COMPUTER AIDED INNOVATIVE RESEARCH IN THE „ECO" EFFICIENT SYNTHESIS MATERIALS DOMAIN APPLIED IN ROAD INFRASTRUCTURE EXECUTION

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Rezumat. *Rolul prioritar al proiectului de faţă îl constituie îmbunătăţirea infrastructurii rutiere la nivel local, regional şi naţional, prin obţinerea de noi materiale de sinteză „eco" eficiente. Se va urmări îmbunătăţirea calităţii materialelor finite ţinând cont şi de creşterea productivităţii muncii, prin buna gestionare a producţiei şi implicare a factorului uman. Tehnologiile de punere în operă vor conduce la reducerea timpilor de lucru şi la îmbunătăţirea infrastructurii rutiere. Obiectivele proiectului se înscriu atât pe linia Strategiei de reabilitare a drumurilor naţionale cât şi pe cea a Programului Guvernului de modernizare a reţelei de drumuri naţionale (autostrăzi) şi locale (judeţene şi comunale), astfel încât să se asigure confortul şi siguranţa.*

Abstract. *The project's priority is the improvement of road infrastructure at local, regional and national levels, by obtaining new "eco" effective synthesis materials. We aim to improve the quality of finished materials considering the growth of labour productivity through better production management and involvement of the human factor. These new technologies will reduce the working time and improve road infrastructure. The project objectives fall as much on the rehabilitation of National Roads Strategy, as well as on the Government's Program to Modernize the National (highways) and Local (county and municipal) Road Network, so as to ensure the comfort and safety of road transportation.*

Keywords: qualitative performance materials, asphalt mixtures, new "eco" synthesis materials, bitumen materials, road infrastructure.

1. Introduction

The project's priority is the improvement of road infrastructure at local, regional and national levels, by obtaining new "eco" effective synthesis materials. We aim to improve the quality of finished materials considering the growth of labour productivity through better production management and involvement of the

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human factor. These new technologies will reduce the working time and improve road infrastructure. The project objectives fall as much on the rehabilitation of National Roads Strategy, as well as on the Government's Program to Modernize the National (highways) and Local (county and municipal) Road Network, so as to ensure the comfort and safety of road transportation. Through this project we will encourage partnerships and knowledge transfer between R&D institutions and enterprises, we will ensure the sustainability of road infrastructure in order to minimize the environmental impact and to ensure a high level of transport safety.

Internationally it's been a while since, based on laborious research and experimentation, was started the execution of bituminous clothing with modified bitumen, by: achieving the road layer from asphalt mixture with discontinuous grain (high chippings); ensuring road layers' tightness by: applying a suitable bitumen / filler ratio in the wear layer (road) and applying the running layer on a durable and tightness support. Such bituminous clothing with modified bitumen is applied in EU countries (France, England, Germany, Holland, etc.).

In Romania the first works with modified bitumen and asphalt mixtures have been performed since 1993 in bridge clothing, as well as in some rehabilitation works on DN 39 and DN 7. Since 2000, trials were resumed on the technology of obtaining modified bitumen, and the preparation of modified bitumen asphalt mixtures. Currently there are few companies that produce modified bitumen, namely: SC ROMPETROL RAFINĂRIE SA - Rafinăria Vega Ploieşti, OMV-PETROM Bucharest and others.

2. Project's objectives

The general objective of the project is to develop and validate modified bitumen with synthesis materials and asphalt mixtures with high qualitative performances in terms of dynamic resistance (creep dynamic mode stiffness, fatigue resistance) and ornieraj resistance. The goal of the project will be achieved through the development a software program that will facilitate correlations and interpretations of experimental results. The specific objectives are: 1) quality analysis of bituminous and synthesis materials which can be used for the execution of road infrastructure, through physical-mechanical and dynamic tests; 2) establishing production technologies for applied bituminous materials and asphalt mixtures by introducing new concepts; 3) determining the application areas with reference to the types of layers which can be executed with these types of asphalt mixtures and are part of the road infrastructure make up; 4) establishing the parameters and developing the technology for new types of asphalt mixtures, through the execution of demonstration models on experimental sectors; 5) evaluating the degree of efficiency and quality of asphalt mixtures in the carried out works by applying the methodology; 6) reaching asphalt mixture quality

requirements as well as the technological parameters of road works execution and developing technical documentation for the new technologies used in construction, road maintenance and rehabilitation materials.

3. Project's activities and results

The demonstration model from experimental sectors will be achieved with innovative technology execution, which will lead to increased sustainability in the exploitation of asphalt mixtures, with efficient "eco" impact on the environment.

The entire phase of research, data analyses and experimental demonstration is based on a software solution that will be developed in the project. The software shall contain a data comparing module that can corroborate experiments' results data with structural parameters in order to achieve the needed results. The database shall be consequently built on 2 main components:

• The Reference Component shall consist in the database built on the reference values, which shall be introduced thus becoming the reference starting point for all further measurements. A predefined features' scheme shall be developed in order to facilitate data storage, interrogation, update and analysis. The Components shall be: a scheme that defines the storage, syntax and semantics method applied to acknowledged data; an indexing mechanism; a set of functions and operators needed to execute interrogations, data junctions, and other analysis operations; the data model used to corroborate data is objective-relational.

• The Measurements Component shall consist in the database built on all measured parameters. Materials' parameters needed for the database shall be also associated with other parameters (dates, exact measurement timing, etc.). Each recording shall be unique, assigned with a unique ID in the database, in order to generate reports and statistics, both as compared to the reference database, and to various other recording measurements. This analysis shall permit graphic representations meant to ease graphics interpretations. These databases shall be built on algorithms indicating the percentage similarities between already existing and newly measured values.

Another critical component application is the predictability and analysis algorithms. The algorithms' basic principles are similar to the essential neuronal network principles. Based on automated data collection analysis, shall be detected. This information will constitute the basis for predictions and issued recommendations.

The feasibility is generated by the new technologies developed and validated in the project that will ensure the comfort and safety of road transportation, guidelines from the National Roads Strategy, as well as from the Government's Program to Modernize the National (highways) and Local (county and municipal)

Road Network. The incipient value is TRL 2 and will reach, in the end of the project, TRL 4.

Our project will start by testing raw materials (asphalt, aggregate, filler) used in the preparation of asphalt mixtures utilized in execution of road infrastructure, following that, based on laboratory studies, to determine the conditions of conception through laboratory tests on bitumen and modified asphalt mixtures as well as their production technology by introducing new concepts.

These activities will be TRL 2 and later, by completing the technology used to obtain asphalt mixture with modified bitumen, we will initiate actions to experiment them, by executing experimental testing models in demonstration sectors. Finally, the project will result in a lab validated technology that corresponds to a level of TRL 4.

The preliminary results available revealed that the new technologies that will be developed and validated trough the project will facilitate the integration and cohesion of Romania into EU structures, will develop the economic cooperation in South Eastern region of Eastern Europe by road infrastructure, will create and develop the necessary infrastructure to connect to global networks of services, will increase the opportunities for interregional and international cooperation for the development of transport chains to provide related services and will increase transport safety and risk prevention of accidents.

Also, such new technologies - bituminous clothing with modified bitumen - are already applied in EU countries (France, England, Germany, Holland, etc.).

Also, the project's actions will lead to the creation of a database and a software program that will allow the correlation and interpretation of results obtained during the stages of the experimental study.

4. Project's impact

The project will have an impact on the expected economic, social and environmental impacts. The economic impact is represented by: promotion and development of technologies for production of asphalt mixtures, facilitating the integration of Romania into EU structures and cohesion, development of economic cooperation in the South Eastern and Eastern region of Europe by road infrastructure modernization. The social impact consists in: creating and developing the necessary infrastructure for connecting to global networks of services, increasing the possibilities of interregional and international cooperation in order to develop the chains of transport to provide related services, increasing the competitiveness of the actors involved in multimodal transport logistics service sector, creation of new jobs and professional reorientation in multimodal transport terminals, increasing transport safety and risk prevention of accidents.

The environmental impact refers to: the promotion of the concept of environmental protection and transport, prevention and mitigation of environmental action on road infrastructure by increasing pavement durability.

Conclusions

The main role of the project is the improvement of road infrastructure at local, regional and national levels, by obtaining new materials synthesis "eco" effective. The objective is to improve the quality of finished materials considering the growth of labour productivity through the better management of production and involvement of the human factor. Laying technologies will reduce the working time and improve road infrastructure.

All the studies made until now reveal that the technologies that will be developed in this project will differ from the existing technologies by: modified bitumen with synthesis materials and asphalt mixtures will have superior physical and mechanical properties and polymer modified bitumen will have a superior dynamic, including sustainability and growth-enhancing impact on the environment. Based on everything that we have studied until now we consider that the new technologies proposed by us are crucial for the development of Romania's road infrastructure.

The degree of originality and novelty of the project consists in obtaining performing synthesis materials, high qualitative from the technical stand point, with ecological and economic impact, being used in road infrastructure field. The project proposal provides technical and economic efficiency by using materials used in road sections, taking into account the need to increase and rehabilitate Romania's road infrastructure. The project aims to develop the know-how in the area of products and technologies used in road infrastructure, by improving the performances of the used products and innovation of the technologies used to obtain them.

The degree of complexity is highlighted by the coverage, analysis and systematization of the large volume of technical data, evaluations, comparisons of used materials and structures, materialized in: development a new technology outlook for obtaining modified bitumen with synthesis materials; determining the structure composition of asphalt mixtures used in road infrastructure; studying the possibilities of improving road pavement behaviour during operation and their sustainability; establishing the technical and technological optimal parameters for the application of new solutions.

The technologies developed in this project differ from the existing technologies by: modified bitumen with synthesis materials and asphalt mixtures will have superior physical and mechanical properties and polymer modified bitumen will

have a superior dynamic, including sustainability and growth-enhancing impact on the environment. The expected preliminary results will lead to the establishment of new production and manufacturing technologies for road infrastructure.

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