

WORLD OF EMULSIONS

Emulsion Producers' Day
Journée des fabricants d'émulsion
Jornada de fabricantes de emulsiones

11 OCTOBER 2010
Lyon - France



www.world-of-emulsions.com

Update of Emulsion based mixes (cold & warm)

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ATEB (Spain)

EMULSIONS MARKET IN SPAIN

- Stable market (2004 to 2007) and now in decrease
- 50 Production Plants
- Results
 - 310.000 t in 2005
 - 251.000 t in 2009

	PRODUCTION 2009
TOTAL ANIONICS	4.188
TOTAL CATIONICS	246.941
Quick	199.385
Medium	10.776
Slow	36.780
THERMO-ADHERENT	31.060
MODIFIED EMULSIONS	13.047
TOTAL EMULSIONS	251.129

CIFRES IN TONNES

EMULSIONS MARKET IN SPAIN

Types of emulsions	94 % Conventional emulsions
	6 % Polymer modified emulsions
Particle polarity	97 % Cationic Emulsions
	3 % Anionic emulsions
Applications	
· 78 % Quick setting emulsions	22 % Tack coat
	51 % Surface dressing
· 7 % Medium setting emulsions	Porous cold mixes
· 15 % Slow setting emulsions	2 % Grave-emulsion
	5 % Slurry-seal
	2 % Recycling
	6 % Priming emulsions

HOW INCREASE THE EMULSION MARKET?

AUEB



We are working to:

- Represent Emulsions producers and to support them.
- Improve our emulsions for the new requirements.
- Acceptance of European Specifications (EN 13808)
- Focus on Government to enclose cold and warm techniques in the work projects.
- Education and training of new professionals

Main Problems found in conservation of roads

- Lack of financial resources
- Lack of natural resources
- High energy costs
- Few human resources with proper qualification



WHY EMULSION BASED MIXES?

- For environmental issues in road construction. They allow minimizing the use of non renewable resources (fuel, bitumen, aggregates)
- There are techniques that let us reach similar performance levels than the conventional ones (warm mixes)
- The use of bituminous emulsions allows the manufacturing and working temperature close to ambient. Avoid generation of greenhouse gases.

TYPES OF EMULSION BASED MIXES

COLD MIXES

■ COATS

↪ PRIMING & TACK COAT

↪ SURFACE DRESSING

■ MIXES

↪ SLURRY SURFACING

↪ OPEN COLD MIXES

↪ EMULSION-BOUND GRANULAR MATERIAL

↪ COLD RECYCLING

WARM MIXES

↪ WARM MIXES

↪ WARM RECYCLING

OBJECTIVES:

During the past years, we have been present in the improvement of cold techniques related to the development of new and more efficient bituminous emulsions on road works.

This is the position for prime emulsions, where some research has been done to develop this type of emulsions with ecological fluxes, to be able to pour them onto hydraulic layers before laying asphalt mixes for wearing courses.

NEW EMULSIONS FOR IMPREGNATING

- Flux free (VOC's free)
- Low viscosity and small size particles
- Efficiency (Penetration power according to EN 12849)



TACK COAT IMPORTANCE

- **Correct tack coating is extremely important, not only in order to seal the existing surface against the entry of water and, but also to bond the wearing course to the base course.**
- **Inadequate bonding between layers can result in detachment, followed by longitudinal wheel path cracking, potholes and other distresses, such as rutting that greatly reduce the life of the pavement.**

NON-STICK TACK COAT EMULSIONS

The use of conventional emulsions for tack coats can cause problems as they frequently stick to the tires of construction vehicles. Consequently, the bond between the asphalt layers is inadequate. The importance of tack coats in the performance of the pavement means that bituminous emulsions are constantly being improved.

New types of emulsions have been developed from hard bitumen. They are called "thermo-adherent" emulsions and they are resistant to construction vehicles.

NEW CONVENTIONAL AND MODIFIED THERMOSETTING EMULSIONS

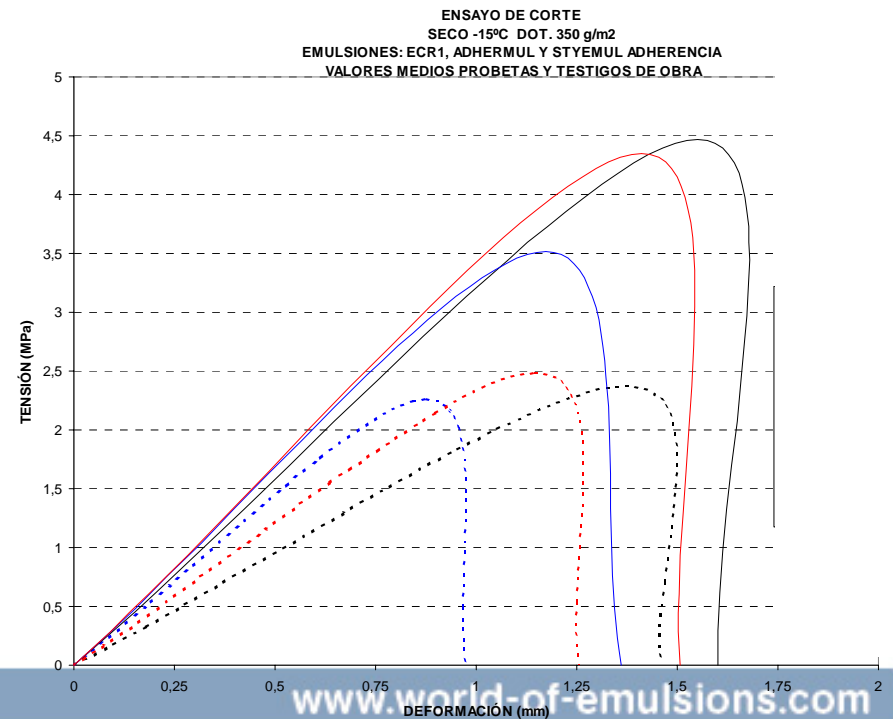
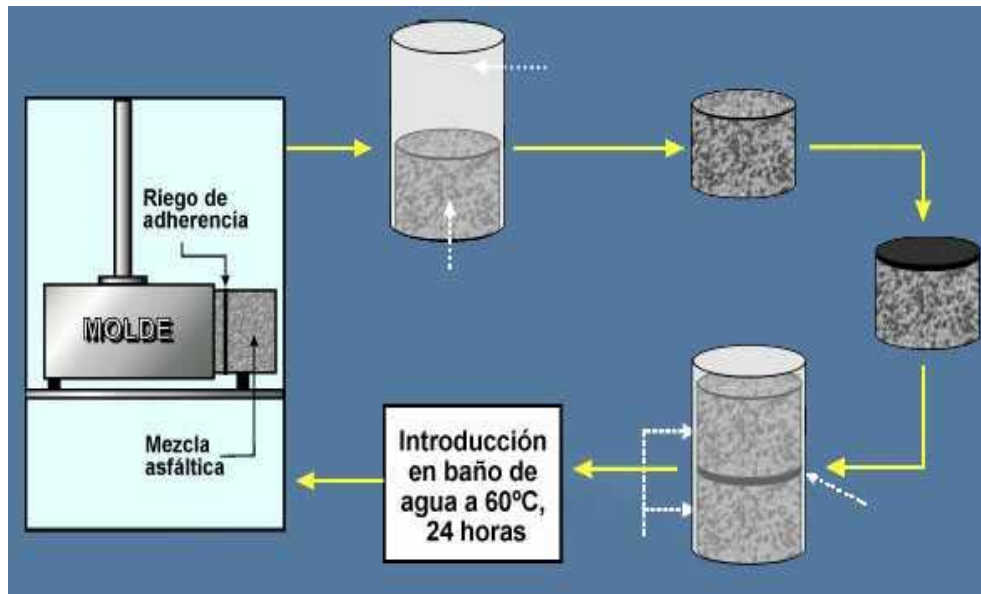
Main goals:

- **High adhesion to pavement surface and no adherence to tyres.**
- **Cleanliness on work site.**
- **Others:**
 - **More efficiency and lower dosage** (save 30% dosage)
 - **To improve storage stability** (>7 days)
 - **To improve workability**
 - **Reduced setting time** (20-60 minutes, depending on the climatic conditions)

LABORATORY TEST

WE HAVE SEVERAL TESTS TO MEASURE THE EFFECTIVENESS OF NEW TACK COAT EMULSION AND TO VERIFY ITS PERFORMANCE IN SERVICE, COMPARED TO A CONVENTIONAL EMULSION:

LCB SHEAR TEST, developed in the Road Research Laboratory of the Technical University of Cataluña (Spain)



TACK COAT BITUMINOUS EMULSIONS

Spreading. Recommendations

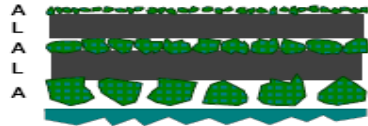
- Tack coat emulsion must be applied by an emulsion spray bar over the entire width of the application area.
- The recommended rates may be between 300-400 g/m² of emulsion.
- Heating is not recommend above 60°C for its final application.
- Spreading of the upper layer of HMA will be carried out after the tack coat emulsion has broken.

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RESISTANCE TO WORK TRAFFIC





WHY SURFACE DRESSINGS?

- SAFETY THANKS TO MACROTEXTURE
- GOOD FOR DURABILITY OF THE PAVEMENTS
- ECONOMIC WEARING COURSE
- HIGH VERSATILITY OF THE MAINTENANCE TECHNIQUES
- NOYSY WEARING COURSE

OTHER APPLICATIONS:

- 1. Slurry seals (maintenance technique)**
- 2. Cold mixes (decreasing technique) and warm mixes (increasing technique)**
- 3. Cold and warm recycling**



- **SLURRY SEAL (MAINTENANCE/SAFETY ROAD)**

- SURFACE WATERPROOFING**

- ✓ Ageing prevention
- ✓ Increase Durability
- ✓ Avoid water action in Base layer

- NON-SLIPPING SURFACE LAYERS**

- ↪ Avoid roughness loss
- ↪ Improve slipping resistance

OPEN COLD MIXES

USEFUL FOR...

- NEW WEARING COURSE
- NEW BINDER COURSE
- BITUMINOUS MACADAM
- FLEXIBLE PAVEMENT
- POTHOLES REPAIR
- CRACKING RESISTANT PAVEMENT

Lab tests on cold mix formulations

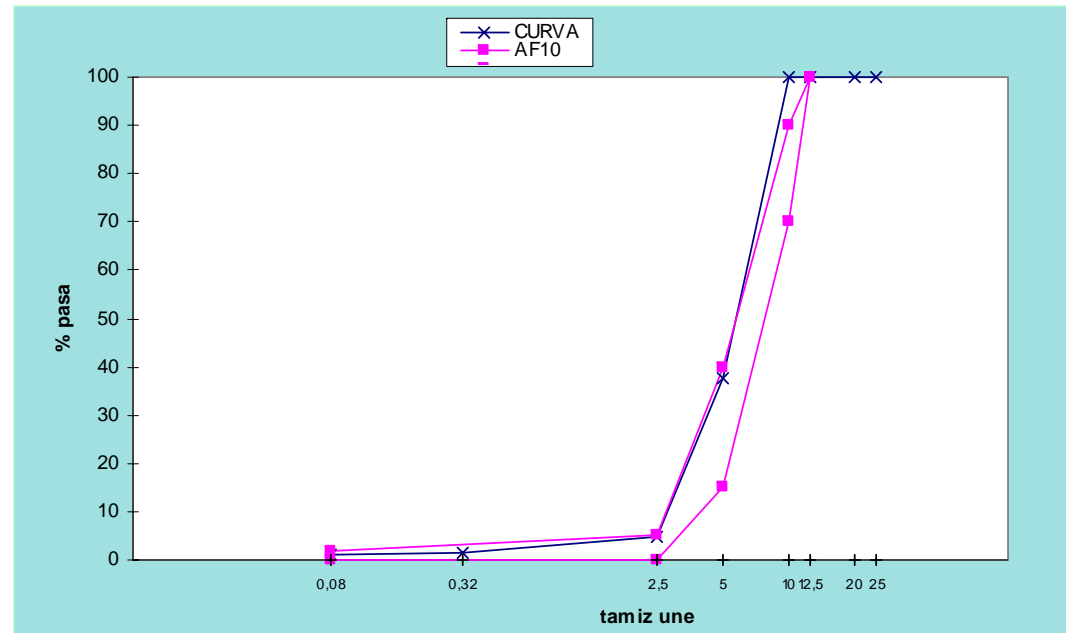
Open graded cold mix - Grading envelope

TAMIZ UNE

CURVA

AF10

12,5	100	100	100
10	100	70	90
5	38	15	40
2,5	4,7	0	5
0,32	1,3		
0,08	1,0	0	2



TESTS ON OPEN COLD MIX FORMULATIONS

Cold mix after coating (before compaction)



	EMULSION C67BF4	EMULSION C67BF4 BIO
ÁGGREGATE	100	100
EMULSIÓN	6	6
BREAKING TIME,s	12	12
INITIAL COVERED SURFACE AREA,%	70	65
24 H COVERED SURFACE AREA,%	95	90
COATING QUALIFICATION	Very good	Very good
COHESIÓN / WORKABILITY	GOOD	GOOD
BEHAVIOUR IN THE PRESENCE OF WATER	VERY GOOD	VERY GOOD

Cold mix after compaction

Application in patching

These types of cold mixes...

1. are suitable for minor repairs on all classes of roads, paths and footways.
2. harden over time to match the performance of traditional hot-mixed asphalt.
3. may be overlaid with any road surfacing material, or sealed with surface treatments, such as surface dressing or microsurfacing.
4. suffer no immediate damage from rain or frost, when properly laid.

WARM techniques

- **Porous hot mix asphalt repairing**
 - **High flexibility**
 - **Excellent mechanical performance**
 - **Stockage capability**
 - **Workability at ambient temperature**
 - **High drainability**
 - **Good initial cohesion after compaction**
 - **Used of modified medium setting emulsion**

Warm techniques : Porous mixes



Reasons for recycling a pavements:

To recover the original properties of the pavement and, if possible, improve them.

Properties:

- Structural capacities or mechanical resistance
- Resistance to water action
- Resistance to fatigue



COLD RECYCLING

It is an homogeneous mixture, properly laid and compacted, of milled material from one or more pavement layers (6 – 12 cm), with bituminous emulsion , water and additives (if required).

The recommended emulsion is a slow setting emulsion, type C60 B5 according to EN 13808.

Classes:

1. type III (only RAP)
2. type I or type II (RAP + granular material)

More information on ATEB web.

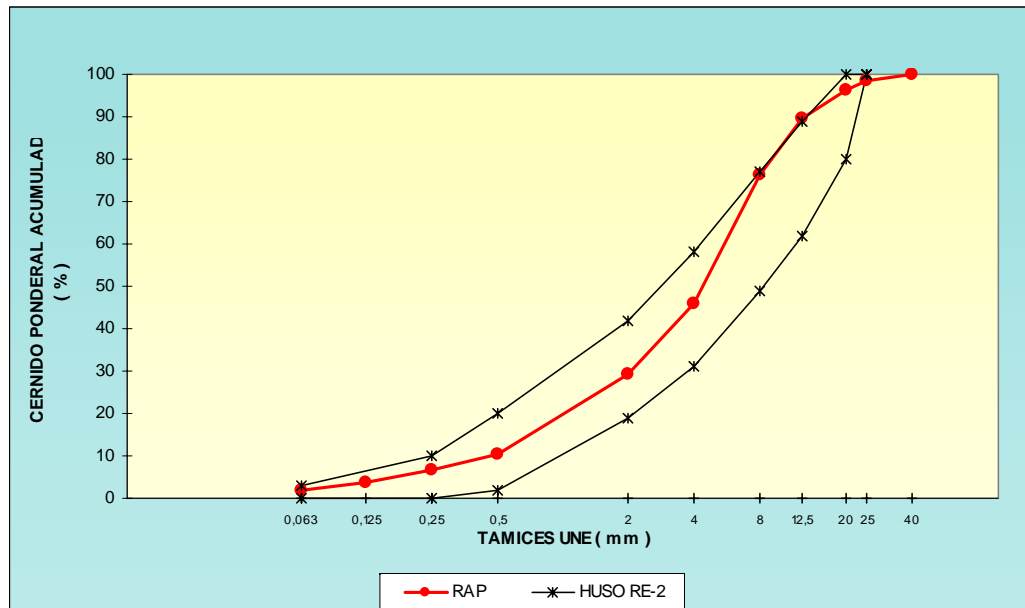
WORK MIX FORMULATIONS FOR RECYCLING

Milled material (RAP) 100

Emulsión C60B5 (ref % dry RAP) 3

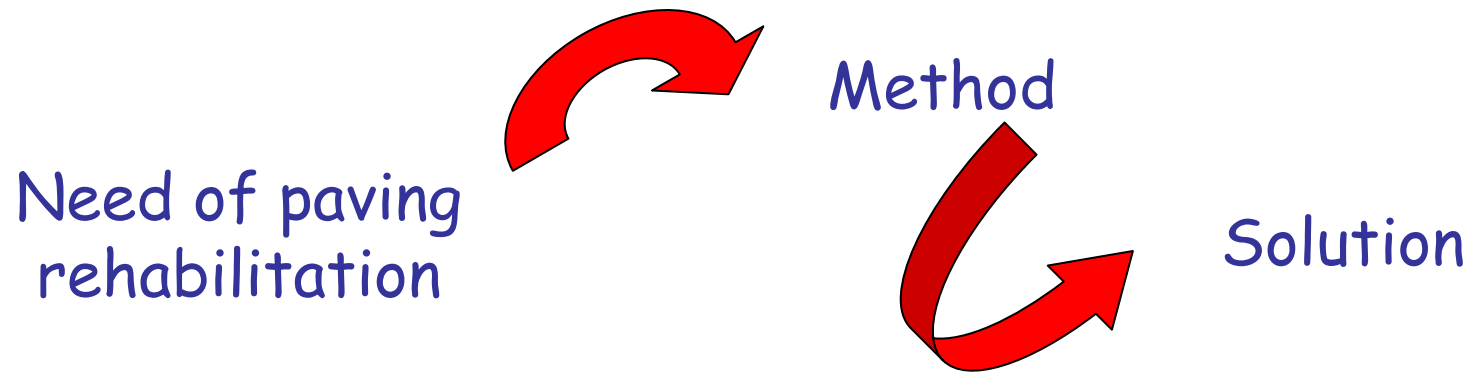
Prewetting water (ref % dry RAP) 2,5

Immersion - Compression test results:



	<i>ECL-2</i>	<i>BIOECL-2</i>
Dry resistance (MPa)	4,1	4,5
Soaked resistance (MPa)	3,2	3,3
Retained resistance (%)	77	75
Specific gravity s.s.s (g/cm ³)	2,272	2,274

Items to have in consideration



- Characterization of the existing pavement and quantification of required solicitations
- Diagnosis of possible problems and forecast of their evolution
- Choice of the most adequate solution and its project

Warm recycling with bituminous emulsion

Advantages

It takes advantage of cold recycling:

- Recycling up to 100%
- Using bituminous emulsions



It takes advantage of hot recycling:

- it can be produced in continuous or discontinuous plants
- The opening to traffic is immediate – no need of curing period

Differences....

Cold recycling “in situ” with BITUMINOUS EMULSION

- 100% of milled material + water + emulsion (medium temp.)
- Curing time between 20 to 30 days

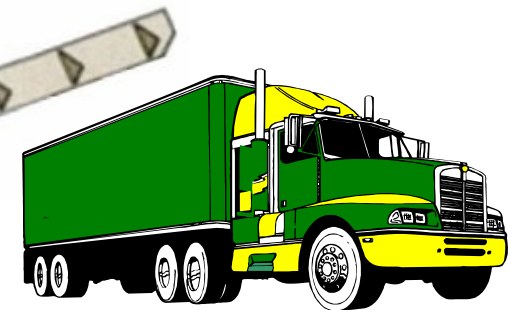
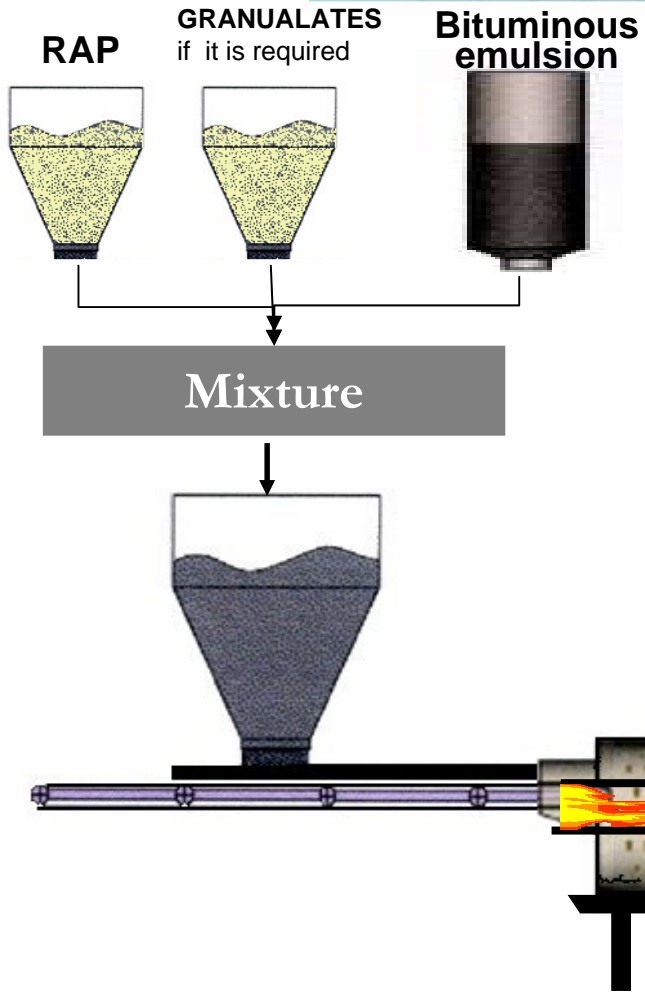
Hot recycling in plant with BITUMEN

- Milled material + aggregates + bitumen (160°C)
- 20 to 30% milled material

Warm recycling with bituminous emulsion

- 100% of milled material + emulsion (medium temp.)
- Produced in plant
- Without later curing period

WARM MIXTURES PRODUCTION



Aggregates

Milled material



Binder

Special emulsion (C60B7) that provides:

- Coating 100%, with no binder run-off
- Resistance to thermal shock
- High initial cohesion
- High active and passive adhesivity
- High workability



Laboratory study

Milled material characterization:

- Grading envelope
- Binder content and characteristics

Immersion-compression test:

- Compression of samples at different loads

17 at 6 ton (6 ton to obtain similar densities as the ones found in the field)

- Temperatures

Mixing = 90°C

Compacting = 60°C

Dynamic modulus test



Laboratory study

Recovered binder



	RAP
Penetration	13
Softening point (°C)	66
Solubility (%)	98,8
Asphaltenes (%)	18,5

Laboratory study

Immersion-compression

Dry resistance	5,0 MPa
Wet resistance	3,7 MPa
Retained resistance	75%
Specific gravity	2,249 g/cm ³
Air voids	7,1%

Dynamic modulus 20°C – 10Hz

Dynamic modulus	6.736 MPa
Phase angle	17°
Specific gravity	2,193 g/cm ³
Air voids	7,5%

Manufacture and put in place

-Conventional hot mix Plant:

-Continuous

-Discontinuous

- Implementation of a feed system, if necessary
- No need of technical adaptations (adaptations cost is null)
- Similar to the manufacture and put in place of a hot bituminous mix
- Milled material is warmed at 90 – 95°C
- Mix with emulsion
- Storage capability
- Transport to the local laying



Put in place of warm recycling



- Conventional laying
- The spreading equipment is the same as the one used for Hot bituminous mixes
- Previous compaction
- Special attention to the minimum temperature of compaction
- Compaction is made by using a metallic cylinder and a pneumatic one
- Opening to traffic is immediate

Work experience (Warm recycling in EN 244)



Work experience(Warm recycling in EN 244)



EMISSIONS MEASUREMENTS

	Hot mix	Warm mix	Difference
Temperature	155°C-165°C	80°C-90°C	70 °C
Fumes temperature	65,6°C	45°C	- 30°C
CO ₂ (%)	2,12	1,39	- 35 %
CO (ppm)	217	131,6	- 40 %
NOx (mg/m ³ eg. NO ₂)	26,8	11,5	- 65 %
Air Dust (mg/m ³)	168	21	- 88 %

Conclusions for Warm recycling

- It is an environmentally friendly solution
- Use of milled material up to 100% (possible no need of new aggregates)
- Storage capability
- No curing period needed
- Manufacture at 80-100°C
- Laying and compaction > 60°C



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THANK YOU FOR YOUR ATENTION!
MERCI POUR VOTRE ATTENTION
GRACIAS POR SU ATENCIÓN