

A QUESTION OF SAFETY

A former top safety expert with General Motors in the United States, Dr Mukul Verma says intelligent' tyres and lighter vehicles could contribute to sustainable mobility. As an automobile safety consultant and adjunct professor on intelligent transportation systems, he draws from several decades of experience in the automobile industry to spell out current thinking on tyre and vehicle development

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When over 40 children in the United States died this year inside cars that were left in hot summer, one of the automobile safety experts whom child advocacy groups contacted to seek advice was Dr Mukul Verma.

A well-known expert in auto safety and crashworthiness, vehicle structures, product design, and statistical analyses of traffic trends and regulations, Dr Verma is a consultant engineer, management expert and an academic.

In this interview the former top safety engineer with General Motors, who has led industry-wide R&D projects in advanced technology evaluation and implementation such as hydrogen fuel cell vehicles, telematics systems, pre-crash sensing and 'smart' systems for vehicle safety, elaborates on measures that should be taken to gain sustainable mobility along with safety.

"In order to be successful, steps towards sustainable mobility must be taken by all the stakeholders – customers, manufacturers, governments, scientists



Dr Mukul Verma

expressed that this step of making all automobiles lighter would mean reduced safety for the driving public.

"This view is simplistic and unnecessarily alarmist. There are several possibilities for moving towards sustainable mobility without increased risk of vehicle-related injuries and fatalities," Dr Verma explained.

Referring to the scientific principle cited in 'lighter vehicle means reduced safety' he

"One way to reduce this risk to smaller cars is by reducing the current weight discrepancy and the incompatibility between vehicles on the road," Dr Verma argued.

This is best achieved by governments through explicit regulations or through taxation policies based on vehicle size and/or fuel consumption.

Reduction in the number of crashes is also achieved by better infrastructure and traffic control policies. In some growing economies, this will also reduce a big part of traffic fatalities – those of pedestrians and cyclists hit by cars.

Reducing risks

"Another way to reduce risks to occupants of cars as these get smaller is to improve the level of occupant protection in these vehicles," he said. This improvement in occupant protection technology has been a trend over the last few years and the newer automobiles generally provide better safety than the older ones.

"I believe that the technology improvements in this direction will continue. There is – and should be – an increasing emphasis on reducing the number of crashes." This could be achieved by governments with improved traffic management and by manufacturers with the implementation of crash avoidance systems and look-ahead pre-crash safety systems.

The concept of 'intelligent transportation' has been explored by several groups but has not been successful on a mass scale yet. This needs to be modified into a 'distributed control' model where the vehicle's control is based, to a large extent on the parameters sensed by the vehicle ('local control') with only a minimum necessary set from a 'central' control system.

However, it should be emphasised that achievement of sustainable mobility requires more than just lighter cars. Even propulsion systems such as electric



DUMMY TEST: Safety simulation tests using dummies are getting sophisticated

and engineers," he told **Polymers & Tyre Asia**. "One immediate step towards this of course is by reducing the consumption of petroleum and one way of achieving this is by reducing the weight of automobiles."

Sometimes, concerns have been

referred to the issue of a small car getting struck by a larger vehicle. The occupants of the smaller car are likely to suffer higher levels of injury, all other factors being equal between the two vehicles. But all other factors need not be equal.

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Sometimes, concerns have been expressed over making all automobiles lighter as that is perceived to reduce safety for the driving public. This view is simplistic and unnecessarily alarmist. There are several possibilities for moving towards sustainable mobility without increased risk of vehicle-related injuries and fatalities

cars are only temporary solutions if the electricity needed to charge them still comes from non-renewable fuels. "Concepts such as fuel cells need to be further expanded," he reasoned.

Structural strength

Commenting on new steel products that are being developed that offer strength and further lower vehicle weight thereby contributing to higher fuel-efficiency, Dr Verma said that the use of such materials should be further explored.

"Several formulations of high-strength steel (HSS) and advanced high-strength steel (AHSS) have been available or are being developed for automotive applications. As these become available, they need to be explored in vehicle designs," he felt.

One of the problems with high-strength steel has been the difficulty in making stamped parts because of the 'spring-back'.

These and other new materials may help in further reducing the mass of today's automobiles. But other engineering advances in developing efficient structural

designs are also needed and will help reduce the vehicle mass.

Other possibilities for reducing fuel consumption in today's cars also need to be explored, he advocated.

"As an example, a significant portion of the total available energy of gasoline remains unused or is wasted in today's automobiles. Some of this is in the form of inefficient combustion but there are also losses in the power-train and in the tyres."

Technology that helps reduce these unwanted losses will further advance the fuel efficiency of vehicles and contribute to sustainable mobility.

Role of tyres

Dr Verma said automobile tyres will play a growing role in ensuring safe and efficient transportation. All tyre manufacturers are experimenting with new materials and new designs which will maximise the traction and stability while minimising the energy loss due to road friction or tyre flexion.

Other desirable characteristics of these tyres – lower levels of noise, higher levels of damping and reduced vibrations

the road and the vehicle, it makes sense that conditions such as loss of traction be sensed by making measurements in the tyre. 'Intelligent tyres' promise major advances in automotive transportation in the future.

"If the dynamic state of the vehicle tyre and of the tyre-road interface can be measured, these data can be used to activate and enhance vehicle control such as braking efficiency, lateral stability, roll stability etc. And when combined with actuators that can change parameters such as tyre internal pressure, this can also be used to optimise fuel efficiency."

Thus, the promises of increasing the vehicle safety and enhancing its fuel efficiency simultaneously need to be developed through this technology. "With Professor Vladimir Vantsevich (**see story on page 74**) I introduced a course in 'Intelligent Tyres and Vehicles' in the Mechanical Engineering department at the Lawrence Technological University. This combines many of the disciplines required to develop tyres which sense the necessary information and interact with the vehicle dynamics control systems," Dr Verma explained.

He hoped that this technology will continue to be developed commercially sometime in the near future and provide the solutions for improving fuel-efficiency and passenger comfort as well as their safety.

Commenting on the key factors that tyre and vehicle designers should always keep in sight while developing modern products, Dr Verma said that these factors for tyres are the same as those for any mass-market consumer product – the ability to deliver the required functionality with a high degree of reliability at minimum cost.



CRASH TESTS: Vehicle engineering aims to produce safer cars

into the vehicle – are also continuing to improve.

"However, it is expected that the current 'passive' role of pneumatic tyres will likely to grow in the future into that of more 'active' systems which 'sense the vehicle's operating condition' and 'control the dynamic parameters,'" Dr Verma said.

Since tyres are the interface between

There are two aspects to tyre reliability – the first is of designing tyres to perform reliably under the expected operating conditions and the second is of ensuring manufacturing quality, he explained.

Tyre manufacturers are implementing innovations such as computer-aided engineering and finite elements analysis at early stages of tyre design. These enable the evaluations of multiple

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aspects of tyres' dynamic behaviour under expected loading conditions and help improve their reliability in the field.

Other operational measures such as internal pressure monitors and tyre wear sensors help customers take steps when repairs or replacements are necessary.

The future possibility of having intelligent tyres with embedded dynamic sensors on all automobiles will be another big step

towards ensuring the reliability of tyres in the field.

Commenting on the future trends in pneumatic tyres, Dr Verma said that in the near-future, the changes are likely to be evolutionary with improved material formulations and with better construction techniques. Some of the needs today are for tyres with higher damping properties and for lower energy dissipation.

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Concepts such as 'Tweel' are admirable because they show a spirit of innovation and willingness to experiment although the 'Tweel' itself is unlikely to play any significant role as an automobile tyre because of the inherent problems of noise, vibration, heat generation etc.

"But other materials and construction techniques will emerge which will help solve some of these problems," Dr Verma thinks.

The biggest advances are likely to come from 'intelligent' technology which can sense tyre parameters and tyre-road interface dynamically and respond by adjusting appropriate variables in the tyre, the suspensions and the vehicles to optimise economy, safety and comfort.

"In order for this to be commercially feasible, advances in fabricating appropriate micro- and nano-sensors and in linking their output to processors on board the vehicle are necessary," Dr Verma noted. ▲