

**Inverse Laplace Transform (ILT) NMR: A powerful tool to differentiate a real rejuvenator and a softener of aged bitumen**Cesare Oliviero Rossi<sup>1</sup>, Paolino Caputo<sup>1</sup>, Valeria Loise<sup>1</sup>, Saltanat Ashimova<sup>1</sup>, Michele Porto<sup>1</sup> and Bagdat Teltayev<sup>2</sup><sup>1</sup>University of Calabria, Italy<sup>2</sup>Kazakhstan Highway Research Institute, Kazakhstan

ILT is particularly useful when the signal is characterized by multi-exponential decay, for example in spin relaxation or in the dephasing of the NMR spin echo signal associated with supra molecular aggregation under the influence of pulsed magnetic or internal field gradients. In this study, an Inverse Laplace Transform of the NMR spin-echo decay (T<sub>2</sub>) was applied as novel approach to observe the real rejuvenating effect of the potential additive. The potentialities of a new, non-toxic and eco-friendly biocompatible additive on aged bitumen are explored for the first time as bitumen rejuvenator, by means of advanced rheological and Relaxometry-NMR measurements. Pristine, aged, and doped aged bitumen morphology have also been investigated by SEM. The new rejuvenator helps to rearrange the structure of the aged bitumen (aiming at the original one), and this mechanism can be observed by ILT/NMR analysis.

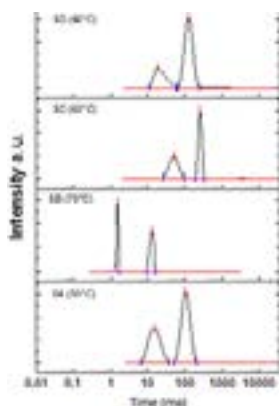


Figure 1: ILT relaxation time distributions of bitumen samples

**Recent Publications**

1. CalandraP, CaputoP, De SantoMP, TodaroL, TurcoL, Oliviero RossiC (2019) Effect of additives on the structural organization of asphaltene aggregates in bitumen. *Construction and Building Materials* 199 :288-297.
2. Oliviero RossiC, CaputoP, LoiseV, AshimovaS, TeltayevB, SangiorgiC (2019) A new green rejuvenator: Evaluation of structural changes of aged and recycled bitumens by means of rheology and NMR. *RILEM Bookseries* 20:177-182.
3. SzerbEI, NicoteraI, TeltayevB, VaianaR, Oliviero RossiC (2018) Highly stable surfactant-crumb rubber-modified bitumen: NMR and rheological investigation. *Road Materials and Pavement Design* 19:1192-1202.

4. Oliviero RossiC, CaputoP, De LucaG, MaiuoloL, EskandarsefatS, SangiorgiC (2018) 1H-NMR spectroscopy: A possible approach to advanced bitumen characterization for industrial and paving applications. Applied Science 8:229
5. Oliviero RossiC, CaputoP, AshimovaS, FabozziA, D'ErricoG, AngelicoR (2018) Effects of natural antioxidant agents on the bitumen aging process: An EPR and rheological investigation. Applied Sciences 8:1405.

### **Biography**

Cesare Oliviero Rossi was born in 1974 in Cosenza, Italy. He received his Degree in Chemistry, cum laude, in 1997 at the University of Calabria, and his PhD. in "Chemical Sciences" in 2002 at the same University, working on the structural characterization of lyotropic systems. His publication track record, including more than 100 papers in international peer reviewed journals, is impressive. His major area of expertise is the study of colloidal systems. In particular, he has recently been focusing on the chemistry of bitumen and its additives, approaching the open challenges in this area of research from a chemical point of view, also making use of investigation and analytical techniques never used before to study asphalt binders. He was awarded the gold medal for contribution to the Road Science by the High Research Institute of Kazakhstan.

### **Notes:**