Rolling resistance focus

Novel reinforcement solutions will remain a core component in new, lighter tire designs – helping to reduce rolling resistance and enabling the auto industry to meet future vehicle emissions targets

There are many research studies and projects underway aimed at reducing the rolling resistance of tires, but only a few of them focus centrally on novel reinforcement solutions. In terms of CO_2 emissions in the mid and long term, taking a global perspective will help us to understand the future challenges in the development of tire reinforcement.

Compounds are a central component of rolling resistance reduction. At first, it appears that reinforcement materials do not impact upon rolling resistance to the same extent that compounds do. However, if compound and reinforcement materials are considered as a composite, then reinforcement materials become an extremely crucial factor. This is due to the fact that using thinner reinforcement cords reduces the amount of the compounds required.

Another novel solution to reduce rolling resistance is to eliminate compounds entirely or apply the reinforcement without any compounds. Kordsa's continuous R&D efforts focus on reduction and elimination of compounds in tires.

The EU target of reducing fleet average CO_2 emissions to 95g/km by 2020 presents challenges for both automotive OEMs and tire makers. Even though today's average fleet emission levels do not look promising to achieve this target by 2020, EU authorities have even discussed an aim to reduce emissions down to 70g/km by 2025.

To reduce emissions – or even better, eliminate them – there are several problems that have to be solved. Table 1 shows the two potential targets and a road map to achieve them. As regulations become stricter than ever, ways to achieve them are becoming more difficult to find. Total elimination of CO_2 emissions is the ideal solution, however currently electric vehicles are the only viable option for doing so.

EVs are not new and many improvements to the technology have already been made by the industry. For example, vehicle range has increased greatly compared with five years ago and battery packs are 65% cheaper. Nevertheless, EVs still have a low penetration in the automotive industry – less than 1%.

It takes several decades for any new technology to achieve market acceptance in the automotive industry. Looking back through history, automatic transmissions, the airbag, navigation systems and hybrid vehicles have had deployment times of between 15 and 50 years. Regulations have become a driving force in accelerating the deployment of EVs. As authorities continue to implement new and more stringent standards, car manufacturers have increased the amount of research and development that is focused on the introduction of electric vehicles.

According to analysts, investment in electrical engines is a much more economic option to achieve future emissions levels of 70g/km by 2025, compared with investment in conventional engines. In fact, many major OEMs have already switched the focus of future R&D from internal combustion engines to EVs. A recent study conducted by KPMG confirms that the rate of introduction of EVs has greatly increased over the past five years.

In future, rolling resistance will therefore remain a central focus for tire and automotive companies. Shared mobility will reduce the total cost of mileage of EVs, however, energy losses must still be greatly reduced.

Tires are claimed to be the industry's easy target for improving vehicle fuel efficiency and reducing emissions – rather than the development of other components.

Tire companies have collaborated on the reduction of rolling resistance for many years now and have achieved considerable improvements in end-products with the help of raw materials innovations and intelligent tire design. Rolling resistance had been considered an area of compromise in favor of other essential performance parameters, including wet grip and mileage.

Tests conducted by OEMs of tall and narrow tires, compared with traditional tires, have shown a quantum leap in the reduction of rolling resistance – by around 15% – with good results in other performance parameters.

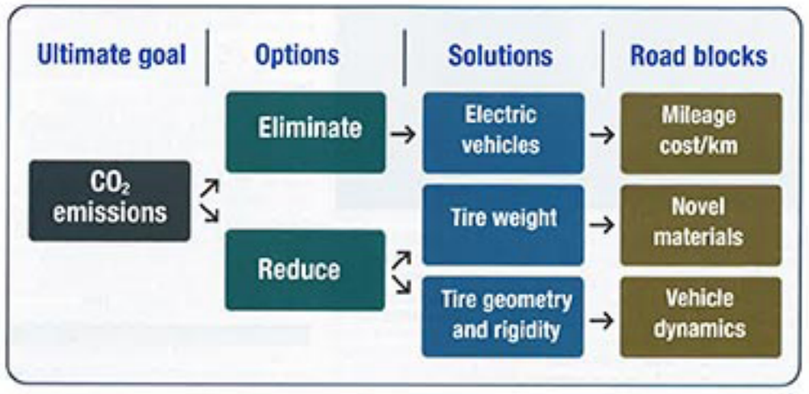
However, rolling resistance also has an impact on vehicle dynamics. Here, vehicle design plays an important role to ensure it does not have a negative impact – therefore it is predicted that the introduction of tall and narrow tires will not be fast.

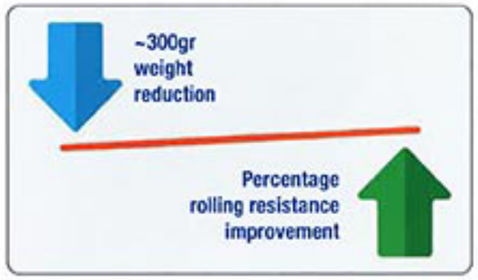
It is expected that most of the automotive OEMs will not meet the EU emissions target by 2020. This indicates that manufacturers will be looking for new and emerging solutions to decrease their fleet-average CO_2 emissions.

As already noted, investment in conventional powertrains may not be a desired option. Therefore, improvement of the rolling resistance of tires for ICE cars will be a crucial solution to meet these targets.

A reduction in tire weight will prevent hysteresis losses directly or indirectly. The hysteresis of a rubber compound is the controlling factor for rolling resistance, therefore a reduction in the rubber compound required is essential. Here, the focus has been on the tire tread. Rubber compound is also applied to cover the reinforcement materials in the tire. Rubberized components include the carcass, cap-ply, steel belts and bead.

Below: Various methods are being adopted by the auto and tire industries to meet future EU emissions targets





Above: The relationship between weight reduction and rolling resistance improvement when using Kordsa's Capmax

It is possible to reduce the amount of compound by applying higher modulus NY66 cords in the cap-ply and higher tenacity PET cords in the carcass. Advanced NY66 cord designs, produced by twisting heavy dtex single yarns, are enabling ultra-high levels of performance. This advanced cord design results in 20% less cord gauge and a 35% higher modulus that enables a huge reduction in the compounds compared with regular NY66 1400/2 cord constructions.

Ready-to-use cap-ply materials, such as Capmax from Kordsa, can also be used to eliminate compounds used in reinforcement. Thanks to the application of this innovative cap-ply material, a reduction of up to ~300g in tire weight can be achieved. Since there is no compound to lead hysteresis, a positive effect is observed in the form of a ~4% reduction in rolling resistance. Depending on the test, tires with Capmax perform the same as tires with conventional rubberized cap-ply.

Pioneering new reinforcement materials – such as Kordsa's Capmax – are leading the way to help reduce rolling resistance and will continue to play a central role in the development of tires for future vehicles. **tire**