

Young Researchers Seminar 2009

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Proposal of Improving The Existing Practice of Pavement Recycling in Serbia

Dusica Drndarski



1. Introduction

Road network of the Republic of Serbia has a total length of 40,845 km and consists of:

- 5,525 km of state roads of Category I,
- 11,540 km of state roads of Category II, and
- 23,780 km of local roads

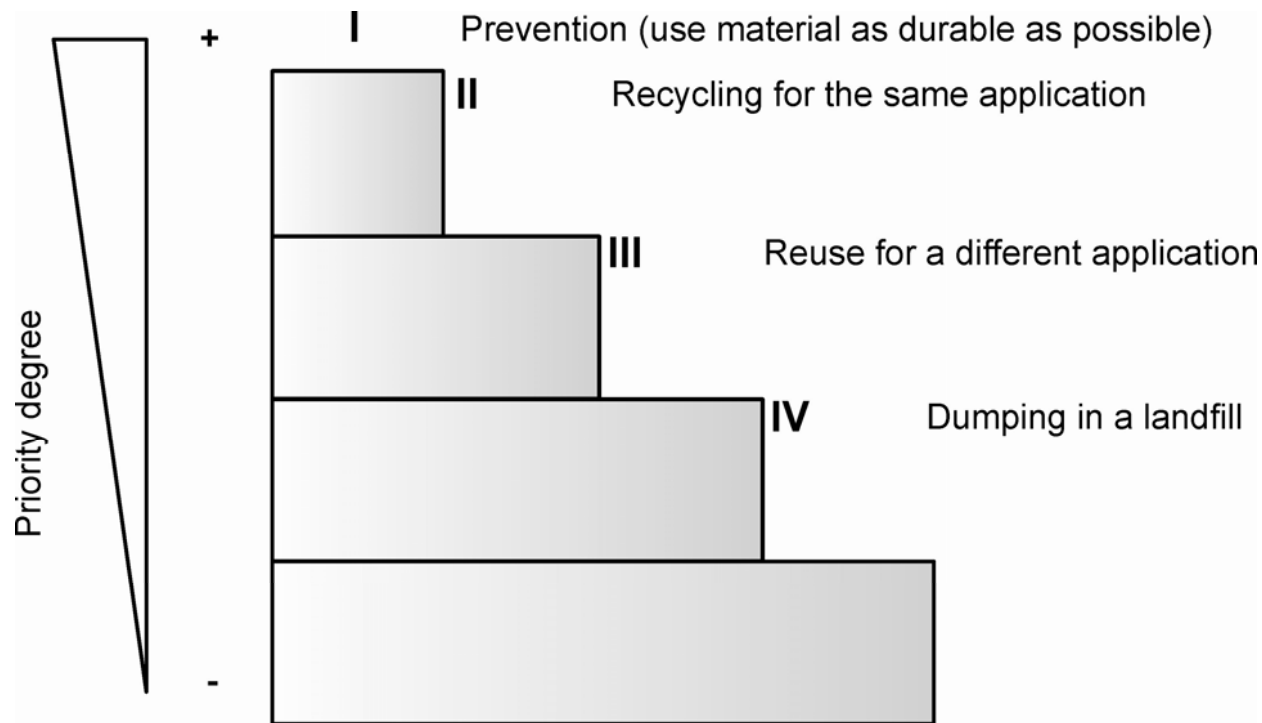
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2. The challenge of sustainable road development

“Ladder – concept”



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3. What has been done until now?

The choice of appropriate recycling technique and road sections was based the following aspects:

- The present condition of the pavement and the calculated overlay thickness in the period of exploitation, and
- The accessed to recycling equipment.

Recycling was applied within the framework of two basic categories of interventions:

- Interventions meant to provide required pavement structure, and
- Interventions aimed at repairing the functional features on sections with satisfactory structural bearing capacity

Recycling technique as a function of pavement distress

Distress	Recycling method	
	Hot-in-place Recycling – Remix Plus	Cold-in-place Recycling
Alligator Cracking		+
Longitudinal Cracking		+
Transversal Cracking	+	+
Rutting	+	+
Corrugation	+	+
Depression		+
Potholes		
Raveling	+	

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- Obtain representative field samples of the reclaimed material.
- Perform laboratory analysis.
- Select the optimum combination of mix components that meet the mix design criteria.
- Recycling work specifications
- Control testing
- Observation of the road section according to the provided time schedule.

3.1 Hot-in-Place Recycling – Remix Plus

Depending on the pavement distress, several methods for modifying the reclaimed asphalt were used:

- Adding only bitumen - on pavements, which showed only fatigue cracking and raveling;
- Spreading aggregate fraction - on sections whose rut depths were between 2 and 3 cm;
- Polymer modification was used to improve the stability and resistance to plastic deformation of the existing asphalt mix.



Remixer at work Motorway E-75



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3.2 Cold-in-Place Recycling – Full Depth Recycling

The project consisted of processing the existing asphalt layer and part of the underlying base, to an average depth of 20 cm. The existing material was milled, pulverized, screened, and treated with the cement, foamed asphalt and gravel.

Cold recycling Main Road M-19



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3.3 Noticed deficiencies of present experience

- Lack of engineering knowledge about recycled materials;
- Lack of clear standards and technical guidelines for using recycled materials;
- Reduced number of testing road sections;
- Possibilities that the traditional test methods did not give good results.

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4. Improving current recycling practise

- Mandatory procedure for qualification of reclaimed pavement material in accordance with the **ladder concept**;
- Design specifications must be defined always in the Terms of Reference;
- Issue regulations whereby the removal and dumping of materials have to be defined;
- Resort to specific analyses of existing stockpiles of reclaimed material in terms to define the possibilities and conditions of utilizing the reclaimed materials originating from them;
- Issue the rules for utilizing recycled asphalt pavement as aggregate (for the beginning 20-30%).

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Recycling of asphalt layers into new asphalt layers

Potential recyclability/reusability of asphalt aggregates

Course	Reuse in Aggregate of	SMA	DA	OA	CSA	GA	CBA
		Wearing	SMA	-	+	+	+
“	DA	-	+	+	+	+	+
Binder	OA	-	o	+	+	+	+
Base	CSA	-	o	o	+	+	+
“	GA	-	-	-	o	+	+

Legend:	+	Reclaimed asphalt is suitable for those mixes
	-	Reclaimed asphalt is not suitable for those mixes
	o	Reclaimed asphalt is possibly suitable for those mixes
SMA		Stone Mastic Asphalt (wearing course)
DA		Dense Asphalt (wearing course)
OA		Open Asphalt (binder course)
CSA		Crushed Stone Asphalt (base course)
GA		Gravel Asphalt (base course)
CBA		Cement Bound Asphalt aggregate (roadbase)

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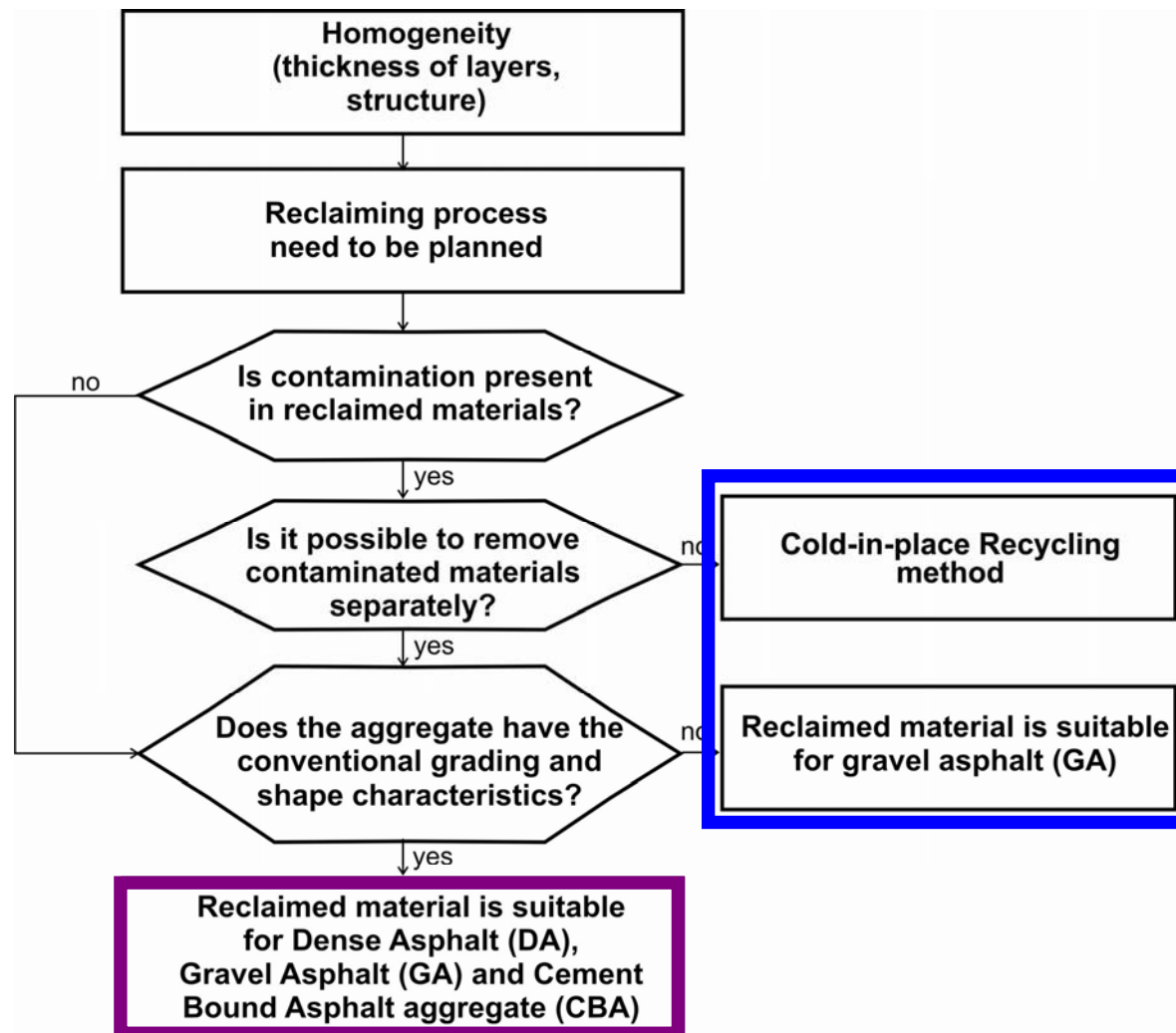
Design of pavement rehabilitation on E-75 Motorway, Belgrade-Nis.

- Characteristic pavement structural elements:
 - Asphalt concrete, 1.8-5.4 cm
 - Binder course, 3.0-7.0 cm
 - Two layers of Crushed Stone Asphalt, 4-11 cm
 - Cement Bound Aggregate, ~20 cm
- Results from laboratory testing of field samples revealed that:
 - The extracted bitumen characteristics indicates that the bitumen was altered by oxidation due to bitumen ageing;
 - The asphalt mixture has a tendency to permanent deformation.

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