

INTRODUCTION

Moisture-damage is an extremely complicated mode of distress that leads to the loss of stiffness and structural strength of the asphalt mixture pavement layers of a road. The susceptibility of road material (aggregate & bitumen) to moisture damage is dependent on the interfacial characteristics of the material and can be evaluated by using the surface energy characteristics of the material.

AIMS AND OBJECTIVES

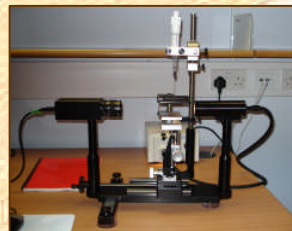
The overall aim of this research is to:

- Use surface free energy measurements to better understand and predict the resistance to moisture-damage of asphalt materials.
- Produce guidelines on the appropriate selection of aggregate, bitumen and filler combinations in order to ensure the long-term performance of asphalt mixtures.
- Develop correlations between standard asphalt mixture moisture-damage (durability) techniques and more fundamental bitumen-aggregate and bitumen-filler mastic-aggregate adhesion tests.
- Enhance performance of asphalt mixtures, with respect to moisture damage.

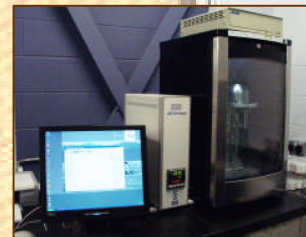
EQUIPMENT

A physico-chemical laboratory has been established at NTEC for this research and the following equipment has been procured.

- **Goniometer:** Static contact angle of the probe liquid with substrate/bitumen is measured which is then used to calculate the surface energy of the bitumen.
- **Dynamic Contact Angle Analyzer, DCA:** Dynamic (advancing/receding) contact angle values are measured to work out the surface energy of bitumen.
- **Dynamic Vapor Sorption System, DVS:** Surface energy components of the aggregates are determined using adsorption isotherm, on the basis of sorption of vapor probes by aggregates.
- **Microcalorimeter:** Heat of Immersion of aggregates in different probe liquids is used to measure their surface energy components. Heat of adhesion between aggregates and bitumen is also measured using this equipment.



Goniometer



DVS



DCA



Microcalorimeter

RESEARCH FEATURES

- Selection of appropriate aggregates, bitumen and fillers for the study.
- Use of standard techniques and procedures to determine the surface free energy of selected aggregates, bitumen and fillers and calculate the intrinsic adhesion for the various bitumen-aggregate systems under dry and wet conditions.
- Development of an adhesion test method to determine the adhesive fracture energy of a system.
- Calculation and comparison of theoretical dry and wet bond energy ratios based on thermodynamic measurements with actual adhesive fracture energies.
- Quantification of the resistance to moisture-damage of asphalt mixtures by means of SATS and AASHTO T283 asphalt mixture screening tests.
- Investigate the possibility to improve the adhesion between bitumen and aggregate by adding primers/polymers to the bitumen.

RESEARCH FUNDING

The University of Nottingham has provided £150K for the establishment of the physico-chemical laboratory at NTEC.

Grants have been awarded by EPSRC for collaborative research with Texas A&M and Imperial College London.