

# Chemical Modification of Bitumen through Polyphosphoric Acid, and Asphalt Mix Properties

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Initial engineering properties of materials (bitumen, granulates and filler) as well as mechanical and environmental conditions govern the behaviour of asphalt pavements in service. To enable pavements to accommodate increasing traffic intensity and axle loads in varying climate environments, high quality bitumen is now required. Special binders are also needed for other applications, such as bridges and airport runways. These examples suggest the necessity of bitumen modification. A few modification methods have been developed, mainly air blowing and polymer modification: polymer as SBS or EVA elastomer are today extensively used despite cost and processing conditions problems.

This presentation discusses the performance of high grade bituminous binders modified via a chemical way (polyphosphoric acid), a physical way (elastomeric polymers), and combinations thereof, and their performance in asphalt mixtures in subsequent laboratory evaluation as moisture and rutting resistance. Chemical modification of bitumen is another way to improve asphalt binders properties: with polyphosphoric acid, an increase of one to two classification grades ('pene' grade) is obtained at a low addition content (< 2 %); in combination with polymer, it is possible to obtain same performances at a lower content of polymer. The rheological and ageing properties of asphalt binder containing different amounts of polyphosphoric acid, alone or in combination with a polymer, are studied using dynamical mechanical analysis, creep test and conventional methods. High temperature stiffness is increased with improved behaviour at low temperature. The impact of this chemical modification on short and long term ageing of bituminous binders is observed using the Rotating Cylinder Ageing Test (RCAT): polyphosphoric acid modification doesn't induce any oxidation phenomena or accelerated ageing of the bitumen. The chemical modification through polyphosphoric acid based additives allows a reduction and even the suppression of polymer as well as good antistripping effects similar to antistripping additives. Relationship between modified binders and asphalt mixtures properties are discussed.

**KEYWORDS** : Bitumen, Rheology, Permanent Deformation, Cracking, Stripping, Polyphosphoric Acid, Polymer, Asphalt mixture, Tensile Stress Ratio, Hamburg Wheel Tracking Device.

## Recent Publications

<sup>1</sup> "Chemical modification of bitumen through Polyphosphoric Acid: properties – microstructure relationship," G. Orange, D. Dupuis, J.V. Martin, F. Farcas, C. Such, B. Marcant, Paper 334, Eurasphalt and Eurobitume 2004, Vienna.

<sup>2</sup> "Modification Chimique des Bitumes : une Nouvelle Alternative aux Bitumes Modifiés Polymères" ; G. Orange, J.V. Martin, C. Such ; Revue Générale des Routes et Aéroports, N° 833, Nov. 2004.

<sup>3</sup> "Rutting and Moisture Resistance of Asphalt Mixtures Containing Polymer and Polyphosphoric Acid Modified Bitumen" ; G. Orange, J.V. Martin, G. Baumgardner, Road Pavement and Design Material, Vol.5, N°3, Dec. 2004.