

Road Maintenance Forum: Status of CSIR Research Laboratory

Date: 13 April 2023

Presenter: Dr N Mayedwa



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



Contents

Introduction

Advanced Material Testing Laboratories (AMTL)

- Bituminous Binders Laboratory
- Asphalt and Dynamic Testing Laboratory
- Granular (soils, gravel and aggregates) and Cementitious Materials Laboratory
- Technology Innovation Centre (TIC)

Conclusion

Introduction

- **Road Materials Testing research group has been involved in road material testing activities in South Africa and the continent since the 1950s**
- **Road Materials Testing main mandate is the provision of specialist testing services.**
- **The development of innovative kits and customized equipment.**
- **The creation and validation of new technologies; and the localization of new characterization fields to support the needs of the pavement engineering sectors in South Africa and internationally.**

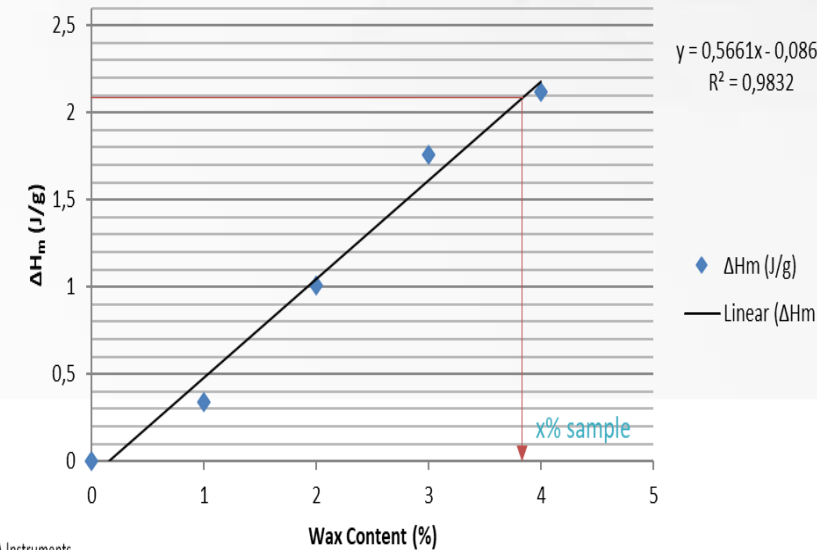
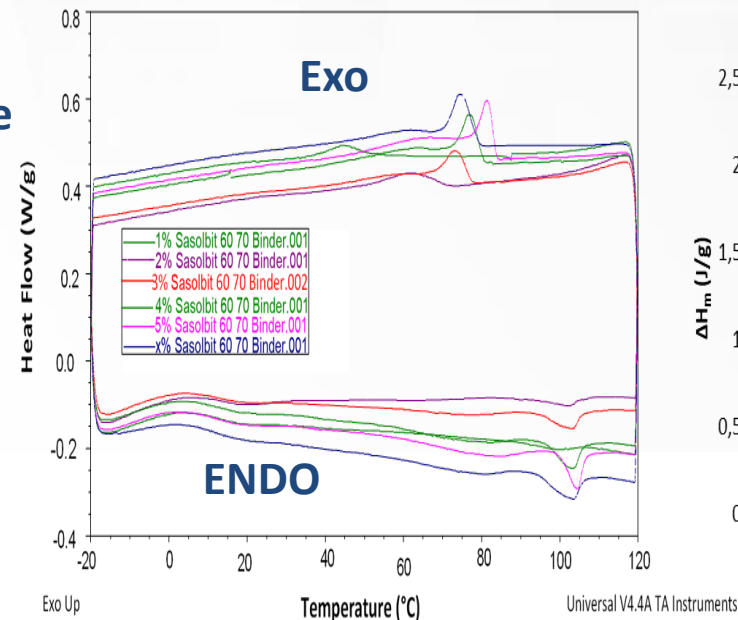
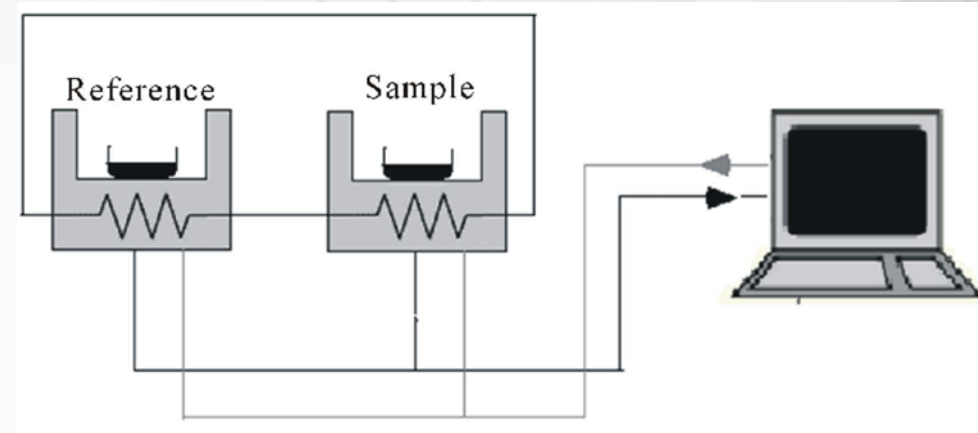
Introduction

- **RMT's research group is a multi-disciplinary team that consists of civil engineers, chemical engineers, mechanical engineers, geologists, forensic scientists and chemists with appropriate higher degrees, diplomas or certificates**
- **Majority of staff have years of experience to qualify them as competent technicians in accordance with various ISO standards.**
- **The laboratories are unique in the continent in that their services include 250-300 test methods conducted by technicians of various skill sets.**
- **The research group consists of two facilities:**
 - **Advanced Material Testing Laboratories (AMTL) and**
 - **Technology Innovation Centre (TIC).**
- **Under AMTL there are 3 Laboratories;**
 - **Bituminous Binders Laboratory,**
 - **Asphalt and Dynamic Testing Laboratory and**
 - **Granular (soils, gravel and aggregates) and Cementitious Materials Laboratory.**

Bituminous Binders Laboratory

Representative Analytical tools;

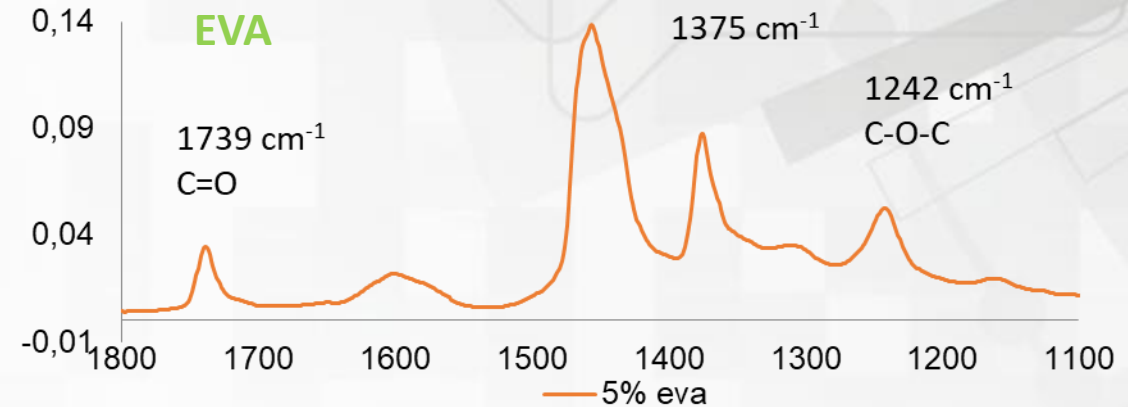
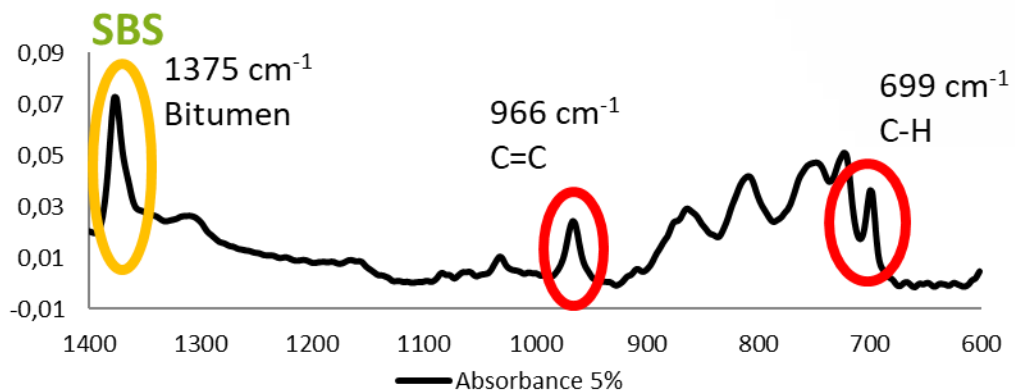
- **Differential Scanning Calorimetry (DSC)**
 - Fourier Transform Infra-Red (FTIR)
 - Epi-Fluorescence Microscopy
-
- DSC is used to Identify the presence of wax in the bitumen.
 - Thermo-analytical technique used where the difference in the heat required to increase the temperature of a sample and its reference (empty crucible) is measured.
 - Observe for the exothermic peak during the cooling process.
 - Observe the endothermic peak during the melting process.



Bituminous Binders Laboratory

Representative Analytical tools;

- Differential Scanning Calorimetry (DSC)
- **Fourier Transform Infra-Red (FTIR)**
- **Epi-Fluorescence Microscopy**
- **Identifying modifiers in the bitumen by their characteristic peaks.**
- **IR radiation is passed through a sample where the molecules absorbs/transmit at a particular wavelength, depending on the bonds present, resulting in a spectrum (absorption/emission).**
- **Molecular fingerprint of the sample.**

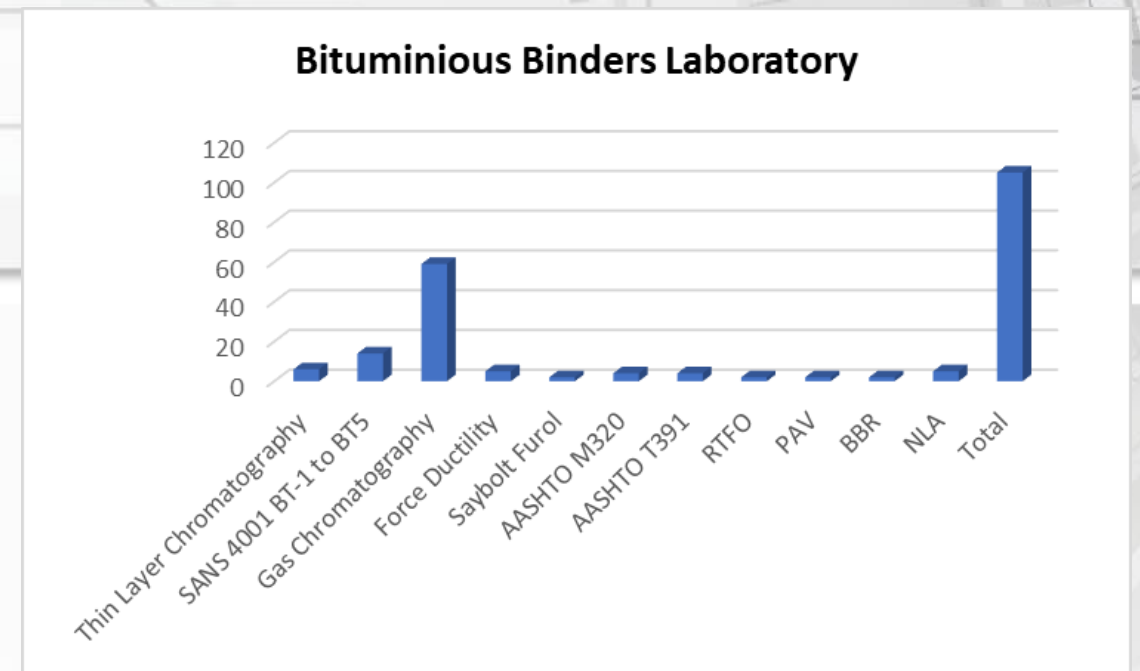
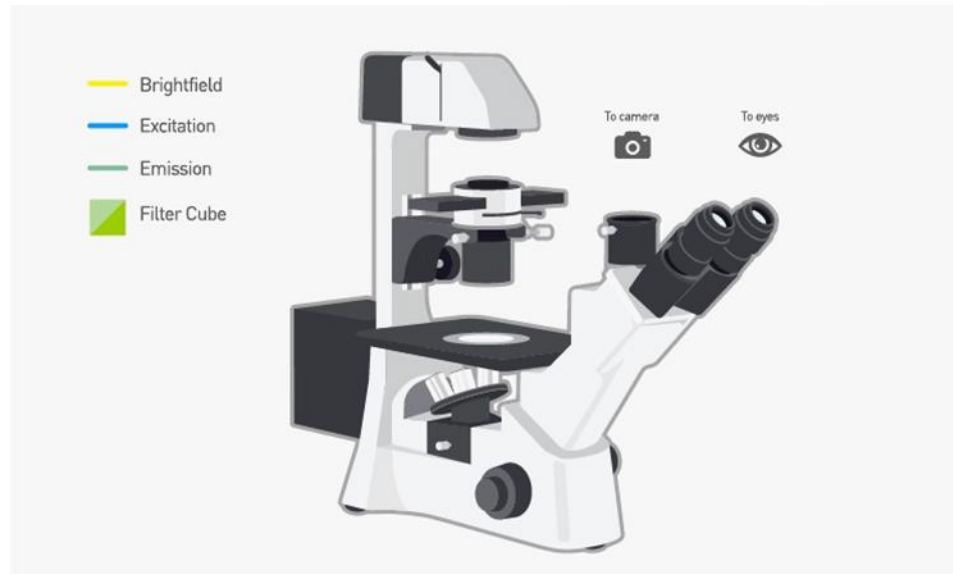


- **Epi fluorescence is used to Observe the homogeneity of modified bitumen**
- **High-intensity light is beamed and passed directly through sample, exciting particles which emit the light at a particular wavelength through the same (“epi”) objective lens.**
- **Bitumen doesn’t emit light; the modifier present may be visually observed.**

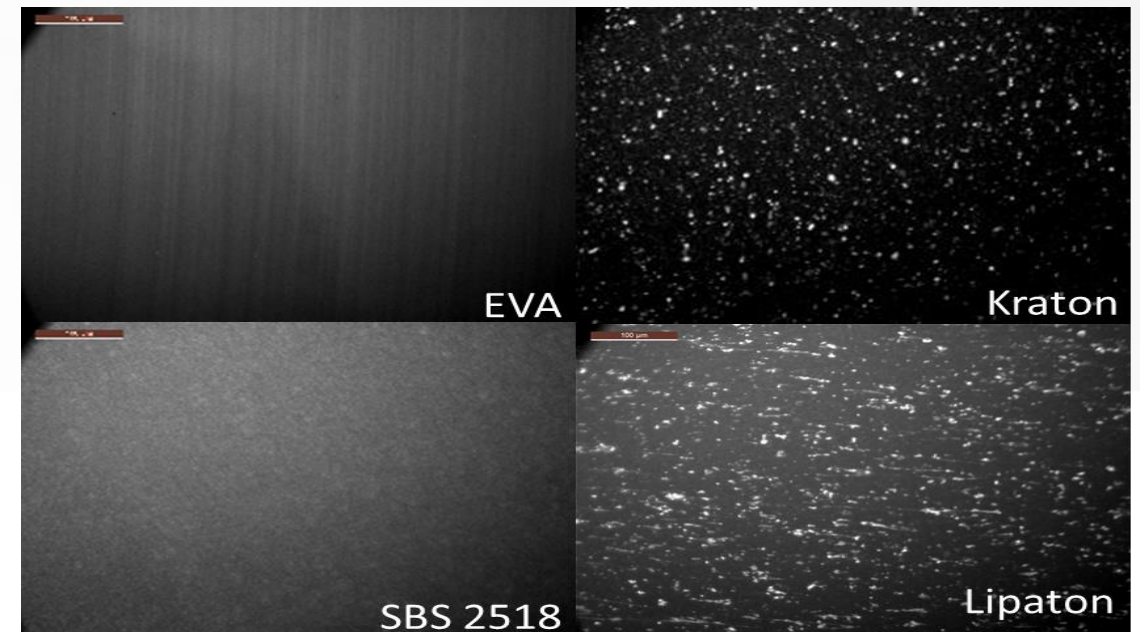
Bituminous Binders Laboratory

Representative Analytical tools;

- Differential Scanning Calorimetry (DSC)
- Fourier Transform Infra-Red (FTIR)
- **Epi-Fluorescence Microscopy**



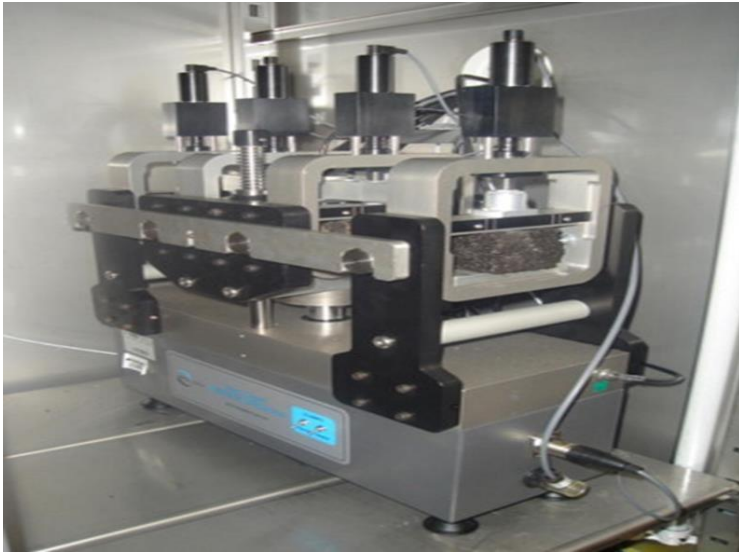
Number of test done March 2022 to March 2023



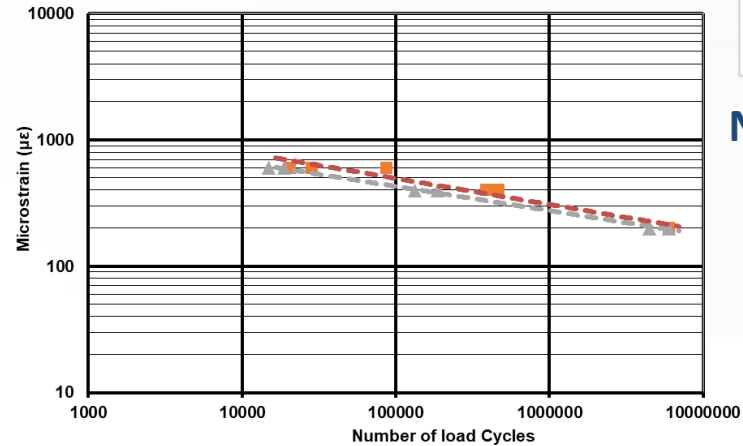
The morphology of modified binders at 100µm resolution

Asphalt and Dynamic Testing Laboratory

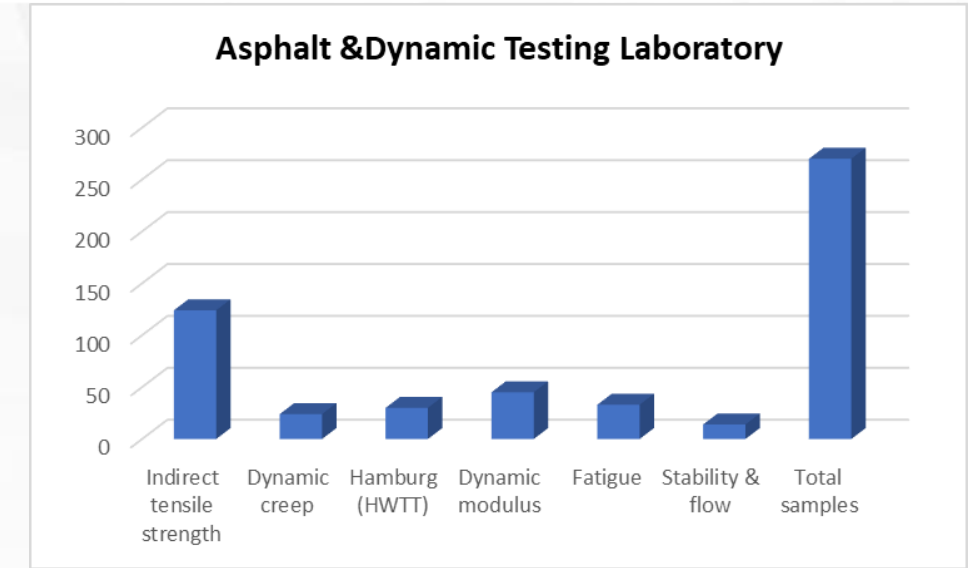
- Representative analytical tool is Fatigue cracking
- Evaluates the ability of the asphalt mix to withstand repeated tensile strain without fracture.



Beam fatigue tester



Fatigue life at a temperature of 10° C and frequency of 10 Hz

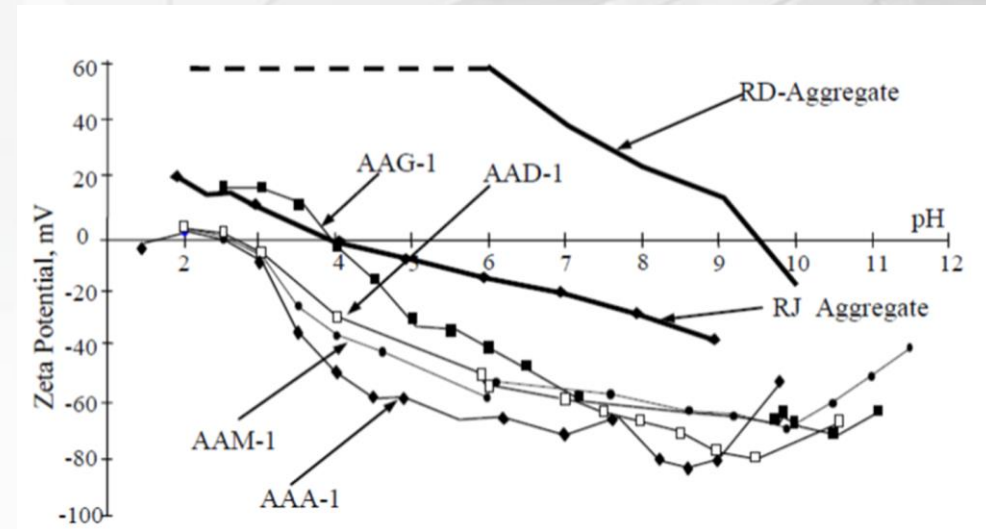


Number of test done March 2022 to March 2023

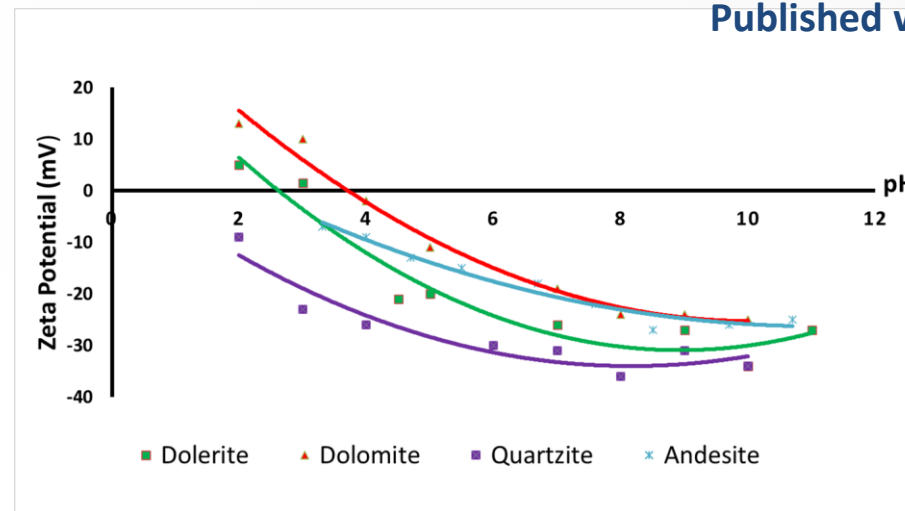
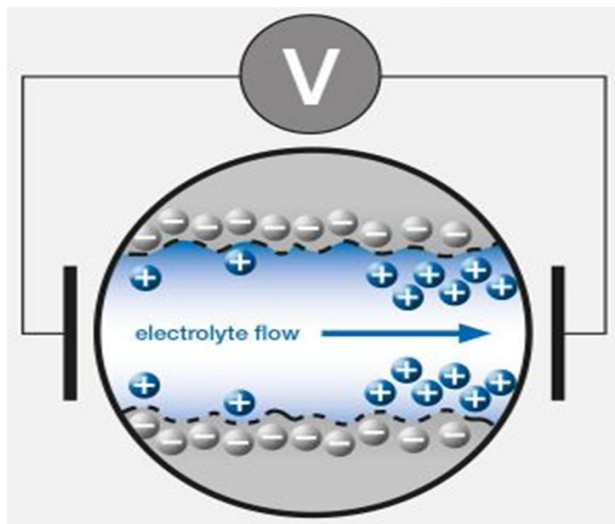
Granular (soils, gravel and aggregates) and Cementitious Materials Laboratory

Representative Analytical tools;

- **SurPASS™ 3 Zeta Potential (streaming potential)**
- Advanced Aggregate Image Analyzer
- Adiabatic calorimeter
- **Zeta potential consists of an electrolyte, KCl (potassium chloride)**
- **pH control**
 - HCl (hydrochloric acid) for acid titration
 - NaOH (sodium hydroxide) for base titration



Published work (Labib et al 2007)



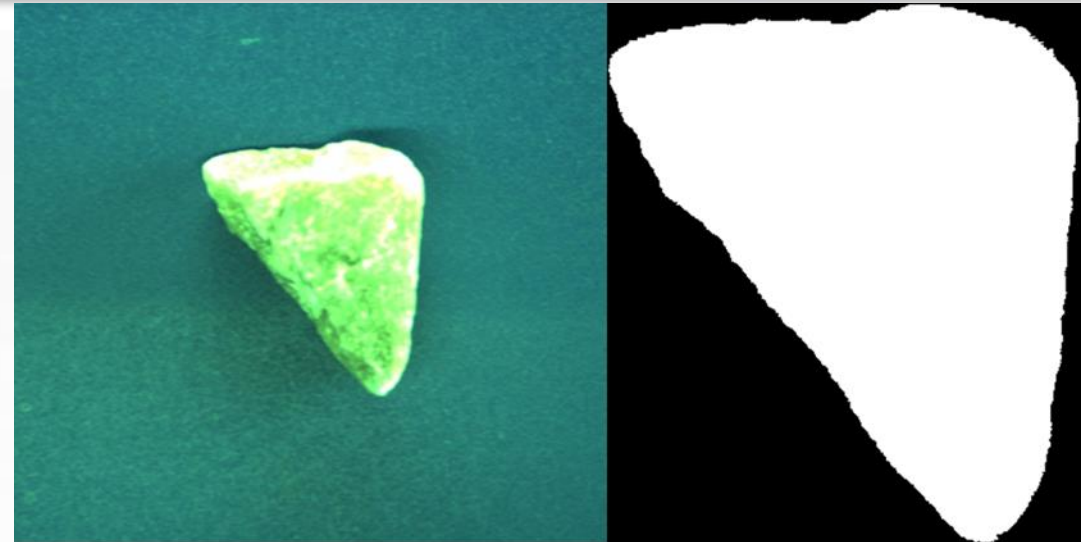
Work done at CSIR

Granular (soils, gravel and aggregates) and Cementitious Materials Laboratory

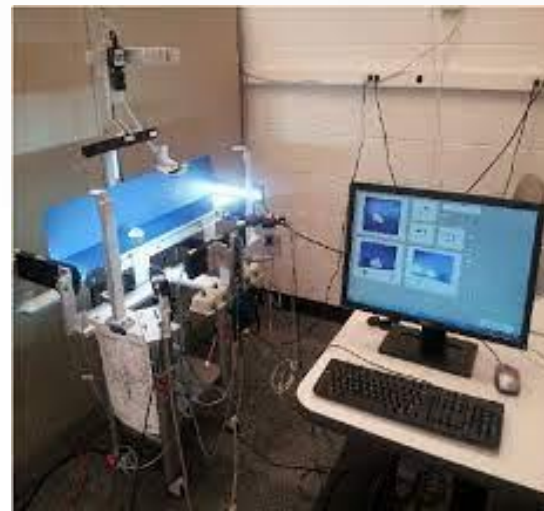
Representative Analytical tools;

- SurPASS™ 3 Zeta Potential (streaming potential)
- **Advanced Aggregate Image Analyzer**
- Adiabatic calorimeter

- **The Advanced Aggregate Image Analyzer quantifies physical characteristics of aggregate particles. The equipment utilizes three (3) cameras to create a semi 3D image of an aggregate particle.**
- **The equipment analyses the binary image to quantify the physical properties of the particle**
- **These include the sieve size, angularity, surface texture, area, volume, flat and elongation ratio, minimum and maximum dimensions**



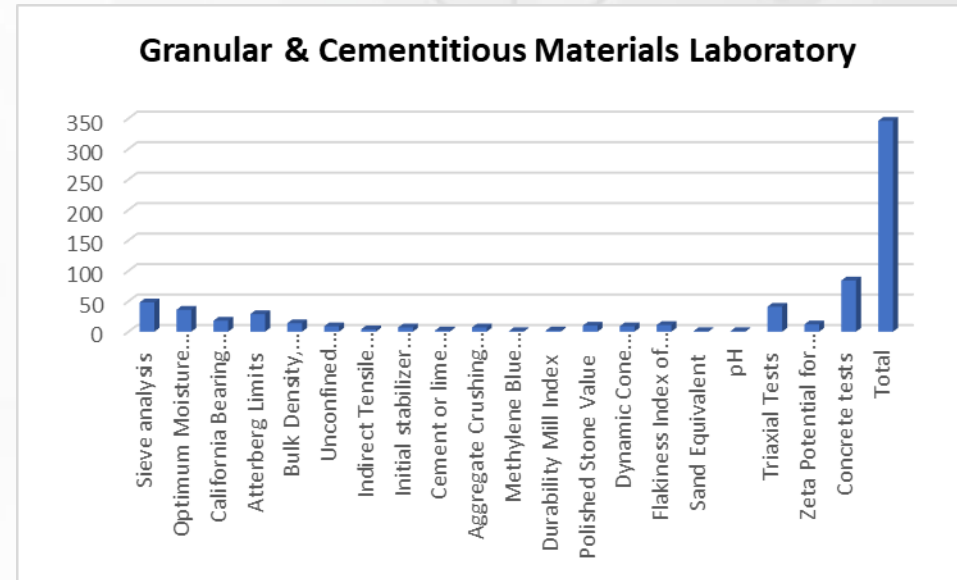
The image output of the equipment. A JPEG and binary image analyzed to acquire the particle properties



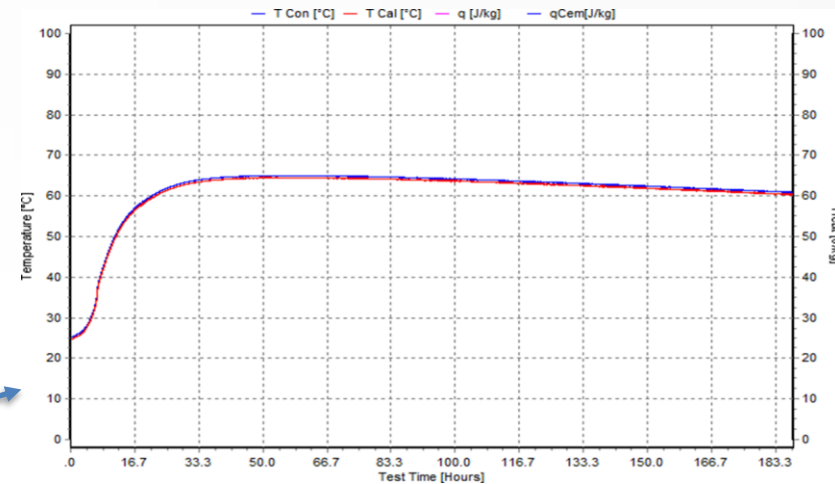
Granular (soils, gravel and aggregates) and Cementitious Materials Laboratory

Representative Analytical tools;

- SurPASSTM 3 Zeta Potential (streaming potential)
- Advanced Aggregate Image Analyzer
- **Adiabatic calorimeter**
- **Adiabatic calorimeter prevent heat transfer.**
- **It is the only method allowing correct evaluation**
- **Real time measurement of heat of hydration**
- **Evaluation of the heat of hydration**
- **It gives an indication of the target strength**



Number of test done March 2022 to March 2023



Temperature vs time graph displayed in Real time

Technology Innovation Centre (TIC)

- The establishment of TIC facility acts as a support for the country's drive toward the fourth industrial revolution (4IR) in the road engineering industries.
- The new facility will stimulate the growth and competitiveness of current and future technologies in the transport sector



Type 1
FARO focus S150



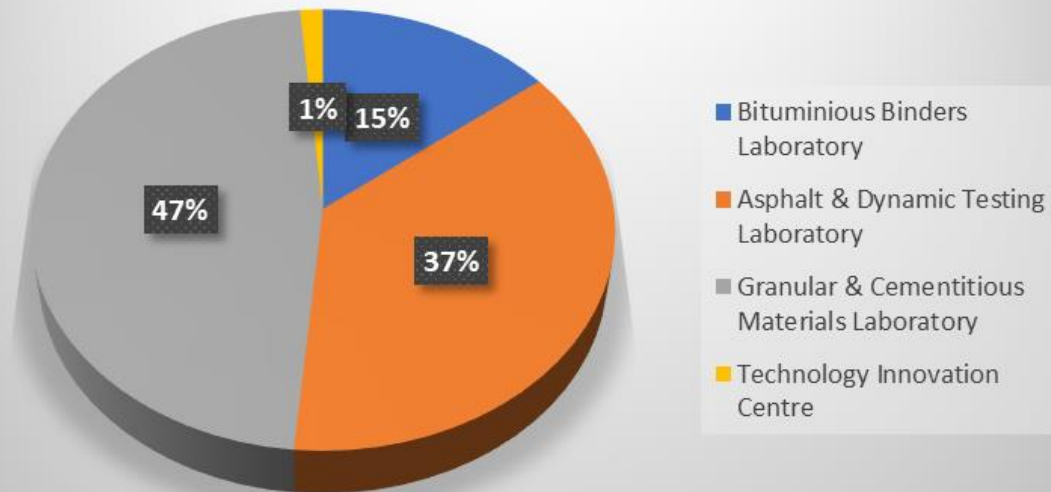
Type 2
FARO freestyle



Gravel Road Test Kit (GRTK)

Conclusion

Total tests done in AMTL over a year



- Total test and projects done over a year in AMTL is 729.
- Accreditation for ISO 17025 for laboratories is 85% completed.
- AMTL is a well-equipped state of the art laboratory which produces quality results.
- Multi-disciplinary team which is highly competent across board.

The background is a dark blue gradient with a complex, abstract pattern of white and light blue geometric shapes, including circles, lines, and polygons, creating a sense of depth and connectivity.

Thank you