# Rheology Applied to Investigate Roofing Membranes: The Case of an Ecological Alternative

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Received: 9.3.2009, Final version: 30.6.2009

**Abstract:**
The viscoelastic performance indicators of a commercial roofing membrane and an ecological bituminous membrane, which contains EVA copolymer from disused greenhouses and filler from landfill, are investigated. Rheological methods reveal as a useful tool to investigate basic and technical aspects of these materials. It is shown that using an extrusion rheometer adapted to measure the flexibility at low temperatures and measuring the tackiness by means of a plate-plate rheometer, constitute basic experiments that help to develop new membranes. Under these premises, it is demonstrated that the ecological membrane is a performing material, whose sole shortcoming is a slightly higher application temperature.

**Zusammenfassung:**
Die Indikatoren der viskoelastischen Eigenschaften einer kommerziellen Dachmembran und einer ökologischen pechhaltigen Membran, die ein EVA-Copolymer von gebrauchten Treibhäusern und Füllstoffen von Deponien enthält, werden untersucht. Die rheologischen Experimente sind eine nützliche Methode, um sowohl die grundlegenden als auch die technischen Aspekte dieser Materialien zu erforschen. In dieser Arbeit wird gezeigt, dass mit Hilfe eines Extrusionsrheometers (um die Flexibilität bei niedrigen Temperaturen zu messen) und mit Hilfe eines Platte-Platte-Rheometers (um die Klebkraft zu bestimmen) grundlegende Experimente durchgeführt werden können, die der Entwicklung neuer Membranen dienen. Es wird gezeigt, dass die ökologische Membran ein geeignetes Material darstellt, dessen einziger Nachteil die etwas höhere Anwendungstemperatur ist.

**Résumé:**
On étudie les indicateurs de la performance viscoélastique d'une membrane commerciale de toiture et une membrane écologique bitumineuse, contenant copolymère EVA provenant de serres agricoles et filler de dépôt. Les méthodes rhéologiques se révèlent très utiles pour étudier des aspects basiques et appliqués de ces matériaux. L'utilisation d'un rhéomètre d'extrusion capillaire adapté pour mesurer la flexibilité a basses températures et l'étude de la pegosité ou tack menée grâce à un rhéomètre a plaques parallèles, constituent expérimentes basiques qui contribuent à développer de nouvelles membranes. Avec ses prémisses, nous montrons les bonnes prestations de la membrane écologique dont la seule limitation reste une légèrement plus haute température d'application.

**Key words:** bitumen, ecological-membrane, flexibility, roofing, tack

## 1 INTRODUCTION

Because of its waterproofing properties, bitumen has been traditionally employed for roofing. However, bitumen presents rheological and mechanical shortcomings which reduce its possibilities as a performing industrial material. It behaves like a viscoelastic material with limited stress resistance properties, typically brittleness at low temperature, and excessive fluidity at working temperatures, besides of rheological alterations with aging. These problems have been solved, at least partially, modifying bitumen with polymers to adapt the viscoelastic properties to roofing conditions. Blends based on 85 – 88 % bitumen and 15 – 12 % synthetic polymer are typically prepared to constitute a polymer-rich continuous phase which contributes decisively to give appropriate rheological and mechanical properties to the mastic. The partial miscibility, which leads the polymer to absorb part of the bitumen, is based on the interaction of the synthetic polymer with the maltenic phase (constituted by saturate oils, aromatics and resins), whereas the fourth component of the bitumen, asphaltene, does not show practically any affinity.

© Appl. Rheol. 19 (2009) 62305 DOI: 10.3933/ApplRheol-19-62305





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reached when blowtorching, just in the instant of applying the membrane to the roof or terrace surface.

## 4 CONCLUSION

Rheological methods reveal as a performing tool to investigate bitumen/polymer/filler blends apt for waterproofing membranes. In particular, it is shown that using an extrusion rheometer adapted to measure the flexibility at low temperatures and measuring the tackiness by means of a plate-plate rheometer, is helpful to develop new membranes. Under these premises, the comparison of a commercial roofing membrane with an ecological membrane based partially on the use of waste materials, allows us to state that the latter is a performing material, whose sole shortcoming is a slightly higher application temperature.


## ACKNOWLEDGEMENTS

Financial support through MEC (MAT2004-06299-C02-01) (Spanish Government) and (GIC07/135-IT-284-07) (Basque Government) is acknowledged. Sanchez-Pando S.A. and Asfaltos de Campezo S.A. are acknowledged for the supplied materials and help given. Finally, G. Goikoetxeaundia would like to acknowledge the Spanish Government for the FPI fellowship.


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