Increased performance
through reduced wear
High-performance lubricants with plastic deformation characteristics significantly boost productivity and profitability

At Castrol, we have developed additive combinations for lubricants that generate a smoothing effect in the micro-range. These additive packages were launched under the names of Microflux Trans™ and TGOA™.

The basic idea behind Microflux Trans and TGOA is to improve surface quality without depositing or removing material. These state-of-the-art additive technologies adjust themselves selectively to changing loads in the lubricated system. The stressed surface is smoothed in the micro-range by an almost non-sacrificial, physical-chemical three-stage reaction. This is most active when it comes to countering gear damage and grey staining, where this micro-smoothing action offers very effective protection.

The three-stage process is also referred to as ‘Surface Engineering’ (SE) or ‘Plastic Deformation’ (PD) and was confirmed in various research projects by the FVA (Forschungsvereinigung Antriebstechnik – the German Power Transmission Engineering Research Association).

Our high-performance lubricants that contain either Microflux Trans or TGOA additives increase the contact area of the lubricated components by in some cases more than 80% when compared with conventional lubricants. That means a lower unit loading, leading to a lower coefficient of friction and reduced wear.

Switching to high-performance lubricants incorporating PD characteristics increases the profitability of your production through:

> Extended service life of machines
> Energy savings resulting from extremely low coefficients of friction and lower temperatures at the lubricating points
> Reduced maintenance because of minimised wear
> Higher availability of machinery owing to fewer failures and less downtime and repair work
> Reduced material, lubricant and disposal costs generated by extended relubrication intervals
> Prevention or elimination of running-in pitting
Surface topography

A new ground or lapped metal surface is far from perfect when viewed under an electron microscope. It appears like a mountainous landscape with peaks and valleys, as shown in the photograph. The rough surface of a work piece is clearly visible and is obtained by scanning the surface with extremely precise diamond sensors or a laser beam and then displaying the profile in a highly magnified form. This demonstrates that the roughness – that is, the difference between the highest ‘peak’ and the lowest ‘valley’ – can reach almost 2 μm.

Friction and wear always occur when two surfaces slide against each other, since extremely high pressures are concentrated on the relatively small area occupied by these peaks.

The three-stage reaction of plastic deformation

Stage 1: Formation of the protective layer

On the surfaces of a system lubricated with high-performance lubricants with PD characteristics, a pressure-resistant additive combination is immediately formed. This leads to the formation of a protective layer with a high lubricating effect.

Stage 2: Compression of the protective layer

With increasing load, this protective layer is compressed, becomes even more pressure-resistant and at the same time improves the coefficients of friction.

Stage 3: Micro-smoothing

The final stage signifies the actual unique performance of these lubricants. As the pressure increases further, special additive components migrate from the deposited protective layer into the structure of the metal surfaces, thus initiating the micro-smoothing effect. At the same time, reaction products are produced that contribute to the formation of extremely adhesive tribopolymers with excellent sliding properties. These form an additional extremely pressure-resistant protective layer.

During the smoothing effect the metal surfaces are levelled, which results in a considerable decrease in the coefficient of friction. The additive consumption is extremely low during this process.
The proven smoothing effect of lubricants with PD properties

Case 1: Gear wheels in drum drives

Picture 1 shows the pitting formation that covers almost the entire tooth area of the damaged drum drive after applying a conventional gear oil.

In picture 2, after 10,000 operating hours with a high-performance lubricant featuring PD characteristics, you can see that the existing damage is hardly visible because of the activated smoothing effect.

Case 2: Three-stage spur gear unit

Picture 3 shows progressive pitting formation with a CLPF 460 (AGMA 6EP) gear oil.

Picture 4 identifies the smoothing effect after one year of using a high-performance lubricant with PD characteristics.

As picture 5 shows, this condition remained stable after a further five years, and the lubricant that was applied prevented the formation of new pittings.

The additives of this PD package are oil-soluble and free of solids. This means that they are not filtered or centrifuged out and do not precipitate. Also, by carefully selecting the right PD additive combination, the additive concentration is not significantly depleted during the entire period of using the lubricant.
Clear advantages for your operations

Easier running-in

High-performance lubricants with PD properties can reduce the running-in periods of machines by approximately 50%. This allows running-in to take place under almost full load with a considerably increased seizing resistance. This delivers significantly higher operational reliability right from the start.

When comparing conventional gear oils with high-performance lubricants with PD characteristics, you will notice an immediate smoothing and a continuous improvement of the surfaces without running-in wear. The non-sacrificial micro-smoothing effect that is already activated in the running-in phase leads to improved rolling and sliding motions, which in turn result in reduced noise levels.

Extended lubricating intervals

Unlike conventional lubricants, the oil drain intervals of PD lubricants can be significantly extended. This ensures unimpaired performance with longer drain intervals, and provides optimum wear protection for long machine life. As a result, lubricant consumption is also considerably reduced.
Good wear protection

Subjected to heavy loads, friction partners lubricated with conventional lubricating oils soon reach the seizure range, resulting in severe damage of the surfaces. By means of the highly effective, pressure-resistant protective layer and the activated micro-smoothing effect of these high-performance lubricants, operating with extremely low coefficients of friction is possible. This in turn stops the friction partners reaching the seizure range.

Helpful temperature reduction

Thermal stress at friction points can have drastic consequences, not only for the machine units themselves, but also for seals, paint coatings and of course the long-term stability of the lubricant.

A decrease in temperature leads to a higher oil viscosity and, as a result, to a thicker lubricant film. A test carried out with high-performance lubricants featuring PD properties in a helical spur gear, lasting over 250 operating hours, proved that after about 100 hours, an almost constant temperature pattern was reached – which was about 10°C below that reached with a conventional CLP gear oil. This reduction in operating temperature leads to higher oxidation life of the product and a thicker film at the operating temperature, leading to lower wear.
Useful corrosion protection

Another task of a lubricant is to protect against corrosive influences. This need is fully met by high-performance lubricants with PD characteristics.

When we look inside a bearing shell of a gear lubricated with these high-performance lubricants, we can see a clean sliding surface as in picture 6.

However, the bearing shell lubricated with a conventional Extreme Pressure (EP) oil under the same operating conditions looks completely different. Here, large-surface corrosion damage is clearly visible, as can be seen in picture 7.