

Compressive properties of bitumen based composite materials

Citation for published version (APA):

Puig, C. C., Segeren, L. H. G. J., Vancso, G. J., Michels, M. A. J., & Meijer, H. E. H. (2001). *Compressive properties of bitumen based composite materials*. Poster session presented at Mate Poster Award 2001 : 6th Annual Poster Contest.

Document status and date:

Published: 01/01/2001

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Compressive Properties of Bitumen Based Composite Materials

C.C. Puig†, L.H.G.J. Segeren‡, G.J. Vancso‡, M.A.J. Michels* and H.E.H. Meijer†

† Materials Technology, Faculty of Mechanical Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, the Netherlands.

* Department of Applied Physics, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, the Netherlands.

‡ Dutch Polymer Institute and Faculty of Chemical Technology, University of Twente, P.O. BOX 217, 7500 AE Enschede, the Netherlands.

Introduction

Recently, intermediate material properties (compressive strength) between those shown by traditional asphalts (9-11MPa) and those by cement concrete (30-60MPa or higher) were found by using some bitumens in the preparation of composites with a high content of minerals.

Experimental and discussion

Fig.1 shows the compressive mechanical behavior of two composites made up of a mineral filler (particle size $\sim 8 \mu\text{m}$) and two bitumens (A and B) of different origin. Fig.1 also shows the compressive curves for the pure bitumens. The compressive stress at yield for the bitumen A based composite is about 50% higher than that shown by the traditional asphalt (bitumen B). If a mineral filler of larger particle size ($\sim 50 \mu\text{m}$) is used then a lower compressive stress is obtained.

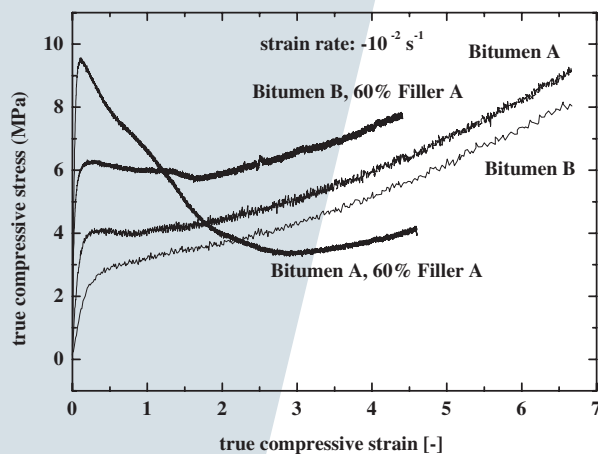


Figure 1 Uniaxial compression curves for the composites and pure bitumens.

We also investigated the nature of the surface energy properties of the bitumens by carrying out inverse gas chromatography at -30°C , i.e. below their glass transition temperature. By plotting $RTL\ln(V_N)$ versus $a(\gamma_L^D)^{1/2}$, where V_N is the retention volume given by the interaction of the probe (alkane molecules) with the bitumen, a and γ_L^D are the surface area and the dispersive surface energy of the probe molecules, respectively, the dispersive surface energy of the sample (γ_s^D) can be deduced from the slope. The corresponding values for bitumen A and bitumen B are 59.3 and 50.6 mJ/m^2 , respectively, it is almost a 20% difference.

In order to gain some knowledge on the differences in composition between the two bitumens, thermal gravimetric analysis was carried out under an inert nitrogen atmosphere between room temperature and 700°C . The amount of residue in bitumen A is 31% whereas in bitumen B is about 23%. The difference is attributed to the asphaltene content.

/department of mechanical engineering

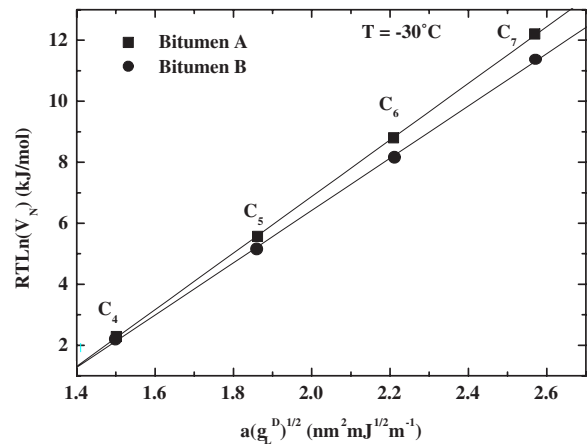


Figure 2 Plot of $RTL\ln(V_N)$ versus $a(\gamma_L^D)^{1/2}$.

Anisotropic properties are expected from aggregates of asphaltene, which are highly planar polyaromatic molecules. The scattering of X-rays on the small angle region by doing in situ heating and cooling experiments using the synchrotron radiation shows the collapse of structures ($\sim 20 \text{ nm}$ in size) in bitumen A (Fig. 3). We must bear in mind that in the presence of a constrained environment imposed by the presence of rigid mineral particles, the collapse of these anisotropic structures and their arrangement can be somehow modified.

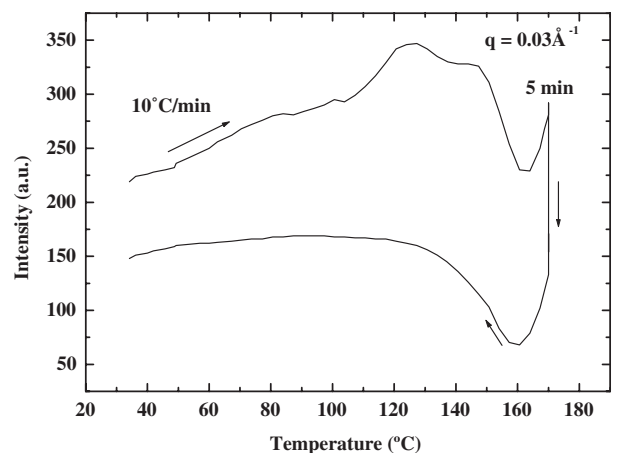


Figure 3 X-ray intensity profile for a heating and cooling cycle at a given q value for bitumen A.

Conclusions

The enhanced mechanical properties observed in some bitumen based composites may be explained by the higher asphaltene content and by the higher dispersive surface energy of the bitumen. The constrained imposed upon the aggregates of asphaltene molecules by the presence of filler particles may also be a contributing factor to the enhanced mechanical behavior.