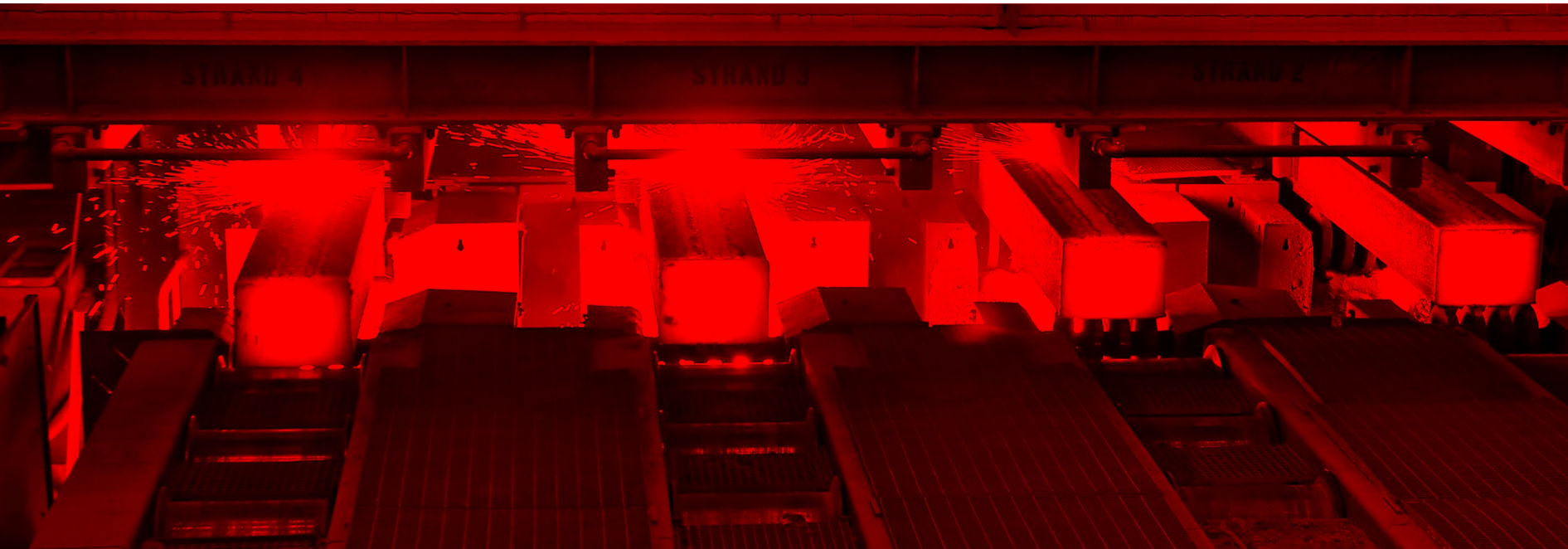




## Improving the isotropy of steels for automotive components subjected to multiaxial loadings



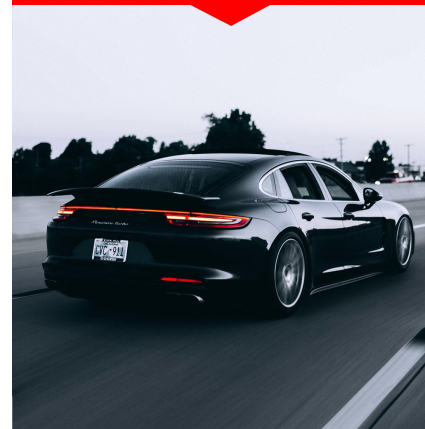
In ICE vehicles for  
**CO<sub>2</sub> reduction**



In BEV vehicles for  
**range extension**



In FCV because  
**space required**



Downsizing implies that **to keep the component performance, its properties must be improved.**

This is especially relevant in components subjected to complex loadings. In those cases, the **isotropy enhancement appears as a very attractive alternative to improve the performance**

- Machining costs represent an important part of the component total production costs
- **To reduce machining costs, S is added to the steel** in order to form MnS inclusions which present the following beneficial effects on the steel machinability:



**Lower power consumption**



**Shorter chips**

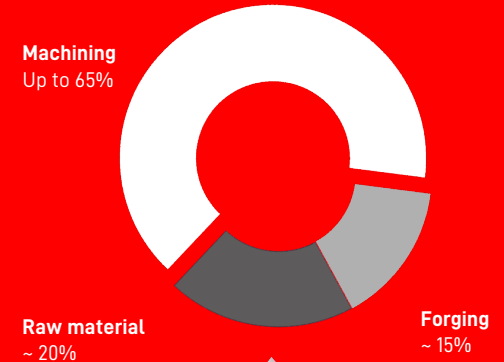


**Longer tool life**

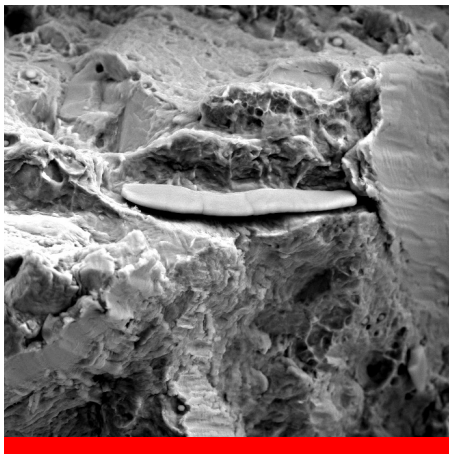
- After the steel rolling **the MnS are found as elongated inclusions**

<sup>1</sup>N. Anmark et al. "The effect of different non-metallic inclusions on the machinability of steels". Materials. Vol. 8, 751-783. 2015

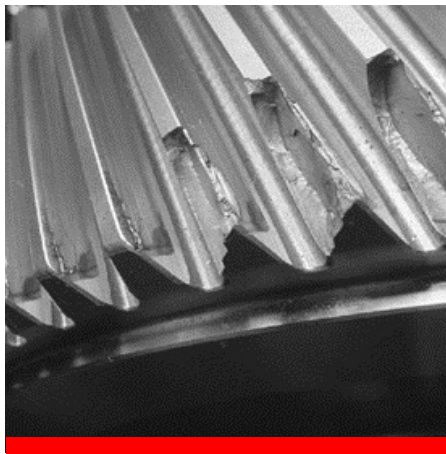
Example of the production costs distribution for an automotive piece (gear shaft)<sup>1</sup>



# Reasons to reduce the Sulphur content



The elongated shape of **MnS** notably deteriorates the steel isotropy



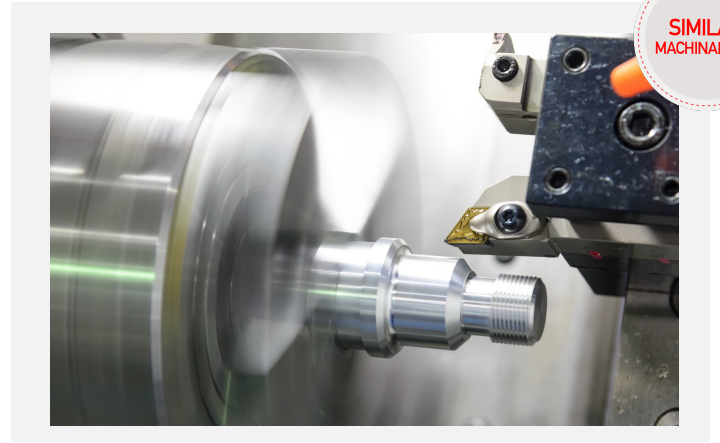
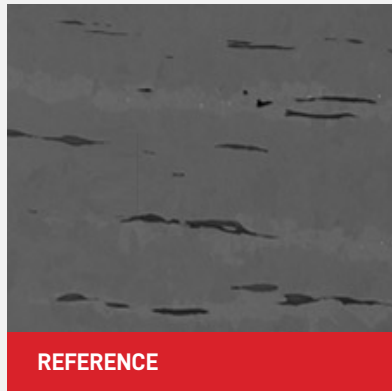
This deterioration is especially relevant for components subjected to multiaxial loads, increasing the risk of catastrophic failures



To avoid this problem **S content could be reduced**. However, this would deteriorate the steel machinability, drastically increasing the production costs

A compromise between the steel isotropy and machinability must be found

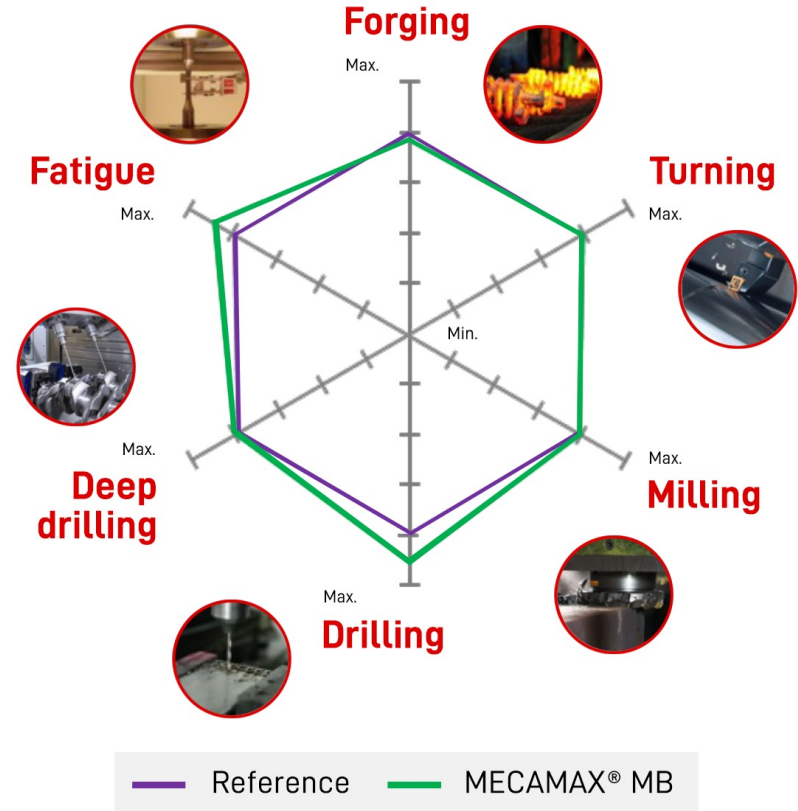
- The **MECAMAX® MB technology** is the innovative solution developed by Sidenor to face this problem
- This technology is based on the bismuth addition to the steel. The especial properties of the **bismuth inclusions allow to reduce the sulphur content**, improving thus the steel isotropy, **without deteriorating its machinability**

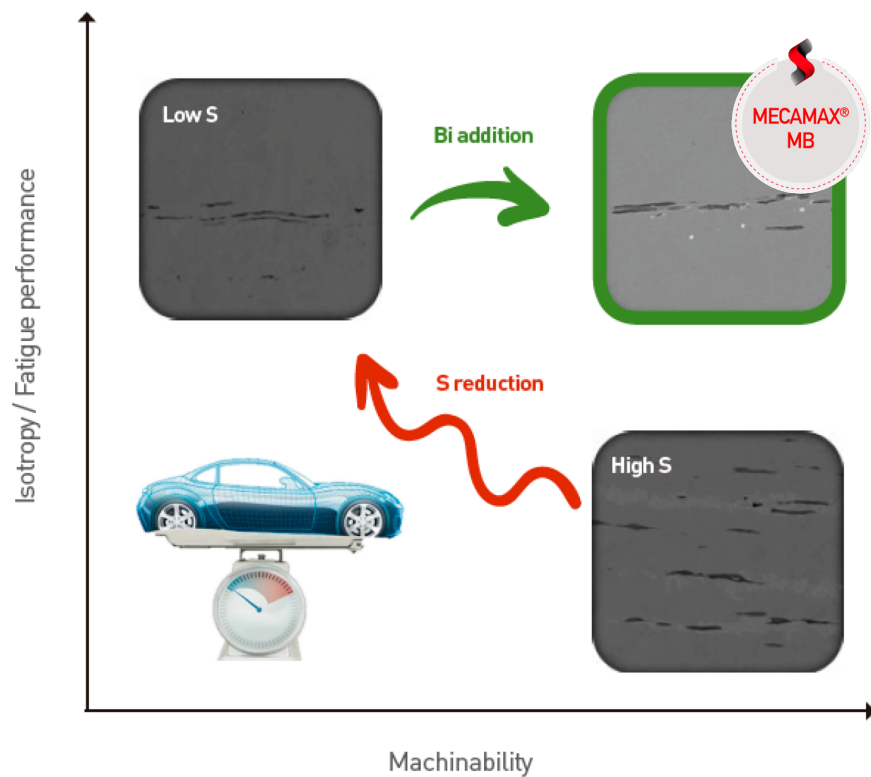




The results showed that **MECAMAX® MB** steel...

- is **perfectly forgeable** at high temperature
- presents **similar machinability** than the reference (even with notably lower S content) **in turning, milling and deep drilling**
- shows **better machinability in drilling**
- **increases the fatigue limit of the reference steel in about 10%**





**MECAMAX® MB:**  
**THE BEST COMPROMISE BETWEEN  
MACHINABILITY AND ISOTROPY!**



**Lower power  
consumption**



**Shorter  
chips**



**Longer  
tool life**



**Improved  
isotropy**



**Excellent fatigue  
performance**



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Thank you very much

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