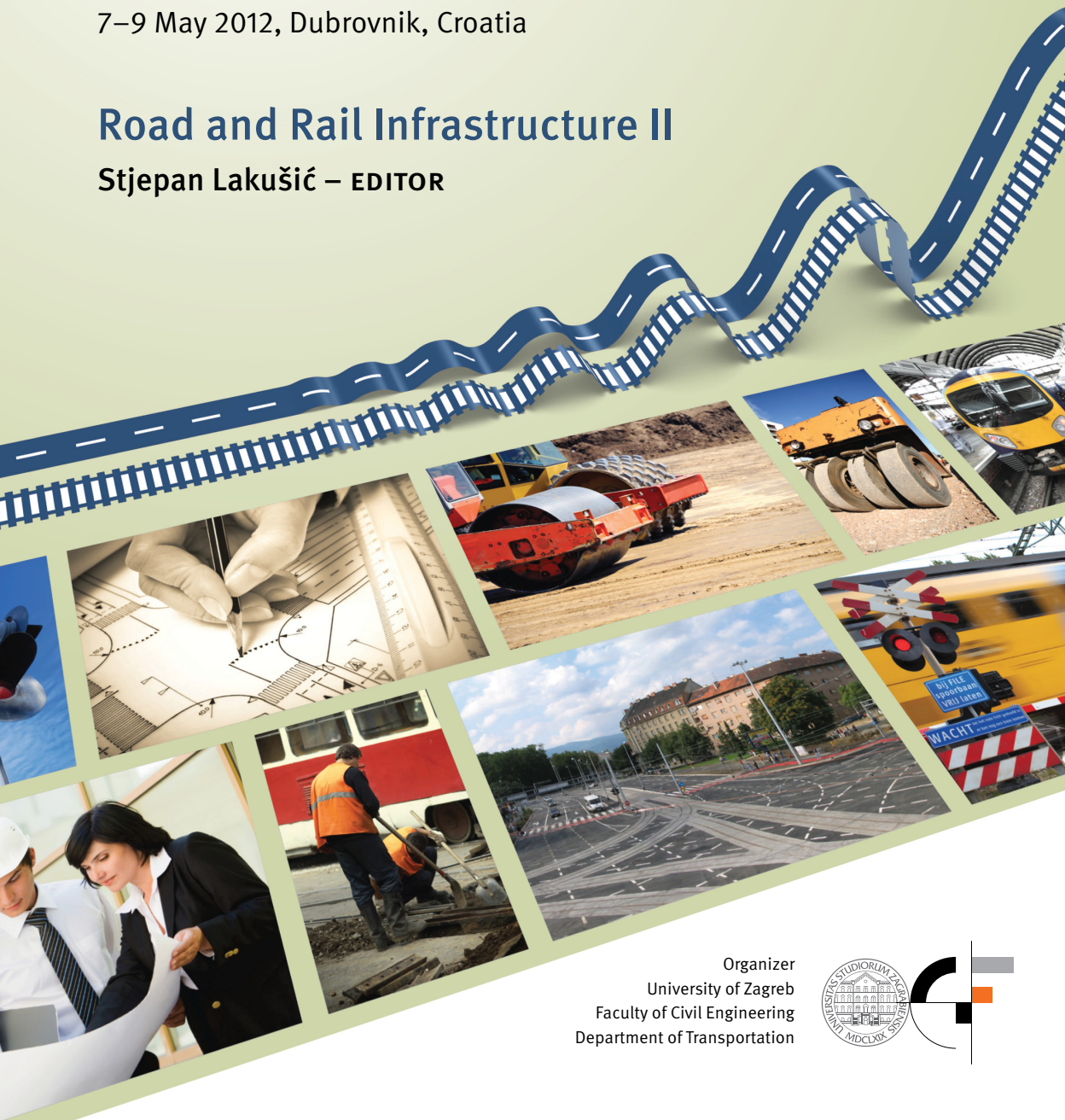
CETRA 2012

2nd International Conference on Road and Rail Infrastructure
7–9 May 2012, Dubrovnik, Croatia

Road and Rail Infrastructure II

Stjepan Lakušić – EDITOR



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MICRO–SURFACING ON FRENCH HIGHWAYS: RECENT SUCCESSFUL EXPERIENCES

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Abstract

The majority of the maintenance works on high traffic roads are based on hot or warm bituminous products, this kind of traditional products offer all the properties required for wearing course issues. Micro–surfacing is right now at the margins of this type of works. Nevertheless, this technique has already been designed, studied and implemented on highways in the past.
Answering totally the objectives of the project owner, micro–surfacing has been laid recently on French highway section. The product chosen for these maintenance works was the GRIPFIBRE®, a micro–surfacing product adapted to high traffics.
The follow up indicates that the GRIPFIBRE® applied in 2007 on A87 motorway (near Cholet) has kept very good properties of skid resistance. Measurements have been performed concerning macrotexture (ATD through sand patches test) and microtexture (through friction coefficient). The values of the sideways force coefficient indeed stabilize around 0.63 in both directions after 4 years (measurements done in 2011).
The 4 years follow–up on A87 shows that the good level of skid resistance is long–lasting and sustainable over time, which proves the good mechanical behavior of the product under very high traffic.
In comparison with a traditional solution of maintenance work with VTAC 0/10 (Very Thin Asphalt Concrete called BBTM in France), the technique micro–surfacing thus allows, among others:
· A reduction of 62 % of the transport of aggregates,
· A decrease of 182 tons of greenhouse gases representing – 63 %,
· An economy of 3 330 tons of aggregates, which means 59 % of saved natural resources.
The low environmental impact of GRIPFIBRE®, a cold technique produced on site hence reducing transport and saving materials, is an obvious additional advantage.

Keywords: maintenance, surface characteristics, safety, low environmental impact

1 Introduction

The maintenance of motorway wearing course is very important to guarantee user safety and comfort. Most maintenance works on heavy traffic pavements rely on a wide range of hot or warm mix asphalt materials able to cover all wearing course functions: skid resistance, waterproofing, drainage, evenness, rolling noise, etc. But micro–surfacing also has good characteristics and that is why this process can be used instead of asphalt mixes.
Micro–surfacing has been laid on one highway section, answering the owner's targets. GRIPFIBRE® process, an adapted micro–surfacing technique for the high traffic, has been used for maintenance works. It has an advantageous environmental impact and a very good level of skid resistance proved by the measurements which have been performed on this product to estimate the macrotexture and microtexture over time.

2 GRIPFIBRE®

GRIPFIBRE® process is a micro–surfacing with gap–graded or continuous grading curve, associating a bitumen emulsion often modified by polymer and organics fibers. A picture of this process is shown on Fig. 1.

Figure 1 Fibers used in GRIPFIBRE® mix design

During the summer 1998, a section of 2 kilometers of the A71 has been realized for maintenance works with GRIPFIBRE® 0/10. Some measurements of braking force coefficient have been performed after 6 and 18 months of service. The results are shown on Fig. 2.

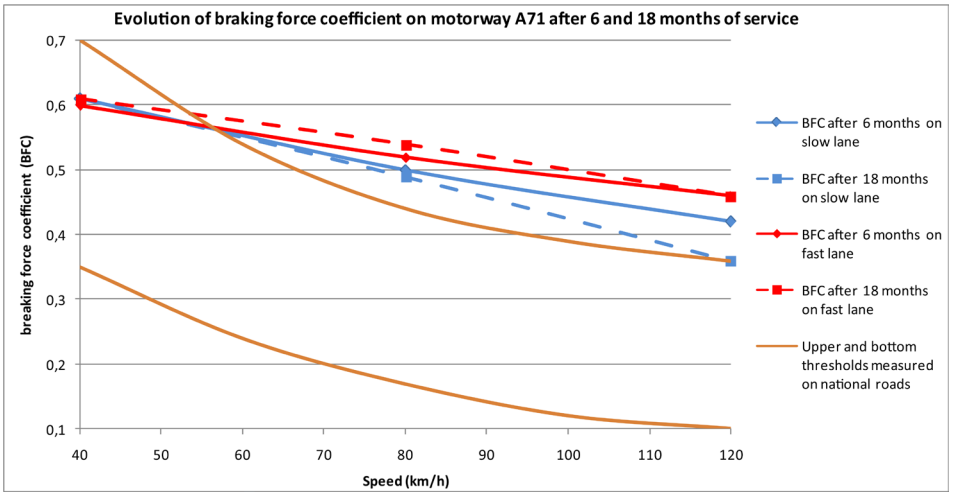

Figure 2 Evolution of braking force coefficient on motorway A71

At the early stage, GRIPFIBRE® has braking force coefficient values located at the top of the upper threshold for national roads. After 18 months the braking force coefficient stays at a high level. The conclusion of the Regional Laboratory (CETE), who had performed the measurement, was: 'the skid resistance level measured on A71 motorway remains at an excellent level after 18 months'.

3 A87 construction site

3.1 Characteristics of the construction site

The works section is located between Cholet North and Cholet South exits on the A87 highway. The works took place from 10 to 20 September 2007 and were realized by a special team of Eurovia South–West. The road bears a heavy traffic T1 with 500 trucks per day and the support layer was composed of a semi–coarse asphaltic concrete applied in 2000. Choice was made to use dual layers application 0/4 and 0/10 continuous grading. The first layer is composed of 0/4 grading with a bitumen emulsion modified by polymer. The second layer contains 0/10 grading with fibers to facilitate the laying of the product; moreover these fibers avoid segregation. The use of fibers allows GRIPFIBRE® to get an improved ageing resistance.

3.1.1 Mix design

The mix design of the micro–surfacing has been realized by the regional laboratory of the South–West technical delegation, it is detailed in Table 1. These two mix design have been tested according to the interne Eurovia method and the results are shown on Table 2.

Table 1 Mix design of dual–layer micro–surfacing used on motorway A87

Formula	**Microsurfacing 0/4 Pont Charron/Meilleraie**		**Microsurfacing 0/10 c Pont Charron**	
Composition	0/4 Pont Charron	60%	0/2 Pont Charron	40%
	2/4 La Meilleraie	40%	2/6 Pont Charron	40%
			6/10 Pont Charron	20%
	Hydrated lime (ppc)	0.5	Hydrated lime (ppc)	0.5
	Fibers (ppc)	-	Fibers (ppc)	0.07
	Added water (ppc)	11	Added water (ppc)	10
	PmB Emulsion (ppc)	11.8	PmB Emulsion (ppc)	10.8
	Residual binder (ppc)	7.1	Residual binder (ppc)	6.48
	Maximum density (t/m3)	2.638	Maximum density (t/m3)	2.683
	Binder modulus	4.54	Binder modulus	4.24

Table 2 Test conducted on motorway A87 on dual–layer micro surfacing

	Standard	**Unit**	**Specifications**	**Micro-surfacing 0/4**	**Micro-surfacing 0/10 c**
Working time	MEI				
Workability time		s	≥ 90	90	110
Breaking time		min	≤ 20	4	4
Benedict cohesion	NF EN 12274-4				
Cohesion at 30 min		kg.cm	≥ 20	23	23
Cohesion at 60 min		kg.cm	≥ 23	24	24
Abrasion WTAT	MEI				
Weight loss (T = 18°C, HR=55%)		%	≤ 5	-	0
Weight loss (T = 18°C, HR=100%)		%	≤ 25	-	2

3.1.2 Laying

Production controls have been carried out during the construction site with a minimal frequency of 1 control per day. The results have confirmed the perfect control of the production of the micro–surfacing. The works have been carried out in 6 days and a half. The road surface coated was around 117 300 m² in other word 234 600 m² of micro–surfacing. The daily cadence has reached 36 000 m². The laying speed varies between 1.5 and 2.5 km/h for a width of 3.8 m.

The technique of micro–surfacing allows reaching of a high laying rate; that is very appreciated on highway construction site.

3.2 Monitoring of surface characteristics over time

The A87 site has been monitored over the time by ASF and Eurovia.

ASF has used the equipment SCRIM® (Sideway force Coefficient Routine Investigation Machine) to measure the texture depth and the sideway force coefficient after 1 and 4 years of service.

Eurovia has realized the measurement of the average texture depth in October 2008 (sand patches), in slow lane (Table 3).

After the first summer, GRIPFIBRE® had kept its high macrotexture over the time. The behaviour over the time after 1 year is appreciated by the ASF's values which are shown in Table 4.

Table 3 Monitoring of macrotexture after one year

		Average texture depth	
		Sand patch values	**Standard deviation**
October 2008	Direction 1 : From Paris to la Roche-sur-Yon	1.15 mm	0.05 mm
	Direction 2 : From La Roche-sur-Yon to Paris	1.1 mm	0.08 mm

Table 4 Monitoring of macrotexture after one year and four years

		Average texture depth	
		Average	Standard deviation
June 2008	Direction 1 : From Paris to La Roche-sur-Yon	1.3 mm	0.11 mm
	Direction 2 : From La-Roche-sur-Yon to Paris	1.2 mm	0.13 mm
June 2011	Direction 1 : From Paris to La Roche-sur-Yon	1.0 mm	0.10 mm
	Direction 2 : From La-Roche-sur-Yon to Paris	1.0 mm	0.15 mm

The two tables show a good correlation between the two measurements. After 4 years, a weak erosion occurs but it remains homogeneous in the two directions. The average values of 1 mm after 4 years of service prove that the mosaic is well established and that the macrotexture is stabilized at a high level.

The sideway force coefficient has been measured by the SCRIM® device and the results are given in Table 5.

Table 5 Monitoring of sideways force coefficient after 1 and 4 years

		Sideways force coefficient	
		Average	Standard deviation
June 2008	Direction 1 : From Paris to La Roche-sur-Yon	0.71	0.02
	Direction 2 : From La-Roche-sur-Yon to Paris	0.66	0.02
June 2011	Direction 1 : From Paris to La Roche-sur-Yon	0.63	0.02
	Direction 2 : From La-Roche-sur-Yon to Paris	0.63	0.02

These values are calculated on 400 measurements, so it is interesting to analyze the distribution of the results under the form of distribution histograms after 1 and 4 years of service in the two directions. (Fig. 3 & 4)

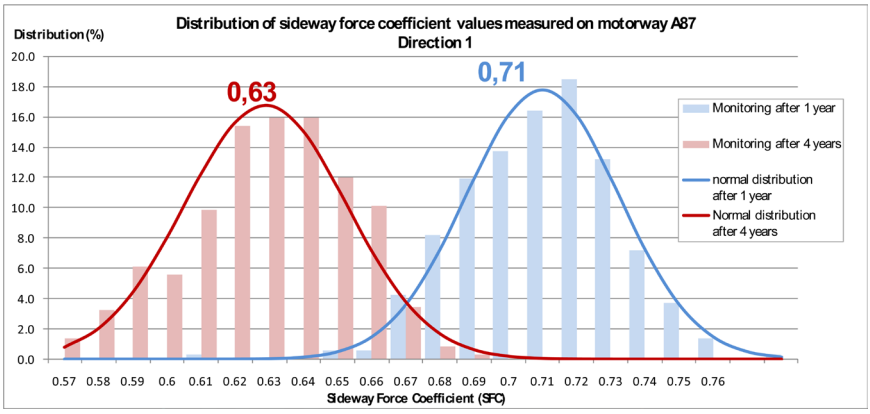

Figure 3 Evolution of skid resistance on motorway A87 – Direction 1

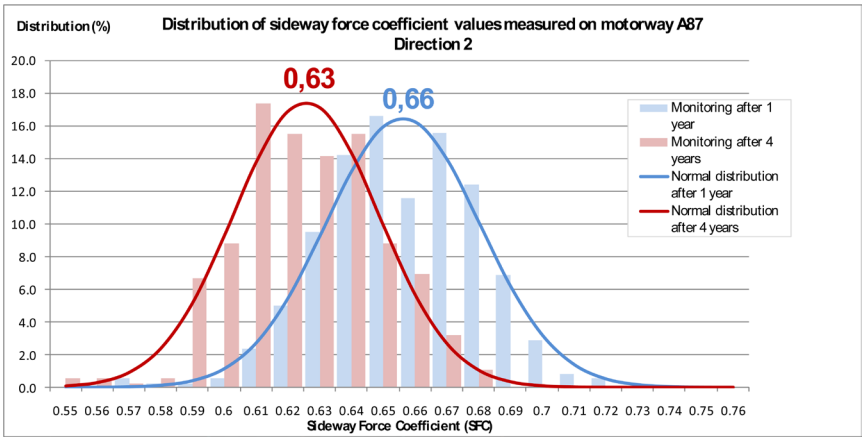

Figure 4 Evolution of skid resistance on motorway A87 – Direction 2

These histograms show that GRIPFIBRE® keeps very good properties of skid resistance after 4 years. In both directions the skid force resistance values are stabilized at 0.63. Moreover, used aggregates have a middle PSV value of 52. After a visual check, no problem was listed. The performance class of this micro–surfacing is the best: VDA 1 (class 1 of the Visual Defect

Assessment according to the European standard EN 12273). The good homogeneity of micro-texture after one year of service is illustrated on Fig. 5.

Figure 5 Surface aspect of micro–surfacing after one year of service

4 Environmental impact

An environmental comparison is established between dual layer micro–surfacing 0/4 – 0/10 and a very thin asphalt concrete overlay 0/10: the dual layer micro–surfacing has a lot of advantages environmentally speaking. To highlight this difference, the eco–comparator GAIA.be® software was used, in considering the furniture, the fabrication in mixing plant, the transport and the laying. The conditions of the construction site are a surface of 120,000 m² and a distance of 20 km with the mixing plant. (Table 6)
Compared with a very thin asphalt concrete overlay 0/10 ('base'), the micro–surfacing ('proposition') offers, among other things:
· A reduction of 62 % of the transport of materials
· An economy of 182 tons of greenhouse gas, corresponding to – 63 %
· A reduction of 3,330 tons of aggregates, corresponding to 59 % of saved natural materials

Table 6 Environmental impact of micro surfacing solution

Environmental indicator	Difference		
	Absolute value	%	100%
Depletion of ressources (ADP) (kg eq Sb)	-4,579	-55%	base / proposition
Aggregate consumption (Tonnes)	-3,330	-59%	base / proposition
Energy resources consumption (MJ)	-2,889,798	-62%	base / proposition
Direct fuel oil consumption (Liters)	-61,909	-80%	base / proposition
Overall transport (Tonnes km)	-479,754	-62%	base / proposition
Emission of GHG climate change (kg eq CO2)	-182,444	-63%	base / proposition
Atmospheric acidification (kg SO2 equ)	-1,932	-69%	base / proposition
Air pollution (m3)	-21,720,265	-70%	base / proposition
Water pollution (m3)	-109,549	-61%	base / proposition
Photochemical ozone creation ozone (kg eq Eth)	-205	-67%	base / proposition

5 Conclusion

Recently, GRIPFIBRE product was applied on sections of highway with high traffic levels (motorway A87). This technique meets the needs of high laying rates and restoration of an excellent level of skid resistance, vector of safety. Besides, the speed of execution limits the embarrassment to the traffic and the exposure of the staff in the dangerousness of the circulation.

The monitoring during 4 years shows that the level of skid resistance is sustainable in the time, which proves the good mechanical behaviour of the product under very high traffic.

The low environmental impact of this 'cold technique' product in terms of transport reduction and materials savings, is besides an obvious additional advantage.