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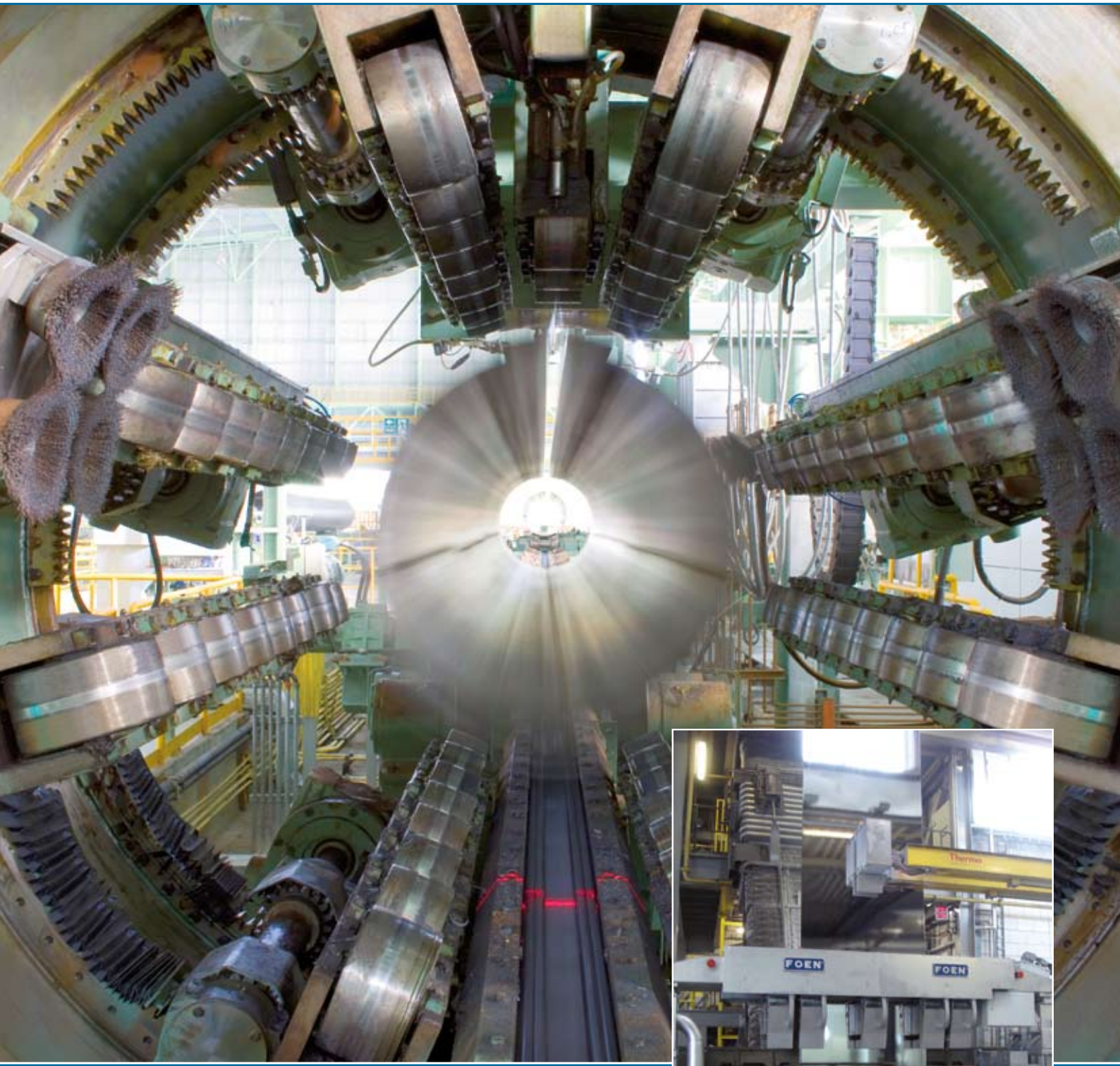

Non-contact electromagnetic strip stabilization for galvanizing lines

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High-performing greases for the steel industry

Greases using modern thickener systems offer very good water resistance, wear protection and heat resistance. Nevertheless, depending on the ingredients and the production process, the performance of these greases may differ drastically. Comparing common mineral based urea-greases available on the international market revealed significant differences between the products. Bechem, producer of lubricants since 1834, has recently developed a new urea-thickened grease which sets a benchmark.

Figure 1. **Base oils and additives for the grease are carefully selected at the Carl Bechem laboratories**

In the steel industry requirements on greases are very demanding. High temperatures, extreme mechanical loads and huge amounts of process water contaminated by abrasive particles as well as corrosive chemicals require high-quality lubricants. Additionally, to cut operational costs, to reduce residues of used grease in the plants and to limit the content of oil in the circulating water the operators are aiming at lower consumptions of lubricants.

Greases with a urea-thickener system are a rather new approach to meet these requirements. Today only 4 % of the global grease production is based on this technology even though thermal resistance is clearly improved in comparison to ordinary soap-thickeners. They may resist temperatures around 200°C; additionally, they often offer outstanding water resistance and wear protection.

Urea-thickeners are generated from a chemical reaction of diisocyanate with amines. Depending on the type of diisocyanate and depending on the types of amines and their fractions the result may be very different, not to forget the tremendous influence of the production process. This may lead to an infinite number of different characteristics even though the same base oil and the same additives were used.

Tests to validate grease performance

As for any other product, testing procedures for greases have to follow common standards to validate the characteristics of greases. Water resistance, wear protection and heat resistance are considered to be the most important parameters for greases in the steel industry.

To assess the **water resistance** of greases, the German industry standard DIN 51807-2 recommends the following test: a jet of water of 40 or 80°C is sprayed for one hour on an unloaded grooved ball bearing running with 600 rpm. Afterwards the bearing is dried and the loss of greases is evaluated by weighing. The weight percentage of grease wash-out gives information

Frank Reichmann, Head of Business Unit Heavy Industry, **Carl Bechem GmbH**, Hagen, Germany

Contact: www.bechem.com
E-mail: reichmann@bechem.com

about the water resistance. The lower the percentage of wash-out, the higher the water resistance.

The **wear protection** properties of a lubricating grease can be evaluated by means of a 4-ball-apparatus (according to German industry standard DIN 51350-5). For each test run 12 ml of grease are lubricating one upper ball and three lower balls. Loaded with a 1,000 N weight the upper ball rotates for 60 s at 1,420 rpm. Afterwards the wear groove diameters of the three lower balls are measured. The lower the wear groove diameter, the better the wear protection properties of the grease.

To evaluate the **thermal resistance** of a grease, Carl Bechem GmbH performs its own standard (CB-E-003) using a heated test pipe. Grease samples are pumped through the pipe heated to a definite temperature. After passing the pipe grease, samples are compared to fresh grease. Typical criteria are appearance, odour and worked penetration, the latter specified according to European industry standard DIN ISO 2137. The higher the **worked penetration** of a grease, the softer its consistency. Depending on their worked penetration, greases are classified by NLGI grades (NLGI: National Lubricating Grease Institute). The higher the worked penetration, the lower the NLGI grade. Typical bearing greases have worked penetrations ranging from NLGI grades 1 to 3 (220 – 340 mm/10).

All these tests are performed at the laboratories of Carl Bechem GmbH in Hagen, Germany. To optimise product parameters for the dedicated application in steel works, the products of Carl Bechem undergo most intensive tests in comparison with competitive greases available on the market.

Outstanding performance of urea-thickened greases

Berutox M 21 KN is a proven urea-grease for the steel industry, well known for excellent wear protection and water resistance. Passing the thermal resistance test at 200°C, it does not change colour nor does it separate any oil. However, a certain tendency to hardening is observed. The wear grove diameter is 0.77 mm (according to DIN 51350-5). Dynamic water resistance tests certify 9.4 – 10.4% weight loss for this grease. The figures of wear protection and water resistance are among the very best compared to similar greases. Unlike other competitive products tested in the Bechem laboratories, Berutox M 21 KN does not perform poorly in any of the categories. All in all Berutox M 21 KN shows very balanced properties.

As a result of intensive developments on urea-thickener systems, Bechem has introduced the new product Berutox M 21 HT. Water resistance and wear protection are as good as known from the M 21 KN grease. However, just from modifications on the thickener system, the new grease offers clearly improved temperature resistance. At 200°C, hardly any change was observed, and at 220°C only slight hardening occurred. Therefore, Berutox M 21 HT offers the best results in all categories.

Table 1 summarises the results gathered during the performance tests. The thermal characteristics of both greases are compared in figure 2. The worked penetration of M 21 KN drops clearly at 200°C and even leaves the range of bearing greases. M 21 HT hardly changes at 200°C and hardens slightly at 220°C. However, even at 240°C the consistency is still in the range of bearing greases.

Comparison testing with competitive products

Three other common urea-greases with similar base oils were tested and compared to the characteristics of the Bechem product. Even though all greases have comparable compositions, their performance differs clearly from each other.

One competitive grease is rather poor in water resistance and in thermal stability. At 200°C the grease becomes dark in colour, hardens strongly and separates oil. However, the wear protection is very good; the average diameter of the wear grooves was only 0.69 mm.

An other product performs completely different even though it is a urea-thickened grease, too, containing mineral oil of about the same viscosity. This second grease withstands a temperature of 200°C without changing, but it softens at 220°C and separates oil. Nevertheless, this is a good result. Additionally, the water resistance is good, too. However, the wear protection is extremely poor. An average wear groove diameter of more than 2 mm does by far not fulfil the requirement of an extreme-pressure grease.

A third product tested showed the poorest results in this comparison. Water resistance is poor and wear protection is disastrous. Only the thermal resistance is acceptable, but not very good either. It withstands temperatures of 200°C but disintegrates completely at 220°C.

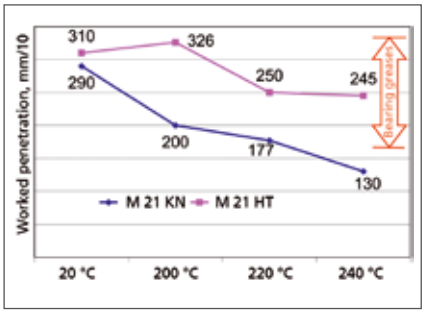

Figure 2. **Worked penetration characterising thermal resistance of Berutox M 21 KN and M 21 HT greases**

Conclusion

Outstanding performance does not result from any additive modification but has been obtained through an optimisation of the urea-thickener system. This clearly points out that urea-thickened greases still provide many options and will certainly play an important role for lubrication in the steel industry. ■

	Berutox		Best	Poorest
	M 21 KN	M 21 HT	competitive grease	
NLGI class	1 – 2	1 – 2	2	1
Hardening/Softening	Hardening at 200°C	Hardening slightly at 220°C	Softening at 220°C	Hardening strongly at 200°C
Wear groove diameter	0.77 mm	0.79 mm	0.69 mm	2.65 mm
Water resistance	9.4% / 10.4%	8.9% / 10.2%	8.3% / 9.4%	19.2% / 13.4%

Table 1. **Performance characteristics according to benchmark tests**