NATIONAL TRANSPORT RESEARCH ORGANISATION

Best Practice Method

On-Site Assessment of Sprayed Seal Binder Oxidation Procedure

Version History

Version	Release Date	Release Notes
1.0	December 2025	Initial release of NTRO Test Method

Foreword

NTRO Best Practice Methods exist to articulate how a transport network owner or operator should require a specific, contemporary issue/challenge to be solved/resolved to ensure that it is delivering positive outcomes and meeting its statutory safety-, serviceability- and sustainability-related obligations effectively and efficiently. Rather than being totally prescriptive, NTRO Best Practice Methods identify the key building blocks to be followed to arrive at a desired outcome or solution and how they interrelate and combine. They are supported by NTRO and other specifications and/or test methods that set out which things must be done and specifically how they are to be done.

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1. Introduction

1.1 Background Information

Sprayed seals are a widely used pavement surfacing treatment in Australia, utilised for their cost efficiency and reliable performance. Oxidation of sprayed seal binders is a critical factor when assessing the condition of sprayed seals.

1.2 Test Method Scope

This test method sets out a procedure for the rapid on-site measurement of bituminous binder oxidation using a portable Fourier Transform Infrared spectroscopy (FTIR) device. The FTIR spectrum can be used on-site to measure an oxidation peak to assess how oxidised a bituminous binder is.

The scope of this test method includes FTIR testing of sprayed seal binder samples that have been collected either from an aggregate particle removed from the sprayed seal or were removed directly from between aggregate particles within the sprayed seal.

1.3 Objectives

The objective of this test method is to provide a rapid, field-based method for assessing the oxidative aging of bituminous binders in sprayed seals using portable FTIR spectroscopy, enabling timely evaluation of a binder's condition without the need for laboratory extraction or processing.

2. Equipment

The following equipment is required:

1. a portable FTIR spectrometer with a diamond crystal light source covering an appropriate range (e.g. 4,000 – 450 cm^{-1}) and an adequate, portable power source to enable its use in the field.

   The FTIR instrument and software should be maintained at regular intervals, in accordance with the quality assurance procedures applicable to the manufacturer's requirements. Regular checks should also be conducted to ensure the instrument is in good working order.
2. a portable computer capable of operating the manufacturer-supplied software to control the FTIR instrumentation, collect data and allow data manipulation
   Ensure the system is suitable for offline use, so no network capabilities are required.
3. a soft cleaning material – e.g. lens cleaning tissue or other soft material that can be used to clean the FTIR surface
4. a metal spatula
5. an extraction device – screwdriver or other suitable extraction implement used for the removal of aggregates or binder from the test specimen
6. kerosene or other suitable solvent used to clean binder from the FTIR crystal
7. acetone or isopropyl alcohol, or a cleaning solvent that will not leave a residue, to clean the FTIR crystal prior to testing.

3. Sample Collection

A binder sample shall be collected either from an aggregate particle removed from the sprayed seal surface (Figure 3.1), or it shall be removed directly from between aggregate particles within the seal surface itself.

Figure 3.1: Aggregate collection in the field

The procedure for sample collection is as follows:

1. Using the extraction device and taking care to minimise contaminants in the sample (e.g. dirt or dust particles), collect either:
   a. a single aggregate particle from the top layer of the sprayed seal at the field site
   b. sample of the binder directly from the sprayed seal.
2. Using the metal spatula or a clean extraction device, scrape a small amount of binder from either the:
   a. extracted aggregate particle
   b. sampled binder.
3. The sample is ready for testing as per Section 4.

4. FTIR Analysis

4.1 Preparation of the FTIR Instrument

1. Ensure the portable FTIR battery and laptop device are fully charged prior to use in the field.
2. Connect the portable FTIR to the laptop device with the supplied cable.
3. Turn both devices on and ensure the laptop recognises the connection. Wait for the FTIR to warm up for the recommended amount of time (if required by the manufacturer's instructions).
4. Log onto the FTIR software.
5. The following are recommended software settings for the FTIR instrument:
   a. Ordinate units: absorbance (A)
   b. Resolution: 4 cm^{-1}
   c. Scan type: sample
   d. Accumulation: 4 scans.
6. Apply a small amount of kerosene to a soft cleaning material. Clean the FTIR crystal with the soft cleaning material and allow the kerosene to evaporate.

   Note: Care must be taken to avoid scratching or abrading the FTIR crystal.
7. Apply a small amount of acetone to a separate soft cleaning material and clean the crystal again to remove any residue. Ensure the acetone has fully evaporated before proceeding.
8. Using the FTIR software, run a background test.

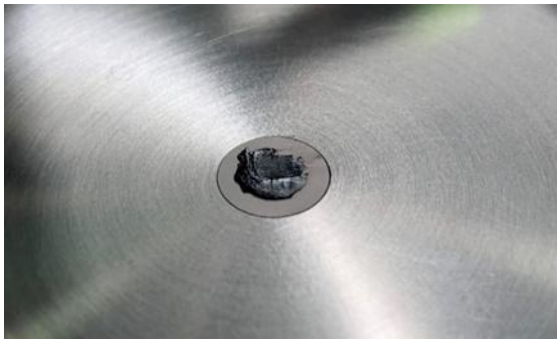
4.2 FTIR Testing Procedure

The procedure for FTIR testing is as follows:

1. Using the metal spatula, press a small amount of the binder sample collected as described in Section 3 directly onto the clean FTIR crystal.

   The sample size needs to be large enough to completely cover the FTIR crystal and approximately 2–3 mm thick *(*Figure 4.1*).*

Figure 4.1: Binder sample on FTIR instrument crystal



2. Input the appropriate sample identification information into the software. Refer to Appendix A for appropriate sample identification terms.
3. Initiate the FTIR scan using the software.
4. Once the scan is complete, save and/or export the spectrum in the appropriate FTIR output format.

   Note: The spectrum can also be exported into other formats (e.g. a Microsoft Excel spreadsheet) as required.

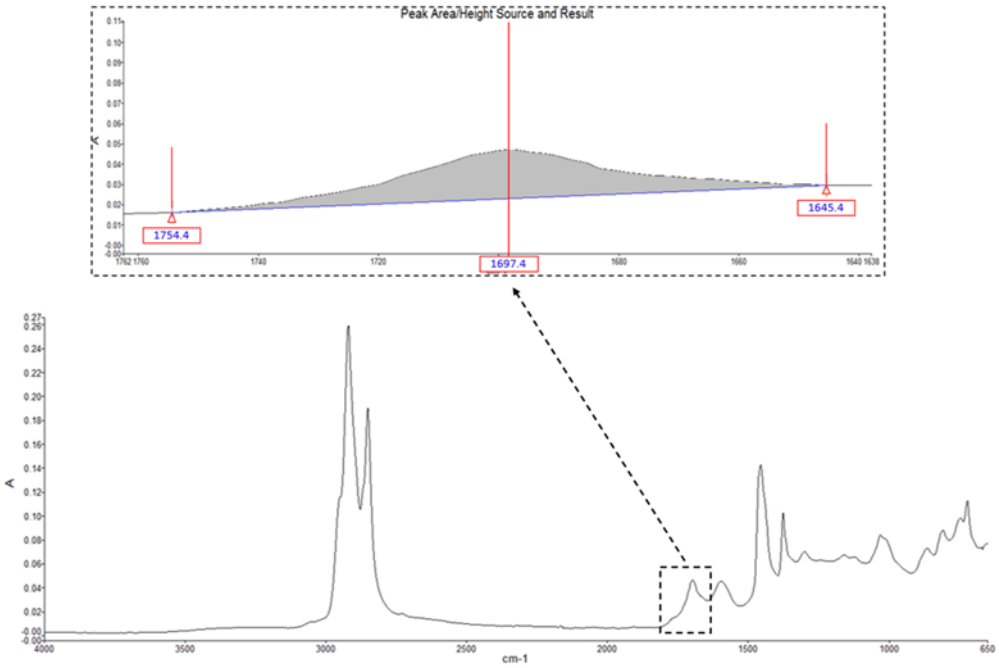
5. Apply a small amount of kerosene to a soft cleaning material(s). Clean and remove all the binder sample from the FTIR crystal. Allow the kerosene to evaporate.
6. Apply a small amount of acetone to a separate soft cleaning material and clean the crystal again to remove any residue. Ensure the acetone has fully evaporated before proceeding.

5. Analysis

To assess the degree of oxidation in bituminous binders, the carbonyl peak area in the FTIR spectrum is calculated using the following procedure:

1. Define the baseline: use the FTIR software to draw a linear baseline between the wavenumbers 1,754.4 cm^{-1} and 1,645.4 cm^{-1} on the FTIR spectrum. These points represent the boundaries of the carbonyl absorption region (as indicated by the red triangles in Figure 5.1).
2. Integrate the area: using the FTIR software, calculate the area enclosed between the FTIR spectrum and the defined baseline within the range of 1,754.4 cm^{-1} to 1,645.4 cm^{-1}. This integrated area corresponds to the carbonyl peak and is shaded grey in Figure 5.1.

Figure 5.1: Example spectrum demonstrating the calculation of the carbonyl peak



6. Reporting

The following shall be reported:

1. sample identification as per Section 4.1 Clause 2
2. sample spectra as obtained from Section 4.2 Clause 4
3. calculated carbonyl peak area as obtained from Section 5.

Appendix A Sample Identification

The sample identification shall include sufficient information to enable clear and reliable tracking. It is recommended this includes:

- the location:
  - road ID
  - lane/direction ID
  - GPS coordinates
  - point of extraction (i.e. inner wheelpath (IWP), outer wheelpath (OWP), between wheelpaths (BWP), centreline (CL), shoulder, etc.)
- date sampled
- person/s taking sample
- any other unique identification data or observations related to the sample taken.