DANNYS ENTERPRISES COMPANY LIMITED

KMA IN-PLANT BITUMEN STABILISED MATERIAL (BSM) FOR PAVEMENT CONSTRUCTION AND REHABILITATION IN TRINIDAD AND TOBAGO




AUGUST 2018

INTRODUCTION

The construction and rehabilitation of our roads, car parks and driveways in Trinidad and Tobago, currently utilizes virgin natural aggregate materials as key components of pavement structural layers. Moreover, accompanying ongoing local infrastructural development is a continuous demand for suitable road building aggregates, for construction and upgrade applications. Depleting local natural deposits and limited supplies of quality virgin granular aggregates has prompted consideration towards alternative sources, for addressing the demands of the industry.

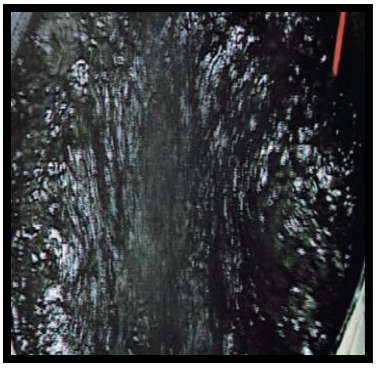
Fortuitously, effective global advancements in material technology, specialized equipment and construction techniques, currently provides opportunity for the improvement of a wider range of our available materials and subsequent satisfactory inclusion in our local pavement structural layers. The option of chemical stabilization of our available aggregate materials, has also provided for the consideration of more cost effective and durable pavement structural designs, utilizing layers with increased carrying capacity, in its treated form. Foamed bitumen stabilization is one such technique with the chemical improvement of road building materials, producing bitumen stabilised materials (BSMs), which has been successfully incorporated into pavement base and sub base structural layers globally.

BSMs have been utilized in road construction and rehabilitation of major local carriageways for over a decade, with its introduction in Trinidad in the initial Cold In-Place recycling applications by Danny's Enterprises Company Limited. Fortunately, advancements in equipment and technology now offers the attractive option of Cold In Plant treatment of aggregates, with chemical enhancement providing for the controlled production of materials of improved properties for base and sub base applications. In-plant produced BSMs display improved shear strengths, flexural strengths, stiffness and moisture resilience, and as such can be included in pavement structural layers of increased capacity and durability, compared to that of similar thickness conventional granular aggregate layer systems. The cold in-plant treatment option also provides for controlled blending of available aggregates, which allows for the inclusion of a wider range of available materials for enhancement and construction applications.

In-plant blending of our available natural granular materials and the production of a bitumen treated blended product, provides opportunity for the construction of a thinner, enhanced BSM pavement layer in a durable pavement structure, as an alternative to the thick layered conventional aggregate pavement system, utilized in the traditional method of pavement rehabilitation and construction.

BACKGROUND

Foamed Bitumen



Foamed bitumen or expanded asphalt is produced when hot bitumen, at temperatures in excess of 150°C, comes into contact with cold water in the presence of air. The injection of the water into hot bitumen produces foaming which involves the production of vapour trapped in thousands of tiny bitumen bubbles. Upon mixing, these bubbles burst into splinters which disperse into the aggregate, producing a mastic with the finer particles. During compaction, the bituminous particles within the mastic adhere to the large aggregate particles, creating spot welds and a non-continuously bound layer
(Wirtgen Cold Recycling Technology 2012, 107).

Bitumen Stabilised Materials

BSMs are produced from the mixing of selected aggregate materials with foamed bitumen or expanded bitumen and often low amounts of cement or lime secondary stabilising agents BSMs behave in a manner similar to unbound granular material, but with a notable improvement in cohesive strength and reduced moisture sensitivity. The improvement offered by bitumen stabilisation allows for inclusion of available materials which would have been initially limited in terms of capacity and unsuitable for inclusion in stressed pavement layers.

Section of BSM1-AGG compacted layer core (Bridgemohan, 2018)

Bitumen stabilisation of provides for the enhancement of the parent materials producing a material inherent of a unique skeleton with unlinked bitumen droplets and uncoated coarser aggregate particles. This results in a treated material reflecting the granular characteristics of an untreated material displaying notable:

1) Improved cohesion

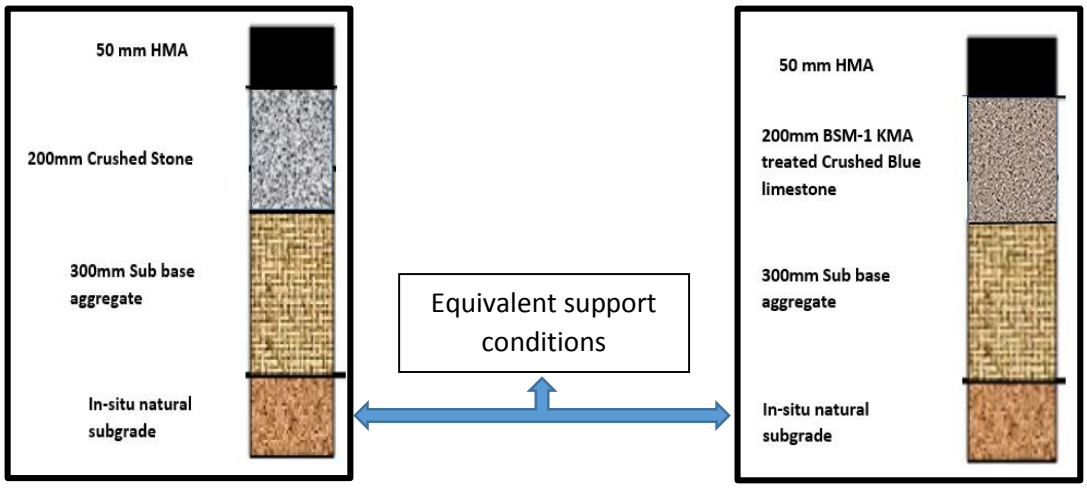
2) Improved tensile strength

3) Improved stiffness

4) Improved durability, particularly with increased resistance to moisture

5) Improved workability.

Typical Pavement Structural Comparison



CBR 5 in-situ subgrade/CBR 30 sub base support CBR 80 Unbound Granular Agg Base **550,000 ESALs**	CBR 5 in-situ subgrade/CBR 30 sub base support BSM1-AGG Stabilised Base **3,500,000 ESALs**

Bitumen Stabilised Layers display enhanced strength properties with notable improvement in cohesion, in addition to inherent frictional strength. These qualities are in comparison to the untreated parent aggregate which relies immensely on frictional interlock for its strength. The result is the required thickness of a BSM1 base is usually less than that of a granular base carrying similar traffic.

BSM PRODUCT TECHNOLOGY

The enhanced properties of the in-plant BSM blends promotes its suitability for use as a base or sub base in a stabilised pavement structure, as an alternative to the conventional aggregate system, in new construction and rehabilitation of roads, car parks and driveways in Trinidad and Tobago.

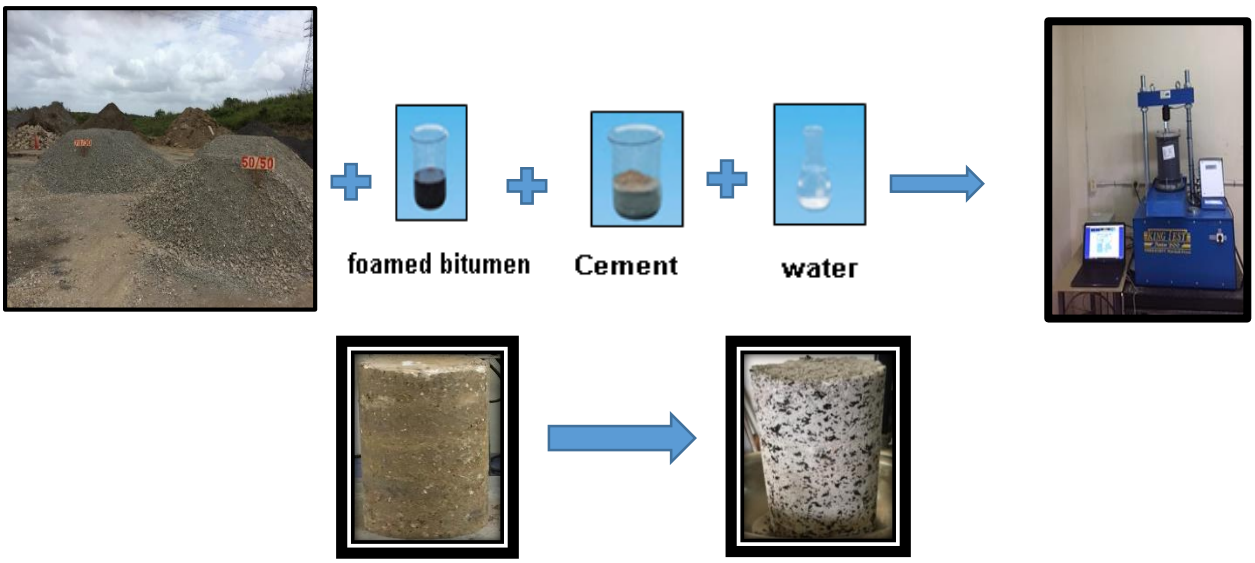
Technical Data

- The proposed bitumen stabilised offers the opportunity for the sustainable production of a BSM1 allowing for the use of available materials inclusive of reclaimed pavement materials as well as locally sourced granular aggregates, with enhancement and controlled treatment executed in-plant.

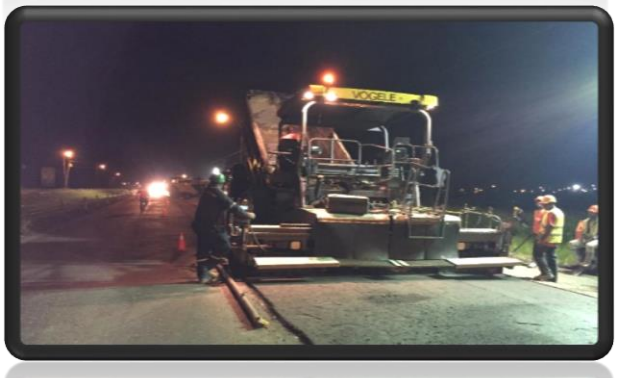
- BSMs may be produced from
  - Reclaimed asphalt pavement materials (RAP millings)
  - Quarried aggregates (Northern Range crushed blue limestone)

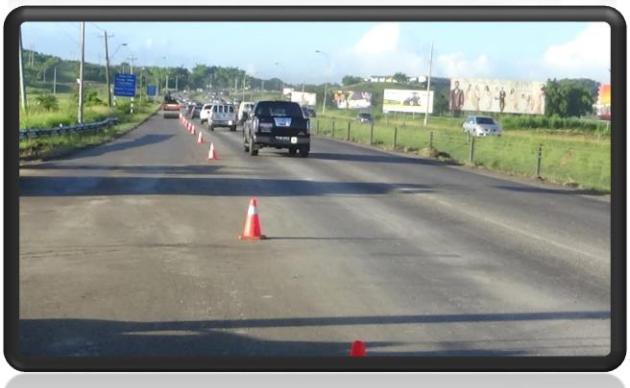
- BSM Strength Test Results:
  - Shear Parameters: Cohesion,C >250kPa / Friction Angle > 40°
  - Indirect Tensile Strength (ITS-flexural strength) laboratory values > 225kPa (Wirtgen Cold Recycling Technology 2016)
  - Retained Tensile Strength (Tensile Strength Ratio) > 0.7

- Material Design and Quality Monitoring



CONSTRUCTION APPLICATIONS





BENEFITS OF THE COLD IN PLANT BSMs AND CONSTRUCTION METHODOLOGY

a) The benefits of a stabilised material of improved engineering strength and durability properties which provides for increased pavement layer carrying capacities and which lends to more economical, durable pavement designs and construction.

b) BSMs produced in plant are laid in single passes, using the conventional asphalt pavers to the desired thicknesses, grade and levels, allowing for higher site production rates.

c) The in-plant treatment provided by the Wirtgen KMA mobile cold recycling plant which promotes the controlled production of an enhanced BSM, for construction of stabilised, thinner layer pavement systems, suitable for all pavement applications.

d) In-plant production utilising metered moisture control options provides for optimal mixes with improved workability, eliminating construction challenges which accompany conventional quarried aggregate sourced materials, in wet weather conditions.

e) The opportunity for the improvement of locally sourced marginal aggregates, allows for the use of local resources, whilst ensuring consistency in quality and subsequent fulfilment of requirements for its inclusion in pavement structures.

f) The BSM produced in-plant allows the material to be pre-mixed, sampled, inspected and tested, with allowed adjustments to input parameters and mixing times as required.

g) Construction method using conventional asphalt pavers allows for reduced risk with aggregate breakdown often accompanying repeated grading and compaction during conventional aggregate layer construction.

h) BSM provides for a durable layers as base or sub base layers in designed pavement structures and may also be considered for surfaces for temporary unpaved applications.

i) The enhanced strength properties of in-plant BSM, its improved workability and option for paver laid construction applications, provide opportunities for economically designed pavement structures and higher construction production rates, with available overall cost savings in both design and construction.