

# Chapter 68

## Alternative, Environmentally Acceptable Materials in Road Construction

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### ABSTRACT

*Environmental conservation and energy savings, as the fundamental assumptions for sustainable development, and financial savings are possible through the use of new, non-standard materials and technologies in the building and maintenance of roads. Different types of waste materials and industrial by-products may be used in road construction as an alternative to standard materials. In order to be applicable, alternative materials must meet certain engineering characteristics, show an acceptable level of execution, and be economical in comparison with traditional materials. The reasons for the use of alternative materials are many and largely outweigh the possible shortcomings. The use of alternative materials is significant from both the ecological and economic perspectives. Ecologically, the use of alternative materials means a lesser need for the exploitation of natural resources and the quantity of waste accumulated in landfills is reduced. Economically, the use of alternative materials reduces total construction costs. This chapter explores the use of alternative materials.*

### INTRODUCTION

Construction uses very large quantities of natural aggregates (gravel, sand, crushed stone) from excavation, and a considerable part of those quantities

is used for the needs of road construction. Such continuous demand for natural materials depletes natural sources, and, in the areas lacking quality natural aggregates, the purchasing and transport costs increase the construction costs considerably. Exploitation of natural aggregates represents a loss, not only of aggregates themselves, but of the

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natural environment from which the aggregates are extracted. The exploitation procedure also gives rise to various negative effects that bring visual changes of the environment, increased heavy traffic carried out on the existing roads with an insufficient bearing capacity, noise, dust and vibrations.

On the other side, accumulation of various waste materials on dumpsites or disposal of the materials that arose as byproducts in a technological or production process represents one of the crucial environmental problems.

Pursuant to the EU regulations, waste deposition is the final option of waste management, and is applied only in the case that there is no possible treatment and management of waste, which includes prevention, minimisation, reuse and recycling. Article 3 of the European Directive 2006/12/EC on waste (Official Journal of the European Union, 2006) requires Member States to:

- Encourage recycling, reuse or restoration, and
- Take measures to ensure recycling.

Clear requirements for preservation of the environment, stated in the sustainable development guidelines, resulted not only in an increase of the price of stone aggregate, but also in imposing a need to research the possibilities of using alternative materials in construction, that would be a replacement for the standard construction material. The notion of alternative materials comprises all the materials except natural aggregates, thus, waste materials and industrial byproducts.

A wide range of such non-standard, alternative materials has been used very successfully for a long number of years in Europe and around the world (Holtz & Eighmy, 2000). Many state companies and services, as well as universities, are included in years-long research, development and demonstration of these materials. In order to be exploitable, alternative materials must meet certain engineering characteristics, show an ac-

ceptable level of execution and be economically comparable with the traditional materials. It is not a rare case that the same alternative material, which is used in various applications, is only in the research phase in one field, while there is already experience with its use elsewhere.

Alternative materials that can be used as a replacement for standard building material differ by their chemical and physical characteristics, the original state in which they are found, the additional processing they should undergo before being used, and by their intended purpose. A whole array of materials can be reused, with minor finishing or without it. Thus, for a variety of uses in the construction of roads and highways can be utilized: the construction and demolition waste, recycled asphalt, crushed concrete, fly ash and slag from thermal power plants, metallurgical slag, cement and lime kiln dust, silica fume, foundry sand, waste-rock, ash from incinerating plants for solid municipal waste, byproducts of quarries, roofing shingle waste, old rubber, sewage sludge ash, glass and ceramics, and plastics waste (Collins & Ciesielski, 1994; Chesner et al, 2002, Sherwood, 2001).

The industrially developed countries of Europe and the world have many years of experience in the use of alternative materials, with the US at the forefront. The American experiences in the use of alternative materials are largely positive, and research on new application of these materials is ongoing (Schroeder, 1994; Collins & Ciesielski, 1994).

The research project ALT-MAT (ALternative MATerials in road construction) further encouraged the greater application of alternative materials in Europe. In the period from 1998–2000, nine organisations from seven European countries (Austria, Denmark, Finland, France, Sweden and Great Britain) participated in the ALT-MAT project (Reid, 2000; Sherwood, 2001; ALternative MATerials, 2001). The project was made possible by the support of the European Commission (EC, 4th Framework Programme). The objective of the

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