

Sumitomo makes breakthrough with 'noise-absorbing sponge'

Noise reduction technology is a hot topic among tire engineers. During the recent International Tire Exhibition and Conference in Akron, Ohio, Naoki Yukawa of Sumitomo Rubber Industries Ltd. gave a presentation on how his company has succeeded in reducing tire cavity resonance. In January 2006, Sumitomo Rubber Industries Ltd. (SRI) in Japan released a tire with sponge that absorbed tire cavity noise. Together with existing noise reduction technology, SRI succeeded in reducing cavity resonance due to the resonance of air inside the tire that till now had been very difficult to eliminate. Through this technology, SRI was able to give a tire unprecedented silence.

This new noise reduction technology is applied to the Dunlop Le Mans S LM703 range, which is sold as an aftermarket product in Japan. The positioning of this tire in the Japanese aftermarket is as a general-purpose tire which has balanced handling and driveability. It is one of the main product lines of Dunlop for car models ranging from compact car, through minivan to luxury sedan, and resides in a category where competition is intense.

Recently, marketing research results for summer tire performance suggest that there is a requirement for refined characteristics and safety in Japan. SRI paid special attention in particular to the noise performance that was required for comfort and satisfaction for a user. Users were requested to: see and understand it, touch and understand it, ride and understand it. As a result, Sumitomo Rubber Industries' advanced technology was used to develop a special low noise tire that included the world's first noise-absorbing sponge.

TECHNOLOGY

There are three main factors influencing the noise inside of a car.

- Pattern noise (pitch noise) of 100-500Hz band.
- Road noise of 125-315Hz band.
- Cavity resonance of 200-315Hz band. (The cavity resonance is a noise of narrow frequency band caused by resonance of the air inside the tire.)

APPROACH

Reduction of these noise characteristics was examined, while considering the following questions:

1. Is it only necessary to delete the noise characteristic that is most dominant?
2. Does the secondary noise now become dominant if only the formerly dominant noise is eliminated?
3. Is there another case that subsequent noise characteristics become unacceptable when the primary sources are eliminated?

Ultimately therefore, it was decided to attempt to reduce all three main noise factors significantly. The following three technologies were adopted:

- a pattern noise improvement – to reduce the pattern noise in the 100-500Hz band.
- a PEN (Polyethylene naphthanate) combination cap-ply to reduce road noise in the 125-315Hz band.
- a special sponge material which absorbs noise to reduce cavity resonance in the 200-315Hz band.

Through this, a noise reduction result was achieved that could easily be detected by a general user. *Pattern noise (pitch noise) improvement pattern:* The

flow of a pattern is regarded as important when designing a pattern for low noise generation. Additionally it was planned to reduce pitch noise by adopting five kinds of random pitch. With simulation, optimisation of a shift in the pattern to further reduce pattern noise was also incorporated. As a result, the LM703 was able to demonstrate a significant improvement in pitch noise over the previous LM702 in the 100Hz-500Hz band.

PEN combination cap-ply layer to improve road noise: PEN was adopted as a cap-ply layer to reduce road noise mainly in the 160Hz and 250Hz range. Polyethylene naphthanate is a high strength fibre, being some four times higher than general nylon. Road noise was able to be reduced by adopting this material as the cap-ply. The reason that this is effective in noise reduction of the 250Hz band is that the power to restrict the edge part of a belt increases by adopting this material as a cap layer. As a result, resonance of a tire can be shifted in a higher direction from the neighbourhood of 250Hz where the noise was easily generated by the vehicle. Consequently, 'Gaa' Noise is reduced significantly in the 250Hz region. The reason that this is also effective in the 160Hz band is that there is a resonance related to the tread twisting mode in this frequency band. Again, power to restrict the edge part of a belt increases by adopting the PEN material as a cap-ply layer. As a result, the tire deformation due to this resonance can be suppressed and 'Goh' Noise can be reduced in the 160Hz region. As discussed, it is necessary to restrict the edge part of the belt to show noise reduction effects. On the other hand, the need to restrict the centre part of the belt is small. In addition, power to restrict the belt centre becomes high when PEN is used for the entire cap-ply. This results in high tread rigidity, and ride comfort is degraded. Therefore, a normal nylon cap-ply layer is used for

the centre part of the tread with minimal effect on the noise reduction. It is a so-called combination cap-ply layer structure and is compatible with both noise performance and ride comfort.

Technology to eliminate cavity resonance: The technology eliminates the noise due to the resonance of air inside the tire, by arranging a sponge material in the tire cavity. The effect of this is great and can completely erase the cavity resonance peak in the 220Hz neighbourhood. Till now, the technique used to improve this noise was by lowering tread strength. However, in many cases improvement was difficult since handling was often reduced in exchange. Additionally, in recent years noise reduction technology of vehicles has also developed and become very sophisticated. However, because this particular noise was a peak, it stands out from the surrounding background noise and becomes a problem. So using this technology, SRI has succeeded in completely erasing the cavity resonance that was difficult to improve by changes to the structure of the tire. For the shape (of the noise absorbing sponge material), a double humped profile was adopted which was compatible both with the effect of absorbing noise and also with durability. The material adopted was a special ether polyurethane sponge having both light weight and durability. Several types of material were evaluated, but considering performance from the point of view of the severe environment inside the tire and from the consideration of cost, it is believed that the light weight sponge material is the optimum. The placement position of the sponge was selected as the underside of the tread by using SRI simulation technology. This is because vibration of air in that region is large. These simulation techniques were also extremely useful in deciding an optimised shape for the sponge in the tire on a size-by-size basis. The LM703 shows a noise reduction effect of

about 3dB in comparison with the old pattern LM702 on a smooth road surface. On a specific road noise generating surface, there was a noise reduction effect of about 4dB.

A new product, the Dunlop Le Mans LM703, was released which concentrated all the noise reduction

technology of Sumitomo Rubber Industries Ltd. in to the one tire. This tire was able to significantly reduce noise generation when compared with previous conventional technology tires. Sale of this tire range was started in January 2006 in Japan. So far, LM703 sales are good and the reaction from the market is good, too, it is reported.

SUVARNABHUMI RESIDENTS

Residents around Suvarnabhumi Airport, Thailand, are blocking roads as a way of voicing their frustration over the noise pollution being produced by the new airport. As a consequence, the Deputy Prime Minister and Finance Minister, M.R. Pridiyathorn Devakula, has sent a team of people to study the facts of the case, and the result is expected to be concluded within a week. M.R. Pridiyathorn then will find proper solutions such as compensating the affected residents. The Airport of Thailand (AOT) will be responsible in providing the compensation, according to an official statement.

SAMSUNG VACUUM CLEANER

Samsung Electronics Co's bag-less vacuum cleaner "Stealth" is a result of Samsung Group's "creative management." Bag-less cleaners come without paper filters, enhancing consumer convenience as the filter does not need to be changed or disposed. The cleaner, launched last month in the domestic market, is designed to produce the lowest sound possible. It generates a 59-decibel noise, which is several times lower than other cleaners. In comparison, washing machines generate 57.8 decibels during the drying process and hoods on gas ranges 59 decibels. "Its name came from the Stealth jet. The Stealth cleaner avoids unnecessary noise just as the Stealth jet avoids areas deemed dangerous," said Joo Jae-man, a principle engineer at Samsung's digital appliances R&D centre. Joo has been studying noise and vibration levels for cleaners for the past 10 years at Samsung. The cleaner resulted from a reversal in thinking by a team of engineers. Conventional methods used to find the cause of a noise and minimise it with materials that absorbed sound. "But we approached the matter differently by setting a very low imaginary sound level. Using the imaginary level, we made 20 cleaners with very slightly different sound levels. We tested these products in France and Germany and found the best possible noise level and tested it on European consumers," Joo said. But the result was rather different than expected. European consumers found the sound displeasing because it was too low. Engineers therefore arrived at a point where consumer demand met industry demand at 59 decibels. "Users can now watch TV, chat or make calls while cleaning. Thanks to our engineers who majored in computational fluid dynamics, we could minimise sound in frequency bands while retaining proper booster sound. This balance will deliver to consumers a sense that the product has strong absorption power with minimum sound," he said.

AVIANO AIR BASE

Mayors from five communes around the US air base at Aviano, Italy met last month to talk about noise pollution, with much of the emphasis placed on the sounds coming from the base. A study has been commissioned to try to quantify the noise. "The process has nothing to do with trying to find a way to get the base to leave" said Renzo Liva, mayor of Roveredo in Piano. Though the base is not the sole target of the study – experts also will monitor emissions from industry and other sources – it is clearly the focus. But it isn't being singled out because it's used by Americans or by the military. The evaluation is similar to ones being conducted across the country around all airports, the mayors said. Riccardo Berto, the mayor of Aviano, said the five communes agreed to provide information to the region and environmental agencies in order for the study to be conducted. He said it was "premature" to discuss the impact the study could have on such things as new construction in the affected areas. The initial part of the process will be to map out areas where the noise is the loudest. Unless the Italian military decides to alter the routes that planes fly around Aviano, it's likely that no new residential construction would be allowed in those areas.

NAVY JET

More than a third of the 2,000 homeowners who sued the U.S. federal government over Navy jet noise have agreed to accept part of a \$38 million settlement, and others appear ready to settle, plaintiffs' lawyers recently announced. Lawyers representing the homeowners have until mid-January to persuade at least 96 percent of the plaintiffs to accept the settlement or it will be void. The median settlement per household is expected to be about \$5,000, said Kieron Quinn, a Baltimore lawyer who represents some property owners. At least one home-owner would receive \$50,000 or more if the settlement is finalised, Quinn said. The homeowners, who live near Oceana Naval Air Station in Virginia Beach and Fentress Naval Auxiliary Landing Field in Chesapeake, filed lawsuits against the federal government from 2001 to 2004. The lawsuits stem from the 1998 and 1999 arrival of the Navy's F/A-18 Hornets at Oceana. Homeowners said the jets – which are noisier than the F-14 Tomcats they replaced – subjected their homes to substantially louder noise, which devalued their property. According to appraisers, plaintiffs' properties appreciated at a lower rate than similar properties in the city outside jet-noise zones. The plaintiffs say this resulted in the government "taking" their property without just compensation.

BRISBANE SECOND RUNWAY

Residents living in some of Brisbane's (Australia) most exclusive suburbs will be forced to endure the roar of up to 55 low-flying planes a day if the federal Government approves plans for a second runway at the city's domestic and international airport. Brisbane Airport Corporation has released its environmental impact study on the proposed \$1 billion runway, revealing prime suburbs such as Hamilton, Balmoral, Bulimba and Ascot would be worst hit by the increased plane noise. Although residents and politicians fear the runway – due to be completed by 2015 – will cause real estate prices to drop, the corporation in charge of one of the nation's largest private infrastructure programs disagrees. According to BAC's environmental impact study, the new runway and the additional 60,000 flights expected over Brisbane by 2015 will have no significant effect on real estate prices, the environment or public health. Not even a plan to dredge 15 million cubic metres of sand from nearby Moreton Bay to use as landfill was found to be an environmental issue. BAC chief executive Koen Rooijmans said the new runway would allow for tens of millions more passengers every year by 2035, generating about \$5 billion a year for the Queensland economy.