

Report on the outcomes of a Short-Term Scientific Mission¹

Action number: CA170107- European Network to connect research and innovation efforts on advanced Smart Textiles

Grantee name: Funda Buyuk Mazari

Details of the STSM

Title: Thermo-physiological comfort and functionality of car seats
Start and end date: 12/01/2023 to 22/01/2023

Description of the work carried out during the STSM

Turkey is one of the biggest hub for the production of technical textiles, especially for the car seat industry. The short term mobility was very helpful for early researcher like me to obtain samples, meet with the experts and share my result outcomes. A total of 6 samples of car seat's cover from Czech republic were pre-tested and further tested at the host University, following test were performed during the training period.

- 1- Mechanical testing of car seats covers with pre-determined compression and delay time according to real conditions. The setup was made on Instron tester with special setting to obtain a realistic mechanical load (connected with pre measured average peak load by humans). Comparable loads were applied to compress the car seat cover material and then relaxed for 2 seconds; the test was performed multiple times to see the effect of repeated loading on the car seat covers.
- 2- Meeting with the experts; the meeting with the industrial experts from company Tofas (car seat producer) was very helpful to understand the issues of the mechanical performance and durability of car seats and what are customer expectations.
- 3- The moisture transport and air permeability test are performed at the home institute, whereas compression and multiple load test were conducted at the host institute.

All the samples were tested as planned, huge collection of new samples are collected from industry and meetings with the industrial and research partners went as planned.

All six commonly used Foam lining(3D spacer, PU foam, felt, non-woven web) for the car seats were tested for multiple load cycles of 20 to 60 thousand cycles. This shows a real time usage (sitting cycles) of car seat per year. The change in thickness may bring huge difference of comfort, durability and breathability of the car seats, this test shows either the thickness changes with cyclic loading or not. Following results were obtained by extensive testing of the materials with loading, unloading and providing the relaxation time of 2 seconds between each load. Results shows (figure 1) a linear decrease of the thickness with dynamic loading, whereas 3D spacer PU foams performed significantly better than other materials.

¹ This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

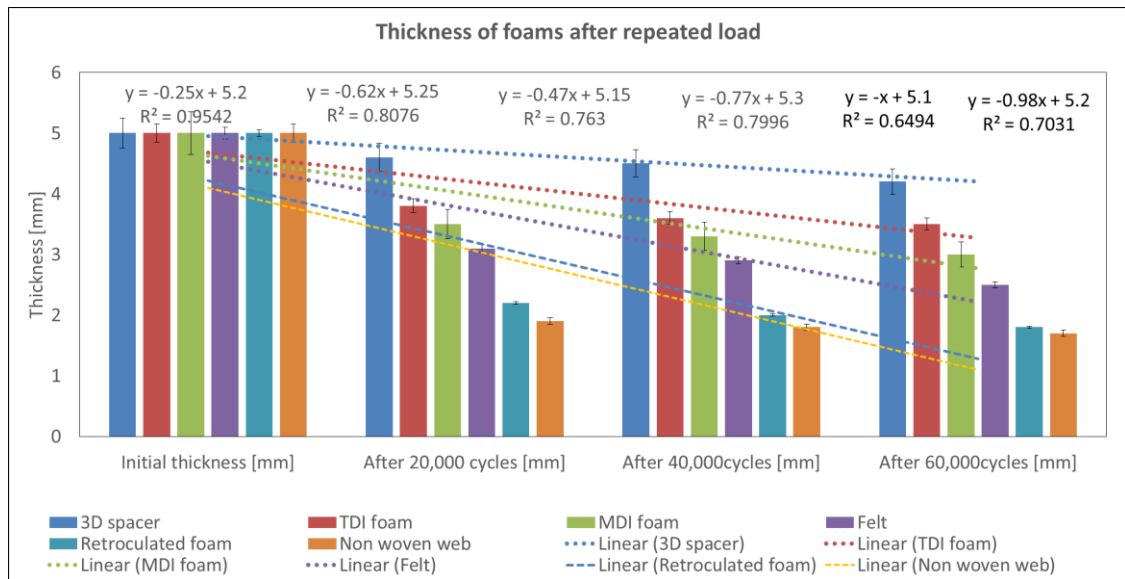


Figure 1. Effect of repeated loading on car seat foam(lining material)

Description of the STSM main achievements and planned follow-up activities

The main achievements of the STSM are as below

- Testing of the car seat samples related to the mechanical dynamic loading.
- Meeting with industrial partners and collection of samples.
- Compilation of results from home and host experiments for future publication either in journal of conference proceedings.

The air permeability of the samples were tested on the device FX3300, there was a significant decrease of the air permeability after repeated loading as the pores are closed and the material becomes more dense. Whereas the 3D spacer fabric showed higher permeability which might be due to the extended pore dimension due to compression. The results of air permeability are shown in figure 2.

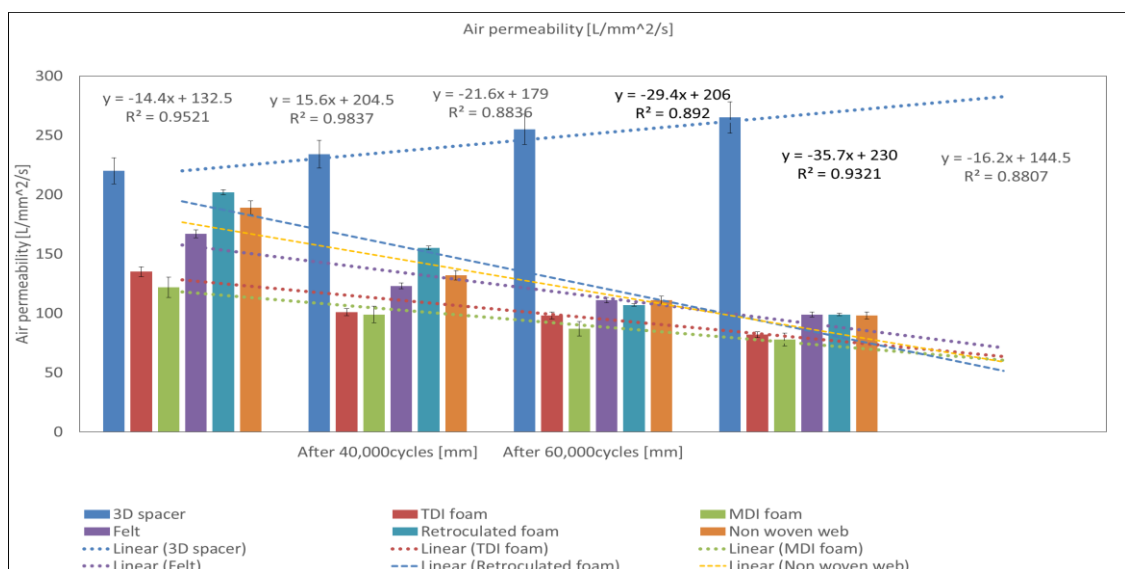


Figure 2. Air permeability after repeated loading

The water vapour permeability is also an important factor in determining the comfort or breathability of the textile materials, the inverted cup method was used to determine the water vapour permeability before and after repeated loadings. Table 1 shows the results of water vapour permeability.

Table 1. Water vapour resistance of car seat covers.

Samples	Original water permeability [g/m ² /24h]	Standard Deviation	water permeability [g/m ² /24h] after 20,000 cycles [mm]	Standard Deviation	water permeability [g/m ² /24h] after 40,000cycles [mm]	Standard Deviation	water permeability [g/m ² /24h] after 60,000cycles [mm]	Standard Deviation
3D spacer	4500	±52	4560	±47	4599	±42	4610	±52
TDI foam	400	±12	385	±18	376	±13	370	±12
MDI foam	330	±9	320	±11	315	±14	314	±9
Felt	780	±18	700	±24	680	±22	650	±18
Retroculated foam	1200	±45	1070	±49	1050	±39	1000	±45
Non woven web	870	±32	830	±35	800	±22	790	±32

The result in table 1 clearly shows that the water vapour of textile decreases with repeated loading (sitting behaviour of driver), for 3D spacer fabric; the difference was insignificant. Whereas linear decrease was observed for the other car seat cover materials.

The work plan was not limited to only testing but visit to labs, finding new possibilities of testing and collection of related samples from the car seat producer in Turkey. The research will be useful to perform a mutual research project and deliver it in the form of an article or conference paper. The visit to the car seat producers was a good opportunity to know the issues of the industrial partners and collect samples for the future research.