Hybrid Polyfoam T Ultimate: an efficient chips urethane based green & light insulator

A. Duval, M. Goret, D. Lemaire, G. Crignon

Treves Product, Services & Innovation, 2-4, rue Emile Arquès,
CS 70017 - 51686 Reims Cedex 2 - France

1 Introduction

The hybrid stiff insulators family, hard porous layer - impervious layer - soft porous layer, has been successful in the automotive industry these last years, especially for very light lay-ups. Indeed, the classically lightweight top hard layer gives mechanical stability to the insulator and is thus easy to manipulate for assembly purposes, while ensuring a mass-spring like good insulation behavior thanks to its intrinsic stiffness and to the impervious glued film-like backlayer. These "textile septum" good properties already reported present a drawback linked to their relatively low thicknesses (top hard layer) and therefore relatively bad absorption properties in the middle frequency range [1, 2]. Indeed, in order to get Young's modulus above 1 MPa typically, the usually light $1000\,g/m^2$ up to $2000\,g/m^2$ top compressed porous layers are presenting thicknesses lying between $5\,mm$ and maximum $9\,mm$. The overall available thicknesses of insulators in the automotive industry going rarely above 30 mm typically do not allow to go beyond risking then to overcompress the soft spring layer which may become too hard in that case and thus not decoupling correctly anymore!

2 Hybrid Polyfoam T Ultimate description

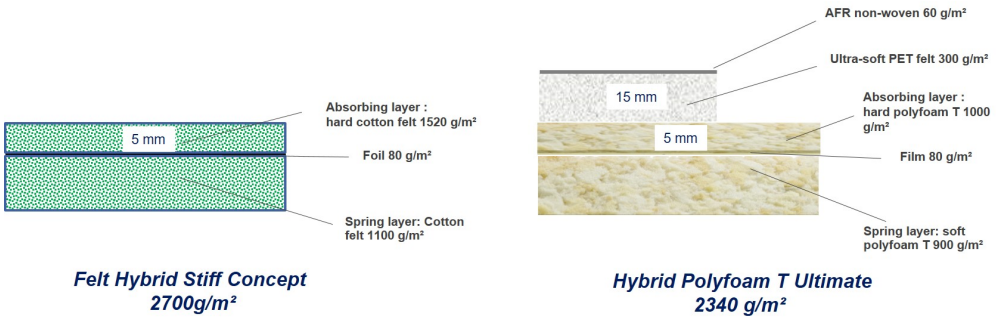

Figure 1: Hybrid Polyfoam T Ultimate typical - 15 % weight reduction

A solution consists in using an ultra-soft highly compressible PET felt out of the available thickness CAD of the insulators (with a tuned AirFlow Resistance nonwoven on top). Therefore, this ultra-soft PET felt will be locally in interference with components behind the Instrument Panel (up to 70 % or 80 % of the total PET felt thickness) like the HVAC air-conditioning unit or glove box for example etc... Figure 1 right illustrates the typical lay-up applied locally where the interferences allow it, as well as the resulting weight reduction between - 15 % to - 20 % enabled by this broadband additional absorption and Polyfoam T material (cf. Figure 2).

3 Hybrid Polyfoam T Ultimate NVH performance

Beyond the addition of this ultra-soft PET, the switch from a Felt Hybrid Stiff concept to a Hybrid Polyfoam T 80 % recycled and 100 % recyclable construction presents the advantage of drastically increasing the insulation performance for the low thicknesses for the normally soft poroelastic spring layer. Indeed, the cotton felt material becomes very hard above $200\,kg/m^3$ up to $300\,kg/m^3$ with Young's modulus between 1E6 Pa up to 1E8 Pa progressively depending on the binder percentage and nature, whereas the Polyfoam T made of chips urethane coming from shredded used mattresses remains below 5E5 Pa with an optimal percentage of Co-PET bi-component fibers (density $260\,kg/m^3$)...

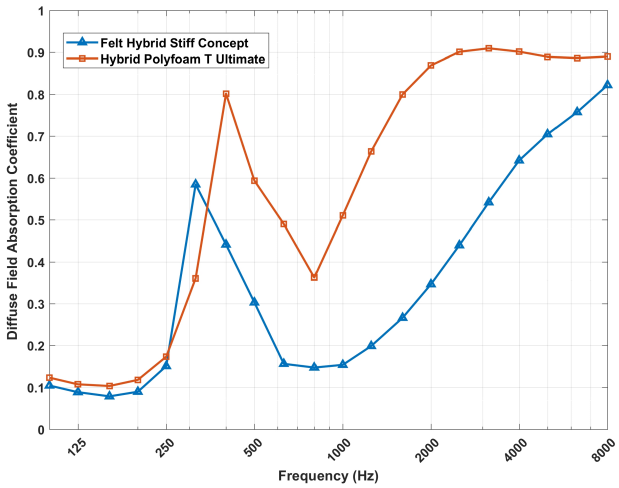

Figure 2: Hybrid Polyfoam T Ultimate Absorption Coefficient

Figure 3 shows a measured Insertion Loss improvement of 7 dB in average compared to an injected foam $58\,kg/m^3$, which remains relatively soft at 5 mm thickness with Young's modulus below 1E5 Pa, proving that the increased density is thus favorably contributing here. The comparison with the super hard cotton felt as poroelastic spring does not make sense (thus not reported here) and would be highly in favor of the still soft highly compressed Polyfoam T material anyway [3]...

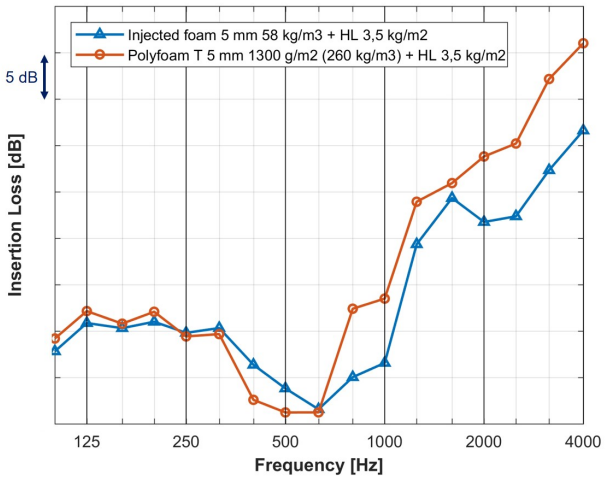

Figure 3: Polyfoam T Insertion Loss small cabin measurements at low thicknesses

4 Conclusion

Beyond its one shot competitive process, the Hybrid Polyfoam T concept (without PET felt optionally) presents the additional advantage for the hard absorbing barrier layer to be easily charged with solid inclusions in the volume up to 30 % while maintaing a good absorption (cf. [4]) or powdered below backfoiled here for even higher equivalent masses (cf. [5]), in order to increase the overall Transmission Loss and thus address upper segment vehicles. With superior middle and especially high frequency acoustic global performance within actual available spaces, the Hybrid Polyfoam T Ultimate insulator with its ultra-soft PET felt is thus particularly adapted to electric or hybrid electrified vehicles with easily tunable acoustic performances.

References

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