

## Towards a better understanding of Warm Mix Asphalt Additives

F. Geisler<sup>1\*</sup>, L. Lapalu<sup>2</sup>, P. Kapsa<sup>1</sup>

<sup>1</sup>Laboratoire de Tribologie et Dynamique des Systèmes, UMR 5513, CNRS, Ecole Centrale de Lyon, Bât. H10, 36, Avenue Guy de Collongue, 69134 Ecully Cedex, France.

<sup>2</sup>Centre de Recherche de TOTAL, B.P. 22, Chemin du Canal, 69360 Solaize, France.

\*Corresponding author for [flavien.geisler@ec-lyon.fr](mailto:flavien.geisler@ec-lyon.fr)

### 1. Introduction

Warm Mix Asphalt (WMA) allows lowering the temperatures at which the usual hot mix is mixed and laid down on the road. Due to their environmental benefits, there is an increasing interest in WMA and different technologies are nowadays available. One of them consists in introducing around one percent of WMA additives in the bitumen. Although the interest of this kind of WMA increases, the mechanisms of such additives are still not well understood.

### 2. Inter-granular lubrication

Literature shows that the studied additives have only a slight impact on the viscosity <sup>[1]</sup>. This slight effect cannot explain why WMA additives improve the mixture workability.

Because an asphalt mix is composed of around 95 weight percent of granular materials and only 5% of bitumen, recent publications <sup>[2]</sup>, <sup>[3]</sup> supposed that inter-granular contacts could be numerous and showed that friction forces should play a key role.

### 3. Experiments

In order to evaluate possible reactions of WMA additives with mineral substrates and/or bitumen components, tribological experiments were done on the linear alternative tribometer available at the Laboratory of Tribology and System Dynamics (LTDS). Several parameters able to act on the friction coefficient were tested.

### 4. Surfactant aspects

Experimentally, it can be observed that some WMA additives improve the adhesion between bitumen and aggregates. To know if (/how) WMA additives modify the asphalt surface tension at mixing temperature, we intend to realize pendant drop measurements. Moreover, to characterize the influence of WMA additives on the bitumen-aggregate interaction, sessile drop experiments on different minerals and at mixing temperature will be realized as well.

### 5. Conclusion

Results and interpretations of tribological, rheological and wettability experiments should enable us to better understand how WMA additives work

### 6. References

- [1] F. Xiao, V. S. Punith, S. N. Amirkhanian, "Effects of non-foaming WMA additives on asphalt binders at high performance temperatures.", *Fuel*, 94, 2012, 144-155
- [2] B. Bahia, A. Hanz, E. Mahmoud, "Quantifying the Effects of Warm Mix Asphalt Using the Asphalt Lubricity Test.", Warm Mix Technical Working Group Meeting Seattle, WA. December 16, 2009
- [3] G. L. Baumgardner, G. R. Reinke, J. Brown II. "Lubricity Properties of Asphalt Binders Used in Hot-Mix and Warm-Mix Asphalt Pavements.", 5th Eurasphalt & Eurobitume Congress. Istanbul. 2012