Asphalt Research and Development

EAPA

Rue du Commerce 77
B-1040 Brussels
www.eapa.org
Info@eapa.org
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Contents

1. Summary & Conclusions

With this document EAPA formulates the view of the European asphalt industry on the required direction of future research on asphalt. Entries are:

- Development of sustainable, durable and environmental construction and maintenance techniques
- Enhancing competitive strength of the enterprises
- Enhancing innovative strength of the industry

Additionally, it is of major importance that the regulatory environment is enhanced in such a way that more active participation of the industry becomes feasible. Future R&D programmes should be designed in such a way that the construction industry, aware of developing its human capital, has a possibility to actively participate, taking into consideration its special relationship to its clients and its SME structure. More coordination in this area is essential in Europe to make R&D activities more effective.

The goal of the paper is being used both on a national level by single member countries and by EAPA on a European level when either actively contacting the road research community or when receiving inquiries about asphalt research topics from national and international organisations and institutions.

The EAPA research items are summarised in the following table:

Construction technologies	
Research area	***Research objectives***
Pavement design, including life cycle assessment	Develop a functionally based mix design procedure enabling the determination of the optimal pavement composition regarding traffic load, climate, visual aspects etc.
Surface characteristics	Investigation of functional surface characteristics of pavements and evaluation of field test methods for surface characteristics.
Heavy Duty Asphalt Pavements (HDAP's)	Refine existing models or introduce new models enabling the calculation of the exact effect of increased/different pavement loadings. Investigate pavement failure mechanisms with the purpose of improving the resistance to permanent deformation and (thermal) cracking. Optimise/improve the relevant properties for Porous Asphalt, SMA and High Modulus Base Course (EME) used on roads with heavy traffic and develop new types of HDAP's.
Low volume roads	Develop cost effective constructions for low volume roads.
Maintenance methods	Develop more cost efficient maintenance methods with special reference to asphalt types placed on heavy duty pavements, in particular old Porous Asphalt pavements.
Special applications	Investigate the possible use of asphalt in new application areas as e.g. railroad track courses and landfill/waterproofing constructions.

Material technologies	
Research area	***Research objectives***
Test methods	Develop accelerated laboratory test methods which provide rational ("fundamental") information on the functional material characteristics of asphalt, including mixture design considerations. Develop test methods for cold asphalt mixes. Assess the possible usage and relevance of the US SHRP test methods and specifications (especially for binders) for European conditions.
Modified binders and additives to asphalt mixtures	Develop a decision model for the optimal use of modified binders, including recycling possibilities.
Asphalt recycling	Develop methods to optimise the recycling process taking account of economically and technically factors.
Cold mix technology	Improve cold asphalt production and laying techniques as well as performance prediction.
Warm and low and cold temperature mix technology	In the recent years different techniques have been developed to reduce the mix temperature. The lower temperature mix technologies can be further developed and improved.
Energy recovery	Road infrastructure is occupying a very large surface area with a great potential for energy recovery. Different systems could be explored collecting heat from the pavement in the summer and returning heat in the winter. The collected energy could be used for different purposes.

Production and laying technologies	
Research area	***Research objectives***
Process controls	Develop methods for efficient Quality Control/Quality Assurance of asphalt production. Develop product certification/asphalt mixes, functional process control techniques, RAP quality control techniques and statistical data interpretation techniques
Process controls instruments	Develop process controls systems that enables enhanced controlling and thereby optimisation of the asphalt production processes both technically and environmentally.
Road infrastructure construction Asphalt laying	Further research on high-speed quality control during road construction should allow improving the quality of the construction. Automatic guidance and robotisation of construction equipment could lead to better (riding) quality. Develop a system that enables controlling of factors influencing paver performance.
Improvement of constituent materials	Develop more refined reclaiming techniques and prehandling techniques for RAP, including RAP quality control techniques. Develop better techniques for detection of tar and other contaminants in old asphalt.

Regulatory environment	
Research area	***Research objectives***
Contractual relationships	Wider implementation of contract forms as the functional contract, DBFO contract (Design, Build, Finance and Operate), Avis Technique system and related warranty schemes.
Technical harmonisation	Implement pre-normative research.

2. Introduction

A general increase in traffic flow, higher axle loads and tyre pressure of trucks on European roads have steadily increased the demand for stronger and more durable road pavements. The increase in traffic flow also means that traffic interruption for maintenance becomes less desirable. Additionally the road user has become more vocal in asking for quieter and safer roads, with reduced environmental impact. Therefore there has been put more focus on research in transport related areas in the last years, including road materials.

Discussions in the Technical Committee of EAPA have clarified that it is important for the industry, as the road research user representing practitioner interests, to actively participate in the decision process for road research projects much more than is the case today. This accounts especially for projects on a European level but also to some extend for the national level.

This development has consequently now promoted the Technical Committee of EAPA to formulate a clear research policy, including a list of areas of priority on asphalt research, emphasising the strong commitment for asphalt research of the industry. In this way the document forms a good basis in relation to discussions and coordinating negotiations with other organisations like FEHRL, CEDR, RILEM, Eurobitume and PIARC and towards influencing future road research carried out in EU or other funded road research programmes.

3. Background and objective

Each year billions are spend to build new roads and maintain the hundred thousands of kilometres of existing roads in Europe. Due to the paramount importance of the road network in the economic development and social cohesion of each country, the asphalt industry is continually involved in improving the product and its performance. Varying from country to country the industry has nationally in a more or less ambitious manner tried to influence public asphalt research and establish cooperation with public institutions on research projects of common interest.

During the 1990’s the implementation of the EU single market has given transport issues, including road pavements, a stronger European dimension. Cross-border contacts and cooperation has grown rapidly. In the wake of this development towards a more international environment increasingly more public funds for areas related to transport research have become available especially within EU.

In summary the following observations can be made on the current R&D situation in Europe:

- R&D activities in Europe are highly decentralised, where coordination of activities would be beneficial for the sector. No overview of available budgets in research items is available.
- Very often active participation of the industry is regulated by research institutes.
- Only few producers and contractors in the asphalt industry are equipped with research facilities.
- So far the asphalt industry has not defined on an European level its research priorities.

The regulatory and competitive environment in the European road sector has left fundamental research mainly to be carried our by the dedicated Road Research Centres and universities. The dedicated Road Research Centres, united in FEHRL, have proposed a (third) Strategic European Road Research Programme (SERRP III), which identifies scientific road research projects. Under the umbrella of the European Road Transport Research Advisory Council (ERTRAC), the stakeholders of the road research sector agreed on a joint vision for the future of European road transport and it was published as “Vision 2020 and Challenges” in Brussels in July 2004.

Even though the industry itself in this environment dedicate only limited resources for research, the industry is very determined to become more involved in asphalt research in order to influence future European asphalt research in a direction enhancing the competitiveness and innovative strength of the asphalt industry and to continuously fulfil the needs of the clients.

To accomplish this, the industry has formulated a common research policy containing a list of asphalt research areas of special importance to the industry. The initial objective of the document is in other words not to raise more funds in the industry for research but to try to incorporate priority areas of research to the asphalt industry in existing research programs. Furthermore it should add to the awareness in the industry about the necessity to be involved in innovation. The effect of this growing awareness will be increased budgets for research in road construction and maintenance.

In general EAPA acknowledges the responsibility of the industry for supporting asphalt researchers in closing the gap between theoretical research and practical implementation. Furthermore to have a sound balance between fundamental and applied research.

4. Asphalt research from an industry perspective

A survey has been carried out among the members of EAPA with subsequent discussion in the Technical Committee of EAPA resulting in a list of research areas supported by at least a majority of the EAPA members.
The asphalt research areas identified by EAPA reflect an overall wish to link theoretical research to practical use/implementation. It should be mentioned that all asphalt research naturally must be in closely agreement with the development of the ongoing work in elaborating asphalt specifications and test methods on an European level.

The different asphalt research areas are grouped under the following main headlines:

1. Construction Technologies: These are strategically important to improve the competitiveness of the industry. Construction technologies has influence on a major part of the total life cycle costs for road construction and has long term consequences considering the whole product life cycle.
2. Material Technologies: Development of material technology is important in increasing durability, environmental friendly and safety performance and functional performance.
3. Production and laying Technologies: These may be upgraded by implementing Quality Assurance (QA) resulting in higher efficiency, new design and improved working environment. Implementation of new sophisticated computer technology is to be considered in EDI, etc.
4. Regulatory environment: Optimisation is needed, among others concerning DBFO contracts (Design, Build, Finance and Operate), regarding cost, durability, reliability, sustainability, maintainability, recyclability and eventually final disposal.

   The following pages give an introductory description of the identified asphalt research areas. In reality the overall research areas are closely interrelated making a clear distinction between them impossible. Therefore some of the specified research items are mentioned in more or less the same way under more headings.

   Before describing in a random order each of the identified asphalt research areas separately it in conclusion should be stated that an overall research topic covering all areas is the development of methods focused on a more rapid practical implementation of research results.

4.1. Construction technologies

Pavement design, including life cycle assessment

The existing empirical approach for pavement design based on practical understanding and experience employing an inventory of typical pavements suffices under a more or less static physical environment. The need for a faster adaptation to new conditions in essence requires a different approach towards pavement design resulting in a shift from a system based on empirical test methods to a system focusing on fundamental and functional properties.

New design concepts for modular, factory-constructed pavements (long term behaviour) can improve road infrastructure construction and maintenance efficiencies.

Surface characteristics

The road surface has a significant impact on the safety performance, noise level and comfort level of the road user. Research is needed to further add to the good performance of asphalt in this respect, including the development of functional test methods.

Optimisation of pavement surface characteristics (like smoothness and the rolling resistance of the different asphalt surface layers) could reduce rolling resistance and consequently energy consumption. Splash and spray of surface water by vehicles is limited by using porous pavements. Developing methods for cleaning and prevention of clogging of such pavements will increase the functionality.

Heavy Duty Asphalt Pavement's (HDAP's)

In response to meet the increasing demands to pavements caused by the constant growth in traffic loadings mainly originating from a greater number of heavy goods vehicles (HGVs), increased HGV axle loadings, increased stresses due to slower moving HGVs, higher tyre pressures and the widespread use of "super single" tyres, the European asphalt industry, has developed the concept "Heavy Duty Asphalt Pavement" (HDAP). In this connection it should be emphasised that today's design models for HDAPs do not cover all important performance criteria, including thermally induced cracking from the surface of the pavement. The growing demand for HDAPs, however, requires a current improvement of existing asphalt pavements and the possible introduction of new ones.

Low volume roads

The larger part of the European road network exists of low volume roads. Investments in those roads, especially on maintenance, consume a large part of the budgets of many road authorities. Development of improved cost-effective sustainable construction techniques for low volume roads will be very beneficial.

Maintenance methods

Today most asphalt is used in connection with pavement maintenance operations and only a smaller part is used for the construction of new roads. Especially on heavily trafficked roads maintenance operations can cause severe congestion and hereby incur large user delay costs. Generally research in more rapid and efficient and maintenance techniques will result in a more efficient traffic flow on the European road network combined with enhanced traffic safety. Particularly research in enhanced maintenance techniques with special reference to asphalt types placed on heavy duty pavements is important.

The lifetime of good performance of noise reducing asphalt pavements should be increased. The clogging of the pavement needs to be solved too. Improved pavement maintenance techniques, in particular for the low noise porous surface layers need also more attention.

Special applications

Asphalt has proven to be a very cost effective product in new application areas as e.g. railroad track courses and landfill/waterproofing constructions. New design methods have to be developed in these areas.

4.2. Material technologies

Test methods

It is essential for the asphalt industry to possess reliable test methods to control and demonstrate the properties of different asphalt mixes either by functionally based laboratory tests or field tests of surface characteristics. The first relates to deformation, road wear, loading, (thermal) cracking, fatigue, adhesion, ageing, compaction etc. The latter encompasses pavement profile, roughness, texture, friction, brightness, drainage, noise etc. Therefore it is important to develop accelerated laboratory test methods which provide rational ("fundamental") information on the functional material characteristics of asphalt. Specifically, methods for Quality Control (QC) based on fundamental properties and recycling of HDP's should be encouraged.

The development of a satisfactory test specimen preparation method for mixture design which reproduces field condition also has high priority. In addition, the development of a mix design procedure based on predictive theory of asphalt pavement performance. To assess the performance properties of cold asphalt mixes, additionally test methods for cold asphalt mixes has to be investigated. USA has completed the Strategic Highway Research Programme (SHRP) targeted at improving the performance and durability of American roads. In this connection it is beneficial to assess the possible usage and relevance of the US SHRP test methods and specifications (especially for binders) for European conditions. Additionally, evaluation of construction and performance of bituminous mixes designed by SHRP methology.

Modified binders and additives to asphalt mixtures

The bitumen industry is providing a large number of modified binders. The assessment of the potential benefits and limitations is needed to provide a decision model for the optimal use of these binders, including recycling possibilities. Other additives which may improve the performance of the asphalt product should be incorporated in the same decision model.

Asphalt recycling

Environmental considerations are very important for the asphalt industry. Adding old asphalt to new asphalt mixtures helps to reduce disposal of reclaimed asphalt and reduce the use of virgin aggregate and bitumen. The recycling concept contributes to sustainable development by optimising the use of natural resources and constitutes a closed material life cycle. A more widespread inclusion of recycled asphalt pavements (RAP) in asphalt mixtures primarily requires support from the state authorities. To further the recycling concept and improve RAP quality EAPA therefore sees a need for additional investigation of the optimisation of the recycling process taking account of economically and technically factors.

Impact of the increased complexity of new materials on recyclability and waste treatment needs study. The recycling percentages in high quality pavement surface layers needs to increase to be able to recycle all reclaimed asphalt.

Cold mix technology

In the last ten years there has been a general increase in the interest to use cold asphalt mixes for road construction and maintenance. In contradiction to hot mixed asphalt cold mixes are blended without heating. This is possible by the use of bitumen emulsion. Cold mix technology is therefore especially appealing because it offers reduced emissions and energy savings. The production of cold asphalt mixes is also advantageous in remote areas where no production plant for hot mix asphalt is available. This development calls for a general research in cold mix technology to enhance the performance of this type of asphalt.

Warm and low temperature mix technology

In the recent years different techniques have been developed to reduce the mix temperature. One technique is producing a mix by mixing the aggregates with a soft binder and subsequently with a hard binder added as foam.
The other technique called low temperature asphalt offers the possibility of lowering the hot paving temperature to approx. 30^{o}C compared to the traditional hot mix asphalt. Here there are two ways to reach this reduction; by adding zeolite or adding a paraffin wax.

Energy recovery

Road infrastructure is occupying a very large surface area with a great potential for energy recovery. Different systems should be explored: solar energy, traffic flow windmills, piezoelectric elements, heat exchange systems and heat pipes collecting heat from the pavement in the summer and returning heat in the winter. The amount of heat returned in the winter can be sufficient to prevent snow and ice on the pavement and thus increase the winter safety and at the same time avoid the use of de-icing salts. In particular the cooling of bituminous pavements in the summer will reduce rutting and thus increase the lifetime of these pavements.

4.3. Production and laying technologies

Process controls

Quality Control/Quality Assurance is an important part in connection to asphalt production and subsequent asphalt laying. At the moment an official certification system for asphalt type testing, however, still remains to be established. Seen in the light of the coming CEN standard "Factory Production Control" describing a set of operational procedures and practices with which producers can regulate the quality of a product, it is in all circumstances necessary for the asphalt industry to improve the knowledge and understanding of Quality Control systems in order to enhance product confidence, including the laying quality. In this context it is additionally relevant to mention the experience from asphalt plants showing that it often is difficult to establish conformity between registered process input parameters and laboratory tested output.

Process controls instruments

The technological development throughout the last 10 year has resulted in the introduction of a lot of new electronic equipment in the asphalt industry in general and in connection with the production process on the asphalt plant in particular. The utilisation of computer systems and electronic devices has made it possible to carefully monitor and control most steps in the asphalt production process. The increased data flow of control parameters in reality forms the basis for optimising the plant process both in terms of environmental and technical considerations. Moreover, the development of cleaner technology and pollution abatement techniques should be furthered throughout the asphalt industry.

Road infrastructure construction

Further research on traffic-friendly monitoring and high-speed quality inspection during road construction should allow improving the quality of the construction.
Research on automatic guidance and robotisation of construction equipment, using new and precise positioning systems and automatic steering should lead to better quality (e.g more accurate layer thickness and evenness).
New construction techniques for increased and more uniform performance of road subgrades and subbase layers and for quantifying the performance should be developed. This should lead to a more economical design of the pavements structures, reinforcement and rehabilitation

Asphalt laying

In many cases the process of laying asphalt constitutes one of the most critical factors concerning the future life and properties of an asphalt pavement. Therefore special attention to paver performance and control during road construction and maintenance will be very beneficial for the future properties of a road pavement.

Improvement of constituent materials

The asphalt industry pays more and more attention to aspects of recycling. In this respect there is a need to develop more refined reclaiming techniques and pre-handling techniques for RAP, including RAP quality control techniques. Especially, it is important to develop better techniques for detection of tar and other contaminants in old asphalt.

4.4. Regulatory environment

Contractual relationships

The contractual relation between the asphalt contractor and the road authority is getting more and more attention these years. A shift from a traditional contract system where the client specifies the required construction and materials in detail to modern contract forms as the functional contract and DBFO contract (Design, Build, Finance and Operate) where the contractor is granted much more responsibility and liability will stimulate contractor innovation and cost effectiveness of road pavements. To facilitate the introduction of innovative products the French system of Avis Technique or European Technical Agreements should be further developed and implemented.

Functional requirements for road pavements, based on user expectations and performance based specifications need to be studied in order to allow for new types of contracting for construction and maintenance leading to better user satisfaction.

Technical harmonisation

The asphalt industry has established the adoption of European standards as an item of high priority and consequently pre-normative research viz. research aimed at continuously improving the European standards is required. More priority should be given to make standards more performance oriented.

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Rue du Commerce 77
B-1040 Brussels, Belgium
www.eapa.org
info@eapa.org