/swarf and filter media. More importantly, if left untreated excessive amounts of tramp oil contamination can render a water soluble metalworking emulsion unsuitable for use.

In addition, the ingress of excessive tramp oil can give rise to general housekeeping issues such as excessive smoking during machining and suspension of particulate in the emulsion, creating the potential for health and safety concerns and surface finish problems on components.

These symptoms are all common in the conventional approach to the use of metalworking coolants, industrial cleaners, neat cutting oils and machine lubricants such as hydraulic and gear oils which contain mineral oil as their primary lubrication means.

Common compatible chemistry

The Castrol total system approach uses a common compatible chemistry platform to formulate metalworking fluids, honing oils, cleaners and machine tool lubricants. This creates a closed-loop system where the compatible nature of these products virtually eliminates the issues associated with the non-compatibility of typical traditional non-compatible chemistries. Ensuring compatibility between the chemistry of Castrol's products minimises the potential for one product to undermine the performance of another product. This serves to significantly reduce the overall chemical usage and waste generated for the products described above.

By changing to compatible lubricants it is possible to replace water soluble metalworking fluid concentrate with the lubricant leaking into the water soluble metalworking fluid. The compatible nature of the chemistry used across the product platform described consequently ensures that any losses from hydraulic, slideway, spindle and other potential lubrication points becomes part of the oil phase of the water soluble metalworking fluid. The correct balance between the oil and water phases of the water-soluble metalworking fluid is maintained through the addition of emulsifying additives.

In systems with excessively high levels of hydraulic oil leakage it is not unreasonable to reach a point where a system's oil concentration becomes higher than desired. In these instances the excess is usually transferred to other systems for immediate use or to storage for future use as coolant make-up.

Only when system leaks reach levels in excess of the total water soluble metalworking fluid concentrate use, is it necessary for such excess to be dumped to waste.

Advancing the process requires a review of the parts-cleaning process. There is a significant amount of water soluble metalworking usage associated with wash systems. In a conventional wash process oily parts are cleaned in the washer. Tramp oil consisting of water soluble metalworking fluid, lubricating tramp oils, etc, are carried over into the washer and are removed via filter systems and sent to waste. Utilising the total system approach, the oily waste is recycled and re-used in the same manner that the machine lubricants are recovered and recycled in the coolant system, resulting in further cost savings through waste reduction and reduced chemical usage.

Value analysis

Castrol's total system approach offers a number of waste and product/tank-side additive usage reduction opportunities that translate into significant cost savings.

The following are some of the major benefits:

- Elimination of tramp oil and associated problems such as bacterial and fungal growth; destabilisation of emulsion; foul odour and operator complaints; addition of tank-side additives to control bacteria and other associated problems
- Increased performance through optimised usage of lubrication and other key product components
- Reduction in usage by reducing system dumps and top-ups
- Reduction in usage by recycling and recovery of lubricant oils
- Reduction in waste management costs as a result of the use of natural esters as the lubrication component across a range of compatible products.

Cost savings achieved through waste and usage reduction associated with moving from a conventional manufacturing fluid to a total system approach are based on compatible chemistry. ✱