



Quality Control of Polymer Modified Bitumen (PMB)

Application Note M190

Introduction

Bitumen is widely used in road construction and roofing due to its adhesive and waterproofing properties. To enhance its performance, various additives such as polymers are introduced. Ensuring the correct composition of bitumen is crucial for quality control, as deviations in polymer content can significantly impact durability and mechanical performance. Attenuated Reflectance (ATR) Fourier Transform Infrared (FT-IR) Spectroscopy is a powerful, non-destructive tool for identifying and quantifying bitumen components, offering rapid and reliable analysis.

This application note highlights the detection and quantification of polymeric additives, particularly styrene-butadiene-styrene (SBS). The ability to verify the presence and concentration of SBS and other modifying agents ensures compliance with specifications and optimal performance.

Materials & Methods

Bitumen samples were analyzed using a Bruker ALPHA II FT-IR spectrometer equipped with an ATR module. The samples included unmodified bitumen and SBS-modified binders with varying polymer content.

Results & Discussion

The FT-IR spectra of bitumen show characteristic peaks corresponding to its chemical composition and even reveal oxidation markers with ageing.

The presence of SBS is confirmed by characteristic absorption peaks at 966 cm^{-1} and 698 cm^{-1} , which correspond to butadiene and styrene vibrations. Comparisons between unmodified and SBS-modified bitumen samples show a clear increase in these characteristic peaks.

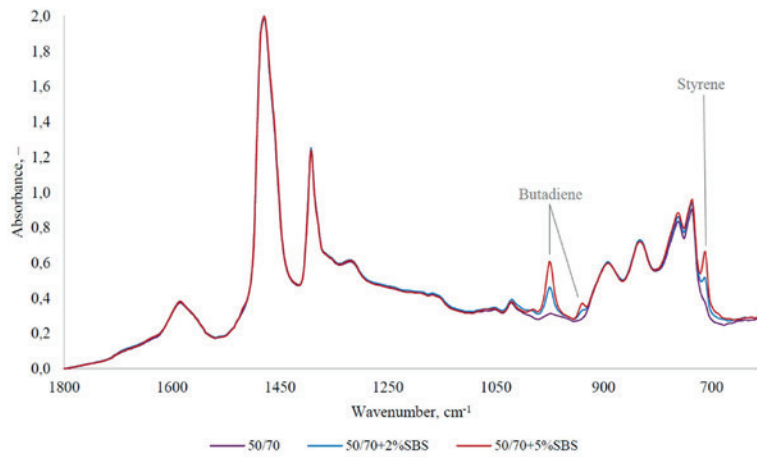


Fig. 2
FT-IR-ATR spectra of neat and laboratory-modified bitumen in the wave number range from 1800 cm^{-1} to 600 cm^{-1} .

Making use of the guidance provided by official standard methods such as AASHTO T 302-22, DB33/T 989-2015 and TJC E1001-2024 calibration curves for quantitative determination of SBS content in bitumen can be generated.

Besides SBS, ATR-FT-IR can detect other additives like adhesion promoters and anti-stripping agents, or even degradation markers such as carbonyls and sulfoxides. The technique is also capable of distinguishing bitumen from different crude oil sources based on spectral differences in aromatic and aliphatic hydrocarbon regions.

- Aliphatic hydrocarbons (CH stretching at 2920 cm^{-1} and 2850 cm^{-1})
- Aromatic compounds (C=C stretching at 1600 cm^{-1})
- Carbonyl groups (C=O stretching at 1700 cm^{-1} ; indicator of oxidation)
- Sulfoxide groups (S=O stretching at 1030 cm^{-1} ; oxidation marker)

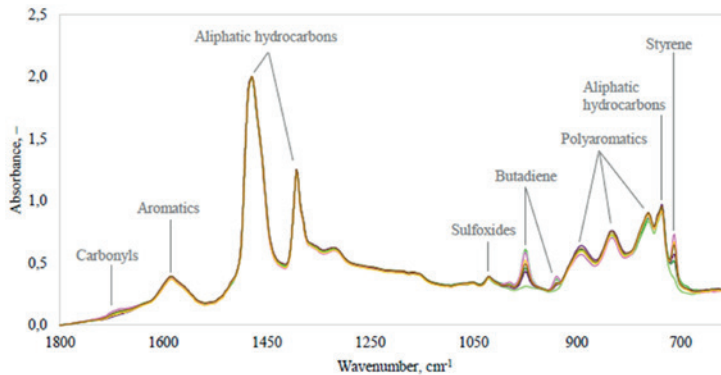


Fig. 2
FT-IR-ATR indicating where to find the specific spectral bands of additives and degradation markers.

For routine quality control, ATR-FT-IR enables tracking of polymer dispersion within bitumen, detecting variations due to processing conditions or material inconsistencies. Additionally, the method allows comparison with standardized reference spectra to ensure compliance with industry specifications.

Conclusion

ATR-FT-IR spectroscopy is an essential tool for quality control in bitumen production, enabling rapid identification and quantification of polymeric additives such as SBS. The technique ensures consistency in material properties, leading to improved road performance and longevity. Bruker's ATR-FT-IR systems provide high reproducibility and sensitivity, making them ideal for industrial applications in bitumen analysis.

References

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