Physical differentiation between air-rectified and oxidised bitumens

Technical Committee Task Force

Background

CONCAWE has requested technical support from Eurobitume on differentiation between air-rectified bitumen and oxidised bitumen. An extract from the CONCAWE minutes detailing the request is shown below:

"Eurobitume should focus on distinctions between types of bitumen and terminology. The Eurobitume update to "The Bitumen Industry – A Global Perspective" in 2011 *may help us in terms of understanding. Eurobitume should focus on addressing how to distinguish between semi-blown and fully blown, if possible, in terms of definition and phys/chem. parameters. If a note based on Phys/chem. parameters can be appropriately developed, Eurobitume would address this point".*

The objective of this task force is to present proposals to CONCAWE based on at least one physical and/or chemical parameter, or a combination of those, and to define the associated threshold value(s) to technically differentiate air rectified bitumen grades from severely oxidised bitumen grades.

The criteria developed by the Task Force apply strictly to the category covering the CAS number for Asphalt Oxidised (64742-93-4) and not to any other bitumens.

Introduction

Oxidised bitumen, also known commonly as blown bitumen, is made in a manufacturing unit known as the bitumen blowing unit (BBU) or Air Blowing Unit (ABU) or Oxidiser. Depending on the feedstock viscosity and the processing conditions, the BBU produces two types of product with distinctly different characteristics: air rectified (also known as semi-blown) and oxidised (also known as blown) bitumen. Both products are covered by the CAS# 64742-93-4 (equivalent to EINECS# 265-196-4).

A mild degree of air blowing, known as air-rectification, is commonly used to adjust the physical properties of a given feed in order to manufacture substances used to make products used in paving. Products that are air-rectified may be used in paving, some roofing applications, such as shingle saturants and Type 1 Built Up Roofing Asphalt (BURA), and also for some industrial applications.

An intense degree of air blowing, known as oxidation, is commonly used to adjust the physical properties of a given feed in order to manufacture substances used to make products for roofing, such as Type III BURA, and for some industrial applications.

Task Force recommendations

The Task Force reviewed a list of potential options for differentiation of air-rectified and oxidised bitumen and proposed Penetration Index (PI)[1]. This criterion is workable in Europe because the bitumen specifications for both air-rectified and oxidised bitumen require the measurement of both Penetration (EN1426) and Ring & Ball softening point (EN 1427), both of which are required for calculating the Penetration Index. The Penetration value, Softening point and PI calculation methods are all standardised in European harmonised standards and specifications and are therefore unambiguous.

In the European standards the PI is calculated from a combination of Penetration at 25 °C and the Ring and Ball softening point, wherein the softening point is considered to be equal to the temperature at which the Penetration value is equal to 800dmm.

The processing through a blowing unit induces a modification of the penetration-softening point relationship, resulting in a systematic increase of the PI of the blown substance. Therefore PI is considered to be a good indicator of the level of oxidation of an oxidised bitumen.

The recommended criteria for differentiation are:

- **Air rectified bitumen = PI ≤ 2.0**
- **Oxidised bitumen = PI >2.0**

The above criterion can be visualised against current EU and ASTM specification values in Figure 1.

Key to figure

= oxidised

= air-rectified

= proposed limit

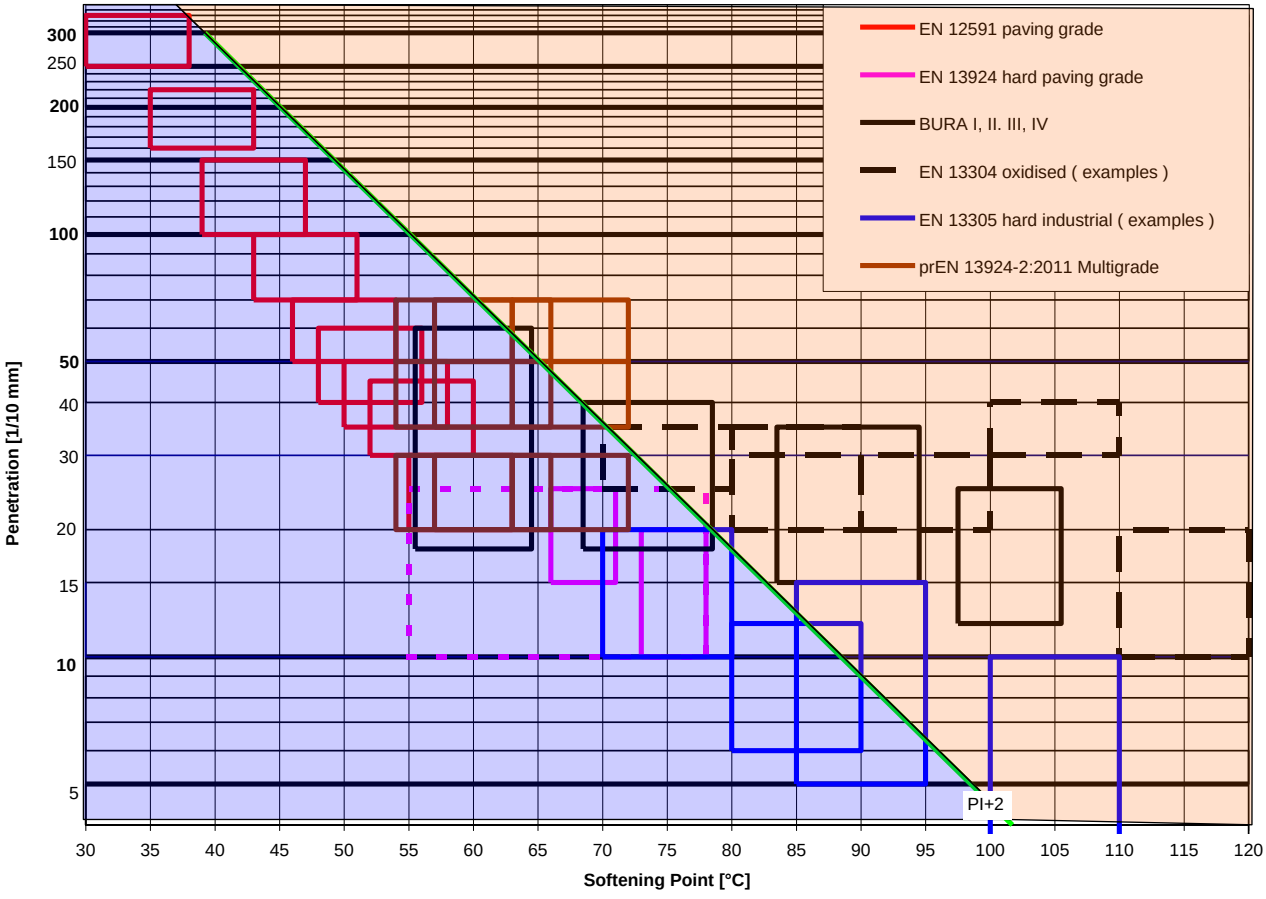

Figure 1 - Schematic diagram showing typical specification values and proposed differentiation criterion

Note: **ASTM specification values have been adjusted by 1.5 °C to correct them for EN SPt values**

Reference

[1] Indication of the thermal susceptibility of a bituminous binder. The penetration index is calculated from the values of PENETRATION and the SOFTENING POINT. It is based on the following hypothesis of Pfeiffer and Van Doormaal*:

a) At the temperature of the softening point, the penetration of a bitumen is 800 dmm.

b) When the logarithm (base 10) of PENETRATION is plotted against temperature, a straight line is obtained, the slope A of which is defined by:

$$A = \frac{(20 - I_p)}{(10 + I_p)} \times \frac{1}{50}$$

I_p = Penetration Index in the above formula

* J.-P. Pfeiffer and P.M. van Doormaal: The rheological properties of asphaltic bitumens. Journal of the Institution of Petroleum Technologists, Vol 22, pp 414-440, 1936