Asphalts
catalog

REPSOL

Let's invent the future

- Bitumens
- Special binders
- Emulsions
- Industrial Bitumen

Bitumens

- Paving grade bitumen
- Hard paving grade bitumen
- Polymer-modified bitumen

Special binders

- High-performance modified bitumen PMB 45/80 75 F
- High-viscosity modified bitumen PMB 45/80 75 AV
- Modified bitumen for Asphalts for Ultra Thin Layer
- Hard modified bitumen PMB 10/40-70 BUS
- Crumb rubber modified bitumen (CRMB)
- Fuel-resistant bitumen
- Activated bitumen
- Multigrade bitumen
- Low-temperature bitumen
- Special bitumen for recycling
- Pigmentable synthetic binders
- Recofal S-100P

Emulsion

- Bituminous and modified emulsion
- Thermal-adhesive emulsion
- Export emulsion
- Long-life emulsion
- Prime coat emulsion with high penetration power
- Protection coat emulsion
- High-performance emulsion for cold mix microsurfacing and slurry
- Rejuvenating emulsion for cold-mix recycling
- EFIMUL emulsions. Open-graded cold mixtures
- Emulsions for Half Warm Mix Asphalts

Industrial Bitumen

INTRODUCTION

When you choose Repsol asphalts, you get so much more. These are the highest quality products backed by the Repsol guarantee. An integrated and global energy company operating in more than 90 countries in the areas of exploration, production, refining, distribution, and marketing. Providing millions of people and businesses all over the world with more efficient, responsible, and innovative energy solutions.

Trustworthy products based on a careful selection of crude oils, our bituminous binder production process includes rigorous quality control, which guarantees that these products fulfill national and international specifications. Therefore, Repsol Asphalts works within a complex management system that includes quality (ISO 9001), the environment (ISO 14001), and safety (OSHAS 18001), as well as CE marking.

ENVIRONMENTAL COMMITMENT

The asphalts line **is committed to manufacturing environmentally-friendly products** that are in line with the search for to neutral environmental impact, operating with the utmost safety and reliability criteria.

We aim to meet society's current and future needs, under the parameters of respect for and commitment to our surroundings.

Technological innovation

We promote technological innovation as a basic element of our business, focused on finding eco-efficient solutions and developing special products that are adapted to our customers' needs.

As to result of its steadfast commitment to innovation, Repsol drives its technological development capacity in line with its business growth. For this purpose it has the Repsol Technology Lab, a nationally and internationally recognized research center. This commitment to innovation goes hand in hand with the development of environmentally-friendly technologies, an essential value in the management of all its businesses.

In addition to highly-qualified, industry-renowned technical personnel, this center also houses the latest technological advances for bituminous binder development and research, as well as the necessary equipment to measure their rheological properties.

The Asphalts Laboratory is equipped with all the equipment needed to test bituminous mixtures, which allows us to check the suitability of our products in service conditions.

Technical support and development

A fundamental part of the service we offer to customers is the Technical Support and Development Department, which serves the following functions:

- Prior assessment.
- Support during execution.
- Custom-designed products.
- Training.

FORMATS

In order to meet sector demands and new customer needs, Repsol has worked to implement smarter transportation logistics that are highly adapted to constantly-evolving market needs.

BULK

Due to our reliability, experience, and capacity, bulk supply (in tankers) is our main delivery method in the local market, which allows us to guarantee our customers an efficient service for all our manufactured and commercialized products. Repsol also has the required capacity and experience for maritime transportation, particularly with deliveries of large quantities of bituminous products to both national and international maritime terminals.

DRUMS

The main advantage of delivery in 208-liter, 220-liter, or 250-liter drums is the possibility of keeping large stocks and easy handling both during transportation and at the destination. This packaging method is well suited to long-distance transportation, as between 16 and 20 metric tons of any of our products can be stored in to standard 20-foot container, depending on the type of drum.

BITUBAG

The BituBag is an innovative container that allows for the transportation and storage of solid bitumens and modified bitumens with to significant reduction in logistical and energy costs, in addition to bituminous emulsions. In this format, standard 20-foot (TEU) containers with 22 metric tons of product can be delivered, which makes long-distance transportation (road, ship, and train) easier and less of a problem.

From a safety perspective, the BituBag offers many advantages as transportation and storage is carried out at ambient temperature in high-resistance bags. This prevents the risks inherent to liquid products and makes for easier handling compared to common traditional solutions.

BITUCONTAINER

The bitucontainer is an innovative mode of transportation that allows products to be delivered in bulk at temperatures suitable for transfer thanks to a separate heating system inside the container. Long-distance transport is also easier as it is adapted to the standard 20-foot container (TEU). These advantages allow us to transport our products while making transfer and industrial handling easier. In addition, the bitucontainer can be used as a final or intermediary tank.

PELLET

Repsol has developed specific formulations so that their pigmentable synthetic binders can be pelletized. This pellet or pillow format allows for the transport and storage of binders at cold temperatures, with the corresponding advantages in terms of safety and the environment. Pellets are packaged in bags or boxes to make product handling and storage easier.

IBC (INTERMEIDATE BULK CONTAINER)

The IBC (intermediate bulk container) is a pallet-mounted, 1,000-liter molded cubic tank covered by to rigid tubular cage that has to filler neck and outlet valve and can be maneuvered from all four sides, making it incredibly versatile in terms of handling. This format makes it possible to deliver standard 20-foot containers (TEU) containing between 18 and 20 metric tons of product.

The great innovation that Repsol has brought to this container is the development of a range of overstabilized emulsions with a specific formulation that allows for long-distance transportation, without long-term storage affecting any of the properties of this type of product.

Asphalt bitumen

Asphalt bitumens are hydrocarbon binders resulting from oil distillation that have temperature-dependent viscoelastic behavior and high chemical stability. They are also called penetration-grade bitumens or paving grade bitumen, as this is the property used to classify them.

Bitumen is the component that gives and provides cohesion in bituminous mixtures and is also responsible for most of this product's properties. Their consistency can be modified by temperature, which allows for easy handling, coating of aggregates, compaction of the mixtures, and correct performance at service temperatures.

After selecting the appropriate crude oils, Repsol obtains **asphalt bitumens** that meet the most demanding specifications.

APPLICATIONS

Asphalt bitumens are used in:

Roads

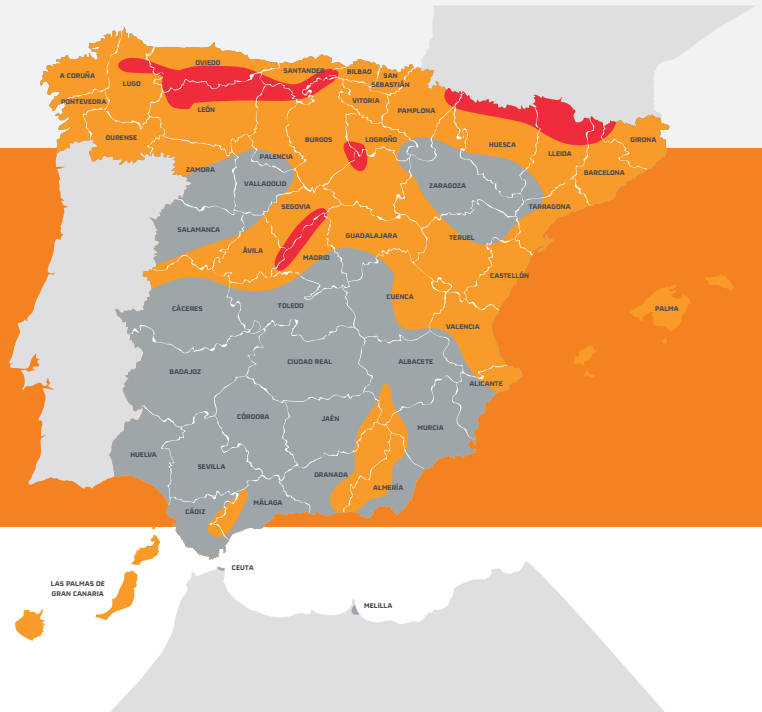
- Conventional bituminous mixtures.
- Polymer-modified bitumens.
  - Bitumens for low temperature mixtures.
  - Bitumens with rejuvenators.
- Crumb rubber modified bitumens (CRMB).
- Fuel-resistant bitumens.
- Multigrade bitumen.
- Emulsions (conventional and modified).

Industrial applications

- Emulsions and mastics for industrial waterproofing.
- Asphalt sheets.
- Pipe coating.
- Hydraulic projects.
- Joint sealant.
- Asphalt paints, etc.

Mainly due to the climate, bitumens with a penetration grade of 35/50 and 50/70 are the most commonly used conventional bitumens in our country.

They are used to produce conventional bituminous mixtures.
This map shows the climate zones in Spain that determine the type of bituminous binder used.



Warm Medium Cool

PRODUCT CHARACTERISTICS

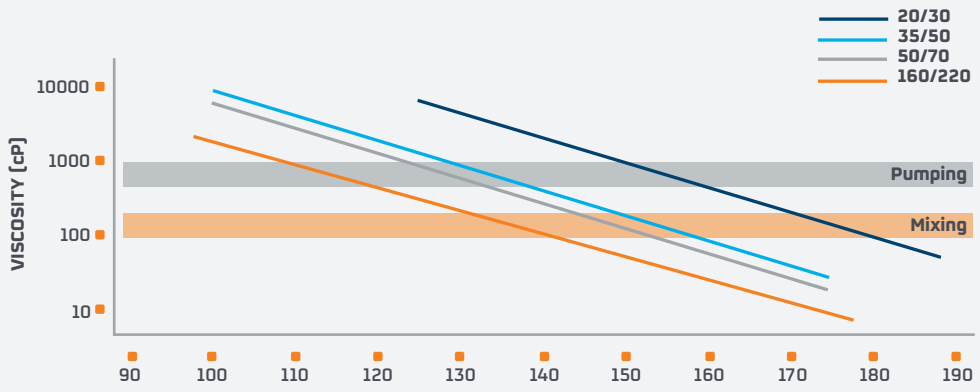
All asphalt bitumens sold by Repsol meet the CE marking requirements, in accordance with the EN 12591 standard. The table below shows the characteristics of bitumens for roads that are sold in Spain.

CHARACTERISTICS		EN STANDARD	UNIT	20/30	35/50	50/70	70/100	160/220
Needle penetration at 25°C		1426	0,1 mm	20-30	35-50	50-70	70-100	160-220
Softening point Ring & Ball		1427	°C	55-63	50-58	46-54	43-51	35-45
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 0,5	≤ 0,5	≤ 0,5	≤ 0,8	≤ 1,0
	Retained Needle penetration	1426	%	≥ 55	≥ 53	≥ 50	≥ 46	≥ 37
	Softening point Ring & Ball increase	1427	°C	≤ 8	sev 1: ≤ 8 and sev 2: ≤ 11	sev 1: ≤ 9 and sev 2: ≤ 11	sev 1: ≤ 9 and sev 2: ≤ 11	sev 1: ≤ 11 and sev 2: ≤ 12
Penetration index		12591 Annex A	°C	From -1.5 to +0.7	From -1.5 to +0.7	From -1.5 to +0.7	From -1.5 to +0.7	From -1.5 to +0.7
Fraass breaking point		12593	°C	NR	≤ -5	≤ -8	≤ -10	≤ -15
Open cup flash point		ISO 2592	°C	≥ 240	≥ 240	≥ 230	≥ 230	≥ 220
Solubility		12592	%	≥ 99,0	≥ 99,0	≥ 99,0	≥ 99,0	≥ 99,0

Specifications established in article 211 of the Spanish General Technical Specifications for Road and Bridge Works (PG-3).

RECOMMENDATIONS FOR USE

The most suitable bitumen usage temperatures are indicated by the viscosity (see figure).



These data are illustrative and not binding. They are not subject to a specification. These values may vary depending on the origin of the product.

Hard paving grade bitumen

Starting with a careful selection of crude oils, Repsol produces and offers its customers different grades of hard paving grade bitumens, in accordance with the EN 13924-1 standard. Mixtures made with these bitumens have a shear modulus value two times greater than mixtures made with conventional bitumens.

APPLICATIONS

- Base layers in new surfaces courses.
- Airport pavements.
- Reinforcement or partial reconstruction of pavements.
- In intermediate anti-rut layers, when a thin wearing course is used.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of hard bitumen for pavement.

CHARACTERISTICS		EN STANDARD	UNIT	15/25	10/20
Needle penetration at 25ºC		1426	0,1 mm	15-25	10-20
Softening point Ring & Ball		1427	ºC	61-71	60-76
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 0,5	≤ 0,5
	Retained Needle penetration	1426	%	≥ 55	≥ 55
	Softening point Ring & Ball increase	1427	ºC	≤ 8	≤ 10
Penetration index		12591 Annex A	-	From -1.5 to +0.7	From -1.5 to +0.7
Fraass breaking point		12593	ºC	TBR	TBR
Open cup flash point		ISO 2592	ºC	≥ 245	≥ 245
Solubility		12592	%	≥ 99,0	≥ 99,0

TBR: to be reported.

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	175 - 180ºC
	Laying and compaction	**165 - 170ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

Structural capacity

The high modulus obtained with this bitumen offers the following advantages when designing pavement structures with a bituminous base:

- Achieve superior structural performance and reach much higher than usual life expectancy values (see the equivalent axes in figure 1).
- Design thinner surface layer for the same structural capacity.

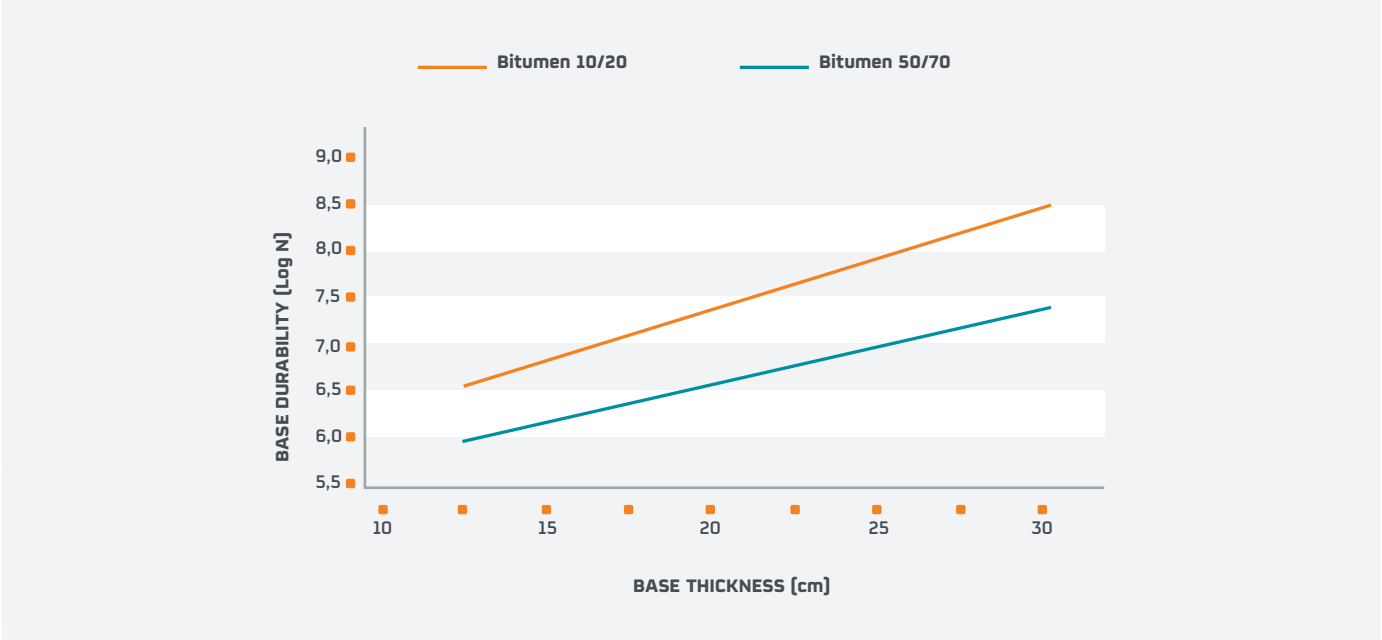
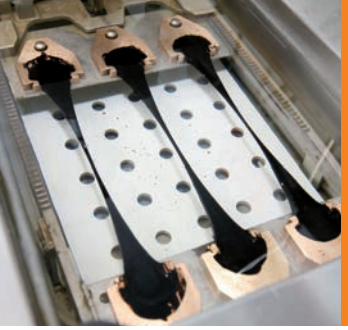


Figure 1. Structural behavior. Indicative data, not contractual, and not subject to specification.

Plastic deformations

Hard bitumens for pavement give the designed mixture extraordinary performance against plastic deformations.



Polymer-modified bitumens

Repsol has a comprehensive range of polymer-modified bitumens that meets the CE marking requirements described in the EN 14023 standard and established in article 212 of the Spanish General Technical Specifications for Road and Bridge Works (PG-3), in addition to other specific products. The majority of our modified bitumens are produced through a chemical cross-linking system developed in-house, which provides a uniform structure to guarantee the product's properties and stability in storage.

Modified bitumens make it possible to produce bituminous mixtures with better mechanical and functional properties, which allow bituminous mixtures for roads to be adapted to increased traffic levels and the consequent greater demands, in turn leading to **enhanced durability** and **reduced maintenance costs.**

APPLICATIONS

The following table shows the main uses of different types of polymer-modified bitumens to produce hot bituminous mixtures.

PMB 10/40-70[1]	High-modulus mixtures with improved resistance to fatigue.
PMB 25/55-65	Mixtures for surface courses or intermediate layers in warm summertime zones with T00- to T1-category traffic, which are resistant to plastic deformations on slow lanes and improve fatigue resistance in strengthening treatments or new pavement.
PMB 45/80-60	AC-type continuous grading mixtures for surface courses or intermediate layers with T1, T2, and T3-category traffic in all climate zones and T00 and T0 in medium and cool climates, which are resistant to plastic deformations and better fatigue properties. Gap-graded and porous mixtures for T1- and T2-category traffic.
PMB 45/80-65[2]	AC-type continuous grading mixtures for T00- and T0-category traffic in all climate zones, including T1 traffic for hot summertime zones, which are resistant to plastic deformations and better fatigue properties. High-performance gap-graded and porous surface courses, including stone mastic asphalt (SMA) mixtures. Porous asphalt mixtures with a high percentage of air voids.
PMB 45/80-75[3]	Anti-cracking mixtures for surface courses. Anti-cracking mixtures for intermediate or thin layers. High-performance SMA and gap-graded mixtures. High-performance porous mixtures.
PMB 75/130-60	High-quality surface courses treatments. Reflective cracking prevention membranes.

(1) See specific data sheet PMB 10/40-70 BUS (2) See specific data sheet PMB 45/80-65 AUTL (3) See specific data sheets PMB 45/80-75 F, PMB 45/80-75 AV and PMB 45/80-75 AUTL.
There is a corresponding crumb rubber modified bitumen and low-temperature bitumen for all polymer-modified bitumens. See specific data sheet.

PRODUCT CHARACTERISTICS

All polymer-modified bitumens sold by Repsol meet the CE marking requirements, in accordance with the EN 14023 standard. The table below shows the characteristics of the most commonly used polymer-modified bitumens in Spain, reported in the Spanish General Technical Specifications for Road and Bridge Works (PG-3).

EN 14023 NAME				PMB 10/ 40-70	PMB 25/ 55-65	PMB 45/ 80-60	PMB 45/ 80-65	PMB 45/ 80-75	PMB 65/ 105-80	PMB 75/ 130-60
CHARACTERISTICS		EN STANDARD	UNIT	TESTS ON THE ORIGINAL BITUMEN						
Needle penetration at 25ºC		1426	0,1 mm	10-40	25-55	45-80	45-80	45-80	65-105	75-130
Softening point Ring & Ball		1427	ºC	≥ 70	≥ 65	≥ 60	≥ 65	≥ 75	≥ 80	≥ 60
Force Ductility		13589 13703	J/cm2	≥ 2 to 15ºC	≥ 2 to 10ºC	≥ 2 to 5ºC	≥ 3 to 5ºC	≥ 3 to 5ºC	≥ 3 a 5ºC	≥ 1 to 5ºC
Fraass breaking point		12593	ºC	≤ -5	≤ -7	≤ -12	≤ -15	≤ -15	≤ -15	≤ -15
Elastic recovery at 25ºC		13398	%	TBR	≥ 50	≥ 50	≥ 70	≥ 80	≥ 70	≥ 60
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 9	≤ 9	≤ 9	≤ 9	≤ 13	≤ 9	≤ 13
Flash point		ISO 2592	ºC	≥ 235	≥ 235	≥ 235	≥ 235	≥ 235	≥ 235	≥ 220
CHARACTERISTICS		EN STANDARD	UNIT	DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1						
Change of mass		12607-1	%	≤ 0,8	≤ 0,8	≤ 1,0	≤ 1,0	≤ 1,0	≤ 0,3	≤ 1,0
Retained Needle penetration		1426	%	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 8	≤ 8	≤ 10	≤ 10	≤ 10	≤ 8	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5

Specifications established in article 212 of the Spanish General Technical Specifications for Road and Bridge Works (PG-3). TBR: to be reported.

The use of polymers significantly improves the properties of bitumens, in particular:

- Increased softening point.
- Lower temperature susceptibility.
- Increased penetration index.
- Increased plasticity range.
- Increased viscosity.
- Greater ductility.
- Better performance at low temperatures.
- Higher resistance to aging.

RECOMMENDATIONS FOR USE

Due to their rheological behavior and configuration, the usage recommendations for conventional bitumens cannot be applied to polymer-modified polymers.

Repsol offers the services of its Technical Support and Development Department, which can advise on the best usage conditions in each case.

PRODUCT BEHAVIOR IN THE MIXTURE

Polymer-modified bitumens greatly improve the performance of bituminous mixtures:

- Greater cohesion and ductility, allowing for more critical grain structures.
- Greater resistance to fatigue, reducing the risk of cracking.
- Greater resistance to aging in the most adverse conditions (greater service durability).
- Greater adhesion to aggregates.
- Increased service temperature range.
- Greater resistance to plastic deformations (ruts).

High-performance modified bitumens PMB 45/80-75 F

The **high-performance modified bitumen** PMB 45/80-75 F is a technologically-innovative binder with a high polymer content obtained by means of a chemical cross-linking process, which presents a microscopically uniform structure and is completely stable in storage. The binder has a high degree of modification, with a high softening point, internal cohesion, and ductility. Mixtures made with this binder have far superior properties compared to those obtained with traditional modified bitumens, providing greater cohesion, tenacity, and ductility. In turn, this allows for more critical grain structures and greater resistance to plastic deformations.

The properties of PMB 45/80-75 F make this binder especially suited to use in high-performance mixtures for surface courses exposed to high tangential stress, minimizing the risk of ruts and improving ductility, resilience, aging and resistance to fatigue. As a result, the road surface courses is more durable and requires less maintenance.

The variety of magnificent properties that this product gives to mixtures makes it possible to create specific formulations depending on the desired application and/or characteristics. The product has great usability thanks to the specific manufacturing process and the additives used.

APPLICATIONS

The main applications of PMB 45/80-75 F are:

- BBTM (asphalt concrete for very thin layers) or SMA (stone mastic asphalt) gap-graded mixtures for surface courses exposed to high traffic demands and tangential stress.
- Mixtures for high-performance surface courses. This binder can be used to manufacture open-graded/gap-graded mixtures with a bitumen content of 5.5–7% and excellent resistance to fatigue.
- Porous asphalt mixtures with a high percentage of air voids. Twin-layer mixtures are an example of this.

PRODUCT CHARACTERISTICS

The following table shows the characteristics:

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-75 F
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	45-80
Softening point Ring & Ball		1427	ºC	≥ 75
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 13
Flash point		ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 1,0
Retained Needle penetration		1426	%	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**165 - 175ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The binder PMB 45/80-75 F provides the asphalt mixture with the following advantages:

- High resistance to surface courses tangential stress.
- Reinforced elasticity, ductility and tenacity characteristics.
- Excellent resistance to fatigue and aging, increasing surface courses durability.
- High resistance to plastic deformations.
- Excellent flexible performance at low temperatures.

High-viscosity modified bitumens PMB 45/80-75 AV

The high-viscosity modified bitumen PMB 45/80-75 AV is specially designed for mixtures that are resistant to crack propagation.

This binder has a high polymer content and is obtained through a chemical cross-linking process,which presents a microscopically uniform structure and is completely stable in storage. The achieved properties are far superior to traditional modified bitumens. The technological innovation provided by high-viscosity modified bitumen allows us to progress in the process of manufacturing anti-cracking and other special mixtures.

The properties of PMB 45/80-75 AV make this binder especially suited to use in high-performance mixtures for anti-cracking layers with high ductility thanks to its elastic component, minimizing the risk of ruts, drainage, exudations, improving resilience, aging, and resistance fatigue. As a result, the road surface courses is more durable and requires less maintenance.

The variety of magnificent properties that this product gives to mixtures makes it possible to create specific mixtures formulations depending on the desired applications and/or characteristics.

APPLICATIONS

The main applications of PMB 45/80-75 AV are:

- Mixtures for high-performance surfaces courses or intermediate layers that are resistant to surface courses crack propagation. This binder can be used to manufacture open-graded/gap-graded mixtures with a bitumen content of 6-7.5 % and excellent resistance to fatigue.
- Anti-cracking mixtures in interlayer systems.

PRODUCT CHARACTERISTICS

The following table shows the characteristics:

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-75 AV
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	45-80
Softening point Ring & Ball		1427	ºC	≥ 75
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 13
Flash point		ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 1,0
Retained Needle penetration		1426	%	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**165 - 175ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The most interesting field of application for these binders is in hot mixtures that are highly resistant to reflective cracking. This bitumen reinforces the mixture's elastomeric recovery characteristics and also provides very good resistance to plastic deformations at high temperatures and excellent flexible behavior at low temperatures.
The higher viscosity and specially-designed grain composition of the modified bitumen PMB 45/80-75 AV make it possible to use a larger amount of the binder without drainage, giving the mixture the desired behavior and properties.

Asphalts for ultra-thin layers (AUTL)

The modified bitumens PMB 45/80-65 AUTL and PMB 45/80-75 AUTL are specially designed for the production of ultra-thin mixtures (< 2 cm).

The modified bitumens PMB 45/80-65 AUTL and PMB 45/80-75 AUTL, specialized for the production of ultra-thin mixtures, are designed to resist surface courses tangential stress and counteract problems due to their lower compaction temperatures.

These modified bitumens meet the CE marking requirements described in the EN 14023 standard.

APPLICATIONS

The main applications of PMB 45/80-65 and 75 AUTL are:

- Mixtures for ultra-thin course layers.
- Special mixtures for gap-graded or SMA-type surface courses.

PRODUCT CHARACTERISTICS

The following table shows the characteristics:

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-65 AUTL**	PMB 45/80-75 AUTL**
Needle penetration at 25ºC		1426	0,1 mm	45-80	45-80
Softening point Ring & Ball		1427	ºC	≥ 65	≥ 75
Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC	≥ 3* to 5ºC
Fraass breaking point		12593	ºC	≤ -15	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 70	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 9	≤ 9
Flash point		ISO 2592	ºC	≥ 235	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1					
Change of mass		12607-1	%	≤ 1,0	≤ 1,0
Retained Needle penetration		1426	%	≥ 60	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5	≤ 5

*Force-Ductility values > 5 J/cm2 at 5ºC. There is no class value for this value in the EN 14023 standard on the specification framework for polymer modified bitumens.
**These modified bitumens have been developed as part of the Asfalthin research and development project.

RECOMMENDATIONS FOR USE

		PMB 45/80-65 AUTL	PMB 45/80-75 AUTL
Recommended temperature ranges for application	Mixing	165 - 140ºC	165 - 145ºC
	Laying and compaction	**160 - 135ºC End 120ºC**	**160 - 145ºC End 130-125ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The most interesting field of application for these binders is in mixtures for ultra-thin layers. This binder reinforces the mixture's cohesive characteristics in thin layers to withstand the demands of road traffic.

Modified bitumen PMB 10/40-70 BUS

The **modified bitumen PMB 10/40-70 BUS** is a binder technologically developed for occasional high traffic demands in roads or surfaces courses used by heavy-duty vehicles.

With this binder, the mixture has increased resistance to plastic deformations. This binder has been modified with special additives and polymers that strengthen this characteristic.

PMB 10/40-70 BUS is a low-penetration binder with additives that increase the modulus of the mixture compared to traditional hard binders. In addition, the polymeric composition optimizes the fatigue-modulus coupling, taking into account loading and unloading cycles and the channeling of heavy and semi-heavy duty traffic. Furthermore, it improves the mixture's performance in the event of fuel spills.

APPLICATIONS

The main applications of PMB 10/40-70 BUS are:

- Asphalt concrete (AC) type continuous grading mixtures and stone mastic asphalt (SMA) gap-graded mixtures for surface courses that are resistant to plastic deformations and can withstand channeled heavy-duty traffic.
- High-modulus mixtures for intermediate layers with improved stiffness modulus values in warm and/or temperate climates, when thin surface courses are used.

PRODUCT CHARACTERISTICS

The following table shows the characteristics:

CHARACTERISTICS	EN STANDARD	UNIT	PMB 10/40-70 BUS
TESTS ON GENERAL BITUMEN			
Needle penetration at 25ºC	1426	0,1 mm	10-40
Softening point Ring & Ball	1427	ºC	≥ 70
Cohesion. Force–Ductility	13589 13703	J/cm^2	≥ 2 to 15ºC
Fraass breaking point	12593	ºC	≤ 0
Elastic recovery at 25ºC	13398	%	TBR
Flash point	ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1			
Change of mass	12607-1	%	≤ 0,8
Retained Needle penetration	1426	%	≥ 60
Softening point Ring & Ball increase	1427	ºC	≤ 10
Softening point Ring & Ball decrease	1427	ºC	≤ 5

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**165 - 175ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The binder PMB 10/40-70 BUS provides the asphalt mixture with the following advantages:

- High resistance to plastic deformations.
- Improved structural characteristics.
- High stiffness modulus values.

Crumb rubber modified bitumens (CRMB)

Repsol has developed its own technology to incorporate and reuse rubber from end-of-life tires (CR) with the intention of improving the performance of bitumen technically and collaborating environmentally in the reuse of end-of-life tires.

Taking into account the Spanish Circular Orders on the use and specifications to be met by bitumen and bituminous mixtures that incorporate CR and the criteria to be taken into account for their manufacture (OC 21/2007 and OC 21bis/2009), Repsol uses an industrial wet process to manufacture them.

The stability and homogeneity of the final product has been achieved thanks a specific process and the use of previously selected bitumens, resulting in the following range of products: Crumb Rubber Bitumen, Crumb Rubber Modified Bitumen, High Performance Crumb Rubber Modified Bitumen and High Viscosity Crumb Rubber Modified Bitumen.

Rubber-improved bitumens

APPLICATIONS

Bitumens improved with rubber are mainly used in conventional concrete-type mixtures in base, intermediate and course layers.

PRODUCT CHARACTERISTICS

The table below shows the characteristics of rubber-improved bitumens approved by the Spanish Ministry of Public Works and Transport (OC 21/2007 and OC 21bis/2009):

CHARACTERISTICS		EN STANDARD	UNIT	BC 35/50	BC 50/70
TESTS ON THE ORIGINAL BITUMEN					
Needle penetration at 25ºC		1426	0,1 mm	35-50	50-70
Softening point Ring & Ball		1427	ºC	≥ 58	≥ 53
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 0,5 to 5ºC	≥ 0,5 to 5ºC
Fraass breaking point		12593	ºC	≤ -5	≤ -8
Elastic recovery at 25ºC		13398	%	≥ 10	≥ 10
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 10	≤ 10
	Needle penetration difference	13399 1426	0,1 mm	≤ 8	≤ 10
Flash point		ISO 2592	ºC	≥ 235	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1					
Change of mass		12607-1	%	≤ 1,0	≤ 1,0
Retained Needle penetration		1426	%	≥ 65	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 8	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ -4	≤ -5

RECOMMENDATIONS FOR USE

The table below shows the recommended mixing, spreading, and compaction temperature for both types of rubber-improved bitumens.

Rubber-improved bitumens BC		35/50	50/70
Recommended temperature ranges for application	Mixing	165 - 175ºC	160 - 170ºC
	Laying and compaction	**155 - 165ºC**	**150 - 160ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

Rubber-improved bitumens provide hot asphalt mixtures with certain advantages compared to conventional bitumens, although to a lesser extent than rubber-modified bitumens:

- Greater resistance to fatigue.
- Greater resistance to aging.
- Increased service temperature range.

Crumb rubber modified bitumens (CRMB)

APPLICATIONS

Rubber-modified bitumens can be used in the same applications as polymer-modified bitumens, notably:

- BBTM and SMA-type gap-graded surface courses.
- Porous asphalt (PA) mixtures.
- Asphalt concrete-type mixtures in intermediate layers with improved fatigue and/or plastic deformation properties.

PRODUCT CHARACTERISTICS

The technical specifications of rubber-modified bitumens are as established in article 212 of the Spanish General Technical Specifications for Road and Bridge Works (PG-3), in accordance with OC 21/2007 approved by the Spanish Ministry of Public Works and Transport.

RECOMMENDATIONS FOR USE

As is the case with polymer-modified bitumens, due to their configuration and rheological behavior, the usage temperatures of rubber-modified bitumens cannot be deduced from the viscosity temperature. For this reason, Repsol offers the services of its Technical Support and Development Department, which can advise on the best usage, handling, and storage conditions for this type of special binder.

PRODUCT BEHAVIOR IN THE MIXTURE

Mixtures with rubber-modified bitumens have the following advantages compared to those made with conventional bitumens:

- Greater cohesion.
- Greater resistance to fatigue.
- Higher resistance to aging.
- Greater adhesion to aggregates.
- Better performance at low temperatures.
- Lower temperature susceptibility.
- Greater resistance to plastic deformations.

High-viscosity rubber-modified bitumen PMB 45/80-70 AV C

APPLICATIONS

The main applications of PMB 45/80-70 AV C are as follows:

- Mixtures for high-performance surface courses or intermediate layers that are resistant to surface courses crack propagation. This binder can be used to manufacture open-graded/gap-graded mixtures with a bitumen content of 6-7.5 % and excellent resistance to fatigue.
- Anti-cracking mixtures in interlayer systems.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of PMB 45/80-70 AV C bitumen:

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-70 AV C
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	45-80
Softening point Ring & Ball		1427	ºC	≥ 70
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 13
Flash point		ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 1,0
Retained Needle penetration		1426	%	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**165 - 175ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The most interesting field of application for these binders is in hot mixtures that are highly resistant to reflective cracking. This bitumen reinforces the mixture's elastomeric recovery characteristics, and also provides very good resistance to plastic deformations at high temperatures and excellent flexible behavior at low temperatures.
The higher viscosity and special grain composition of the modified bitumen PMB 45/80-70 AV C make it possible to use a larger amount of the binder without drainage, giving the mixture the desired behavior and characteristics.

High-performance rubber-modified bitumen PMB 45/80-70 F C

APPLICATIONS

The main applications of PMB 45/80-70 F C are:

- BBTM (asphalt concrete for very thin layers) or SMA (stone mastic asphalt) gap-graded mixtures for surface courses exposed to high traffic demands and tangential stress.
- Mixtures for high-performance surface courses. This binder can be used to manufacture open-graded/gap-graded mixtures with a bitumen content of 5.5–7% and excellent resistance to fatigue.
- Porous asphalt mixtures with a high percentage of air voids. Twin-layer mixtures are an example of this.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of PMB 45/80-70 F C bitumen:

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-70 F C
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	45-80
Softening point Ring & Ball		1427	ºC	≥ 70
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 13
Flash point		ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 1,0
Retained Needle penetration		1426	%	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5

RECOMMENDATIONS FOR USE

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**165 - 175ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT BEHAVIOR IN THE MIXTURE

The binder PMB 45/80-70 F C provides the asphalt mixture with the following advantages:

- Reinforced elasticity, ductility, and toughness characteristics.
- Excellent resistance to fatigue and aging, increasing surface courses durability.
- High resistance to plastic deformations.
- Excellent flexible performance at low temperatures.

Fuel-resistant bitumens

The **fuel-resistant bitumen BAC 35/50** is a specially-designed binder for the production of bituminous mixtures applied in areas where fuel and lubricant spills are a frequent occurrence. They are generally used in fuel loading/unloading areas, industrial areas, airports, service stations, and vehicle parking areas.

Fuel-resistant bitumens offer resistance to the dissolving of asphalt bitumen in the event of hydrocarbon spill, minimizing the loss of cohesion between the bituminous mixture's aggregate and binder, a deterioration that would worsen due to the passage of vehicles.

APPLICATIONS AND RECOMMENDATIONS FOR USE

The main application of fuel-resistant bitumens, also known as FRB, is in areas that frequently come into contact with hydrocarbons: taxiways, airport areas, bus lanes, long-term parking or waiting areas for fleets, freeway tolls, service stations, and garages.

AC D-type mixtures (close/dense graded mixtures) are the most suited to the use of BAC 35/50. **It is highly recommended to adjust the formulation so that the mixture void content is around 3%.**

Usage temperatures are similar to conventional bitumen.

Recommended temperature ranges for application	Mixing	155 - 160ºC
	Laying and compaction	**145 - 150ºC**

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

PRODUCT CHARACTERISTICS

As fuel-resistant bitumen has a solubility in organic solvents of around 97%, for the purpose of quality control, this low solubility must be taken into account when determining the content of soluble binder obtained in the solvent extraction test performed on the bituminous mixture.
The following table shows the characteristics of the fuel-resistant BAC 35/50:

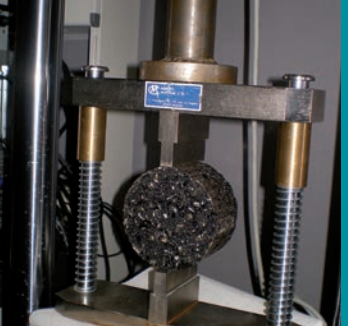
CHARACTERISTICS		EN STANDARD	UNIT	BAC 35/50
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	35-50
Softening point Ring & Ball		1427	ºC	≥ 75
Fraass breaking point		12593	ºC	≤ -14
Elastic recovery at 25ºC		13398	%	≥ 15
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 5
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 0,5
Retained Needle penetration		1426	%	≥ 65
Softening point Ring & Ball increase		1427	ºC	≤ 5

PRODUCT BEHAVIOR IN THE MIXTURE

Compared to conventional binders (bitumens and polymer-modified bitumens) used in bituminous mixtures for roads, the Repsol-developed fuel-resistant bitumen BAC 35/50 has the following advantages:

- Greater resistance to hydrocarbons compared to conventional bitumens.
- Lower sensitivity to temperature and aging.
- Very high resistance to high-service temperatures.
- Easy handling and installation (like a conventional bitumen).

Mixtures designed with the fuel-resistant bitumen BAC 35/50 obtain good results in the resistance to fuel test (EN 12697-43) compared to mixtures designed with conventional bitumens.



Activated bitumens

With certain types of aggregate, both conventional and modified bitumens can have adhesion problems due to a lack of physicochemical affinity between the aggregate and the binder.

In some cases, the use of quality fillers such as lime or cement can improve the behavior of mixtures in the presence of water. Another solution is the addition of adhesion activators. Aware of this problem, Repsol has developed a wide range of additives that, along with a selection of the most suitable bitumens, ensure reliable aggregate-binder behavior in the mixture.

The activator adhesive is added to the bitumen in the production process at the refinery, which guarantees a uniform end product.

APPLICATIONS

Activated bitumens are used in asphalt mixtures that lack aggregate-binder adhesion. Therefore, the applications are the same as asphalt penetration-grade bitumens and polymer-modified bitumens.

All bitumens have the CE marking in accordance with the EN 12591 and EN 14023 standards, for equivalents to conventional penetration-grade bitumens or polymer-modified bitumens, respectively.

PRODUCT CHARACTERISTICS

Activated bitumens have the following characteristics:

- They provide the cohesion needed in hot bituminous mixtures.
- They increase the range of aggregates that can be used.
- They reduce the use of added fillers, and the recovery filler can be used in many cases.

The following table shows the characteristic of activated bitumens:

CHARACTERISTICS		EN STANDARD	UNIT	35/50 ACTIV	50/70 ACTIV
Needle penetration at 25ºC		1426	0,1 mm	35-50	50-70
Softening point Ring & Ball		1427	ºC	50-58	46-54
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 0,5	≤ 0,5
	Retained Needle penetration	1426	%	≥ 53	≥ 50
	Softening point Ring & Ball increase	1427	ºC	≤ 8 (sev 1) ≤ 11 (sev 2)	≤ 9 (sev 1) ≤ 11 (sev 2)
Penetration index		12591 Annex A	-	-1,5 to +0,7	-1,5 to +0,7
Fraass breaking point		12593	ºC	≤ -5	≤ -8
Open cup flash point		ISO 2592	ºC	≥ 240	≥ 230
Solubility		12592	%	≥ 99,0	≥ 99,0

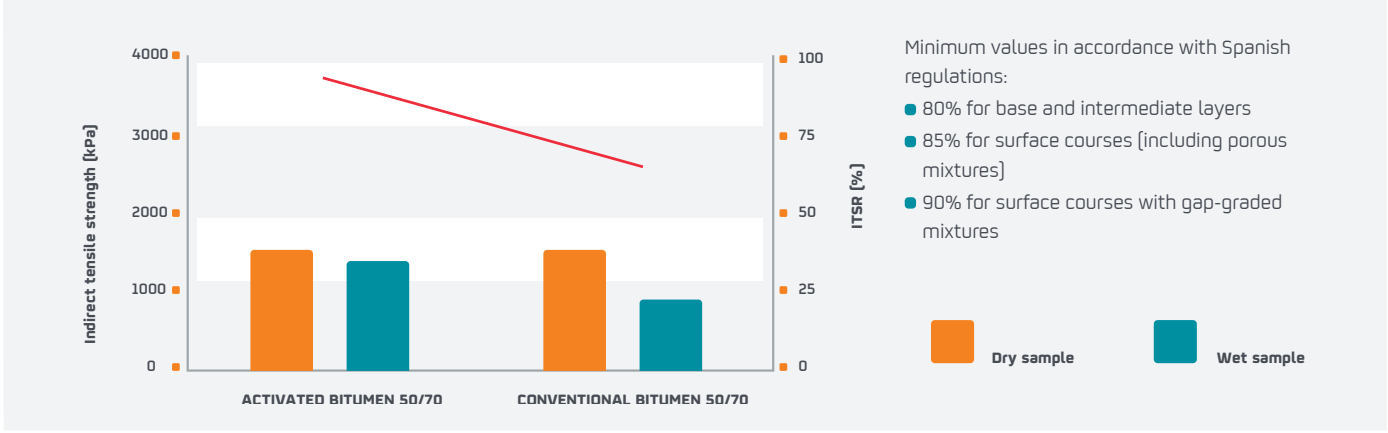
CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-65 ACTIV
TESTS ON THE ORIGINAL BITUMEN				
Needle penetration at 25ºC		1426	0,1 mm	45-80
Softening point Ring & Ball		1427	ºC	≥ 65
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 70
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 9
Flash point		ISO 2592	ºC	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1				
Change of mass		12607-1	%	≤ 1,0
Retained Needle penetration		1426	%	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10
Softening point Ring & Ball decrease		1427	ºC	≤ 5

PRODUCT BEHAVIOR IN THE MIXTURE

The additives used are adhesion promoters that improve the chemical reaction between the aggregate and bitumen, providing excellent cohesion to the mixture, as well as greater durability and reduced aging, and also facilitate binder coverage of the aggregate surface courses.

Aggregate-binder adhesion is assessed through the water sensitivity test (EN 12697-12) by applying Method A which measures indirect tensile strength cylindrical samples prepared in wet and dry conditions.

The following figure shows the results of this test for activated bitumen compared with conventional bitumen, using the same type of aggregate.



Water sensitivity test results (EN 12697-12) (AC22G mixture, with a porphyry aggregate and 4.1% bitumen 50/70 w/o additives). These values are illustrative and not binding. Not subject to a specification.

This binder improves both active adhesion (the binder's ability to make contact with the aggregate) and passive adhesion (the binder's ability to maintain the bond with the aggregate in the presence of water).

Multigrade bitumen

Multigrade bitumens are special binders that are less sensitive to temperature than conventional bitumens. In other words, they are less fragile at low temperatures and more solid at high temperatures, and have a positive penetration index. This type of bitumen is included in the EN 13924-2 standard.

Although the standard considers different grades, the multigrade bitumen MG 35/50-59/69 is the most suitable for the summertime heat zones established in Spanish legislation, offering optimum performance on roads subject to extreme service temperatures and temperature gradients.

APPLICATIONS

These bitumens are suitable for use in all types of bituminous mixtures and especially in surface courses and intermediate layers subject to demanding traffic and weather conditions, such as slow lanes, heavy-duty and channeled traffic, freeways, tolls, road intersections, port docks, airports, parking areas in general, and mountain roads.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of multigrade bitumen MG 35/50-59/69 compared with conventional bitumens 35/50 and 50/70:

CHARACTERISTICS		EN STANDARD	UNIT	35/50	MG 35/50-59/69	50/70
Needle penetration at 25ºC		1426	0,1 mm	35-50	35-50	50-70
Softening point Ring & Ball		1427	ºC	50-58	59-69	46-54
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 0,5	≤ 0,5	≤ 0,5
	Retained Needle penetration	1426	%	≥ 53	≥ 50	≥ 50
	Softening point Ring & Ball increase	1427	ºC	≤ 8	≤ 10	≤ 11
Penetration index		12591 Annex A	-	From -1.5 to +0.7	> 0,1-1,5	From -1.5 to +0.7
Fraass breaking point		12593	ºC	≤ -5	≤ -8	≤ -8
Open cup flash point		ISO 2592	ºC	≥ 240	≥ 235	≥ 230
Solubility		12592	%	≥ 99,0	≥ 99,0	≥ 99,0

As seen in the table above, the bitumen MG 35/50-59/69 has a higher softening point and penetration index, as well as a lower Fraass breaking point.

CHARACTERIZATION ACCORDING TO PERFORMANCE GRADE (PG) GRADING

Figure 1 shows the SHRP grade obtained in testing two conventional bitumens and an MG 35/50-59/69. As seen, the service temperature range of MG 35/50-59/69 is far greater than any of the other bitumens analyzed. This implies a much lower risk of both rut formation at high temperatures and failures resulting from fatigue or cracks due to fragility at low temperatures.

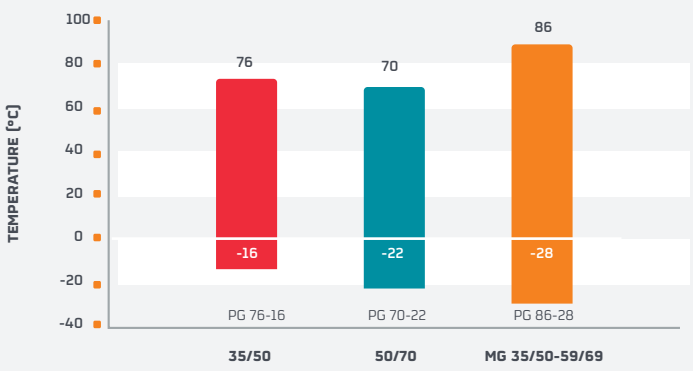


Figure 1.
PG grade of multigrade bitumens

These data are illustrative and not binding. They are not subject to a specification.

RECOMMENDATIONS FOR USE

Due to the special characteristics of these binders, slightly higher temperatures are recommended (10–20°C) than for conventional binders (see figure 2).

Recommended temperature ranges for application	Mixing	170 - 180ºC
	Laying and compaction	**160 - 165ºC**

The temperatures will depend on the specific viscosity curves of each product.

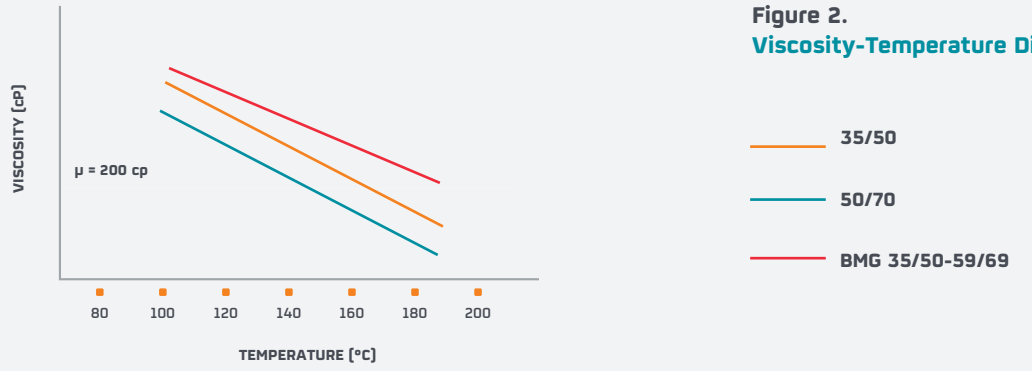


Figure 2.
Viscosity-Temperature Diagram

These data are illustrative and not binding. They are not subject to a specification.

PRODUCT BEHAVIOR IN THE MIXTURE

Compared to conventional bitumens used for road asphalt mixtures, the multigrade bitumens developed by Repsol have the following advantages:

- Greater resistance to plastic deformations.
- Greater resistance to fatigue.
- Higher resistance to aging.

Low-temperature bitumens

Low temperature bitumens – the ECOBET range for conventional bitumens and the BT range for polymer-modified bitumens – are special bituminous binders that reduce the handling temperature (manufacture and installation) compared to conventional bitumens with a similar penetration grade.

Repsol has made great efforts in terms of research and development of these new binders, which offer equal or even superior characteristics as compared to conventional binders once applied.

Due to the reduction in temperatures during manufacturing (between 20 and 40ºC), this product range provides the following advantages:

- Lower emissions.
- Energy efficiency.
- Improved working conditions.

APPLICATIONS

This type of bitumens is used for the same applications as conventional and polymer-modified bitumens with the same penetration grade.

ECOBET and ECOBET IP ranges

ECOBET bitumens have the CE marking, in accordance with the guidelines of the EN 12591 standard.

CHARACTERISTICS		EN STANDARD	UNIT	ECOBET RANGE		ECOBET RANGE IP	
				35/50 ECOBET	50/70 ECOBET	35/50 ECOBET IP	50/70 ECOBET IP
Needle penetration at 25ºC		1426	0,1 mm	35-50	50-70	35-50	50-70
Softening point Ring & Ball		1427	ºC	50-58	46-54	≥ 70	≥ 65
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 0,5	≤ 0,5	≤ 0,8	≤ 0,8
	Retained Needle penetration	1426	%	≥ 53	≥ 50	≥ 60	≥ 55
	Softening point Ring & Ball increase	1427	ºC	≤ 8 (sev 1) ≤ 11 (sev 2)	≤ 9 (sev 1) ≤ 11 (sev 2)	≤ -5	≤ -5
Penetration index		12591 Annex A	-	-1,5 to +0,7	-1,5 to +0,7	> 2,5	> 2,5
Fraass breaking point		12593	ºC	≤ -5	≤ -8	≤ -10	≤ -12
Flash point		ISO 2592	ºC	≥ 240	≥ 230	-	-
Solubility		12592	%	≥ 99,0	≥ 99,0	-	-

All bitumens have the CE marking, in accordance with the guidelines of the EN 14023 standard.

CHARACTERISTICS		EN STANDARD	UNIT	PMB 45/80-60 BT	PMB 45/80-65 BT	PMB 45/80-75 AV BT
TESTS ON THE ORIGINAL BITUMEN						
Needle penetration at 25ºC		1426	0,1 mm	45-80	45-80	45-80
Softening point Ring & Ball		1427	ºC	≥ 60	≥ 65	≥ 75
Cohesion. Force–Ductility		13589 13703	J/cm2	≥ 2 to 5ºC	≥ 3 to 5ºC	≥ 3 to 5ºC
Fraass breaking point		12593	ºC	≤ -12	≤ -15	≤ -15
Elastic recovery at 25ºC		13398	%	≥ 50	≥ 70	≥ 80
Storage stability	Softening point Ring & Ball difference	13399 1427	ºC	≤ 5	≤ 5	≤ 5
	Needle penetration difference	13399 1426	0,1 mm	≤ 9	≤ 9	≤ 13
Flash point		ISO 2592	ºC	≥ 235	≥ 235	≥ 235
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1						
Change of mass		12607-1	%	≤ 1,0	≤ 1,0	≤ 1,0
Retained Needle penetration		1426	%	≥ 60	≥ 60	≥ 60
Softening point Ring & Ball increase		1427	ºC	≤ 10	≤ 10	≤ 10
Softening point Ring & Ball decrease		1427	ºC	-	-	≤ 5

RECOMMENDATIONS FOR USE

The recommended usage temperatures are presented below:

	35/50 ECOBET	50/70 ECOBET	PMB 45/80-60 BT	PMB 45/80-65 BT	PMB 45/80-75 AV BT
Storage	160 ºC	150 ºC	150 ºC	150 ºC	160 ºC
Mixing	130-135 ºC	125-130 ºC	135-140 ºC	135-140 ºC	145-150 ºC
Start of laying and compaction	Min. 120 ºC	Min. 120 ºC	125-130 ºC	125-130 ºC	135-140 ºC
End of compaction	Min. 100 ºC	Min. 100 ºC	-	-	-

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

APPLICATIONS AND PRODUCT BEHAVIOR IN THE MIXTURE

Repsol's low-temperature bitumens are suitable for all types of mixtures and with the usual bitumen content, from the production of conventional asphalt mixtures with 35/50 or 50/70 ECOBET to anti-cracking mixtures with PMB 45/80-75 AV BT, including gap-graded mixtures with PMB 45/80-60 BT and PMB 45/80-65 BT. They provide the following advantages:

- They increase the durability of the mixture by reducing the manufacturing temperature, which leads to decreased aging of the binder.
- They reduce GHG emissions, which is an environmental improvement.
- Less energy is needed due to the decreased (by around 30ºC) manufacturing temperature, which implies costs savings in the bituminous mixture production plant.
- They improve the working conditions for operators during production and installation.

All of these advantages lead to better results for our customers, thanks to a reduction of costs resulting from lower energy consumption, increased safety and productivity, and the social benefit represented by the increased durability of road services.

Special bitumens for recycling

The special bitumens for recycling developed by Repsol are binders that are custom-designed for each case, providing the components that the bitumen in the mixture has lost due to aging and restoring the original characteristics and properties (physical and chemical).

Social concern regarding environmental issues and the use of natural resources makes it increasingly critical and necessary to recycle pavement materials.

Aware of the economic, social, and environmental benefits of recycling techniques, Repsol has developed a range of bitumens with rejuvenators to optimize current regeneration techniques for aged road layers.

Our technical service carries out a prior study of the courses that will be recycled in order to formulate and manufacture an ad-hoc product.

APPLICATIONS

The special bitumen for recycling is used to make new bituminous mixtures that include a certain amount of aged bituminous material from the road. It can be used in production plants of both gap-graded and continuous grading bituminous mixtures, preferably with medium and high degrees of RAP content.

There are several special bitumens for recycling, called REJUV bitumens, that can be used for different technologies:

- Specific bitumens for use in the production of bituminous emulsions such as C60B5 REC REJUV.
- Specific bitumens for use in the production of hot bituminous mixtures with medium and high degrees of RAP content.

PRODUCT CHARACTERISTICS

Bitumen is composed of several types of hydrocarbons that can be grouped into four categories: saturates, aromatics, resins, and asphaltenes. In order to maintain the physicochemical structure, each of these components must be present in specific ratios, which will ensure that the bituminous mixture performs correctly when subject to the demands of traffic. Therefore, the custom-designed special bitumen for recycling provides the fractions that the aged binder has lost, regenerating it and restoring the original characteristics.

CHARACTERISTICS	TYPICAL VALUE
CRR (Durability)	0,4 - 1,0
C (Compatibility)	> 0,5
CI (Colloidal Instability)	< 1

The composition of special bitumen for recycling must be adapted to fulfill the values required by certain indices that give an approximate idea of the bitumen's possibilities in terms of durability (oxidative stability of the bitumen), colloidal stability, etc. These indices are:

- Chemical reactivity ratio (CRR), which indicates the influence of maltenes on the bitumen's oxidative stability (durability parameter).
- Compatibility (C), which indicates the ratio of nitrogenous components of maltenes to saturated hydrocarbons or paraffins.
- Colloidal instability (CI), which indicates the ratio of solids (asphaltenes and paraffins) to dispersant liquid components in the system.

The composition of special bitumen for recycling is determined by two factors:

- The working formula of the mixture to restore, which is influenced by the percentage of recycled material used and the physical characteristics (penetration, softening point, etc.) of the binder to be restored.
- The components (lost fractions) that must be provided to the aged binder to give it the appropriate characteristics.

PRODUCT BEHAVIOR IN THE MIXTURE

A correctly designed special bitumen for recycling must simultaneously meet the following parameters:

- Restore the optimum composition of the aged bitumen to maintain the mixture's durability.
- Give the aged bitumen an appropriate consistency (penetration).
- Provide the mixture with an adequate amount of binder.

Repsol offers the services of its Technical Support and Development Department, which can advise on the best usage conditions in each case.

Pigmentable synthetic binders

Pigmentable synthetic binders are bonding products with similar properties to bitumens that are obtained from a mixture of resins, oils and polymers. They are colorless in a thin film and can be given the desired color by adding mineral pigments.

Repsol markets pigmentable synthetic binders under the name RECOFAL. These product ranges have been developed for the production of pigmented mixtures in special areas where color is an essential requirement.

These binders can be used to create pavements of a variety of colors or be used without pigment to create mixtures with a similar color to the aggregate. They can be used to achieve natural tones that are fully integrated with the surroundings.

APPLICATIONS

The synthetic binders developed by Repsol are suitable for special areas such as:

- Path surfaces courses in parks and gardens.
- Bicycle lanes.
- Bus lanes.
- Pedestrian areas.
- Sports courts.
- Traffic islands.
- Distinguishable areas of the road surface courses.
- Paved tracks and paths in protected areas, natural parks, etc.
- Special areas for safety purposes.

PRODUCT CHARACTERISTICS

The following table shows the characteristic of the binder RECOFAL:

CHARACTERISTICS		EN STANDARD	UNIT	S-50	S-100	S-100P[1]
TESTS ON THE ORIGINAL BITUMEN						
Density		15326	g/cm3	-	-	0,95-1,15
Needle penetration at 25ºC		1426	0,1 mm	40-60	50-70	20-50
Softening point Ring & Ball		1427	˚C	≥ 45	≥ 60	≥ 85
Fraass breaking point		12593	˚C	≤ -5	≤ -8	≤ -20
Elastic recovery		13398	%	≥ 20	≥ 40	-
Storage stability	Needle penetration difference	1426	0,1 mm	≤ 5	≤ 5	-
	Softening point Ring & Ball difference	1427	˚C	≤ 2	≤ 2	-
Brookfield viscosity at 160ºC		13302	Cp	-	-	≥ 400
DURABILITY-RESISTANCE TO AGING AS PER EN 12607-1						
Mass variation		12607-1	%	-	-	≤ 1,5
Retained Needle penetration		1426	%	-	-	≥ 80
Softening point Ring & Ball increase		1427	ºC	-	-	≥ 10

[1] See specific Recofal S-100P product sheet

RECOMMENDATIONS FOR USE

RECOFAL		S-50	S-100
TESTS ON THE ORIGINAL BITUMEN			
Recommended temperature ranges for application	Mixing	140ºC	150ºC
	Laying and compaction	130ºC	140ºC
	Max. temp heating in plant	160ºC	170ºC
	Min. temp storage	120ºC	120ºC

These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

Excessive overheating of both the binder and mixture should be avoided, as this can cause color changes and/or binder degradation.

Repsol offers the services of its Technical Support and Development Department, which can advise on the best usage conditions in each case.

SPECIFIC USES

Our pigmentable synthetic binders can be used to produce hot mixtures with similar mechanical characteristics to those made with conventional bitumens and have the following advantages:

- Easy pigmentation for all colors.
- High resistance to aging and oxidation.
- Possibility to produce mixtures with the natural color of the aggregate.
- Uniform product for all types of applications.

The wide range of Recofal products are conceived for the different applications and production possibilities of colored mixtures:

Recofal S-50
This is the most widely-used, standardized pigmented synthetic binder for manufacturing color mixes applied to unique elements. It can be supplied in bulk to manufacturing plants that have tanks for this purpose, or in drums.

Recofal S-100
Recofal S-100 has the same applications as Recofal S-50, improving both the mechanical behavior of the mix and the desired shade by enabling a much lighter range of final colors.

Recofal S-100 P
This high-performance pigmentable synthetic binder is presented in pellets and is used to produce hot mixtures. This format facilitates storage, the use of small quantities in projects, and short- and long-distance transport (national and international).

Recofal S-100P

Recofal S-100P is a bonding product with similar properties to bitumen, which is obtained from a mixture of resins, oils, and polymers. It is a high-performance synthetic pigmented binder for use in the manufacturing of pigmentable hot mixtures.

Thanks to the product's pellet format, it can be directly added into the manufacturing plant mixer and handled and stored as a solid at ambient temperature.

APPLICATIONS

The synthetic binders developed by Repsol are suitable for special areas such as:

- Path surfaces courses in parks and gardens.
- Bicycle lanes.
- Bus lanes.
- Pedestrian areas.
- Sports courts.
- Lane dividers and islands.
- Distinguishable areas of the road surface courses.
- Paved tracks and paths in protected areas, natural parks, etc.
- Special areas for safety purposes.
- Wearing courses with lighter shades in tunnels: greater luminosity and safety, as well as lower energy consumption.

PRODUCT CHARACTERISTICS

Thanks to the format of Recofal S-100P, it can be stored and handled as a solid at ambient temperature, and just the strictly necessary amount can be used without prior conditioning. Ideal usage conditions (softening and viscosity) occur when the binder comes into contact with the hot aggregate in the manufacturing plant mixer.

Recofal S-100P has a specially studied formulation that is resistant to UV radiation in order to prevent possible changes in color. The product has a neutral color, which makes it possible to produce colored mixtures by adding pigments.

The following table shows the specifications of Recofal S-100P:

CHARACTERISTICS		EN STANDARD	UNIT	RECOFAL S-100P
Density		15326	g/cm^3	0,95-1,15
Needle penetration at 25°C		1426	0,1 mm	20-50
Softening point Ring & Ball		1427	°C	≥ 85
Resistance to aging EN 12607-1	Change of mass	12607-1	%	≤ 1,5
	Retained Needle penetration	1426	%	≥ 80
	Softening point Ring & Ball increase	1427	°C	≤ 10
Brookfield viscosity at 160°C		13302	cP	≥ 400
Fraass breaking point		12593	ºC	≤ -20
Flash point		ISO 2592	ºC	≥ 270

RECOMMENDATIONS FOR USE

Recofal S-100P is directly added to the asphalt plant's mixer in pellet format. The volume of batches in the mixer should ideally be adjusted to 75% of the mixing unit's total capacity.

Pigmented mixtures should be layed and compacted following the same criteria as for their bituminous equivalent, maintaining the same conditions for installation.

All elements involved in the manufacturing, spreading, and compaction processes should be very clean in order to prevent undesirable contamination or possible changes of color in the mixture.

Considering the manufacturing plant and weather conditions, as well as the distance between the plant and the worksite, etc., the recommended working temperatures for Recofal S-100P are as follows:

Aggregate temperature	Max. 180ºC
Compaction temperature	Min. 135ºC

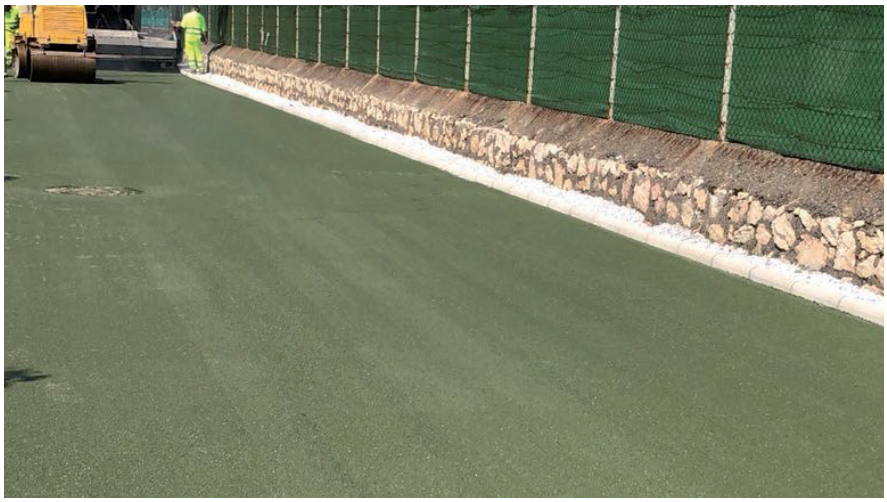
These data are illustrative and not binding. They are not subject to a specification. The temperatures will depend on the specific viscosity curves of each product.

Repsol offers the services of its Technical Support and Development Department, which will provide advice on optimal product usage conditions.

PRODUCT BEHAVIOR IN THE MIXTURE

Recofal S-100P can be used to manufacture any pigmentable hot mixture, and also has the following advantages:

- High resistance to aging and oxidation.
- Greater resistance to discoloration than traditional synthetic binders.
- Mixtures that can be easily pigmented for any color shade.
- Possibility to produce mixtures with the natural color of the aggregate.
- Improved mechanical characteristics due to its reinforced formulation.



Bituminous Emulsions

Bituminous emulsions are colloidal dispersions of (conventional or modified) bitumen droplets in an aqueous phase, composed of water and one or more anionic or cationic emulsifying agents, in addition to other additives such as latex for modified emulsions, which have the purpose of dispersing the bitumen, ensuring the emulsion is stable, and guaranteeing adhesion to aggregates at ambient temperature.

The principal characteristic of bituminous emulsions is that they can be used as a binder at lower temperatures than usual, even at ambient temperature. Due to their consistency, they can be used as a tack coat to improve adhesion between the different layers of the road surface courses or mixed and/or bound with aggregates. This is achieved during the emulsion breaking process, where the free bitumen particles provide cohesion to the whole. Bituminous emulsions are the fundamental base that has made it possible to develop cold-mix technology for roads. Moreover, modified bituminous emulsions can be used in road surface courses layers that require high performance in the presence of heavy-duty traffic and adverse weather conditions, guaranteeing excellent bonding between layers and exceptional cohesion to aggregates.

Repsol produces all kinds of bituminous emulsions — cationic and anionic, conventional and modified — that cover all fields of usage of these materials. The cationic emulsions meet CE marking requirements, as per the EN 13808 standard, and anionic emulsions meet the requirements established in the EN 51603 standard.

APPLICATIONS

These emulsions can be applied as an auxiliary treatment, as is the case of tack coats, or combined with quality aggregates for different types of high-performance treatments.

Anionic bituminous emulsions

APPLICATION	TYPE OF EMULSION
Primer coats	A60BFL
	A50BFL
Tack coats	A60BR
Seal coats	A60BR
Anti-dust coats	A50BR
Cold microsurfacing and slurry seals	A60BL
Surface dressing with gravel chippings	A65BR
Open-graded bituminous mixtures	A67BFM (EAM)

Conventional and modified cationic bituminous emulsions

APLICACIÓN	TYPE OF EMULSION
Primer coats	C50BF4 IMP
	C60BF4 IMP
	C50B4 IMP APP
Tack coats	C50B3 ADH
	C60B3 or C60B2 ADH C60BP2 ADH C60BP3 ADH C60BP3 ADH d
	C60B3 ADH d C69BP3 ADH d
	C60B3 TER Antistick and Antistick Plus C60BP3 TER Antistick and Antistick Plus
Seal coats	C50B3 CUR
	C60B3 or C60B2CUR
	C60B3 CUR d
Cold microsurfacing and slurry seals	C60B4 MIC Slurry C60BP4 MIC C60BP4 MIC b C65BP4 MIC d AP
Gravel emulsion	C60B5 GE
Surface dressing with gravel chippings	C65B2 or C65B3TRG C65BP2 TRG C65BP3 TRG
	C65B3 TRG d C65BP2 TRG d C65BP3 TRG d
	C69B3 or C69B2 TRG C69BP2 TRG C69BP3 TRG
Open-graded bituminous mixtures	C67BF3 MBA C67BPF3 MBA
	C67BF3 MBA d
	C69BF3 MBA d
Cool mixtures	C67B2 and C69B2 C67BP2 and C69BP2
Anti-dust coat emulsions	C35B3 ERP
Emulsions for cold-mix recycling	C60B5 REC C60B5 REC REJUV
Surface dressing with emulsion	C50B2 C50BP2

PRODUCT CHARACTERISTICS

The following table shows the characteristic of bituminous emulsions:

Conventional cationic bituminous emulsions described in the national annex of the EN 13808 standard

EN 13808 name			C50BF4 IMP	C60BF4 IMP	C60B3 ADH[1]	C60B3 TER PLUS
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION			
Particle polarity	1430	-	Positive	Positive	Positive	Positive
Breaking value	13075-1	-	110-195 class 4	110-195 class 4	70-155 class 3	70-155 class 3
Binder content (per water content)	1428	%	48-52 class 4	58-62 class 6	58-62 class 6	58-62 class 6
Binder content recovered by distillation	1431	%	≥ 48 class 4	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6
Fluxing agent content recovered by distillation	1431	%	5-15 class 7	≤ 8 class 5	≤ 2,0 class 2	≤ 2,0 class 2
Fluency time (2 mm, 40°C)	12846-1	s	15-70 class 3	15-70 class 3	15-70 class 3	15-70 class 3
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25°C	1426	0,1 mm	≤ 270 class 6	≤ 220 class 5	≤ 220 class 5	≤ 50 class 2
Softening point Ring & Ball	1427	°C	≥ 35 class 8	≥ 35 class 8	≥ 35 class 8	≥ 50 class 4
RECOVERY BY EVAPORATION, AS PER EN 13074-1						
Needle penetration at 25°C	1426	0,1 mm	90-170 class 8	≤ 330 class 7	≤ 330 class 7	≤ 50 class 2
Softening point Ring & Ball	1427	°C	< 35 class 9	≥ 35 class 8	≥ 35 class 8	≥ 50 class 4
RECOVERY BY EVAPORATION, AS PER EN 13074-1 AND STABILIZATION AS PER EN 13074-2						
Needle penetration at 25°C	1426	0,1 mm	≤ 220 class 5	≤ 220 class 5	≤ 220 class 5	≤ 50 class 2
Softening point Ring & Ball	1427	°C	≥ 35 class 8	≥ 35 class 8	≥ 35 class 8	≥ 50 class 4

EN 13808 name			C60B3[1] CUR	C60B4 MIC	C60B5 GE	C60B5 REC
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION			
Perceptible properties	1425	-	TBR	TBR	TBR	TBR
Particle polarity	1430	-	Positive	Positive	Positive	Positive
Breaking value	13075-1	-	70-155 class 3	110-195 class 4	> 170 class 5	> 170 class 5
Binder content (per water content)	1428	%	58-62 class 6	58-62 class 6	58-62 class 6	58-62 class 6
Binder content recovered by distillation	1431	%	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6
Fluxing agent content recovered by distillation	1431	%	≤ 2,0 class 2	≤ 2,0 class 2	≤ 2,0 class 2	≤ 2,0 class 2
Fluency time (2 mm, 40ºC)	12846-1	s	15-70 class 3	15-70 class 3	15-70 class 3	15-70 class 3
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 100 class 3	≤ 220 class 5	≤ 270 class 6
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 43 class 6	≥ 39 class 7	≥ 35 class 8
RECOVERY BY EVAPORATION, AS PER EN 13074-1						
Needle penetration at 25ºC	1426	0,1 mm	≤ 330 class 7	≤ 100 class 3	≤ 220 class 5	≤ 330 class 7
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 43 class 6	≥ 39 class 7	≥ 35 class 8
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2						
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 100 class 3	≤ 220 class 5	≤ 270 class 6
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 43 class 6	≥ 39 class 7	≥ 35 class 8

TBR: to be reported.

EN 13808 name			C65B2² TRG	C69B2² TRG	C67BF3 MBA
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION		
Perceptible properties	1425	-	TBR	TBR	TBR
Particle polarity	1430	-	Positive	Positive	Positive
Breaking value	13075-1	-	< 110 class 2	< 110 class 2	70-155 class 3
Binder content (per water content)	1428	%	63-67 class 7	67-71 class 9	65-69 class 8
Binder content recovered by distillation	1431	%	≥ 63 class 7	≥ 67 class 9	≥ 65 class 8
Fluxing agent content recovered by distillation	1431	%	≤ 2,0 class 2	≤ 2,0 class 2	≤ 10 class 6
Fluency time (4 mm, 40ºC)	12846-1	s	5-70 class 5	5-70 class 5	5-70 class 5
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 5 class 2	≤ 5 class 2
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 220 class 5	≤ 330 class 7
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 35 class 8	≤ 35 class 9
RECOVERY BY EVAPORATION, AS PER EN 13074-1					
Needle penetration at 25ºC	1426	0,1 mm	≤ 330 class 7	≤ 330 class 7	140-260 class 9
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 35 class 8	≤ 35 class 9
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 220 class 5	≤ 220 class 5
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 35 class 8	≥ 39 class 7

TBR: to be reported.

Modified cationic bituminous emulsions described in the national annex of the EN 13808 standard

EN 13808 name			C60BP2 ADH	C60BP3 TER	C60BP4 MIC
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION		
Perceptible properties	1425	-	TBR	TBR	TBR
Particle polarity	1430	-	Positive	Positive	Positive
Breaking value	13075-1	-	< 110 class 2	70-155 class 3	110-195 class 4
Binder content (per water content)	1428	%	58-62 class 6	58-62 class 6	58-62 class 6
Binder content recovered by distillation	1431	%	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6
Fluxing agent content recovered by distillation	1431	%	≤ 2,0 class 2	≤ 2,0 class 2	≤ 2,0 class 2
Fluency time (2 mm, 40ºC)	12846-1	s	15-70 class 3	15-70 class 3	15-70 class 3
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 50 class 2	≤ 100 class 3
Softening point Ring & Ball	1427	ºC	≥ 43 class 6	≥ 55 class 3	≥ 50 class 4
Pendulum cohesion test	13588	J/cm²	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1
RECOVERY BY EVAPORATION, AS PER EN 13074-1					
Needle penetration at 25ºC	1426	0,1 mm	≤ 330 class 7	≤ 100 class 3	≤ 100 class 3
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 50 class 4	≥ 50 class 4
Pendulum cohesion test	13588	J/cm²	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 50 class 2	≤ 100 class 3
Softening point Ring & Ball	1427	ºC	≥ 43 class 6	≥ 55 class 3	≥ 50 class 4
Pendulum cohesion test	13588	J/cm²	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1

(1) There are emulsions with a class 2 breaking value of < 110.
(2) There are emulsions with a class 3 breaking value of 70–155.
TBR: to be reported.

Modified cationic bituminous emulsions described in the national annex of the EN 13808 standard

EN 13808 name			C65BP2[2] TRG	C69BP2[2]TRG	C67BPF3 MBA
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION		
Perceptible properties	1425	-	TBR	TBR	TBR
Particle polarity	1430	-	Positive	Positive	Positive
Breaking value	13075-1	-	< 110 class 2	< 110 class 2	70-155 class 3
Binder content (per water content)	1428	%	63-67 class 7	67-71 class 9	65-69 class 8
Binder content recovered by distillation	1431	%	≥ 63 class 7	≥ 67 class 9	≥ 65 class 8
Fluxing agent content recovered by distillation	1431	%	≤ 2,0 class 2	≤ 2,0 class 2	≤ 10 class 6
Fluency time (4 mm, 40ºC)	12846-1	S	5-70 class 5	5-70 class 5	5-70 class 5
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 10 class 3	≤ 5 class 2
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 220 class 5	≤ 220 class 5
Softening point Ring & Ball	1427	ºC	≥ 43 class 6	≥ 43 class 6	≥ 39 class 7
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1
RECOVERY BY EVAPORATION, AS PER EN 13074-1					
Needle penetration at 25ºC	1426	0,1 mm	≤ 330 class 7	≤ 330 class 7	≤ 330 class 7
Softening point Ring & Ball	1427	ºC	≥ 35 class 8	≥ 35 class 8	≥ 35 class 8
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2					
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5	≤ 220 class 5	≤ 220 class 5
Softening point Ring & Ball	1427	ºC	≥ 43 class 6	≥ 43 class 6	≥ 39 class 7
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 class 6	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	DV class 1	DV class 1	DV class 1

(1) There are emulsions with a class 2 breaking value of < 110.
(2) There are emulsions with a class 3 breaking value of 70–155.
TBR: to be reported.

Conventional and modified anionic bituminous emulsions not included in the national annex, but described in the EN 51603 standard

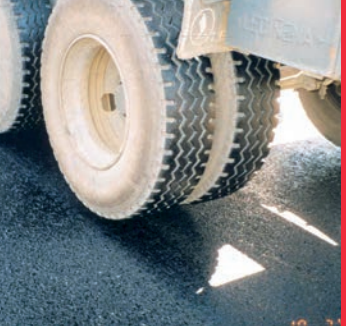
EN 51603 name			A50BR	A50BFR	A60BR	A65BR
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION			
Perceptible properties	1425	-	TBR	TBR	TBR	TBR
Particle polarity	1430	-	Negative	Negative	Negative	Negative
Binder content (per water content)	1428	%	48-52	48-52	58-62	63-67
Fluxing agent content recovered by distillation	1431	%	< 3	3-5	3-8	< 3
Fluency time (2 mm, 40°C)	12846-1	s	15-70	15-70	15-70	
Fluency time (4 mm, 40°C)	12846-1	s	-	-	-	5-70
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1	≤ 0,1	≤ 0,1	≤ 0,1
Sedimentation tendency (7 days)	12847	%	≤ 10	≤ 10	≤ 10	≤ 5
Mixing stability with cement	12848	%	-	-	-	-
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25°C	1426	0,1 mm	≤ 220	≤ 220	≤ 220	≤ 220
Softening point Ring & Ball	1427	°C	< 35	< 35	> 35	> 35

EN 51603 name			A67BFM	A67BPFM	A60BFL	A60BL	A50BFL
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION				
Perceptible properties	1425	-	TBR	TBR	TBR	TBR	TBR
Particle polarity	1430	-	Negative	Negative	Negative	Negative	Negative
Binder content (per water content)	1428	%	65-69	65-69	58-62	58-62	48-52
Fluxing agent content recovered by distillation	1431	%	3-10	3-10	3-8	< 3	5-15
Fluency time (2 mm, 40°C)	12846-1	s	-	-	15-70	40-130	15-70
Fluency time (4 mm, 40°C)	12846-1	s	5-70	5-70	-	-	-
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1	≤ 0,1	≤ 0,1	≤ 0,1	≤ 0,1
Sedimentation tendency (7 days)	12847	%	≤ 5	≤ 5	≤ 10	≤ 10	≤ 10
Mixing stability with cement	12848	%	-	-	-	≤ 2	-
RECOVERY BY DISTILLATION, AS PER EN 1431							
Needle penetration at 25°C	1426	0,1 mm	≤ 270	≤ 220	≤ 220	≤ 220	220-330
Softening point Ring & Ball	1427	°C	≥ 35	≥ 39	≥ 35	≥ 35	≥ 35
Elastic recovery	13398	%	-	≤ 40	-	-	-

TBR: to be reported.

Other cationic bituminous emulsions with special applications included in the EN 13808 standard

Repsol has developed specific emulsions for different types of applications which are not included in the national annex, but which fall under CE marking as per the EN 13808 standard, and the characteristics of which are described in several data sheets. It is possible to manufacture emulsions that are highly stable in storage for the Export and Long Life emulsion ranges.



Thermal-adhesive emulsions

Thermal-adhesive emulsions are quick-breaking emulsions with special characteristics to ensure adhesion between layers, support structures, and reduce the amount of product that sticks to the tires of construction vehicles to low or non-existent levels.

Due to the product's thermal-adhesive properties, no elements become sticky until the hot bituminous mixture is applied, modifying the viscosity of the binder and facilitating adhesion between layers.

The residual bitumen from conventional emulsions used in tack coats tends to come away from the road surface courses with the passage of construction traffic and mixture-spreading machinery. This reduces adhesion between layers due to lack of solidity, which in turn significantly diminishes the surface courses's service life.

Thermal-adhesive emulsions prevent this situation, providing the following advantages:

- The tack coat is not removed after application.
- They lead to significant cost savings by optimizing the amount of emulsion and the resources used to install it, as there is no need to retouch areas that are not covered with emulsion.
- There is no need to stop construction traffic (greater availability).

Repsol's range of thermal-adhesive emulsions includes the following types: **C60B3 TER Antistick, C60B3 TER Antistick Plus, C60BP3 TER Antistick, and C60BP3 Antistick Plus.** All are quick-breaking cationic emulsions and are made from hard bitumens or low-penetration, polymer-modified bitumens.

APPLICATIONS

Thermal-adhesive emulsions are generally used in tack coats below layers of bituminous mixtures applied at temperatures of over 100°C.
The emulsion C60BP3 TER Antistick Plus is normally used for wearing course tack coats, especially when the course contains porous asphalt (PA) mixtures or thin-layer mixtures (BBTM, SMA, or AUTL).
The emulsions C60B3 TER Antistick and C60B3 Antistick Plus are recommended for the tack coats of all other layers.

PRODUCT CHARACTERISTICS

The following table shows the characteristic of thermal-adhesive emulsions:

EN 13808 name			C60B3 TER[1]	C60B3 TER PLUS[2]	C60BP3 TER[1]	C60BP3 TER PLUS[2]
CHARACTERISTICS	EN STANDARD	UNIT				
Perceptible properties	1425	-	TBR	TBR	TBR	TBR
Particle polarity	1430	-	Positive	Positive	Positive	Positive
Breaking value	13075-1	-	70-155 class 3	70-155 class 3	70-155 class 3	70-155 class 3
Binder content (per water content)	1428	%	58-62 class 6	58-62 class 6	58-62 class 6	58-62 class 6
Binder content recovered by distillation	1431	%	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6	≥ 58 class 6
Fluxing agent content recovered by distillation	1431	%	≤ 2,0 class 2	≤ 2,0 class 2	≤ 2,0 class 2	≤ 2,0 class 2
Fluency time (2 mm, 40ºC)	12846-1	s	15-70 class 3	15-70 class 3	15-70 class 3	15-70 class 3
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3	≤ 10 class 3
Adhesion	13614	%	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25ºC	1426	0,1 mm	≤ 50 class 2	≤ 50 class 2	≤ 50 class 2	≤ 50 class 2
Softening point Ring & Ball	1427	ºC	≥ 50 class 4	≥ 50 class 4	≥ 55 class 3	≥ 55 class 3
Pendulum cohesion test	13588	J/cm^2	-	-	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	-	-	DV class 1	DV class 1
RECOVERY BY EVAPORATION, AS PER EN 13074-1						
Needle penetration at 25ºC	1426	0,1 mm	≤ 100 class 3	≤ 50 class 2	≤ 100 class 3	≤ 50 class 2
Softening point Ring & Ball	1427	ºC	≥ 50 class 4	≥ 50 class 4	≥ 50 class 4	≥ 55 class 3
Pendulum cohesion test	13588	J/cm^2	-	-	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	-	-	DV class 1	DV class 1
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2						
Needle penetration at 25ºC	1426	0,1 mm	≤ 50 class 2	≤ 50 class 2	≤ 50 class 2	≤ 50 class 2
Softening point Ring & Ball	1427	ºC	≥ 50 class 4	≥ 50 class 4	≥ 55 class 3	≥ 55 class 3
Pendulum cohesion test	13588	J/cm^2	-	-	≥ 0,5 class 6	≥ 0,5 class 6
Elastic recovery, 25 ºC	13588	%	-	-	DV class 1	DV class 1

(1) Emulsion made using bitumen with a penetration grade of 35/50.
(2) Emulsion made using bitumen with a penetration grade of 10/20 or 15/25.
TBR: to be reported.

RECOMMENDATIONS FOR USE

The emulsions are installed at temperatures of between 50 and 70°C. Breaking occurs more or less quickly depending on the surface courses temperature, the weather conditions (temperature, wind, humidity, and sun), and the type of support structure. It can vary from 5-10 minutes in ideal conditions up to 60 minutes in the most extreme conditions.

For installation, a sprayer tank is necessary with clean injectors that are in good condition (avoid spraying with a spray wand). Once the emulsion has broken, the hot bituminous mixture is layed.

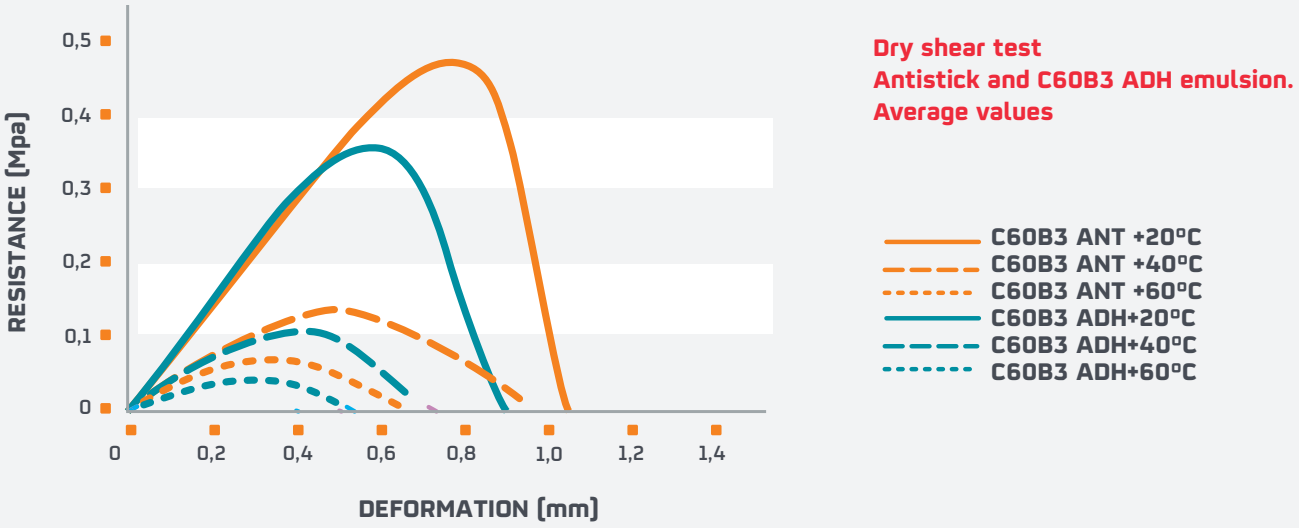
Due to the hardness of the residual binder of plus thermal-adhesive emulsions, the application of a lime water as an auxiliary treatment in not necessary to prevent the binder from being removed by construction traffic.

If these simple rules are followed, this type of emulsions performs exceptionally in the presence of construction traffic.

EVALUATION AND CONTROL OF THERMAL-ADHESIVE EMULSIONS

In order to confirm that emulsions manufactured using a bitumen with a lower penetration grade perform optimally compared to the conventional emulsion C60B3 ADH, a comparative study was performed using the LCB shear test developed at the Polytechnic University of Catalonia (UPC).

This study revealed that superior adhesion between layers is obtained with a thermal-adhesive than with the conventional emulsion C60B3 ADH. The results are shown in the graph below:



Export emulsions

Emulsions can be defined as a heterogeneous, thermodynamically unstable system that is composed of two phases: the bitumen phase and the water phase formed by water, emulsifiers, and pH regulators. Due to this natural instability, a process takes place over time that causes decantation of the binder phase, with the gradual separation of the water and bitumen. This ultimately causes the emulsion to break totally or partially, going from a typical flocculation phenomena to coalescence and finally sedimentation.

In response to these problems, Repsol has developed a range of emulsions called **Export emulsions,** which are highly stable in storage and improve the natural sedimentation process during long-term storage at customs and long-distance transportation.

APPLICATIONS

Export emulsions have the same applications as cationic bituminous emulsions for roads:

- Primer coats
- Tack coats
- Seal coats
- Cold microsurfacing and slurry seals
- Gravel emulsion
- Surface dressing with gravel chippings
- Open-graded bituminous mixtures
- Cooled mixtures made using emulsion

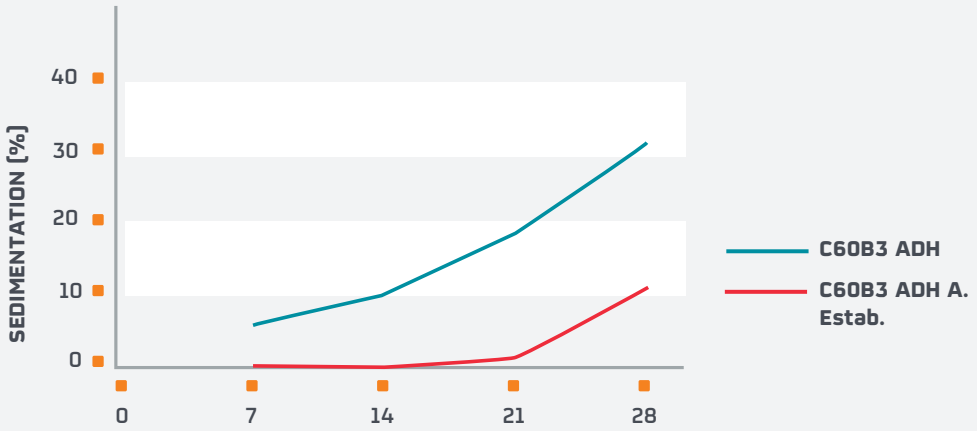
PRODUCT CHARACTERISTICS

The Export emulsions range meets the requirements of the European EN 13808 standard for cationic emulsions.
The main characteristic of this type of emulsions is a lower tendency to sediment than conventional emulsions of the same type, confirming that they preserve the required properties for use over an extended storage period.

SEDIMENTATION TENDENCY	STORAGE PERIOD			
	7 days	14 days	21 days	28 days
C60B3 ADH	3,5	10	18	32
C60B3 ADH EXPORT	0,1	0,2	1,3	10,4

* These data are illustrative and not binding.

C60CB630 ABD3H emulsions



ADVANTAGES

- Good stability in storage compared to conventional emulsions, with improved sedimentation results.
- Export emulsions can be stored for prolonged periods, such as crossing times during maritime transportation, while waiting to be loaded and unloaded at ports, and during long-distance land transportation.
- They are ideal for use in projects that require prolonged storage, and can be transported and stored in IBC containers, flexitanks, or conventional tanks.

Long-life emulsions

Emulsions can be defined as a heterogeneous, thermodynamically unstable system that is composed of two phases: the bitumen phase and the water phase formed by water, emulsifiers, and pH regulators. Due to this natural instability, a process takes place over time that causes decantation of the binder phase, with the gradual separation of the water and bitumen. This ultimately causes the emulsion to break totally or partially, going from a typical flocculation phenomena to coalescence and finally sedimentation.

In response to these problems, Repsol has developed a range of emulsions called **Long Life emulsions,** which are highly stable in storage and improve the natural sedimentation process over time.

This type of emulsions can be stored in tanks for use in small, sporadic actions, making them available in adequate handling conditions and with all the required characteristics for use.

APPLICATIONS

Long Life emulsions have the same applications as cationic bituminous emulsions for roads:

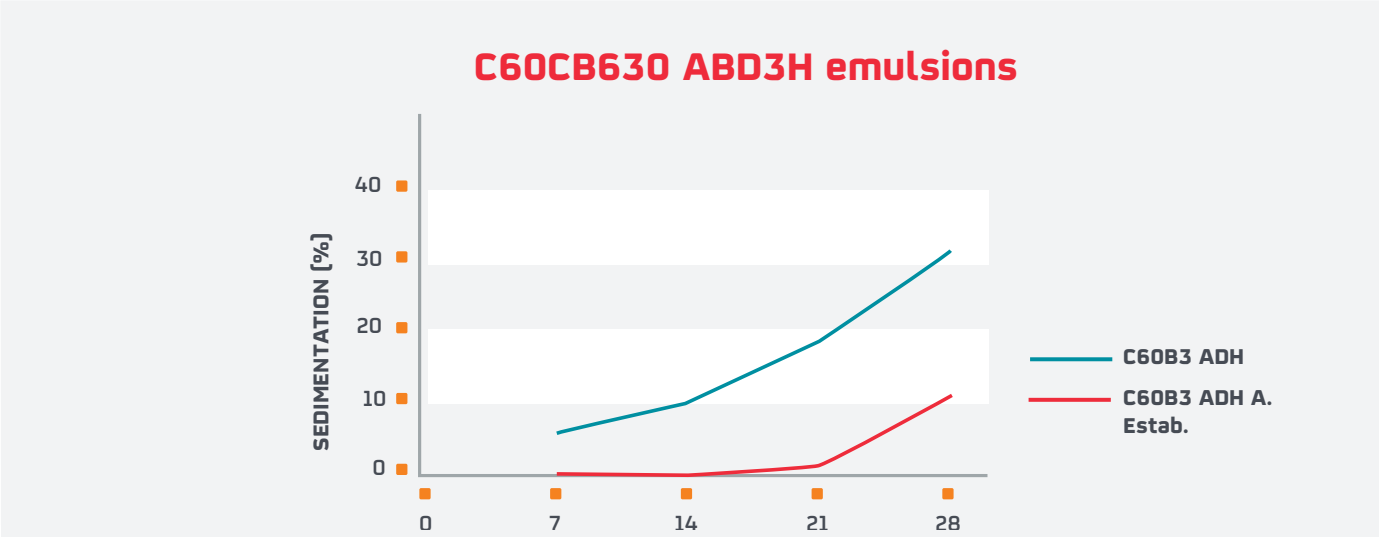
- Primer coats
- Tack coats
- Seal coats
- Cold microsurfacing and slurry seals
- Gravel emulsion
- Surface dressing with gravel chippings
- Open-graded bituminous mixtures
- Cooled mixtures made using emulsion

PRODUCT CHARACTERISTICS

The Long Life emulsions range meets the requirements of the European EN 13808 standard for cationic emulsions.
The main characteristic of this type of emulsions is a lower tendency to sediment than conventional emulsions of the same type, confirming that they preserve the required properties for use over an extended storage period.

SEDIMENTATION TENDENCY	STORAGE PERIOD			
	7 days	14 days	21 days	28 days
C60B3 ADH	3,5	10	18	32
C60B3 LONG LIFE	0,1	0,2	1,3	10,4

* These data are illustrative and not binding.



ADVANTAGES

- Good stability in storage compared to conventional emulsions, with improved sedimentation results.
- Long Life emulsions can be stored for prolonged periods, such as those required for maintenance in tanks when they are used in small quantities over time in project operations.

Primer coat emulsion with high penetration power

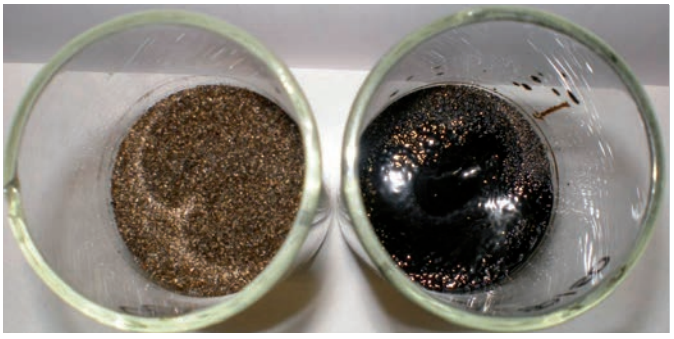
This is a primer coat emulsion that does not contain a fluxing agent and has greater penetration of granular layers, named C50B4 IMP APP.
In accordance with EU guidelines and national organizations, Repsol has developed this line of products with a lower environmental impact and improved performance.

C50B4 IMP APP is a low-concentration, slow-breaking emulsion with high penetration power and a lower environmental impact. It contains no fluxing agents and is more stable in storage than its traditional equivalent, C50BF4 IMP.

APPLICATIONS

The main application of the emulsion C50B4 IMP APP is:

- Priming of granular support structures.



PRODUCT CHARACTERISTICS

The following table shows the characteristics:

CHARACTERISTICS	UNIT	EN STANDARD	SPECIFICATION	CLASS
Particle polarity	-	1430	Positive	-
Breaking value	-	13075-1	110-195	4
Binder content (per water content)	%	1428	48 to 52	4
Binder content recovered (by distillation)	%	1431	≥ 48	4
Fluxing agent content recovered by distillation	%	1431	≤ 2	2
Fluency time, 2 mm at 40°C	s	12846-1	15-70	3
Residue after sieving, 0.5 mm sieve	%	1429	≤ 0,1	2
Sedimentation tendency (7 days in storage)	%	12847	≤ 10	3
Adhesion	%	13614	≥ 90	3
RECOVERY BY EVAPORATION AS PER EN 13074-1				
Needle penetration at 15°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2				
Needle penetration at 25°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY DISTILLATION, AS PER EN 1431				
Needle penetration at 25°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8

ADVANTAGES

The emulsion C50B4 IMP APP provides the following advantages:

- Better priming of the support structure.
- It allows for the passage of construction traffic.
- It makes it possible to adapt the base binder depending on the application objective.
- Greater sealing of the support structure.
- Lower environmental impact.

Protection coat emulsions

Repsol has a technologically conceived emulsion for preventive conservation treatments on pavements that are aged, microcracked, or show signs of particle loss.

The emulsions C50B2 and C50BP2 Emulprotect are formulated for use in preventive protection coats for pavement maintenance operations.

Conservation treatments are used to prevent the pavement from deteriorating as a result of aging, loss of superficial aggregates, and cracking, as well as for sealing and waterproofing. They work by sealing the surface courses of asphalt pavements, thereby impeding the entry of water and reducing bitumen oxidation. This provides greater surface courses tenacity, slowing down the deterioration process and extending the pavement's service life.

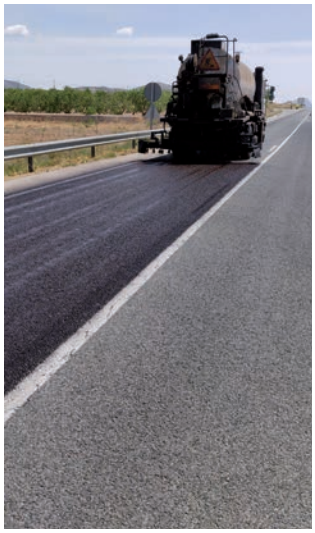
The emulsions C50B2 and C50BP2 Emulprotect are low-concentration, quick-breaking emulsions with residual binders designed to seal the surface courses without the need to use protective aggregates/sand in the coat. These residual binders can be rheologically modified with polymers to improve their tenacity/resistance.

In addition, and depending on the needs of the surface courses to be protected, the use of rejuvenators may be considered in these emulsions to strengthen this quality.

APPLICATIONS

The main applications of the emulsions C50B2 and C50BP2 EMULPROTECT are:

- Protection coats for pavements that show signs of particle loss.
- Protection coats for aged, microcracked pavements.
- Pavement sealing coats.
- Sealing of surface courses dressing with gravel chippings.
- Tack coats between layers.




PRODUCT CHARACTERISTICS

The following table shows the characteristics:

			C50B2 EMULPROTECT		C50BP2 EMULPROTECT	
CHARACTERISTICS	UNIT	EN STANDARD	SPECIFICATION	CLASS	SPECIFICATION	CLASS
Particle polarity	-	1430	Positive	-	Positive	-
Breaking value (filler Forshammer)	-	13075-1	< 110	2	< 110	2
Binder content (per water content)	%	1428	48 to 52	4	48 to 52	4
Binder content recovered (by distillation)	%	1431	≥ 48	4	≥ 48	4
Fluxing agent content recovered by distillation	%	1431	≤ 2,0	2	≤ 2,0	2
Fluency time, 2 mm at 40°C	s	12846-1	15 to 70	3	15 to 70	3
Residue after sieving, 0.5 mm sieve	%	1429	≤ 0,1	2	≤ 0,1	2
Sedimentation tendency (7 days in storage)	%	12847	≤ 10	3	≤ 10	3
Adhesion	%	13614	≥ 90	3	≥ 90	3
RECOVERY BY EVAPORATION AS PER EN 13074-1						
Needle penetration at 25°C	0,1 mm	1426	≤ 50	2	≤ 50	2
Softening point Ring & Ball	°C	1427	≥ 50	4	≥ 55	3
Pendulum cohesion test	J/cm²	13588	-	-	≥ 0,5	6
Elastic recovery at 25°C	%	13398	-	-	DV	1
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2						
Needle penetration at 25°C	0,1 mm	1426	≤ 50	2	≤ 50	2
Softening point Ring & Ball	°C	1427	≥ 50	4	≥ 55	3
Pendulum cohesion test	J/cm²	13588	-	-	≥ 0,5	6
Elastic recovery at 25°C	%	13398	-	-	DV	1
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25°C	0,1 mm	1426	≤ 50	2	≤ 50	2
Softening point Ring & Ball	°C	1427	≥ 50	4	≥ 55	3
Pendulum cohesion test	J/cm²	13588	-	-	≥ 0,5	6
Elastic recovery at 25°C	%	13398	-	-	DV	1

ADVANTAGES

The emulsions C50B2 and C50BP2 Emulprotect allow for:

- Preventive maintenance operations that lengthen the pavement's service life, avoiding the need for more costly paving operations.
- Quick reopening to traffic, with no risk of the protection coat being eliminated by vehicles. No need for protection with protective virgin aggregates.
- Rejuvenation of the pavement surface courses.

High-performance emulsion for cold-mix microsurfacing and slurry

Repsol has developed the high-performance emulsion **C65BP4 MIC d AP,** which can be used for very quick-breaking, high-cohesion cold-mix microsurfacing capable of withstanding the most adverse working conditions.

This emulsion is suitable for areas that require excellent cold-mix microsurfacing performance, both to obtain strong macrotextures and for safety reasons to prevent the projection of particles by vehicle traffic, as well as to minimize pavement conservation needs.

APPLICATIONS

- Airport runways and platforms.
- Reflective cracking prevention techniques using polymer or metallic mesh.
- Wearing courses with high levels of traffic: highways, freeways.
- Treatments to improve adhesion in areas with winding curves.
- Safety and warning pavement in hazardous road sections.

PRODUCT CHARACTERISTICS

The following table shows the comparison of the characteristics of the C65BP4 emulsion with a C60BP4 emulsion

EN 13808 NAME			C60BP4 MIC	C65BP4 MIC d AP
CHARACTERISTICS	EN STANDARD	UNIT	TESTS ON THE ORIGINAL EMULSION	TESTS ON THE ORIGINAL EMULSION
Particle polarity	1430	-	-	-
Breaking value	13075-1	-	110-195 (class 4)	110-195 (class 4)
Binder content (per water content)	1428	%	58-62 (class 6)	63-67 (class 7)
Recovered binder content	1431	%	≥ 58 (class 6)	≥ 63 (class 7)
Fluxing agent content recovered by distillation	1431	%	≤ 2 (class 2)	≤ 2 (class 2)
Fluency time (4 mm, 40ºC)	12846-1	s	-	40-130 (class 4)
Fluency time (2 mm, 40ºC)	12846-1	s	15-70 (class 3)	-
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 (class 2)	≤ 0,1 (class 2)
Sedimentation tendency (7 days)	12847	%	≤ 10 (class 3)	≤ 10 (class 3)
Adhesion	13614	%	≥ 90 (class 3)	≥ 90 (class 3)
RECOVERY BY EVAPORATION, AS PER EN 13074-1				
Needle penetration at 25ºC	1426	0,1 mm	≤ 100 (class 3)	≤ 100 (class 3)
Softening point Ring & Ball	1427	ºC	≥ 50 (class 4)	≥ 50 (class 4)
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 (class 6)	≥ 0,5 (class 6)
Elastic recovery, 25ºC	13398	%	DV (class 1)	DV (class 1)
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2				
Needle penetration at 25ºC	1426	0,1 mm	≤ 100 (class 3)	≤ 100 (class 3)
Softening point Ring & Ball	1427	ºC	≥ 50 (class 4)	≥ 50 (class 4)
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 (class 6)	≥ 0,5 (class 6)
Elastic recovery, 25ºC	13398	%	DV (class 1)	DV (class 1)
RECOVERY BY EVAPORATION, AS PER EN 1431				
Needle penetration at 25ºC	1426	0,1 mm	≤ 100 (class 3)	≤ 100 (class 3)
Softening point Ring & Ball	1427	ºC	≥ 50 (class 4)	≥ 50 (class 4)
Pendulum cohesion test	13588	J/cm^2	≥ 0,5 (class 6)	≥ 0,5 (class 6)
Elastic recovery, 25ºC	13398	%	DV (class 1)	DV (class 1)

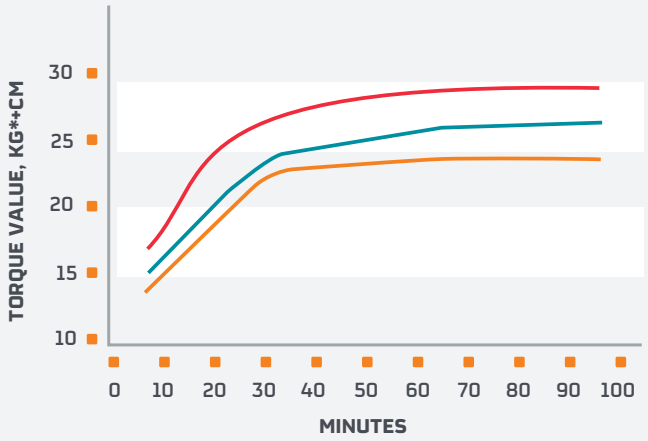
PRODUCT BEHAVIOR IN THE MIXTURE

Compared to conventional emulsions used in bitumen slurry, the emulsion C65BP4 MIC d AP developed by Repsol has the following advantages:

- Increased adhesion (higher resistance to fracture under torque and tensile stress).
- Improved resistance to skidding, due to the improved surface courses macrotexture.
- Greater adhesion to aggregates.
- Improved resistance to aging.
- Better performance at low temperatures.

This high-performance emulsion has **excellent performance in terms of cohesion and abrasion.**
As seen in graph 1, in the EN 12274-4 torque test the high-performance emulsion reaches a minimum torque value of 20 kg*cm, which makes it possible to reopen the road to traffic in half the time of the conventional emulsion C60BP4 MIC, and the time required to reopen the road to traffic is even lower when compared to the emulsion C60B4 MIC Slurry.

As can be seen, less mass is lost in g/m2 with the Repsol emulsion C65BP4 MIC d AP.



Graph 1

Difference in cohesion between the emulsions C60B4 MIC, C60BP4 MIC, and C65BP4 MIC d AP for the same type of aggregate and a grain size corresponding to the MICROF 5 category.

C65BP4 MIC d AP
C60BP4 MIC
C60B4 MIC

LOSS OF MASS (g/m²)		
C65BP4 MIC d AP	C60BP4 MIC	C60B4 MIC
175	270	440

EN 12274-5 wet track abrasion test.

Rejuvenating emulsion for cold-mix recycling

The emulsion **C60B5 REC Rejuv,** specially developed by Repsol for cold-mix recycling of aged surfaces courses, is a slow-breaking emulsion with rejuvenating binders that meets the requirements of the national annex of the EN 13808 standard, on the recycling of bituminous surfaces courses and pavements in relation to C60B5 REC-type emulsions. This product is specifically designed for each project and provides the components that the original bitumen has lost due to aging, restoring its initial characteristics.

Repsol has extensive experience in the use of special emulsions for cold-mix recycling with rejuvenators (C60B5 REC REJUV), obtaining excellent results in installation.

APPLICATIONS

The emulsion C60B5 REC REJUV has been specifically conceived for use in cold-mix recycling that requires high-quality standards.

It is recommended for cold-mix recycling in conjunction with the binder C60B5 REC REJUV in the following situations:

- Structurally fatigued surfaces courses.
- Aged surfaces courses.
- Irregular pavements.
- Selective rehabilitation (on roads with heavy-duty traffic, for example).

Repsol's technical team designs the emulsion's specific formula depending on the surface courses to be rehabilitated, establishing the ideal emulsion formulation to guarantee optimal performance in the final resulting mixture.

Repsol has co-developed an application system for the emulsion C60B5 REC REJUV, called RFE.API (Spanish acronym for Cold-Mix Recycling with Initial High-Performance Emulsion), which involves a new formulation for cold-mix recycling with emulsion that overcomes the existing problems in this procedure when used on roads with high traffic and quality demands. For this purpose, the aim was to overcome two obstacles with these mixes: low mechanical performance in the initial phase and the need for a maturing period before the next levels are laid. This system allows the strengthening layer and/or wearing course to be laid straight away. It accelerates curing, minimizes the amount of pre-mix water, ensures it is eliminated in a short time, and guarantees that the mixture quickly becomes rigid in order to rapidly reduce deflections of the wearing course and avoid consuming its service life.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of the emulsion C60B5 REC REJUV:

CHARACTERISTICS	UNIT	EN STANDARD	SPECIFICATION	CLASS
Particle polarity	-	1430	Positive	-
Breaking value (filler Forshammer)	-	13075-1	> 170	5
Binder content (per water content)	%	1428	58 to 62	6
Binder content recovered (by distillation)	%	1431	≥ 58	6
Fluxing agent content recovered by distillation	%	1431	≤ 2,0	2
Fluency time, 2 mm at 40°C	s	12846-1	15 to 70	3
Residue after sieving, 0.5 mm sieve	%	1429	≤ 0,1	2
Sedimentation tendency (7 days in storage)	%	12847	≤ 10	3
Adhesion	%	13614	≥ 90	3
RECOVERY BY EVAPORATION AS PER EN 13074-1				
Needle penetration at 25°C	0,1 mm	1426	≤ 330	7
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2				
Needle penetration at 25°C	0,1 mm	1426	≤ 270	6
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY EVAPORATION, AS PER EN 1431				
Needle penetration at 25°C	0,1 mm	1426	≤ 270	6
Softening point Ring & Ball	°C	1427	≥ 35	8

PRODUCT BEHAVIOR IN THE MIXTURE

Repsol's C60B5 REC REJUV emulsion provides mixtures with excellent initial cohesion, allowing roads to be reopened to traffic quickly without the need for a protection coat. This leads to agile and efficient project organization, thereby reducing execution times.
To obtain the working formula, tests are carried out to evaluate the resistance of the recycled mixtures and the effect of water, in accordance with the EN 12697-12 standard. These studies are used to obtain the optimal content of emulsion with rejuvenating agents to be used in the mixture. The following table shows the minimum value required in the water sensitivity test (Table. 20.3 of annex 4 of the OC40/2017):

CATEGORY OF HEAVY-DUTY TRAFFIC	DRY (MPa)	AFTER IMMERSION (MPa)	RETAINED R (R)
T1 (Only base layers)	1.7	1.3	75
T3, T4; and shoulders (1)	1.2	0.9	70

(1) Non-agricultural service lanes of freeways and intercity highways.

Attention should be focused on the following two points to ensure that the technique provides successful results:

- Design of a custom emulsion depending on the material to be treated and the development of a suitable working formula.
- Careful installation and strict control of the evolution of the mixture over time.

ADVANTAGES

The road surface courses improvements provided by the on-site cold-mix recycling technique with emulsion can be summed up as follows: the attainment of progressive mechanical resistance, improved fatigue performance, energy and resource savings, and efficient execution.

In addition, the use of the emulsion C60B5 REC Rejuv provides the following benefits:

- The road can be reopened to traffic quickly thanks to the mixture's excellent initial cohesion.
- The mixture gains stability rapidly, shortening waiting times between layers.
- Vehicle traffic safety is improved as particles are not detached or thrown.
- There is no need for a sealing treatment, with its execution being recommended in adverse weather conditions.

Efimul, emulsion for open-graded cold mixtures

Repsol has developed the medium-breaking bituminous emulsion **C67BF3 MBA EFIMUL,** which is formulated ad-hoc for open-graded mixtures that can be stored and handled at ambient temperature. It is specially designed to leverage the versatility and mobility offered by bitumen slurry manufacturing and spreading machinery.

APPLICATIONS AND PRODUCT BEHAVIOR IN THE MIXTURE

In some cases, due to the characteristics of the project it is impossible to install cold-mix surface courses plants, either because there are no adequate locations or because of problems achieving the required administrative and/or industrial licenses.

The emulsion C67BF3 MBA Efimul can be used to manufacture open-graded cold mixtures in a bitumen slurry manufacturing unit, providing the following properties:

- Stability with regard to the aggregate studied.
- Stability in storage.
- Optimal adhesion conditions to the aggregate/binder.
- Suitable viscosity for the aggregate used and the components of the manufacturing equipment.
- Versatility and easy handling in manufacturing and supply.

This product is custom-designed for each project (depending on the type of aggregate and location). Repsol offers the services of its Technical Support and Development Department to elaborate optimal work formulas.

PRODUCT CHARACTERISTICS

The following table shows the characteristics of the emulsion C67BF3 REC REJUV:

EN 13808 name			C67BF3 MBA
CHARACTERISTICS	EN STANDARD	UNIT	
Particle polarity	1430	-	Positive
Breaking value	13075-1	-	70-155 class 3
Binder content (per water content)	1428	%	65-69 class 8
Binder content recovered by distillation	1431	%	≥ 65 class 8
Fluxing agent content recovered by distillation	1431	%	≤ 10 class 6
Fluency time (4 mm, 40ºC)	12846-1	s	5-70 class 5
Residue after sieving (0.5 mm sieve)	1429	%	≤ 0,1 class 2
Sedimentation tendency (7 days)	12847	%	≤ 5 class 2
Adhesion	13614	%	≥ 90 class 3
RECOVERY BY DISTILLATION, AS PER EN 1431			
Needle penetration at 25ºC	1426	0,1 mm	≤ 330 class 7
Softening point Ring & Ball	1427	ºC	< 35 class 9
RECOVERY BY EVAPORATION, AS PER EN 13074-1			
Needle penetration at 25ºC	1426	0,1 mm	140-260 class 9
Softening point Ring & Ball	1427	ºC	< 35 class 9
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2			
Needle penetration at 25ºC	1426	0,1 mm	≤ 220 class 5
Softening point Ring & Ball	1427	ºC	≥ 39 class 7

ADVANTAGES OF USING A COMPACT MACHINE+EMULSION C67BF3 MBA EFIMUL

- Versatility as a project unit.
- Efficient manufacturing/application system.
- System that makes it possible to leverage the available resources, without replacing the traditional system.
- Savings in assembly and disassembly of manufacturing machines compared to traditional means.
- Ecoefficient system: emission-free and low electricity and fuel consumption.
- System adapted to the geographical zone of the project, nature of the aggregates, transportation possibilities, location of the worksite, etc.

Emulsions for Half Warm Mix Asphalt

Repsol has developed the **ECOTEMP and RECITEMP** ranges specifically for the use and manufacturing of half warm mix asphalt mixtures.

In recent years, the use of special emulsions in the manufacturing of half warm mix asphalt has made it possible to reduce temperatures, which in turn implies a reduction of greenhouse gas emissions, increased occupational health and safety, and energy savings in this activity.

The ECOTEMP range meets the following requirements:

- Good wetting/coverage of the aggregate at the manufacturing temperature.
- Low percentage of water in the composition.
- Possibility of handling the mix in the application area.
- Base binder with the required properties for the intended use of the mixture.

The RECITEMP range combines the advantages mentioned above, in addition to those associated with reuse of milled or demolition material from the road. With these emulsions and a suitable mixture manufacturing process, it is possible to reuse 100% of the recycled material in the new mixture.

All emulsions have the CE marking, in accordance with the EN 13808 standard.

APPLICATIONS

The ECOTEMP emulsions that can be used to produce open- and closed-graded cooled bituminous emulsions are as follows:

TYPE OF EMULSION	APPLICATION	TYPE OF MIX
C69B2 MBA ECOTEMP	Open-graded cooled bituminous mixtures for road maintenance and construction	BBTM SMA PA
C69BP2 MBA ECOTEMP	Open-graded cooled bituminous mixtures for road maintenance and construction	BBTM SMA PA
C69B2 MBC ECOTEMP	Closed-graded cooled bituminous mixtures for road maintenance and construction	AC
C67B2 MBC RECITEMP	Recycled closed-graded cooled bituminous mixtures for road maintenance and construction	AC

PRODUCT CHARACTERISTICS

The following table shows the characteristics of the ECOTEMP and RECITEMP emulsion ranges:

ECOTEMP range

			C69BP2 ECOTEMP		C69B2 ECOTEMP	
CHARACTERISTICS	UNIT	EN STANDARD	SPECIFICATION	CLASS	SPECIFICATION	CLASS
Particle polarity	-	1430	Positive	-	Positive	-
Breaking value (filler Forshammer)	-	13075-1	< 110	2	< 110	2
Binder content (per water content)	%	1428	67 to 71	9	67 to 71	9
Binder content recovered (by distillation)	%	1431	≥ 67	9	≥ 67	9
Fluxing agent content recovered by distillation	%	1431	≤ 2,0	2	≤ 2,0	2
Fluency time, 4 mm at 40°C	s	12846-1	40 to 100	6	40 to 100	6
Residue after sieving (0.5 mm sieve)	%	1429	≤ 0,1	2	≤ 0,1	2
Sedimentation tendency (7 days in storage)	%	12847	≤ 10	3	≤ 10	3
Adhesion	%	13614	≥ 90	3	≥ 90	3
RECOVERY BY EVAPORATION AS PER EN 13074-1						
Needle penetration at 25°C	0,1 mm	1426	≤ 100	3	≤ 100	3
Softening point Ring & Ball	°C	1427	≥ 43	6	≥ 43	6
Pendulum cohesion test	J/cm^2	13588	≥ 0.5	6	-	-
Elastic recovery	%	13398	DV	1	-	-
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2						
Needle penetration at 25°C	0,1 mm	1426	≤ 100	3	≤ 100	3
Softening point Ring & Ball	°C	1427	≥ 43	6	≥ 43	6
Pendulum cohesion test	J/cm^2	13588	≥ 0.5	6	-	-
Elastic recovery	%	13398	DV	1	-	-
RECOVERY BY DISTILLATION, AS PER EN 1431						
Needle penetration at 25°C	0,1 mm	1426	≤ 100	3	≤ 100	3
Softening point Ring & Ball	°C	1427	≥ 43	6	≥ 43	6
Pendulum cohesion test	J/cm^2	13588	≥ 0.5	6	-	-
Elastic recovery	%	13398	DV	1	-	-

RECITEMP range

			C67B2 RECITEMP*	
CHARACTERISTICS	UNIT	EN STANDARD	SPECIFICATION	CLASS
Particle polarity	-	1430	Positive	-
Breaking value (filler Forshammer)	-	13075-1	< 110	2
Binder content (per water content)	%	1428	67 to 71	9
Binder content recovered (by distillation)	%	1431	≥ 67	9
Fluxing agent content recovered by distillation	%	1431	≤ 2,0	2
Fluency time, 4 mm at 40°C	s	12846-1	5 to 70	5
Residue after sieving, 0.5 mm sieve	%	1429	≤ 0,1	2
Sedimentation tendency (7 days in storage)	%	12847	≤ 10	3
Adhesion	%	13614	≥ 90	3
RECOVERY BY EVAPORATION AS PER EN 13074-1				
Needle penetration at 25°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY EVAPORATION AS PER EN 13074-1, AND STABILIZATION AS PER EN 13074-2				
Needle penetration at 25°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8
RECOVERY BY DISTILLATION, AS PER EN 1431				
Needle penetration at 25°C	0,1 mm	1426	≤ 220	5
Softening point Ring & Ball	°C	1427	≥ 35	8

*The base binder must be adapted depending on amount of recycled material used, the condition of the aged binder, the type of mixture and the layer.

PRODUCT BEHAVIOR IN THE MIXTURE

Emulsions from the ECOTEMP and RECITEMP ranges can be used to manufacture cooled mixtures with similar mechanical performance to hot bituminous mixtures.

It should be considered that, thanks to the lower manufacturing temperature, the bitumen ages less and therefore the mixture's durability is improved. In addition to these advantages and from the point of view of cooled bituminous mixture manufacturing, there are notable fuel savings and it is also possible to adapt hot-mix production facilities to these techniques.

Furthermore, use of the RECITEMP range leads to savings in raw material consumption thanks to the reuse of material from the road.

Industrial asphalts

Repsol markets the following products from its line of industrial asphalts in national and international markets:

- **Redaspol:** specifically formulated bitumen to manufacture polymeric waterproofing sheets in combination with rubber.
- **Special emulsions:** emulsion for priming and sealing surfaces courses, as well as for manufacturing other waterproofing products. These emulsions are designed in accordance with the customer's specific needs.

APPLICATIONS

- Asphalt sheets for waterproofing
- Bituminous waterproofing solutions
- Acoustic insulation for the automotive industry
- Mortars for waterproofing and industrial pavement
- Bituminous paints and fillers
- Joint sealant
- Pipe coating
- Industrial bituminous emulsions
- Other applications: waste treatment, waterproofing of construction elements, adhesives, dune stabilization, crop protection, etc.

PRODUCT CHARACTERISTICS

The following table shows the characteristic of specially formulated industrial asphalts for making polymeric waterproofing sheets in combination with virgin polymers:

CHARACTERISTICS	UNIT	EN STANDARD	REDASPOL 15	REDASPOL 30	REDASPOL 35
ORIGINAL BITUMEN					
Needle penetration at 25˚C	0,1 mm	1426	15 - 25	160 - 220	35 - 50
Softening point Ring & Ball	˚C	1427	60 - 76	35 - 43	50 - 58
Fraass breaking point	˚C	12593	≤ 0	≤ -15	≤ -5

CHARACTERISTICS	UNIT	EN STANDARD	REDASPOL 55	REDASPOL 90	REDASPOL Flex
ORIGINAL BITUMEN					
Needle penetration at 25˚C	0,1 mm	1426	50 - 70	70 - 100	275 - 350
Softening point Ring & Ball	˚C	1427	46 - 54	43 - 51	≥ 30
Fraass breaking point	˚C	12593	≤ -8	≤ -10	≤ -20
Flash point	˚C	ISO 2592	-	-	≥ 275

REPSOL

Let's invent the future

Customer service
+34 901 101 101
repsol.com