

# PERFORMANCE RELATED SPECIFICATION SYSTEM FOR BITUMINOUS BINDERS

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## ABSTRACT

The paper presents the feedback of a series of technical seminars on bituminous binder testing and specifications, the BiTSpec seminars, held in Europe to support the present work programme for developing performance related standards for the binders used in road construction and maintenance, under the responsibility of the CEN Technical Committee TC 336. The purpose of these events was to facilitate communication at European and national levels between all the stakeholders involved in the definition and the preparation of a suitable performance-related specification system for binders. The BiTSpec project started in 2002 with regional seminars held in ten different countries and ended with a European seminar held in June 2003 in Brussels. The paper also presents the synthesis of the collective viewpoints of the European organisations EAPA (European Asphalt Pavement Association), EUROBITUME (European Bitumen Association), FEHRL (Forum of European National Highway Research Laboratories), IISRP (International Institute of Synthetic Rubber Producers) and WERD (Western European Road Directors), which express their needs and requirements related to the specification system for binders.

## KEY WORDS

BITUMINOUS BINDERS / EUROPEAN STANDARDISATION / SPECIFICATIONS / PERFORMANCE RELATED STANDARDS.

## 1. INTRODUCTION AND BACKGROUND

At the end of 1999 a first generation of European Standards for bitumens, including the specification for paving grade bitumens, was issued by CEN (Comité Européen de Normalisation – European Standardisation Committee). This first generation of European bitumen standards represented the result of some of 9 years of work of CEN Technical Committee 19 'Petroleum Products' / Subcommittee 1 'Bitumen' to harmonise the existing National Specifications.

In 2000 a new CEN Technical Committee 336 'Bituminous Binders' was appointed to prepare the second generation of European Standards for bituminous binders, designated as performance-related standards to correlate more closely with the binder contribution to the asphalt pavement performance.

The scope of CEN TC 336 is the standardisation of test methods, methods of sampling, terminology, classification and specifications for bituminous binders. Its objectives are:

- To develop standards eliminating commercial trade barriers between the European countries, at the request of users/applicators, producers and authorities;
- To develop any European Standard needed for reference;
- To develop performance related standards for bituminous binders;
- To develop harmonized standards in compliance with the European Construction Product Directive requirements.

The process for developing the new generation of European standards will involve a sequence of several steps:

- Identification of the binder properties linked to the asphalt pavement performance;
- Selection and standardisation of the appropriate test methods to measure these properties;
- Design and validation of a new specification system for bituminous binders.

The overall purpose of this specification system will be to ensure that the binders can be evaluated on a fair and comparable basis, that the appropriate binder can easily be selected for an application and that the binder can be used with confidence. Ideally, the system should be suitable throughout Europe, for all types of climatic and traffic conditions, for a large variety of pavement applications, and applicable to all categories of binders: conventional, special and modified bitumens.

It is important that market needs are correctly identified and addressed, and so involvement of the following key stakeholders was essential to the process: road owners and authorities, specifiers, road contractors, asphalt and binder producers. Good and effective communication between these players was necessary for a satisfactory development of the project. A series of regional seminars were designed for that purpose and the main representative European organisations were asked to develop and express their viewpoint on the content and structure of the new specifications.

## **2. OUTPUT OF THE REGIONAL BITSPEC SEMINARS**

### **2.1. Overall presentation of the BiTSpec project**

In order to get the maximum involvement of all the stakeholders in the work of CEN TC 336 it was decided to organise a series of Regional Seminars to be followed by a European Seminar to formulate a consensus viewpoint.

The main goal of the Regional Seminars was to present and discuss the results of the European project on binder standardisation evaluating and standardising new test methods and outlining a transition process leading to a future performance related specification system for bituminous binders. These events were designed to facilitate the communication at European and national levels between all the stakeholders involved in the preparation and the use of the future generation of performance related standards for bituminous binders used in road construction and maintenance.

The Regional Seminars, called “Regional BiTSpec (Bituminous Binder Testing and Specifications) Seminars” were organised in 10 different regions to ‘cover’ Europe.

The European organisations associated in the preparation of this project were:

- CEN Technical Committee 336 Bituminous Binders;
- EAPA, the European Asphalt Pavement Association;
- EUROBITUME, the European Bitumen Association;
- FEHRL, the Forum of European National Highway Research Laboratories;
- IISRP, the International Institute of Synthetic Rubber Producers.

The BiTSpec Seminars were a follow-up of the previous Eurobitume Workshops in 1995 and 1999 and the Eurasphalt&Eurobitume Congresses in 1996 and 2000 which sought to analyse and identify a route for the preparation of improved specifications.

To structure the regional events the participants received the position papers of the organizing associations and there was a list with items to be discussed during the regional seminars. The results of the regional seminars were reported and all the reports were summarized in a Synthesis Feedback Report for presentation and discussion at the European Seminar in Brussels held in June 2003.

The regional seminars were held in the Netherlands (April 2002), Sweden (April 2002), UK (April 2002), Poland (May 2002), France (June 2002), Italy (June 2002), Portugal (November 2002), Germany (November 2002), Belgium (December 2002) and Hungary (April 2003). All together about 900 participants from 27 countries attended the different events.

## 2.2. Main conclusions related to the binder specification system

It is well understood that the performance of a bituminous mixture does not solely depend upon the quality of the bitumen. Other parameters, e.g. aggregate characteristics, mix design, manufacture and laying are equally important.

Current asphalt specifications are mostly recipe based. However performance specifications are now increasingly used and therefore, functional specifications should be developed for all levels, i.e. between road authorities and contractors, between contractors and asphalt producers and between asphalt producers and binder suppliers. In the future, contracts are expected to be based on recipe requirements as well as on functional requirements.

### 2.2.1. Consequences for binder specifications

A single specification system for both penetration grades and modified binders is preferred, but this should not be allowed to complicate the specification system more than necessary. The specification system for the basic grades should be as simple as possible and performance related properties should primarily be used as a means for characterising specialities (i.e. modified binders, special binders...).

It is recognised that the existing system for penetration graded binders works well and is appropriate as an entrance/acceptance control system for the asphalt mixture producer. Therefore, the current system should remain as much as possible and changes should only be introduced when they are clearly needed to improve the system.

The specification system should make it possible to define and require specific binder characteristics to obtain specific bituminous mixture characteristics related to their

application and position in the pavement construction. The test methods which are proposed should measure the characteristics for all types of binders (i.e. normal paving grades, special and polymer-modified binders).

However, characterisation of the binders alone does not cover all relevant characteristics (e.g. adhesion of the binder to the mineral aggregate, mixture fatigue performance, healing performance of the mixture...). Some other mixture characteristics (having a relation to binder properties), also need consideration on mixture level (e.g. stiffness/mixture stability, workability, hot storage stability, traceability of eventual modifiers etc.). The consequence is that the number of possible tests can be rather large, making the choice difficult for the asphalt mix producer.

In practice, these specifications (or characterisations) should provide a sound base for a working relationship between the parties involved. The specification chain can, in general, be described as going from the Road Authority/Road Operators to Contractor/Paving Contractor to Asphalt Supplier to Bitumen Supplier. In addition to compliance with relevant standards, each supplier must supply goods that are fit for purpose.

### 2.2.2. Asphalt paving applications

In most countries, asphalt is the major product used for road construction and maintenance and a wide range of different asphalt mixes for which the recipes are well defined and standardised against established laboratory performance are applied. Major new developments are related to:

- Introduction of high modulus base courses due to increasing traffic loading;
- Use of proprietary thin surfacing systems for lower maintenance costs;
- Use of lower noise surface systems for environmental reasons;

The main causes for pavements failure on European roads are identified as:

- Ravelling of porous asphalt and permanent deformation;
- Fatigue cracking, but also cracking due to low bearing capacity (combined with increased traffic loads). Fatigue failure may appear if the increase in traffic is higher than the initial rate taken into account in the design;
- Rutting and reduced durability associated with higher than predicted traffic flow.

The most important binder properties, which need to be controlled in order to guarantee a good pavement, are:

- Durability: this is the retention of bitumen properties in service. Poor durability may be linked with the incidence of fatigue cracking, low temperature cracking, ageing cracking, fretting and hence the lifetime and maintenance costs of the pavement;
- Adhesion and cohesion properties of the binder/aggregate system;
- Stiffness (at high and intermediate temperatures), deformation resistance and rutting resistance.

Additionally, from a design viewpoint, the constancy of quality (i.e. absence of variation in properties) is also necessary.

Enhanced binder performance is required because of increased user demands (i.e. longer pavement life, reduced maintenance...), but nevertheless, one should not forget that conventional paving grades are satisfactory for about 90% of the European market. The final aim of performance related binder characteristics is that they should facilitate the binder selection process.

### 2.2.3. Binder specification system

As mentioned previously, the current system (penetration/softening point), although not primarily based on performance, can be considered satisfactory for conventional paving grades used for normal applications. However the existing system is focussed on binder characteristics and there is no specific relationship to the role of the binder in the asphalt mixture. This makes the current system unsuitable for modified binders, especially when higher pavement performances are required due to severe climatic and/or traffic conditions. It is expected that a new system will facilitate selection of binders by providing an objective basis for choice. It should be sufficiently clear and transparent that it is able to demonstrate the binder contribution to the asphalt performance and eventual benefit brought by the use of improved binders.

There are a number of pitfalls to be avoided when designing the framework for the next generation of binder specifications:

- A confusing system mixing several purposes (quality control, R&D, performance assessment):
- Over-specification in terms of requirements: i.e. requirement for a higher performance than is necessary for the job in question or unnecessary requirements;
- Over-specification in terms of number of tests: i.e. introduction of complex tests when simple tests are adequate (i.e. for routine quality control);
- An over-specification in terms of double specification: specify only one of either road performance/asphalt performance or asphalt recipe plus bitumen performance;
- An introduction of new tests before they have been validated;
- An introduction of costly and time consuming tests in factory production control.

The introduction of the new test methods into specifications must be progressive and a transition period of some years is sought, to allow European laboratories to gain experience on the use of new test methods and to define repeatability and reproducibility of the tests. In addition to a gradual introduction, an extensive validation process must be defined. This should include validation against road behaviour and validation against existing specification (while maintaining a close link with the new asphalt mix specifications). Final implementation of the new specifications (related to performance) should take place only after the transition period and satisfactory progress in the validation programme.

When selecting the binder specifications the leading consideration should be the contribution of the binder to the functional characteristics of the bituminous mixture (linked to the pavement performance). The purpose is to avoid comparison of binder characteristics without considering also the end product characteristics e.g. the binder vs. the bituminous mixture. A clear insight into the division of responsibilities throughout the supply chain, between the binder supplier, the asphalt producer and the contractor should always be ensured.

### **3. SYNTHESIS OF VIEWPOINTS FROM EUROPEAN ORGANISATIONS: EAPA, EUROBITUME, FEHRL, WERD, IISRP**

The needs and expectations concerning the future system of binder specifications and test methods related to performance were collected among EAPA, Eurobitume, FEHRL, IISRP and WERD members in 2001 and 2002. An ad-hoc group within CEN TC 336 then analysed the viewpoints expressed by these organisations and produced a synthesis report identifying the common, complementary and divergent views, and giving a

suggestion for the future binder specifications system. The key issues are summarised below:

i. Concerning the system of specifications:

*As common agreed points:*

- Specifications should be based on functional properties with no reference to binder composition, provided that regulations regarding classification and labelling are respected;
- To be careful with "over-specification";
- Mandated essential requirements should be modified according to the development of performance-related standards.

*As complementary points:*

- The system of specifications should first pay attention to the characteristics which are predominantly determined by the binder (FEHRL, WERD);
- Enhanced properties of special and modified binders should be demonstrated (Eurobitume, FEHRL);
- Introduction in the market of poor quality binders must be avoided (Eurobitume).

*As divergent points:*

- For "recipe" mixtures, the binder must be clearly specified, but for "performance-based asphalts", binder characteristics should be agreed between the parties involved (Eurobitume);
- EAPA would like new test methods but no specifications (EAPA);
- WERD would like specifications to be based on durability aspects as a minimum (WERD);
- Specifications should permit the final client to select the most appropriate binder regarding his demand and not impose a binder for a given use (WERD).

ii. Concerning the test methods:

*As common agreed points:*

- Test methods related to fundamental properties are desirable;
- Empirical test methods are acceptable if suitable to the needs;
- The costs of testing should be taken into account.

*As complementary points:*

- The set of test methods should cover two purposes:
  - Complete definition of binder performance even with complex test methods,
  - Simple, quick and cost effective tests available for production and delivery control (Eurobitume, EAPA),
- Need to check the constancy of quality of the delivered product (EAPA, WERD);
- Simple tests should have a clear relation with functional tests (EAPA);
- Different tests could be used to assess the same property, depending either on the type of binder (Eurobitume) or on the asphalt mix production steps (EAPA).

iii. Concerning the binder grading system

*As common agreed point:*

- Implementation of a new grading system in the whole of Europe will be the final deliverable of the process.

*As complementary points:*

- Gradual steps will be necessary before technical classes are defined for all binder characteristics (Eurobitume, FEHRL) – to ensure their validity (EAPA),
- Similarly designated grades should have similar characteristics in Europe (Eurobitume, EAPA).

*As divergent point:*

- It is too early to decide now on the final grading system (EAPA).

A list of binder properties to be considered in binder specifications was suggested, as shown in Table 1.

Table 1 – Binder properties to consider in binder specifications

<p><b>IDENTIFICATION PROPERTIES (e.g. for delivery control)</b> Consistency: penetrability or viscosity <i>It could also be one of the performance related properties below, provided the measurement is performed quickly.</i> <i>It should preferably be linked to grading – to facilitate checking of conformity.</i> <b>Including minimum quality requirements:</b> Perceptible properties Solubility Volatility (loss on heating)</p>
<p><b>PERFORMANCE RELATED PROPERTIES</b> Stiffness or rheological property (e.g. modulus) at elevated service temperature Stiffness and/or fracture property at low service temperature Short term ageing behaviour } for durability assessment Long term ageing behaviour } Stiffness at intermediate service temperature (Possibly later: binder fatigue behaviour)</p>
<p><b>HSE PROPERTIES</b> Flammability property (Flash point) Information on classification and labelling Information on recyclability</p>
<p><b>OTHER INFORMATION FOR THE MIX PRODUCER</b> Density Storage stability (for pmb) Viscosity vs temperature (pumpability)</p>
<p><b>SPECIFIC REQUIREMENTS (for specific applications)</b> Examples: Pigmentability Fuel resistance De-icing resistance Etc.</p>

It is clear from this synthesis that there were no serious issues on which strong differences of opinion arose among the different stakeholders. On the contrary many different parties shared similar views on a range of issues, and these will form a good platform on which to build the future framework for binder specifications.

#### **4. CONCLUSION AND FUTURE STEPS**

The process for developing performance-related standards for bituminous binders in Europe is continuing. It has begun with identification of new test methods to measure the binder properties linked to the asphalt performance. The standardisation of these is underway and the first test standards are expected to be published by CEN during year 2004.

The project continues with the design of the future framework for binder specifications. Through the BiTSpec Project and Seminars the stakeholders have delivered an important contribution to CEN for this work. It is recognised that a transition period will be necessary to become more familiar with new measurement methods and to collect data. A "transition framework" is expected to be also available in 2004 in order to proceed to this data collection exercise in a structured way. Before final implementation, new binder specification proposals will need to be validated and their correlation to asphalt and pavement performance well established. This should be gained through a co-operative validation project to be designed and undertaken at a European level.

The active involvement of stakeholders, and open and effective communication between them, and with others, will remain key factors for the success of the project. Initiatives such as the BiTSpec project aim to facilitate and support the process.

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