

EMULSION TECHNIQUES OVERVIEW

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IBEF ERF RAD

Roads are part of our national asset

Roads need to be maintained



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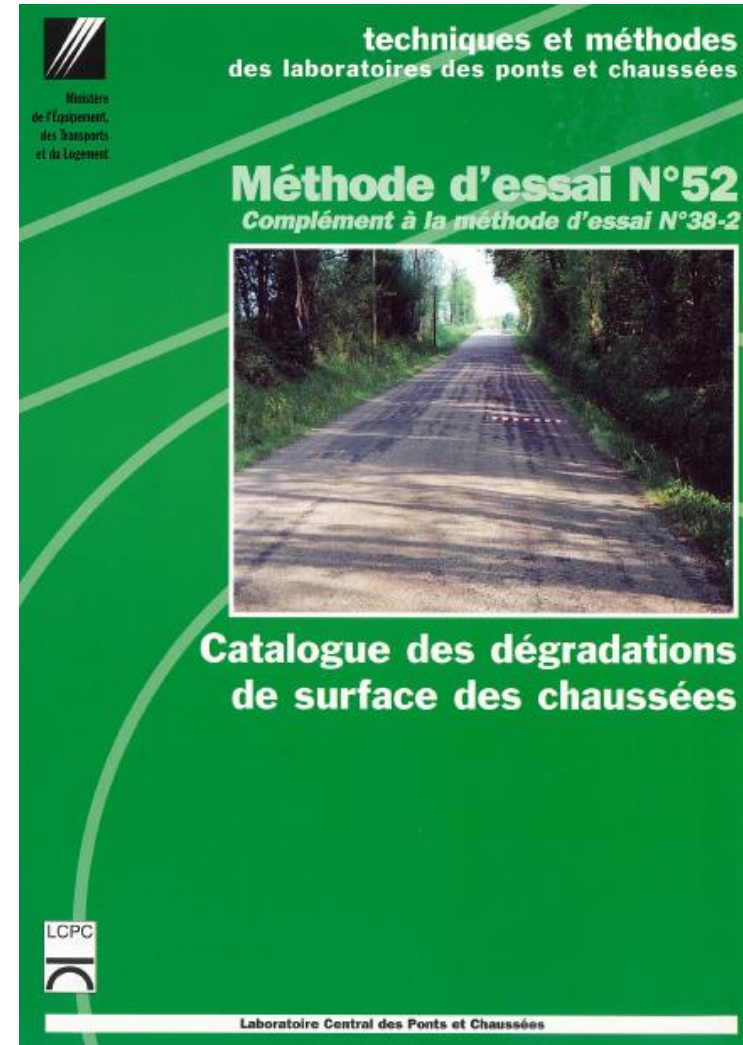
Roads need to be maintained

Without appropriate maintenance, degradations worsen...



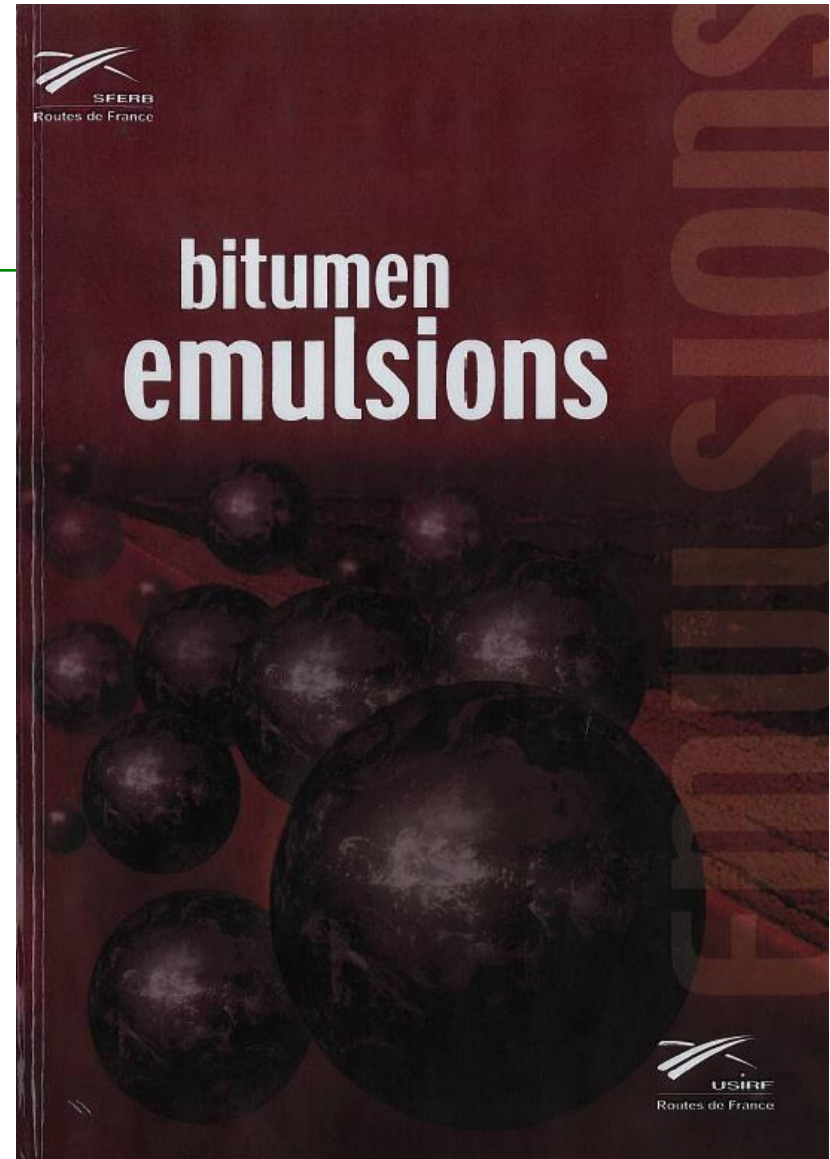
1. FIELDS OF USE

1. Surface maintenance is essential.
2. It should be done regularly.
3. The selection of the maintenance technique depends on the type of degradations and on the traffic.



1. FIELDS OF USE

1. Bitumen emulsions are well designed for surface maintenance
2. Mainly
 - Chip seal / surface dressing
 - Micro surfacing and Cold mixes
3. And also
 - Tack coats and seal coats



2. SURFACE TREATMENTS: CHIP SEAL

1. Chip seal: is that so simple?

Spray the surface with a glue

Spread chippings on it

Roll the whole a bit

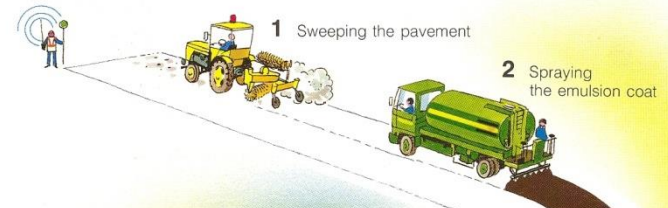
Wait it dries

2. Is that all?

Yes! BUT only with an appropriate design, appropriate materials and an irreproachable workmanship

SINGLE-LAYER SURFACE DRESSINGS

Work stages



2. SURFACE TREATMENTS: CHIP SEAL

1. Design

Which option to select?

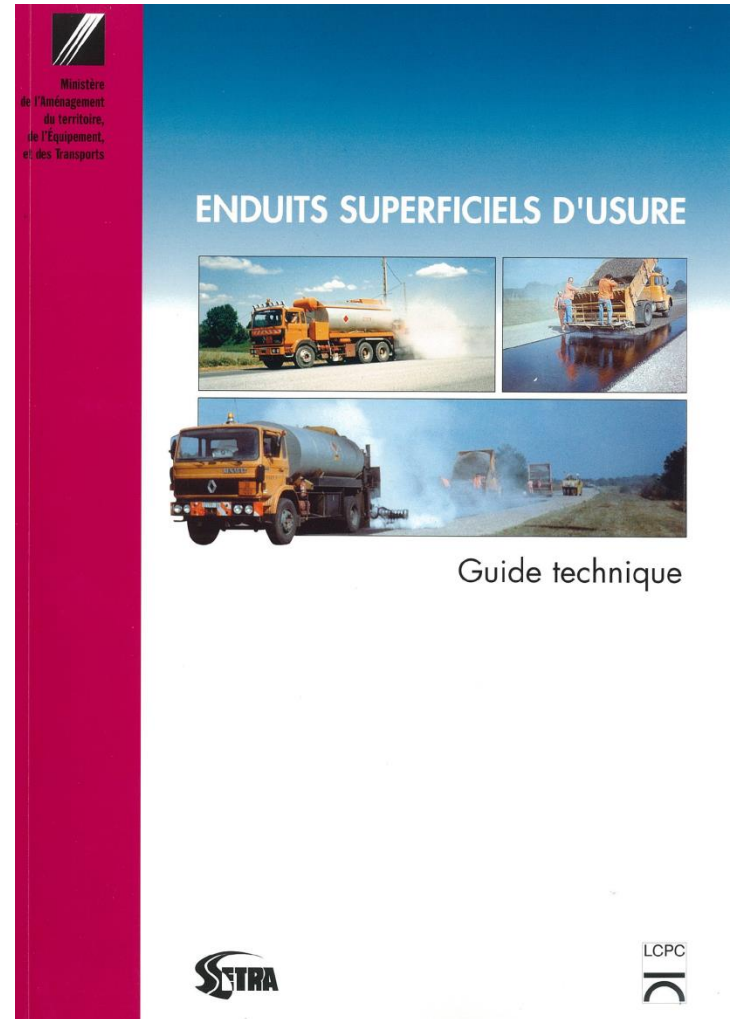
Economical constraints?

Depends on the problem to solve:

Binder rate

Aggregates dosages rules

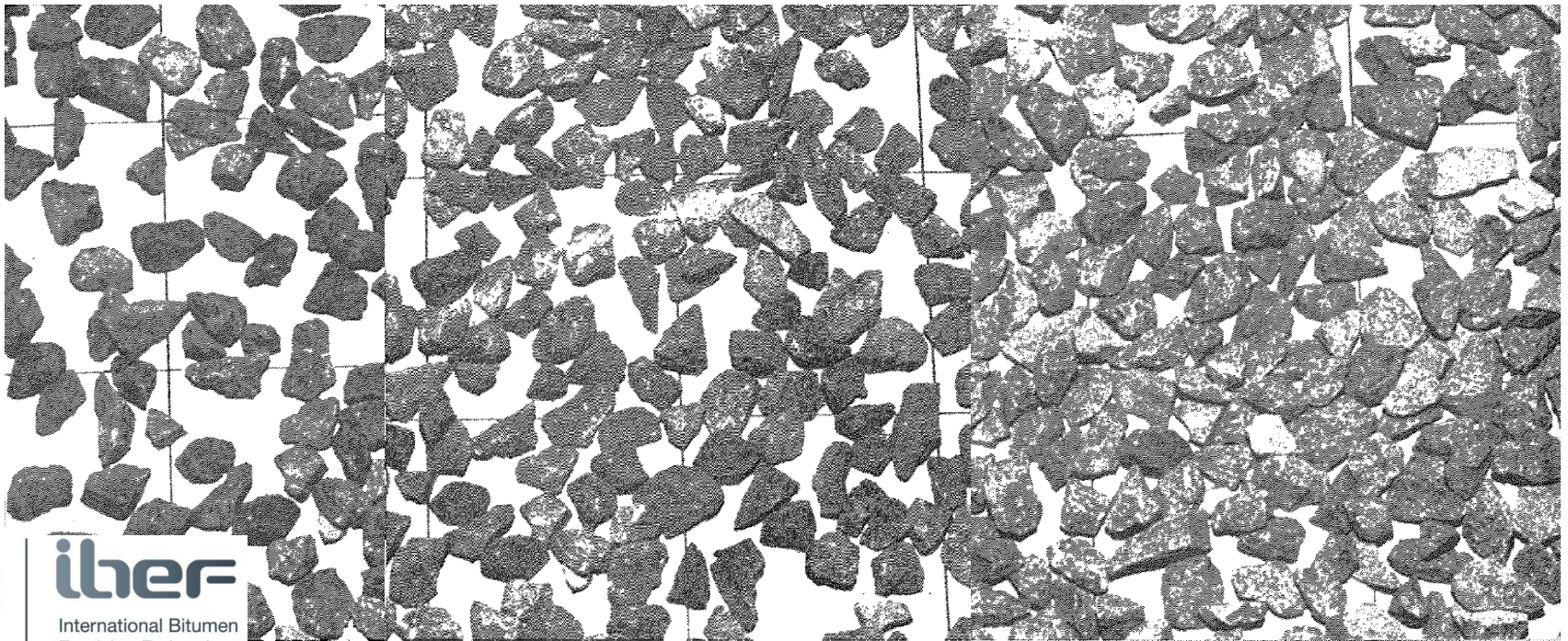
Which surface covering ?



2. SURFACE TREATMENTS: CHIP SEAL

1. Design

Covering ability



Granularité 6/10, dosage 3 l

Granularité 6/10, dosage 4 l/m²

Granularité 6/10, dosage 5 l/m²



iber

International Bitumen
Emulsion Federation

2. SURFACE TREATMENTS: CHIP SEAL

1. Construction

Suitable materials

Aggregate quality

Reliable equipment

Well trained teams

Preliminary survey



2. SURFACE TREATMENTS: CHIP S

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2. SURFACE TREATMENTS: CHIP SEAL

1. Construction

Suitable materials

Binder choice and spraying rate

Reliable equipment

Well trained teams

Preliminary survey

Binder dosage rate corrections									
Parameters				Single layer/ Racked-in	Sandwich	Double-layer		Sandwich	
						First layer	Second layer	First layer	Second layer
Traffic-Trucks/ day/direction	1	T0	>750	-15	-14	-15	-15	-14	-14
	2	T1	300 to 750	-12	-11	-12	-12	-11	-11
	3	T2	150 to 300	-8	-7	-8	-8	-7	-7
	4	T3 +	100 to 150	-5	-4	-5	-5	-4	-4
	5	T3 -	50 to 100	-0	-0	-0	-0	-0	-0
	6	T4	25 to 50	+5	+3	+5	+5	+3	+3
	7	T5	< 25	+10	+8	+10	+10	+8	+8
	8	No truck traffic		+12	+11	+12	+12	+11	+11
Environment	1	High exposure to solar radiation		-5	-5	-5	-5	-5	-5
	2	Exposure to solar radiation		-2	-2	-2	-2	-2	-2
	3	Normal		0	0	0	0	0	0
	4	Shaded		+5	+5	+5	+5	+5	+5
	5	Highly Shaded		+10	+8	+10	+10	+8	+8
Longitudinal profile	1	Staight and flat		0	0	0	0	0	0
	2	Straight on upgrade		-5	-5	-5	-5	-5	-5
	3	Winding and flat		+2	+2	+2	+2	+2	+2
	4	Winding on upgrade		-2	-2	-2	-2	-2	-2
Condition of support	1	Lean and very rough		+18	+6	+15	+3	+6	+2
	2	Lean and rough		+12	+4	+10	+2	+4	+2
	3	Lean and only slightly rough		+6	+2	+5	+1	+2	+1
	4	Smooth and with no bleeding		0	0	0	0	0	0
	5	Tendency to bleed		-5	-2	-5	-1	-2	-1
	6	Bleeding		-10	-4	-10	-2	-4	-2
Season executed	1	April / May		0	0	0	0	0	0
	2	June / July / August		0	0	0	0	0	0
	3	September and later		+5	+5	+5	+5	+5	+5
Binder category	1	Fluxed bitumen	400/800	+4	+4	+4	+4	+4	+4
	2		800/1600	+3	+3	+3	+3	+3	+3
	3		1600/3200	+2	+2	+2	+2	+2	+2
	4	Diluted bitumen	400/600	+4	+4	+4	+4	+4	+4
	5		800/1400	+3	+3	+3	+3	+3	+3
	6	Tar bitumen	1200	+9	+9	+9	+9	+9	+9
	7		2000	+8	+8	+8	+8	+8	+8
	8		2500	+7	+7	+7	+7	+7	+7
	9	Emulsion	65%	+6	+6	+6	+6	+6	+6
	10		> 69%	0	0	0	0	0	0
	11	Modified anhydrous viscous		+1	+1	+1	+1	+1	+1
	12	Modified anhydrous highly viscous		0	0	0	0	0	0
	13	Modified emulsion		0	0	0	0	0	0
Size distribution	1	Normal		0	0	0	0	0	0
	2	Fine		-5	-5	-4	-2	-4	-2
	3	Coarser		+5	+5	+4	+2	+2	+2
Flatness	1	Normal		0	0	0	0	0	0
	2	Flat > 15%		-4	-4	-4	-2	-4	-2
	3	Flat < 10%		+4	+4	+4	+2	+4	+2
Region	1	Hot		-4	-4	-4	-4	-4	-4
	2	Temperate		0	0	0	0	0	0
	3	Cold		+4	+4	+4	+4	+4	+4
Altitude	1	< 500m.		0	0	0	0	0	0
	2	500 to 1,000m.		+2	+2	+2	+2	+2	+2
	3	> 1,000m.		+4	+4	+4	+4	+4	+4
Hardness of support	1	No punch marks visible		0	0	0	0	0	0
	2	Punch marks highly visible		-7	-7	-7	0	-7	0
Permeability	1	Permeable		+5	+5	+5	0	+5	0
	2	Impermeable		0	0	0	0	0	0

2. SURFACE TREATMENTS: CHIP SEAL

1. Improvements

Use of fibers

Modified emulsions



2. SURFACE TREATMENTS: MICRO SURFACING

1. Micro surfacing is simple:

Load sand and emulsion in a specific truck

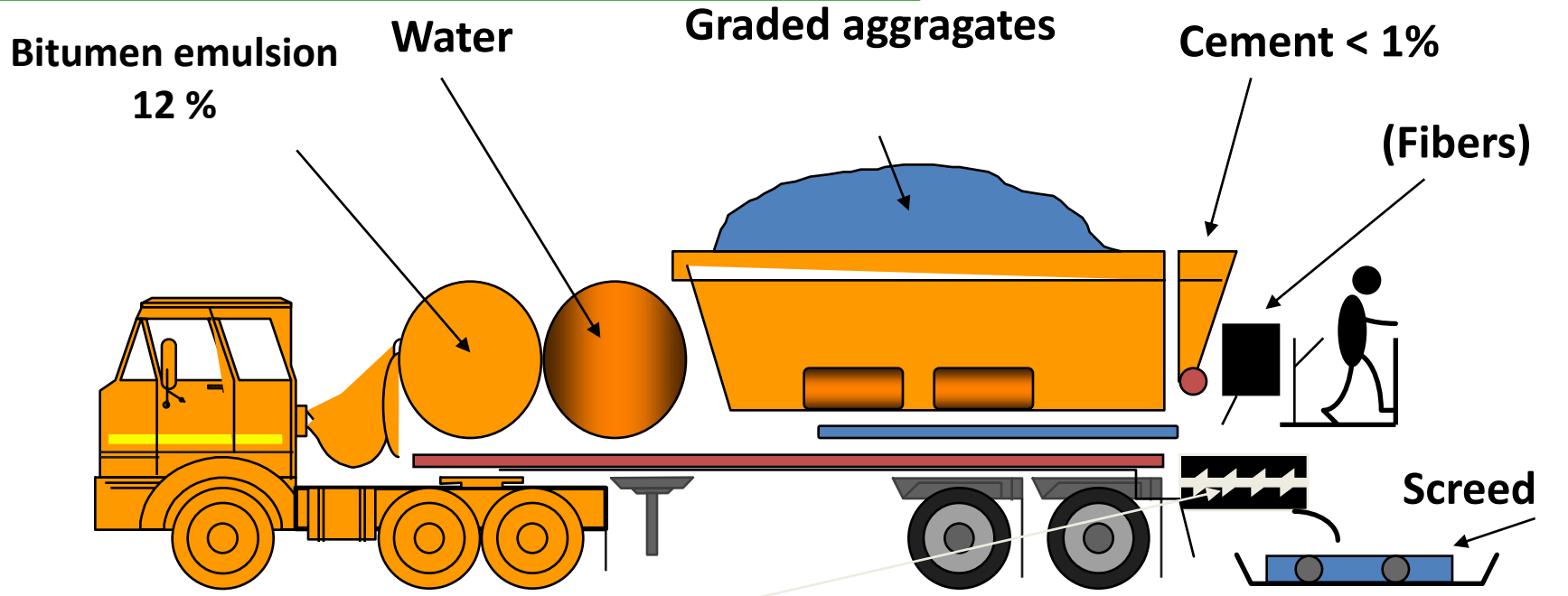
The truck will manage the whole system: proportioning, mixing and placing

2. Is that all?

Yes! BUT only with an appropriate design, appropriate materials and an irreproachable workmanship



2. SURFACE TREATMENTS: MICRO SURFACING



Additives :

- Setting promoters
- Setting retardants
- (Latex)
- (Fibers)

2. SURFACE TREATMENTS: MICRO SURFACING

1. Ingredients

2. Aggregates

Grading 0/4 to 0/10 mm

Control of the fine content and the cleanliness

3. Emulsion

Emulsion to be fluid and stable enough to allow a proper dispersion in the aggregate fraction for a good mixing, and a quick setting after placing

4. Additives

To control the breaking of the emulsion

2. SURFACE TREATMENTS: MICRO SURFACING)

1. Design
2. Adequation binder v/s aggregate: crucial!
Aggregates are more or less reactive
The emulsion deign should be taylord to the aggregates characteristics
3. Emulsion content (Slow set 60%) ranges between 10 and 12%
4. The water and additives contents are adjusted in a second step so that to reach a suitable consistency and a prompt cohesion buildup so that to open the raod to the traffic within 30 minutes

2. SURFACE TREATMENTS: MICRO SURFACING

1. Specific laboratory tests

1. TCS (Surface Cohesion Test)
2. HCT (Hilt cohesion test)



	Formule retenue : MD 13 / HC 12,5						Spécifications
Maniabilité (s)	150		90		90		90 < M < 180
Conditions climatiques (°C/%)	20°C / 50%		25°C / 90%		30°C / 90%		
Temps de mûrissement (min.)	30	60	30	60	30	60	
TCS (g)	200	190	80	44	20	10	< 150

Caractéristiques de l'ECF 0/6 SOCAM.



2. SURFACE TREATMENTS: MICRO SURFACING

1. Placing
2. A specific machine
3. A continuous adjustment of the water and additives flows, according the placing conditions; the skillness of the team is crucial

Temperature (emulsion)

Moisture



2. SURFACE TREATMENTS: MICRO SURFACING

1. Advantages

Skid resistance (sand patch tests $> 0,9$ mm)

Watertightness

Low noise surfacae

No loose aggregate

Thin system

Attractive quality / cost ratio



3. EMULSION BASED MIXES

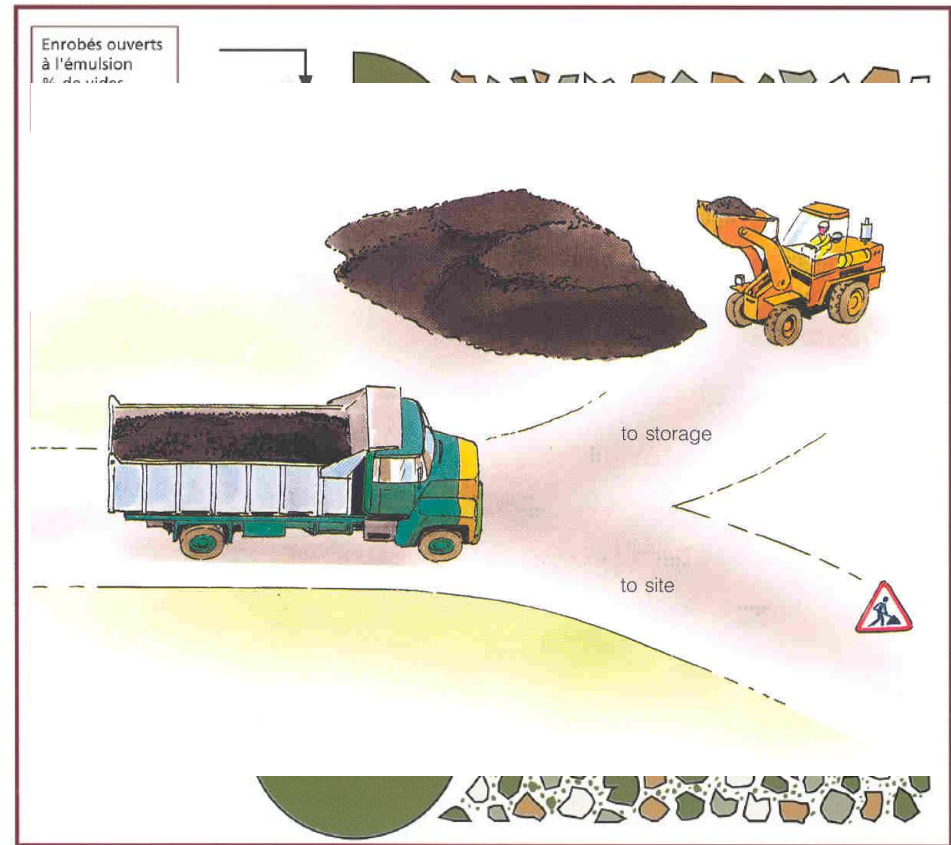
A wide range

- **Mixes for wearing course**
- **Gravel emulsion**
- **In place recycling**
- **1/2 warm mixes (new development)**

Cold mixes have historically been highly regarded for its high mechanical strength against deformable surfaces

3. EMULSION BASED MIXES: MIXES FOR WEARING COURSE

1. Dense, semi dense, open graded mixes
2. Storable mixes or for immediate use
3. Bulk or packaged materials
4. Specific mixing processes



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1. Dense, semi-dense mixes
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3. Bulk or packaged
4. Specific mixes



0/d pré-enrobé



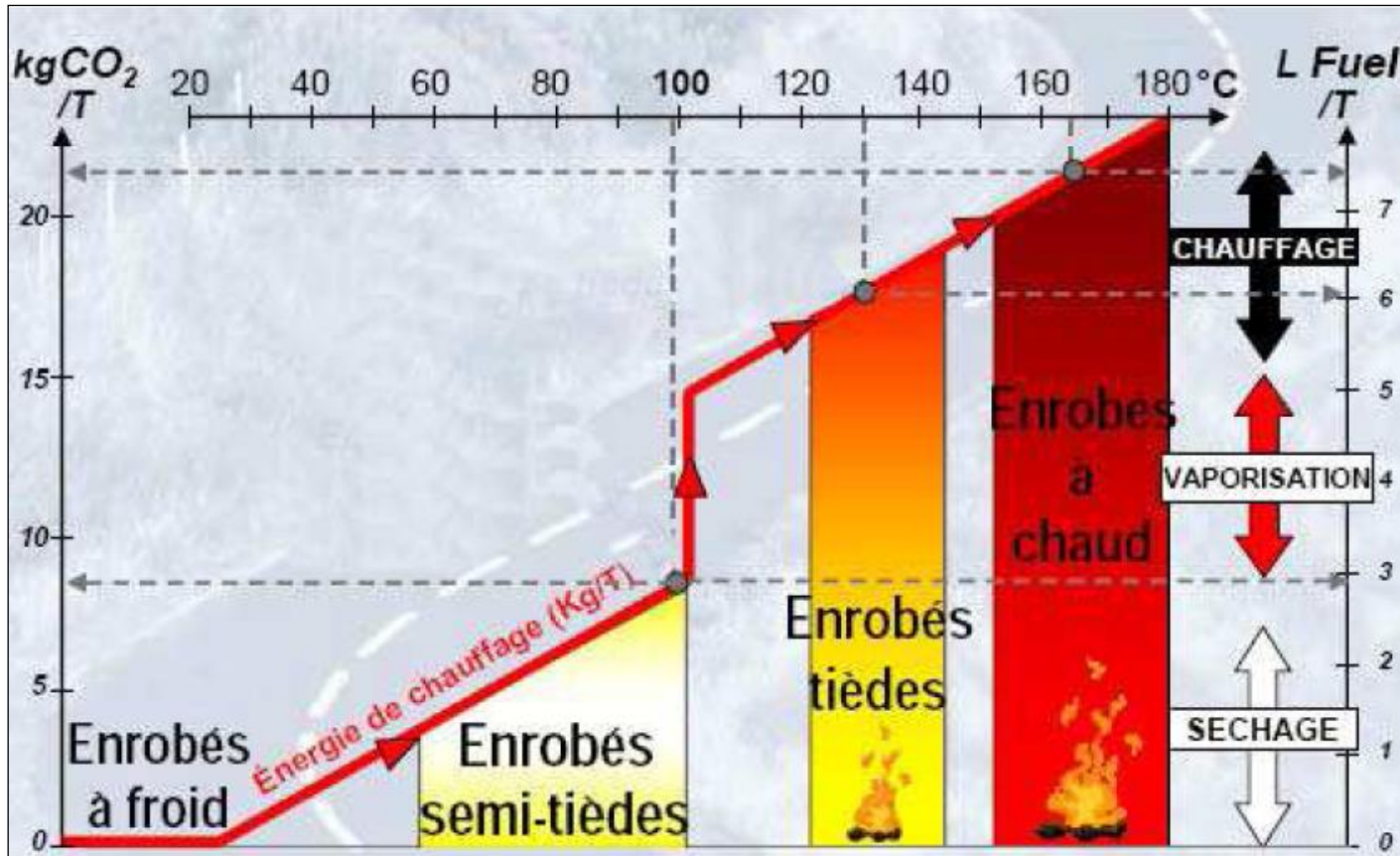
▲ Figure 8
Enrobage séquencé

3. EMULSION BASED MIXES: MIXES FOR WEARING COURSE

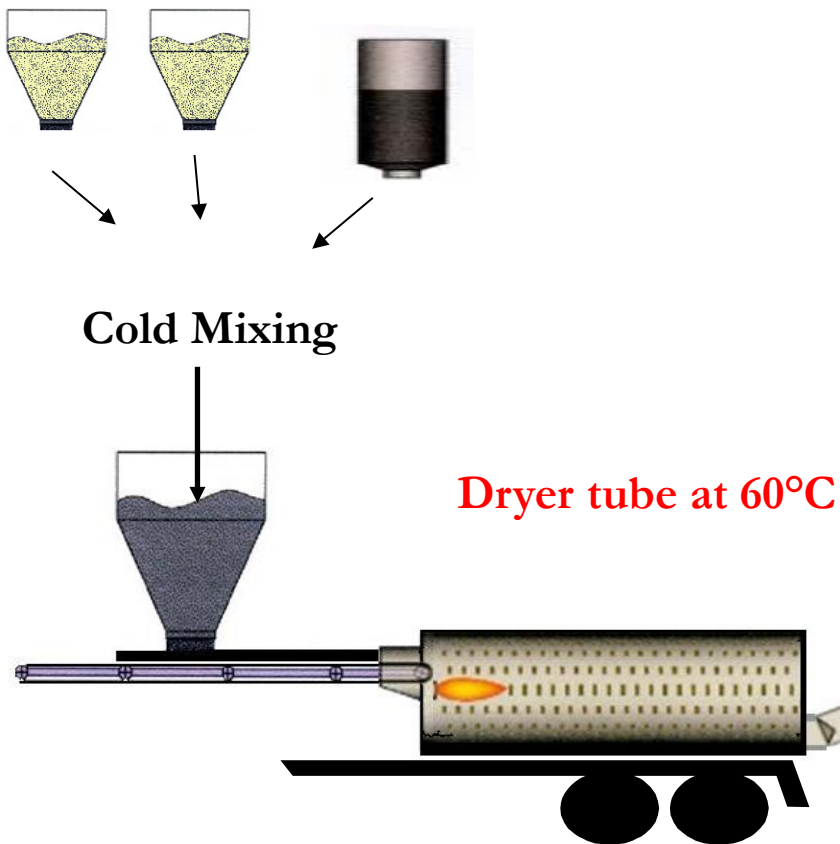
1. Placing
2. Like hot mixes, but cold!
No thaulage constraints or limits
3. Mechanically or by hand
Special care for the compaction



3. EMULSION BASED MIXES: SEMI WARM MIXES (NEW DEVELOPMENT) the challenge is to continually provide a step ahead



3. EMULSION BASED MIXES: SEMI WARM MIXES (NEW DEVELOPMENT)



3. EMULSION BASED MIXES: ½ WARM MIXES (NEW DEVELOPMENT)

1. Emulsion based Warm mixes combine qualities of hot mixes and cold mixes.
2. Use of 100% of milled materials possible.



MEZCLAS TEMPLADAS
CON EMULSIÓN
BITUMINOSA

ASOCIACIÓN TÉCNICA DE EMULSIONES BITUMINOSAS
(ATEB)



3. EMULSION BASED MIXES : A TYPICAL CASE STUDY

- What do you think ?
- How could we maintain that road?



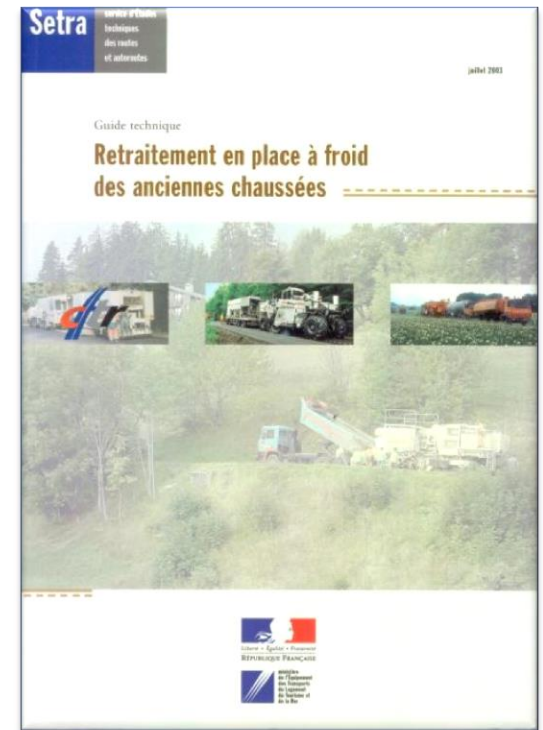
3. EMULSION BASED MIXES : TYPICAL CASE STUDY : GRAVEL EMULSION

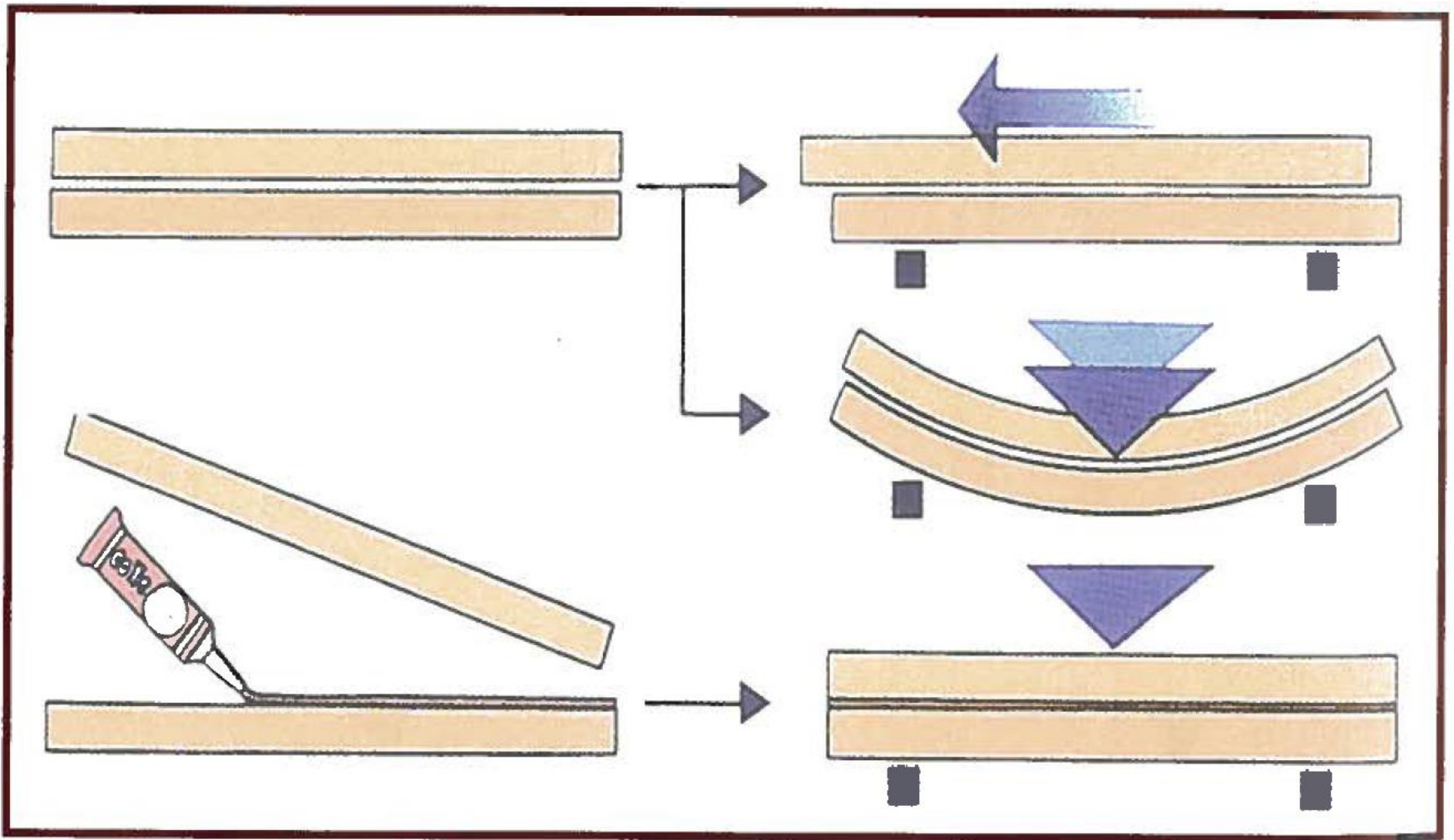
1. Emulsion based mix for base course or reshaping
2. Continuous grading 10 to 20 mm
3. Emulsion content: 6 to 8%
4. Manufacturing, transportation, placing: conventional (grader, paver)



3. EMULSION BASED MIXES : COLD IN PLACE RECYCLING

- 1. Principle
- 2. Applications





▲ **Figure 1**
Outline representation of the effect of slippage between layers

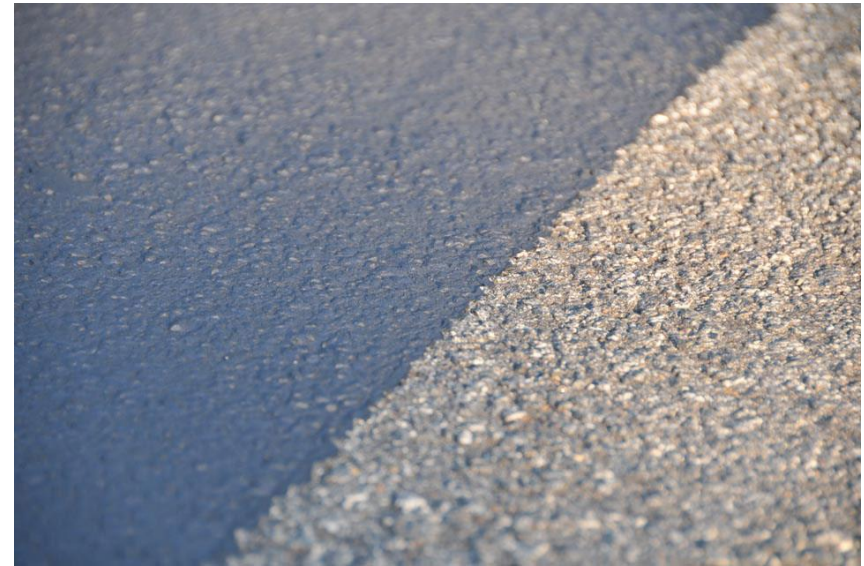
3. TACK COATS, SEAL COATS, PRIME COATS

1. Bituminous layers need to be properly bonded to the surface on which they are placed
2. Obvious! BUT better to say it... and to do it, ... when bonded it increases by 4 the pavement life
3. Need for an appropriate workmanship and equipment
4. Ban cut-back



3. TACK COATS, SEAL COATS, PRIME COATS

1. Seal coats are meant to protect base layers, before they are overlaid with a wearing course
2. Protecting a CTB (Cement Treated Base) against premature desiccation
3. Protecting a gravel emulsion against traffic and bad weather



4. OTHER USES



5. CONCLUSIONS

1. **Amongst road techniques, emulsions are mainly used for maintenance techniques: chip seal, micro surfacing & cold mixes**
2. **Emulsion based mixes provide with reliable and cost effective solutions, especially with regards to operating constraints and environmental requirements**
3. **Emulsions are sensitive to the characteristics of the aggregates: cleanliness, chemical composition**
4. **Emulsion techniques have a low environmental footprint & lower energy consumption**

5. CONCLUSIONS

1. Amongst road techniques, emulsions are mainly used for maintenance techniques: chip seal, micro surfacing, cold mixes
2. Emulsion based mixes provide with reliable and cost effective solutions, especially with regards to operating constraints and environmental requirements
3. Polyvalent techniques



5. CONCLUSIONS

