Meeting the demand for a stronger, lighter and more secure future

The role of process fluids in improving sustainability and productivity in aluminium rolling.

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A Dynamic Outlook for Rolled Aluminium

As the world strives for net zero, the adoption and growth of aluminium is being witnessed across multiple sectors, including renewable energy, transportation, construction and packaging. The overall demand for the green metal is predicted to rise 40% by 2030[1], and rolled aluminium is set to make a significant contribution to this growth.

In the e-Mobility industry, rolled aluminium is integral to weight reduction of the body in white, while demand for batteries and their critical foil component is expected to grow 30% annually[2]. Beverage cans represent another strong area of growth[3], partly due to the need for sustainable, plastic-alternative packaging. Considering that recycled aluminium production requires 95% less energy vs. production from ore[4], and that over 70% of all aluminium cans today are recycled[5], it's no surprise to learn that three new mills dedicated to can stock rolling are currently under construction in the US.

But accompanying this dynamic outlook are changing requirements for rolling fluids. Aluminium mills are facing more demanding applications, such as high strength metallurgical properties for automotive lightweighting; strict cleanliness for battery foils; and high surface quality for beverage cans. Rolling fluid development is being further driven by the demands for more sustainable chemistries and waste reduction, as well as the need to minimise risk against a backdrop of economic and geopolitical uncertainty. A deep understanding of both rolling processes and downstream aluminium usage, as well as supply chain resilience, has never been more critical for process fluid suppliers.

Pic 1. Beverage cans represent a strong area of growth for rolled aluminium, partly due to the need for sustainable, plastic-alternative packaging

Recent Trends in Metallurgical, Surface Quality and Cleanliness Requirements

Replacing steel components with aluminium is an important route toward lightweighting and efficiency savings within the transportation sector. However, despite its excellent strength-to-weight ratio, aluminium's tensile strength is significantly lower than that of steel. Consequently, close attention must be paid to the metallurgical properties of aluminium to ensure suitability for downstream processing, such as deep drawing. A key strategy to achieve this is to run the hot mills at higher coiling temperatures, however these conditions present challenges for traditional rolling fluid technology. In response, new chemistries are being implemented to provide lubrication and surface protection at high temperatures, more specifically,

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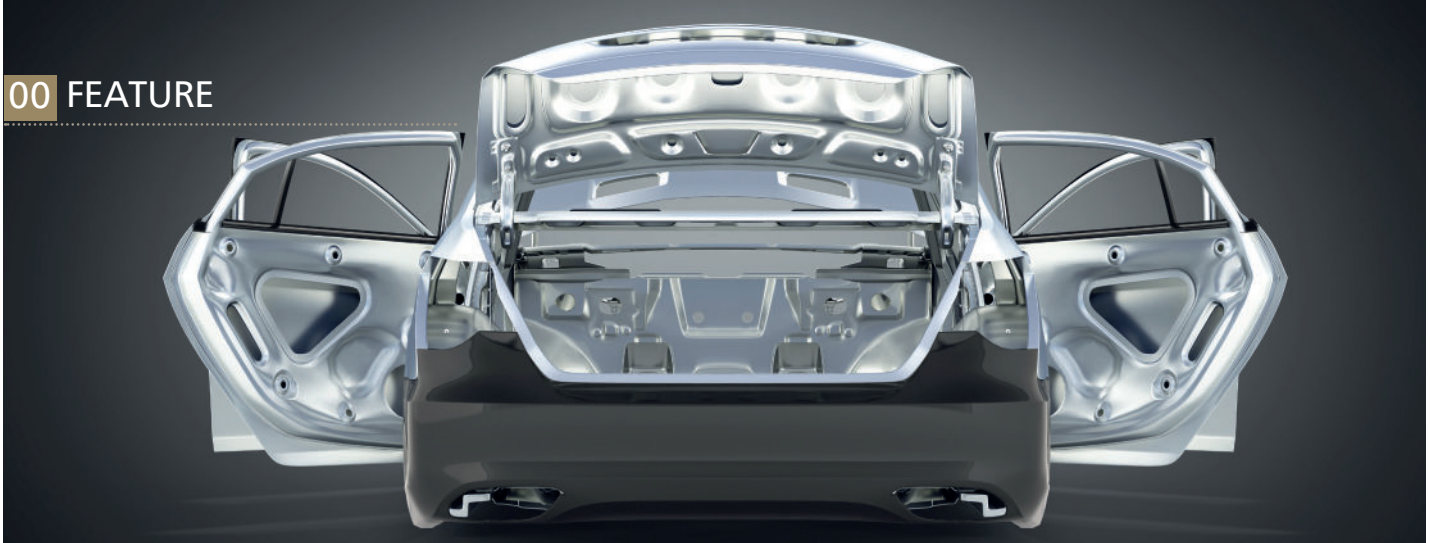

Pic 2. Rolling aluminium for automotive lightweighting applications requires process fluid chemistries that provide lubrication and surface protection at very high temperatures

ensuring that boundary lubrication compounds are effective at temperatures far exceeding 350°C.

Likewise, aluminium strip produced for beverage can body stock requires a progressive rolling fluid in order to achieve both the stringent surface quality and high productivity requirements. Visible surface defects known as pickup are unacceptable on beverage cans, so formulations must be tailored with a high level of lubricity and surface protection in the roll gap during hot rolling operations.

Perhaps the most challenging emerging application for rolling fluids is battery foil. Typically cold rolled to very thin gauges using kerosene-based fluids, battery foil not only requires a high level of lubrication, but also necessitates strict cleanliness requirements. There must be minimal oil or additive residue remaining on the strip surface, as this could affect the adhesion of the electrolytic coating that is integral to battery performance. The chemistry of the additive packages must be expertly tuned in order to meet these demanding specifications.

Although these applications present general challenges for the industry, each mill faces unique obstacles according to its individual processes and operations. Partnering with a rolling fluid supplier who is expert in both surface chemistry and the rolling process can enable the latest solutions to be harnessed and customised to maximise profitability.

Supporting Sustainability Goals

The primary sustainability challenge faced by the aluminium rolling industry is waste generation. The industry produces significant waste rolling fluid that must be either disposed of responsibly or recycled. However, the recycling process is extremely complex, time consuming and energy intensive, hindering its uptake.

Nevertheless, the industry is taking positive steps to reduce waste. Modern rolling fluids are designed to give extended sump life, helping to reduce both fluid consumption and waste. This is achieved by ensuring the formulation provides good cleanliness in operation – avoiding metallic soap build-up and sludge deposits – and offering good filterability. The ultimate goal of rolling fluid suppliers is to develop fully recyclable systems, and thanks to considerable R&D efforts and industry collaboration, this technology may be available in the not-too-distant future.

In addition to tackling waste, the industry is also reducing human health hazards. When formulating new rolling fluids, minimising product labelling is now a key priority to support safety during production, transportation, and usage. Risk can also be reduced by using inherently safer chemistries. For example, some mills are now taking an active interest in replacing kerosene with water-based lubricants in cold rolling applications to minimise fire risk. Similarly, more and more aluminium plants are switching from mineral oil-based to fire-resistant hydraulic fluids on site.

As promising as this progress is, there are no silver bullets for sustainability in aluminium rolling. Sustainability should be an ongoing conversation between fluid providers and mills, with strong collaboration required to protect both people and planet.

De-risking Development

Despite the ever-evolving fluid requirements for today's aluminium rolling industry, expert fluid developers are meeting and anticipating these new demands through both continuous product improvement and next-generation innovations. However, as with any form of change, the adoption of new technologies can carry associated risks. It's imperative that mills have confidence in trialling and implementing new solutions: new products must be proven, as well as innovative.

Through rigorous testing and real-world simulations, it's now possible for fluid developers to de-risk fluid upgrades for their customers. This approach is multi-faceted, combining modern techniques such as computer modelling with specialised lab testing such as roll bite mimicking, as well as conducting trials on pilot mills to understand and fine-tune performance in real rolling conditions.

Reliability and stability of supply is another common concern for the implementation of new fluid technologies. Recent years have seen economic and geopolitical turbulence that continues to disrupt supply chains. Global suppliers with strong regional presence are well placed to navigate these challenges. During new product design, multi-sourcing strategies for raw materials sit at the forefront of the development process alongside considerations for multiple production locations, helping support risk management for rolling mill operations.

Partnerships for a Productive, More Sustainable Future

Aluminium rolling is set to remain a highly dynamic market for the foreseeable future, presenting exciting opportunities for rolling fluid suppliers to develop truly game-changing solutions, with respect to both productivity and sustainability. By leveraging the latest innovations with rigorous testing capabilities and robust supply chain management, an experienced process fluid supplier is a crucial partner for the aluminium rolling operations of today and tomorrow. With this collaboration, rolled aluminium production is headed towards a stronger, lighter, more secure future. ■

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