

# AV '17 KONFERENCE ASFALTOVÉ VOZOVKY 2017

## Noise reduction in asphalt pavements with crumb rubber modification

Aytuna Sayin, Atakan Aksoy, Erol Iskender, Dundar Ayyildiz,  
Kivanc Zorlu Kendir, Berna Erdol

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**Motto: Asfaltové vozovky – bezpečná cesta k prosperitě**

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## Noise reduction in asphalt pavements with crumb rubber modification

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## Introduction

Traffic noise is one of the most important environmental problems.

The focus of the European effort is found in three quiet pavement technologies:

- ➔ Thin-surfaced, negatively textured, gap-graded asphalt mixes (such as NovaChip, microsurfacing and stone matrix asphalt (SMA)).
- ➔ Single and double layer, highly porous asphalt mixes with more than 18 percent voids, and
- ➔ Exposed aggregate concrete pavement

And it is also possible to use crumb rubber to reduce the traffic noise.

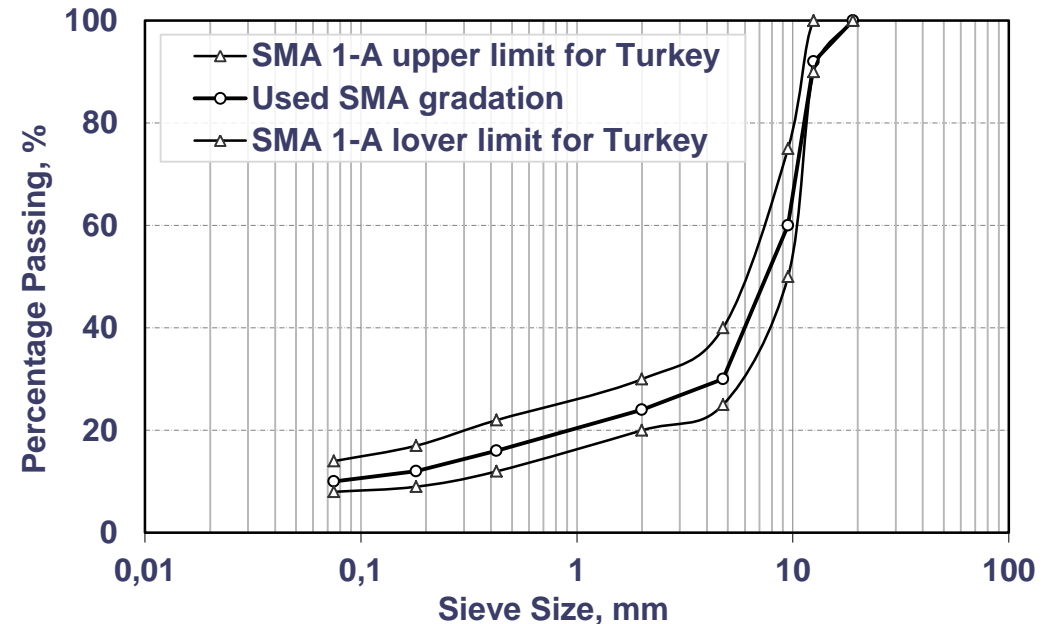
## Scope

**The purpose of this study is to evaluate crumb rubber effects on the noise levels of asphalt mixtures with the selected crumb rubber ratios, rubber sizes, and addition method and evaluate crack resistance of the mixtures.**

## Materials and method (1)

### Stone mastic asphalt mixture gradation

- ➔ 19mm maximum aggregate size
- ➔ Basalt aggregate
- ➔ 50-70 pen. grade bitumen
- ➔ Cellulose fibre



## Materials and method (2)

Four rubber ratios were used:

➔ 6%, 8%, 10%, 12%

Two rubber sizes were selected:

➔ 6%, 8%, 10%, 12%

Two rubber sizes

➔ 0.6mm max. size

➔ 0.6mm-2.5mm size

Crumb rubber was added in two ways:

➔ In asphalt cement

➔ In aggregate mixture



## Material and methods (3)

### Bitumen modification (wet process)

- ➔ High shear mixer
- ➔ 155°C stirring temperature
- ➔ 20 minutes mixing time
- ➔ 4500rpm mixing speed

The mixture modification was carried out with a mechanical mixer. (dry process)



## Materials and methods (4)

In all options, three Marshall Briquettes were produced.

Ultrasonic measurement was performed before and after Modified Lottman conditioning.

Four measurements were performed for each sample.



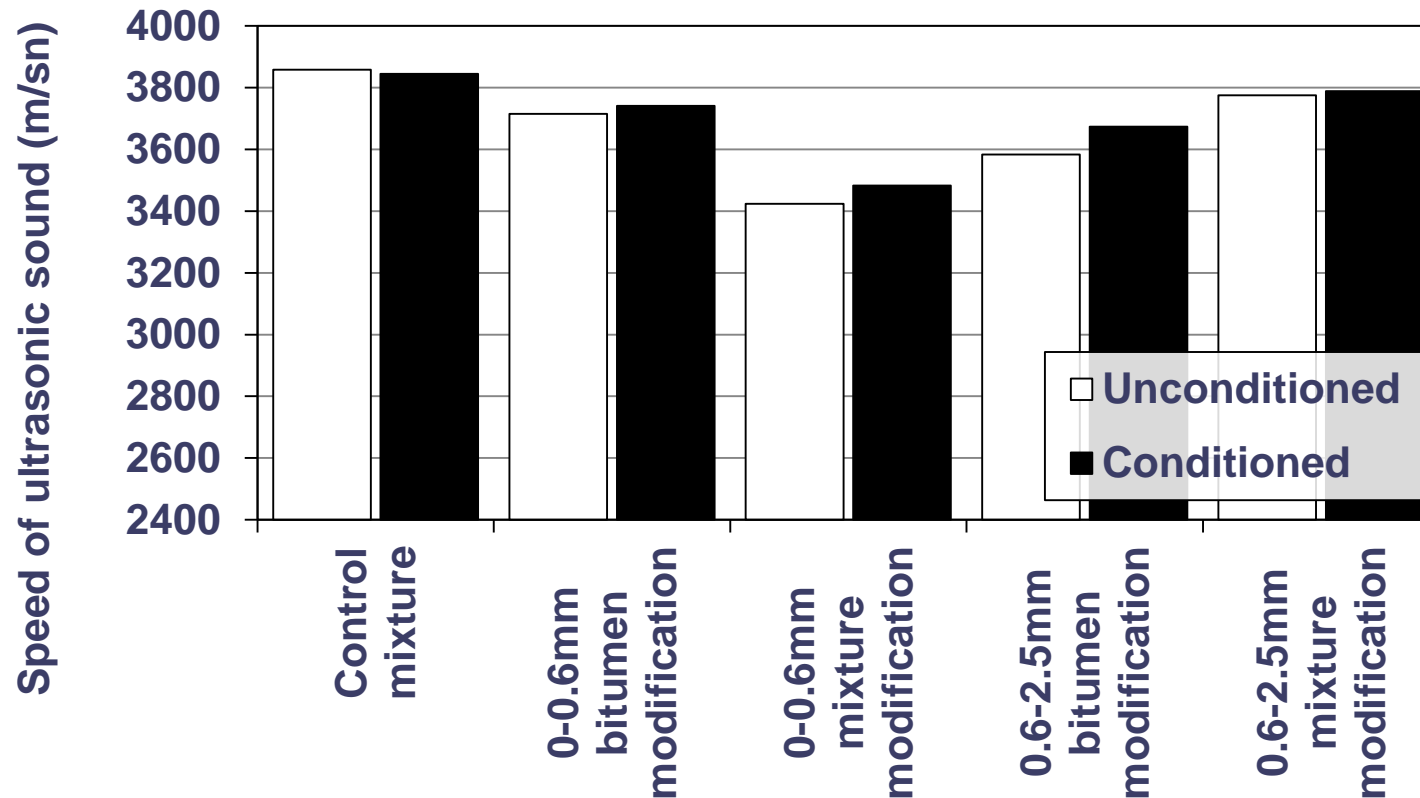


## Test results and evaluation

### Average densities of modified and unmodified asphalt mixture samples

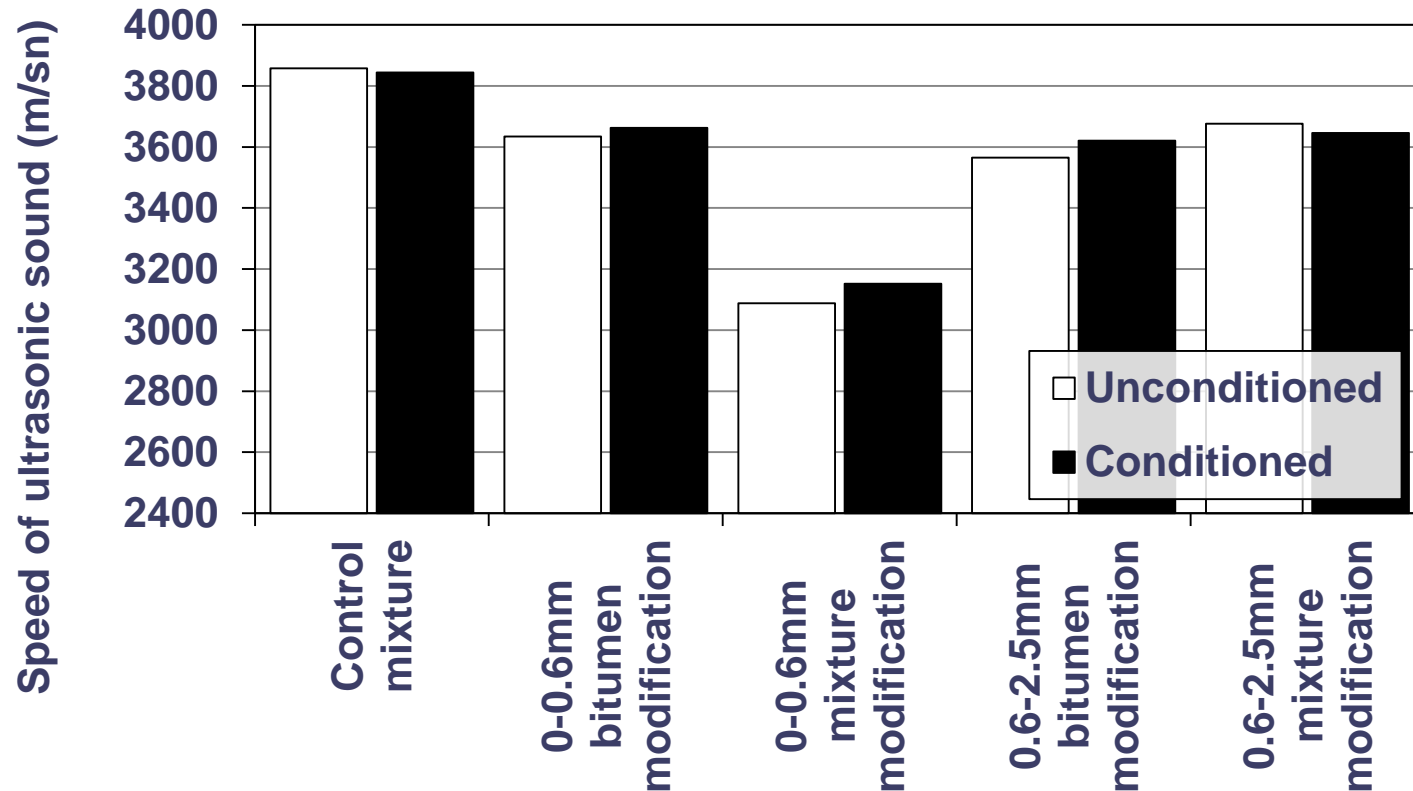
Additive ratio	Control	Mixture with rubber modified bitumen (maximum rubber size: 0.6mm)				Rubber modified mixture (maximum rubber size: 0.6mm)				Mixture with rubber modified bitumen (minimum rubber size: 0.6mm; maximum rubber size: 2.5mm)				Rubber modified mixture (minimum rubber size: 0.6mm; maximum rubber size: 2.5mm)			
	0	6%	8%	10%	12%	6%	8%	10%	12%	6%	8%	10%	12%	6%	8%	10%	12%
Sample 1	2.378	2.367	2.347	2.354	2.358	2.321	2.302	2.30	2.273	2.295	2.276	2.272	2.28	2.362	2.366	2.35	2.354
Sample 2	2.385	2.365	2.348	2.360	2.356	2.320	2.309	2.28	2.284	2.311	2.295	2.284	2.265	2.362	2.361	2.353	2.351
Sample 3	2.377	2.347	2.367	2.367	2.351	2.302	2.298	2.29	2.279	2.304	2.294	2.29	2.269	2.359	2.348	2.360	2.345
Average	2.380	2.360	2.354	2.360	2.355	2.314	2.303	2.290	2.279	2.303	2.288	2.282	2.271	2.361	2.358	2.354	2.350

## Test results and evaluation (2)



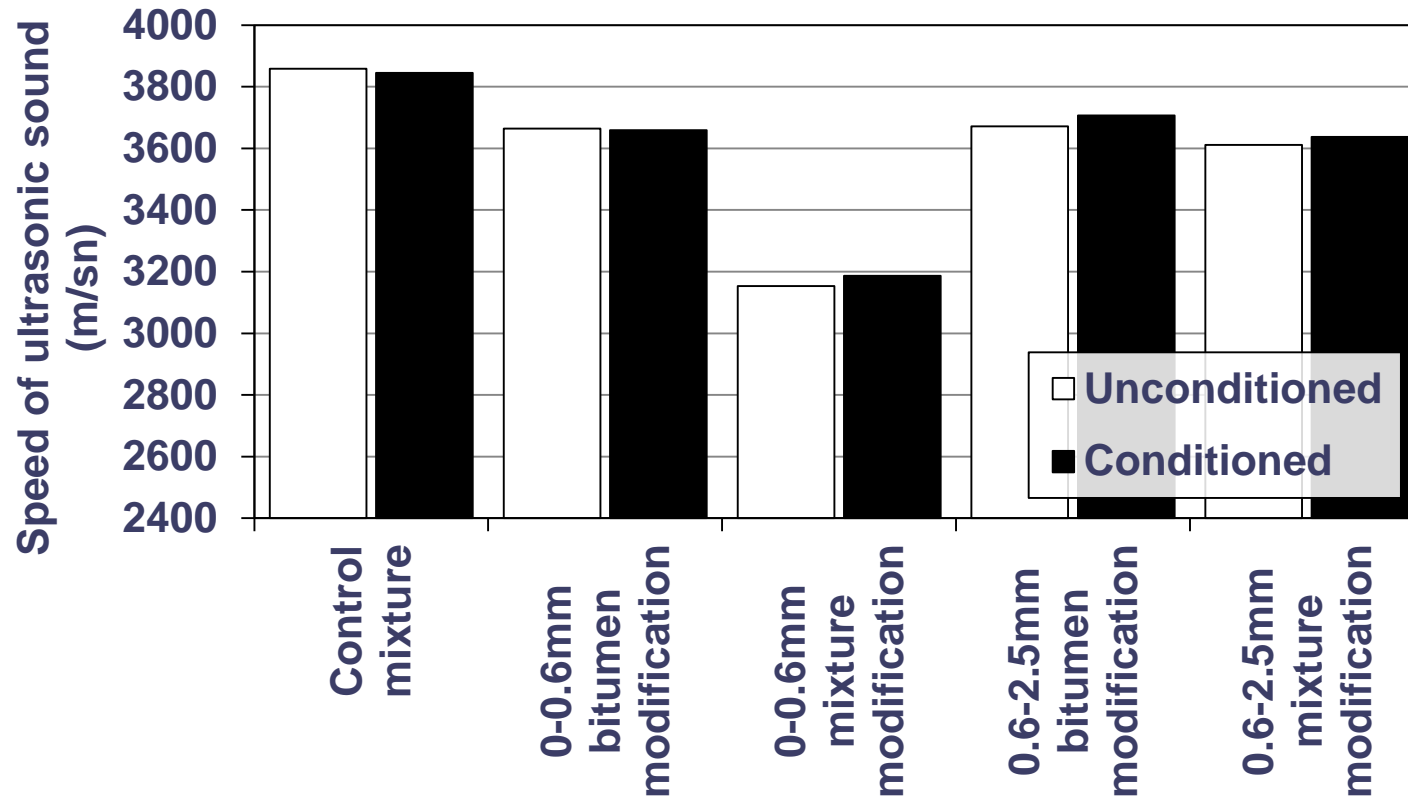
Average ultrasonic sound speed for 6% rubber modification

## Test results and evaluation (3)



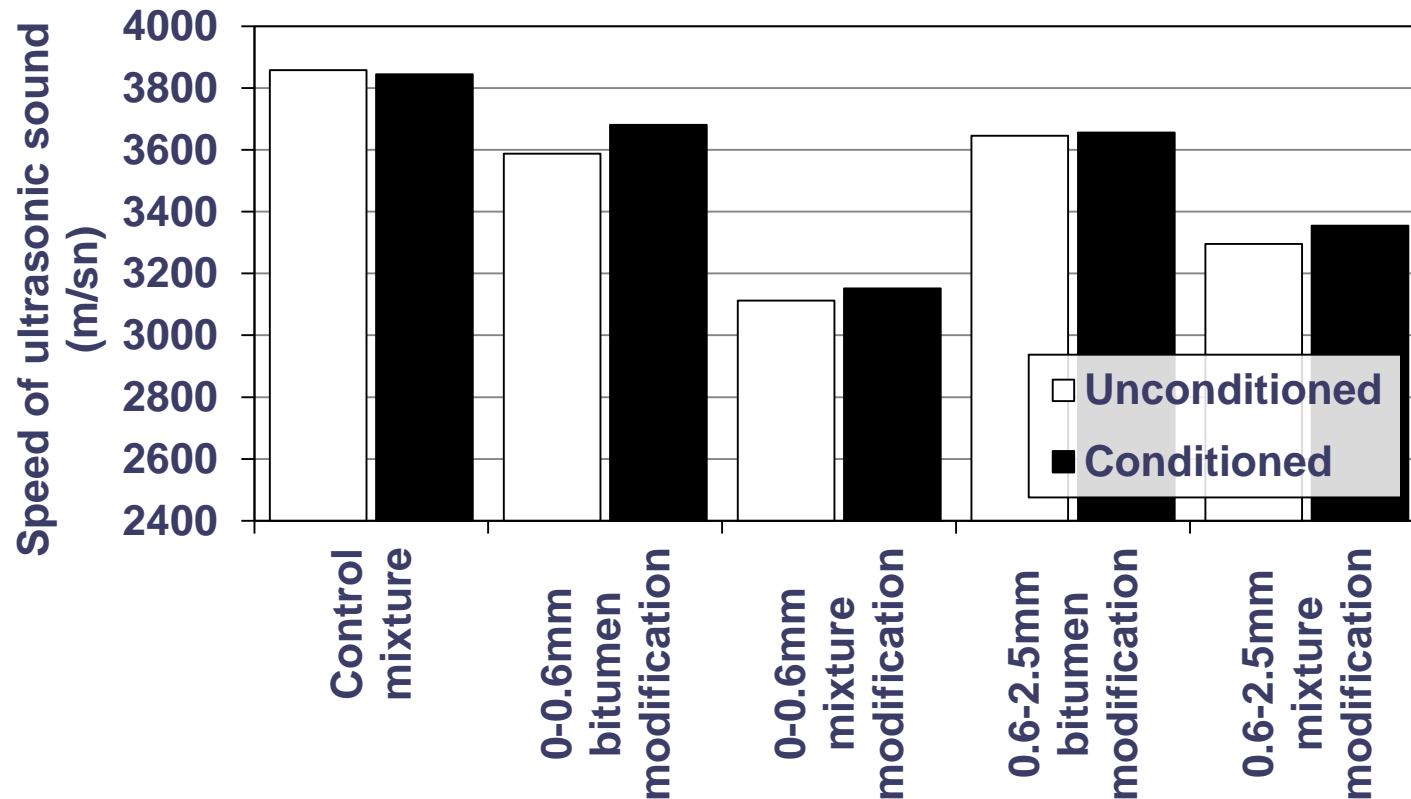
Average ultrasonic sound speed for 8% rubber modification

## Test results and evaluation (4)



Average ultrasonic sound speed for 10% rubber modification

## Test results and evaluation (5)



Average ultrasonic sound speed for 12% rubber modification

## Test results and evaluation (6)

Change in ultrasonic sound velocities according to control mixture

	Unconditioned				Water conditioned			
Mixture type/Rubber content	6%	8%	10%	12%	6%	8%	10%	12%
0-0.6mm bitumen modification	-3.7	-5.8	-5.0	-7.0	-2.7	-4.7	-4.8	-4.3
0-0.6mm mixture modification	-11.2	-20.0	-18.3	-19.3	-9.4	-18.0	-17.1	-18.0
0.6-2.5mm bitumen modification	-7.1	-7.6	-4.8	-5.5	-4.5	-5.8	-3.6	-4.9
0.6-2.5mm mixture modification	-2.1	-4.7	-6.4	-14.6	-1.5	-5.2	-5.4	-12.7

## Conclusions

**Noise reduction subjects in stone mastic asphalt pavements was researched with the effects of crumb rubber modification.**

- ➔ In view of noise reduction 0-0.6mm crumb rubber sizes gives the best result for dry method or else mixture modification.**
- ➔ When it comes to mixture modification (dry method) 8%, 10%, 12% was concerned crumb rubber ratios revealed similar results in point of noise reduction.**

## Conclusions

- ➔ Considering that selected 6%, 8%, 10% and 12% crumb rubber ratios noise reduction effect for bitumen modification is ineffective for both 0-0.6mm and 0.6mm-2.5mm rubber sizes.
- ➔ All in all 0.6-2.5mm rubber sizes with mixture modification with the increasing of rubber ratio from 6% to 12% (6-8-10-12) noise levels decreased correspondingly.
- ➔ Dry method that is to say mixture modification for both 0-0.6mm and 0.6mm-2.5mm rubber sizes was found effectual as far as the wet method (binder modification).



**Thank you for your attention...  
aaksoy@ktu.edu.tr**