COLD MIX ASPHALT

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ABSTRACT

As a means of combining technical quality, economical and environmental considerations, the road designer has a palette of materials to work with, predominated by hot mix asphalts, with warm and cold mix asphalts in the process of development. Based on a combination of conditions needed to harmonise their complementary natures, the innovative process described here is aimed at creating maximised products conforming to sustainable development criteria with high-performance structures, controlled costs and reduced impact of installations and sites. It is original in associating two hydraulic and hydrocarbon binders at ambient temperature, exclusively with separate fractions of a given granular mix, in order to construct a consistent whole comprising structuring elements bonded together with a stable mortar.

The process has been tested on a moderate traffic road as surface course, which provides simultaneously, a re-profiling and reinforcing function. The mechanical and surface properties obtained at the end of application, comparable to those of a hot asphalt mix, allowing easy reopening to traffic under totally safe conditions without any curing period.

The article will go on to cover all the points concerned, emphasising in particular, the principle, composition and studies and the technical, economic and environmental advantages of the process.

1. INTRODUCTION

The political highway policy concerns of the industrialised countries focus essentially on management of their heritage. Building owners are confronted by a multitude of constraints and challenges. It is necessary simultaneously to extend the life duration of the road courses, improve safety and comfort for users, decrease the disturbances caused by road works, and while complying with environmental and economic conditions that are increasingly more severe. Addressing these issues means adapting the concept and developing new materials that are constantly better suited to the demands [1].

So the criterion involving the function separation of road course layers that has been adopted for more than 15 years now has won considerable success in the construction of new road courses designed to deal with heavy and intense traffic levels. It should be borne in mind that the sub-grade courses provide the mechanical properties while surfacing courses offer optimised wearing properties. This resulted in the development of the association of semi-rigid materials, or materials with a high modulus, with a range open texture surfacing asphalts comprising thin or very thin asphalt concrete and porous asphalt mixes. Today except for new projects when it is necessary to allow for minimized future maintenance, the first stake is to cope with the maintenance of a considerable network of existing road surfaces with high-performance techniques. The same course must allow reprofiling, mechanical resurfacing and offer the right surface qualities. This has meant turning towards a concept of the multifunction single surface type. The component material of this single surface dressing must satisfy properties that are something of a self-contradiction: it must be rigid enough not to be deformable, flexible enough to accept thickness variations and not crack, rough-textured enough but without being liable to strip, cohesive enough, as soon as the road is opened to traffic again, to cope with shear forces.

The second challenge is environmental protection, now considered majored and planetary. The Paris Conference (February 2007) concluded in accepting that the temperature of the globe has risen by almost 1.5°C since 1900 as a consequence of human activities and more specifically the emission of greenhouse effect gases and expects there to be an increase of between 3 and 7°C in the next 50 years, depending on how industrial and personal practices develop [2]. The European Union is committed to reducing them in a proportion greater than the Kyoto agreements [3], setting the bar at a level twice as low. Since the beginning of the 2000s, this concern is also at the focal point of the working axes of the research and development departments of the large roadbuilding companies and the oil companies. It has resulted in the development of warm asphalt mixes, a technology making it possible to achieve equivalent performance to hot asphalt mixes, while cutting down on energy expenditure and gas emissions [4].

A radical alternative approach consists in initiating the use of cold asphalt mix techniques, preserving flexible use while aiming at a sufficiently high level of performance to resist traffic aggression come as soon as laying is complete. It is a matter of reducing or even eliminating the consequences linked to relatively long curing period of materials of that kind which is currently studied (bitumen emulsion asphalts) [5][6].

The idea of developing a functionally mixed material incorporating a pozzolan-base binder with an asphalt emulsion, generated by a sequential coating technique using two granular fractions (sand and gravel) has made it possible to bring these properties together.
A third challenge has also been reached: favouring savings from the following aspects:

- energy: technique without any need to heat the materials (saving of fuel)
- environmental: utilization of materials of modest geotechnical quality available in large quantities (pozzolan binder is obtained from the calcination of clay at a moderate temperature for a reasonable period of time) Less use of oil resources (saving of asphalt). No releasing of gas into the atmosphere compared to hot asphalt mix techniques
- production: only one course instead of the two courses generally used in traditional solutions meaning less obstruction of traffic
- financial: immediate (components, manufacturing) and in the longer term (maintenance, reconstruction).

The originality of the process lies in its application to a family of materials able to combine the functions of regulating-reprofiling with the reinforcement of the road courses and has the characteristics of the wearing course.

2. PRINCIPLE

This cold asphalt mix is therefore a road building material based on the usual hydraulic and hydrocarbon granulates and binders. The patented manufacturing process [7] consists in assigning the two binders, individually and exclusively, to two targeted granular fractions according to a double coating process generating:

- A densifying phase associating the hydraulic binder with the fine fraction,
- A skeleton phase associating the hydrocarbon binder with the coarse fraction,

The two phases are prepared separately and mixed so that the mineral skeleton consists of gravel coated with a thin and continuous film of asphalt, bonding them together and with the hardened mortar. An assembly of compact blocks is created in this way, with an operating mechanism based on a system of flexible articulations. The hydrocarbon binder is an asphalt emulsion with a formula adjusted according to its affinity with the gravel being used. The breakdown of this emulsion must be semi-slow to help with its spreading. The hydraulic binder is based on pozzolan. It comes from calcined clay (at 750°C for a few seconds), activated by lime, in powder form. The amount of water added, obtained from the granulates and the emulsion, is adjusted so that most of it is consumed in the chemical reaction of the mineral binder, to obtain high strength at a young age and allow immediate opening to traffic. The action of each binder is applied where it is most efficient. The hydraulic binder favours mechanical strength generated by granular locking. The hydrocarbon binder ensures waterproofing, offers relative flexibility, and resistance to cracking.

3. AREAS OF USE

The respective quantities of hydraulic binder and hydrocarbon binder are proportioned as a function of the destination of the material (structural or wearing course) to obtain characteristics specific to the course in question.

In all cases, it is essential to seek optimum resistance to fracturing and fatigue. The void content and waterproofing of the material are characteristics intrinsically involved and that need to be maximised. For the wearing courses, there are many criteria that need to be mastered related to the state of the surface, for instance, resistance to striping coming off the road, wear and adherence of vehicles. Surface drainability, resistance to rutting and creepage are also essential characteristics affecting the durability of this course.
For the intermediate courses (base and binder courses), mechanical and rheological properties are the main parameters that need to be optimised.

The choice of the tests performed to measure the performance also depends on the field of use. In every case, there is a question of the choice between specific standardised tests concerning hydraulic mixes and asphalt mix courses. In the case of a structural course, the mechanical behaviour is somewhat similar to that of a gravel treated with a hydraulic binder and it will be assessed by means of a diametric compression test on the samples (diameter: 16mm and height: 16mm - NF P 98-232-3). For a wearing course, the most suitable tests are static tests on hydrocarbon mixes measuring the resistance to compression and stability with respect to water (Duriez test: NF P98-251-4). Behavior with respect to compacting it is assessed by means of the Giratory Shear Compactor (NF P 98-260-1). Whatever the case, mechanical performance can be assessed by means of a complex modulus test (NF P98-260-1), which is more difficult to run, and resistance to fracturing by a restrained shrinkage test.

4. LABORATORY STUDY - OPTIMISATION OF THE FORMULA

Preliminary studies in the laboratory have made it possible to understand and control the succession of chemical and mechanical processes involved in the manufacturing of this type of mix. So far, the basic properties that we have attempted to establish are inherent in the wearing courses. They have been adjusted to obtain better surface cohesion, which is evaluated by the density and the compression resistance. A number of parameters have been optimised to this end:

- mix composition
- The proportions of hydrocarbon and hydraulic binder
- the fixing of the asphalt on fraction 2/D

4.1. Influence of mix granular mix composition

The aggregates used in this study are alluvial materials from the Garonne river, essentially of a silica type. Mix composition is based on fractions 0/2, 2/6 and 6/10 to which must be added the hydraulic binder (80% passing at 63µm sieve). The respective percentages of these fractions have been adjusted to obtain the mix composition values indicated in figure 1.

Table 1 – Percentage of various aggregate fractions

No.	0/2F	2/6.3C	6.3/10C	Hydraulic binder
1	38.5%	17%	42%	2.5%
2	24.5%	22%	51%	2.5%
3	30.5%	27%	40%	2.5%
4	34.5%	26%	37%	2.5%
5	32.5%	24%	41%	2.5%

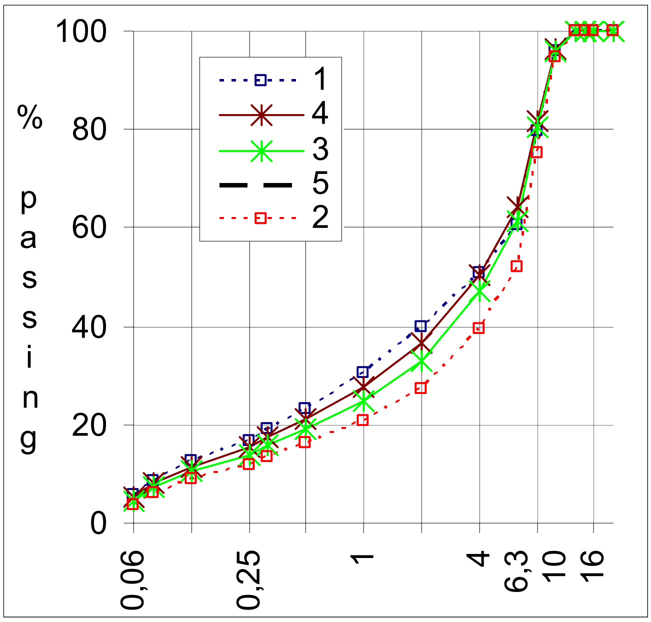

Figure 1 – Various tested mix compositions

The densities and compression strength were evaluated by means of the Duriez test.

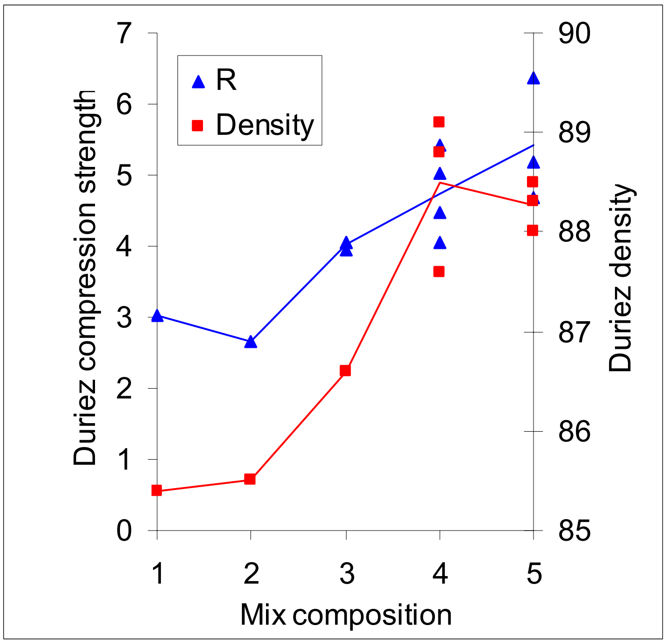

Figure 2 – Influence of mix composition (several asphalt contents)

The definite influence of the mix composition appears to demonstrate better aptitude to compacting for compositions 4 and 5, similar to a formula of the type BBSG (5), or slightly more sandy (4).

4.2. Influence of the hydraulic binder rate

The influence of the hydraulic binder rate on mechanical performance of this coating was evaluated by measuring the compression strength of a Duriez sample (diameter = 80mm), 14 days after production. These formulas are based on mix compositions of type 5 (slightly different in terms of the rate of the hydraulic binder).

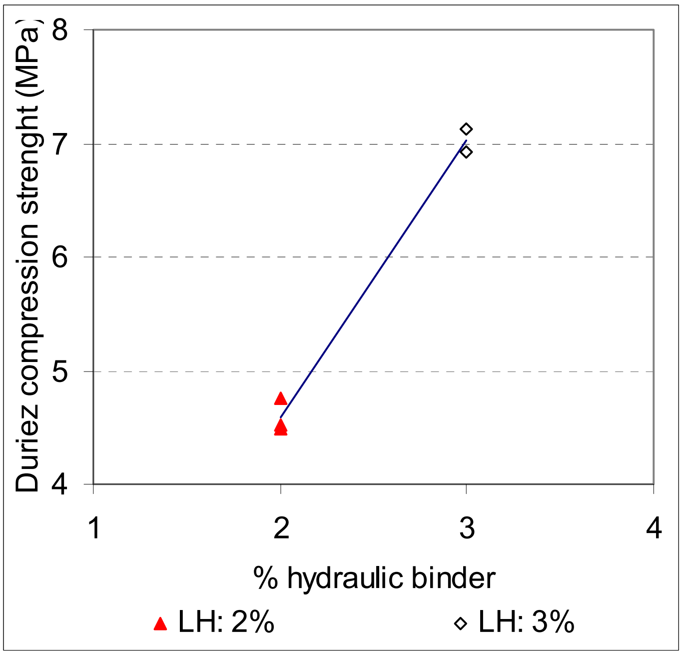

Figure 3 – Influence of hydraulic binder rate on compression strength

Each point denotes the average of three samples. The mechanical performance increases when the hydraulic binder rate increases from 2 to 3% for a total water content included between 6.4 and 7.4%. Furthermore, after 14 days, there is no major change in this compression strength.

4.3. Influence of asphalt content

The specific surface theoretically affected by the asphalt binder is as developed by fraction 2/D. It is far smaller than the one developed by all the aggregates (for compositions 1 to 5). The quantity required for coating this fraction is less than 1%. Nevertheless, it can be considered that part of the sand is involved, during compacting, in an intermediate phase between the mortar and the film of asphalt attached into the aggregate. The residual asphalt contents are consequently optimum around 3.5%. The checking of the asphalt contents during the laboratory controls is lower of around 0.4% of asphalt, in comparison with the theorical amount. This can be explained by the fact that part of the asphalt is absorbed irreversibly by the mortar. In the following figures, the indicated concentration makes no allowance for this loss.

To test the influence of the asphalt, compression strength values on a Duriez sample were measured by varying the grade and rate of the asphalt.

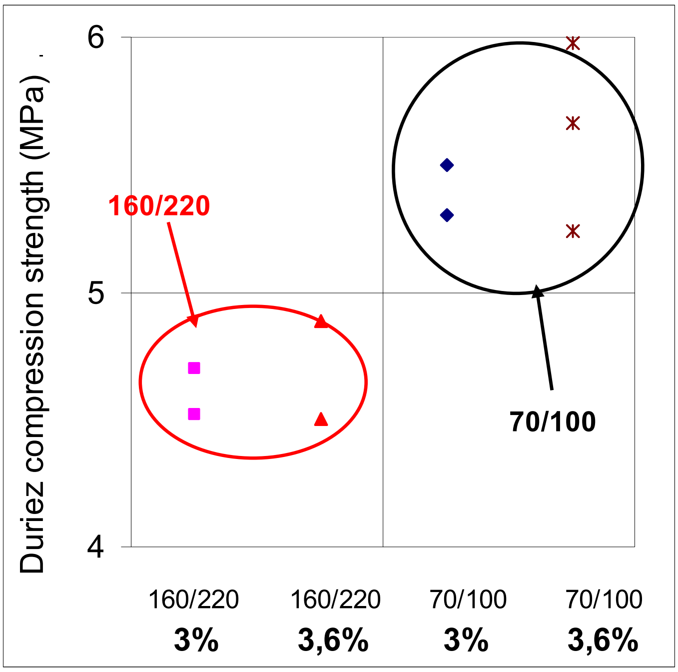

Figure 4 – Influence of asphalt (grade and proportions) on compression strength

The various points obtained in figure 4, for the same formula, corresponds to the use of several emulsions of the same asphalt grade (emulsions differing in their break times). Each point denotes the average of three Duriez samples crushing operations. The compression strength of a Duriez sample is essentially sensitive to the grade of asphalt. The asphalt proportioning factor has less influence.

Compacting was assessed by means of the gyratory shear compactor. The mix composition is the same in all the tested formulas and the added water was adjusted to obtain the same total quantity of water, whatever emulsion was used.

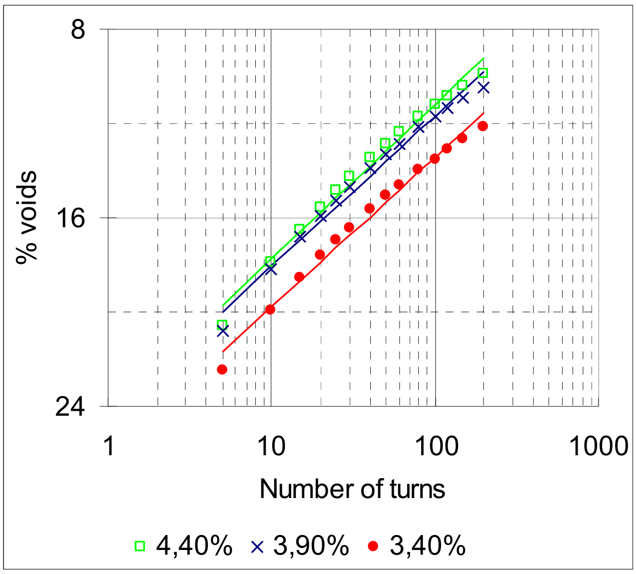

Figure 5 – Influence of asphalt content on density

The compaction effect is much improved when the content of residual asphalt is increased from 3.4% to 3.9%. Beyond 3.9%, improvement is not significant.

4.4. Fixing of bitumen

The fixing of the residual asphalt on fraction 2/D depends on the controlled break of the emulsion during mixing. The preliminary tests performed suggest that we should consider the emulsion break rate as follows:

- Too slow an emulsion is undesirable because it mixes with the fine fraction for which the break is almost immediate (lime effect) causing mastic asphalt balls to form
- The break must be fast enough to allow coating of the entire specific surface in question.
- The emulsion must break so as not to generate any gravel amalgamate and allow the consistent distribution of the densifying phase

The emulsion has been formulated for this purpose. The optimization of the formulation is obviously necessary for each type of aggregate. It may be a good idea to eventually use a breaking agent.

This design methodology has made it possible to optimize the formulations of the materials used on the two job sites presented below.

A compromise must be found between the mechanical strength and the flexibility of the material. The content of the residual asphalt will be included between 3 and 4%, in order to allow for the absorption of the asphalt by the sandy fraction, and that of the hydraulic binder, between 2 and 3%. The mix compositions implemented are identified 1 and 5 in figure 1 and table 1. The optimum water content has been evaluated at around 6.5%.

5. EQUIPMENT

The manufacturing process for this mixed asphalt is based on the assigning of two binders (hydraulic and hydrocarbon) to two mix fractions. The plant used, located at Portet-sur-Garonne (31), has two aggregate conveyors designed for this double allocation.

Figure 6 – Cold mix plant with double conveyor

Fraction 2/D comes in on the first conveyor at the head of the mixer. The asphalt emulsion is generally added at this point. The mixing time of the components is approximately 30 seconds (or 2/3 of the total length of the mixer) allowing the very high quality coating of the aggregates. A second conveyor is then used for adding the hydraulic mortar, which is mixed with the previous mixture on the remaining part of the mixer (or 1/3). This mortar is previously manufactured by a second mixer located at the foot of the conveyor.

6. THE SITES

The process was defined and experimented in situ on several sites by ENTREPRISE MALET. First, the research was validated by carrying out various test sections on private road courses open to a great deal of heavy trucks, used as an overlay-regulating course and wearing course. Their behavior was found to be particularly encouraging contributing to progress in the knowledge of the mechanical operation of the process, and its resistance to the effect of tires, by means of relative and absolute variations of the quantities of hydrocarbon and hydraulic binders.

After this preliminary phase, public sites were carried out by ENTREPRISE MALET under the authority of the "Direction de la Voirie et des Infrastructures" of the "Conseil Général de la Haute-Garonne". So, this technique was tested on road of departmental highways network as a wearing-overlaying course for traffic types T3 to T2 or 200 to 250 heavy trucks daily average per direction.

Two procedures have been initiated:

- IVOR (Innovation Validée par Ouvrage de Référence - innovation validated by reference work), sponsored by DRAST in 2004 [8]
- Experiment program sponsored by the "SETRA" in 2006.

The first information obtained from site performance, shows the changes that have affected the technique.

6.1. IVOR RD 20 Haute-Garonne site (22 and 23 June 2004)

6.1.1. Presentation of site

This is the RD 20 highway from PR 4,500 to PR 5,100 between the commune of Saint-Caprais and RD 29 which includes a 450 m straight line section ended by an intersection. The road is 6 m wide. Totals traffic is 1100 vehicles per day of which 18 % is heavy trucks vehicles. This is traffic in class T3+ at the limit of T2, according to the French classification. The road was extensively deteriorated. The initial proposition was for overlaying with grave emulsion 6 cm thick, covered by a microsurfacing as wearing course.

The alternate innovative solution consisted in applying the cold asphalt mix product in an 8 cm thick coat in the current section and an 11 cm thick coat at the intersection and the entries to it. The scheduled tonnage is around 750 tons. The characteristic deflections were around 90 to 110 / 100th mm. It can be considered that the support was homogeneous.

6.1.2. Mix design

The proposed composition was composition 1 of the laboratory studies (see figure 1), with 3% hydraulic binder and 6.25% emulsion at 60% (producing a residual bitumen content of 3.75%). The total water content was a 6.25%.

6.1.3. Emulsion characteristics

This was a cationic emulsion at 60% (pH = 1,4). Viscosity (STV 2mm 40°C – NF EN 12846) was 36 seconds. The emulsion was stable (IREC = 171 NF EN 13075-1).

6.1.4. Site process

a) Producing controls

The results obtained prompted the following remarks:

- Mineral compositions: these compositions were relatively dispersed and generally corresponded to sandy skeletons (on average, +0.9% fines + 2% at 0.5 mm, + 6.9% at 2 mm, + 10% at 6.3 mm).
- The binder contents will also dispersed but the deviations were comparable to those habitually obtained with emulsion mixes. The average proportions were slightly lower than theoretical (- 0.15 %).
- The water contents were always lower than the theoretical value (-0.75 %). This is to be expected with emulsion techniques. The effect of product storage for several hours probably played a part.

b) Laying operation

Application was by half road course. It was preceded by the spreading of a tack coat in the proportions of 400 g/cm² of residual asphalt.

Figure 7 – Application on site by half road width

c) Observations made in the course of application

The vibrating roller of 10,5t was not used. Indeed, under its action, the coating cracked through to local fracturing. Accordingly, the material was compacted only by the tire compactor (3,5t per tire) which made 12 passes. The surface texture was relatively close (related to the results of the mineral compositions that were sandier than expected). The longitudinal joint was "crushed" by the cylinder before the spreading of the tack coat for the second lane. For each lane, the mix was homogeneous along the longitudinal profile. The cohesion increase was comparable to that of a grave emulsion coated or of an asphalt concrete with emulsion. The product cohesion was good, and it behaved well under traffic.

d) Results of compaction

The surface was regular in terms of flatness without any pneumatic signs. The two spread lanes were identical. The average void content was 12,8%, with very little dispersion (standard deviation = 1.1). These results are on the same order, but slightly better than those obtained usually with emulsion mix surface course.

6.1.5. Observations made after 1 week of traffic

The general coating was homogenous, without any stripping, deformation or local alteration.

6.1.6. *Average Texture Depth (ATD)*

The measurements made one week after reopening to traffic, and one year later, gave the following values:

Table 2 – ARD at 1 week and 1 year

	Grenade dir.			Saint Jory dir.			
	TG	axis	TD	TG	axis	TD	average
Average 1 week	0,75	0,55	0,60	0,75	0,45	0,55	0,58
Std dev	0,19	0,09	0,11	0,12	0,08	0,07	0,11
Average 1 year	0,70	0,55	0,60	0,70	0,65	0,70	0,65
Std dev	0,11	0,08	0,13	0,20	0,10	0,18	0,13

The average TD level was considered acceptable (comparable to a BBSG) but a great deal of heterogeneousness was observed. Values considered to be at the limit were observed. A stripping effect by vehicles occurred between the centre line and the left and right traces.

6.1.7. Core samples after 14 days

Core samples were consistent and of excellent strength, a situation rarely possible with grave emulsions or cold asphalt concrete mixes. Their condition made it possible to measure the thickness, respective mass and density, simple and indirect traction compression strength.

Table 3 – Simple and indirect traction strength

Simple compression strength				
Density	Fmax in KN	Height in cm	Diameter in cm	Rc in MPa
92,2	19,3	9,9	9,3	6,6
92,7	12,2	9,3	9,3	4,2
			Average	5,4
Indirect traction strength				
Density	Fmax in KN	Height in cm	Diameter in cm	Rtb in MPa
91,9	1,82	8,2	9,3	0,15
90,8	1,76	7,8	9,3	0,16
			Average	0,16

The density was higher than measured during work on the site (although the measuring method was different) and compression strength, even during indirect traction, was encouraging.

6.1.8. Samples after 1 year

Two samples of coating were sampled 1 year after application. On these samples, it was possible to extract cores having a diameter of 80 mm and a height of 200 mm. The direct tensile secant modulus (15°C; 0.02s NFP 98 260-1) was measured at 7800 ± 300 MPa for an average void content of 8.8%. This value places the product between cold hydrocarbon mix materials such as grave emulsion, with a modulus included between 2000 and 3500 MPa, and hot hydrocarbon mix materials with a higher modulus such as gravel asphalt (9000 MPa), and in fact corresponds to then value presented by a BBSG type (5500 to 7000 MPa).

6.2. Experimental program site RD 630 Haute-Garonne (17 October 2006)

6.2.1. Presentation of site

In this section, the RD 630 highway is a road with two lanes in the open country will slight backfill. It consists of two straight lines separated by an open curve on a slight banking angle. In the course of time, it has had several hydrocarbon overlayings. Traffic (permanent chanting) totals 4120 vehicles per day of which 12.2% is heavy trucks vehicles. The traffic is in the T2 class. The support was not deformed. TUS tests performed in both directions revealed rutting values of around 5 mm over the entire section. Deflections were very shallow and consistent between the edge and the centre line ($m + 2\sigma \approx 20/100$ mm). These values are to be related to the nature of the hydraulic grave support. However, there was extensive surface cracking related to this structure and the ageing of the asphalt concrete mix course in place


Figure 8: support fracturing

6.2.2. Mix design

The proposed formula was composition 5 of the laboratory studies (see figure 1), with 2.5% hydraulic binder and 6.7% emulsion at 60% (producing a residual asphalt content of 4 %). The total water content was a 6.75%.

6.2.3. Emulsion characteristics

This was a cationic emulsion at 60 %. The basic asphalt after recovery had a Ring and Ball value of 46,2°C, confirming the initial asphalt grade in class 160/220. The FRAASS point was at an excellent level (-22°C). The viscosity (STV – 2 mm 40°C) was 34 s and appeared to be well suited to the process. This emulsion was stable (IREC = 157) with good finesse (d average = 8.4 µm, with only 40 % greater than 10 µm).

6.2.4. Site process

The site was from PR 5,8 to PR 6,280. The weather was overcast and the temperature was 18°C at 11 a.m.

Figure 9 – Application on site by half road width

a) Producing controls

The results are given below and prompted the following comments:

- The fines contents were generally homogeneous (9.1 to 10.1%) and higher than the theoretical value by 1.1 %

- The 2 mm pass value generated fluctuation from 34.6% to 40.8%. It was higher than the theoretical 2%
- The 6.3 mm pass value was included between 63.7% and 69.8%, 3% higher than the theoretical value.
- The water content values appeared to be consistent (6.2 to 7%), 0.36% higher than the theoretical value
- The asphalt contents were also consistent for this type of product and their variation extended between 3.4 to 3.8%, but the average value after (extended) extraction was 3.64%, a deficit of 0.36% compared to the theoretical value. This situation which confirmed the observations of the laboratory appears to be customary with this type of mix.

b) Laying operation

The tack coat was consistent, in proportions of 600 g/m² residual and 3 to 4 liters/m² of gravel 6/10. The application and contacting equipment was similar to that of the initial trial. The chosen compacting plan was: 1 pass with a steel roller; 4 passes with a vibrating roller and 20 passes with a tire compactor.

Figure 10: Site compacting

The compacting results obtained were as follows:

First lane (morning)	Vm% = 13,9	σ = 1,1
Second lane (afternoon)	Vm% = 14,2	σ = 1.5

Values were consistent at a good level for a cold mix.

c) Observations made in the course of application

The (machine) mixing plant was set for 140 T/h. The edge of the script was correctly "squeezed" by the tire compactor (2 passes). The material was particularly visually homogeneous (total absence of mastic balls) and in terms of the water content. The cohesion rose very quickly. The developed thickness was 9 cm on average.

During the afternoon less water bleeding was observed compared to the end of the morning. After compacting, bleeding was considered to be normal. The axial joint was a success even if, locally, the appearance was slightly "open" (gritting), due to the fact that the morning joint was not compacted over 10 cm. We observed that performance under traffic was very good. The surface primarily seemed to be closed, but the mosaic soon appeared under the effect of the vehicles. In spite of site stoppages and waiting times, the material remained wet and easy to handle. Even after a 4 hour delay between the applications of the 2 lanes the centre joint remained suitably closed during final compacting.

6.2.5. Average Texture Depth (ATD)

The TD were measured after two weeks of traffic.

Table 4 – ATD measurements after two weeks of traffic

	Montauban / Castres dir.			Castres / Montauban dir		
	Min	Max	Average	Min	Max	Average
After 2 weeks	0,48	0,78	0,56	0,51	0,78	0,61

The results were homogeneous. The macro texture was relatively slight at a young age but was deemed to be acceptable.

6.2.6. Lengthwise Profile Analyzer (LPA)

The evaluation of the even level quantity is quantified in the Wave Band Notation (WBN) system. The results of the WBN LPA are synthesized in the following

Table 5 - Lengthwise profile measured before and after the work

Before work			
Dir +	PO 96 % ≥ 5	Average value: 7	Minimum value: 4
	MO	Average value: 9	Minimum value: 8
Dir -	PO 91 % ≥ 5	Average value: 6	Minimum value: 4
	MO	Average value: 8	Minimum value: 7

After work			
Dir +	PO 87 % ≥ 5	Average value: 7	Minimum value: 2
	MO	Average value: 8	Minimum value: 7
Dir -	PO 100 % ≥ 5	Average value: 7	Minimum value: 5
	MO	Average value: 8	Minimum value: 5

Starting from an even support level, no improvement was observed and the average values were of the same order, while the minimum values were affected by the last few meters of the site, at the junction with the adjacent section. The level reached was considered as correct in the current section.

6.2.7. Skid resistance measurements

These were made using the ADHERA trailer belonging to the "Laboratoire Régional des Ponts et Chaussées de Bordeaux" within two weeks after application.

The longitudinal breaking force coefficient obtained were as follows:

Table 6 –Skid resistance measurements

		National envelope for all coatings	Cold asphalt mix
LFF	40 km/h	0,36 – 0,70	0,61
LFF	60 km/h	0,25 – 0,55	0,41
LFF	80 km/h	0,17 – 0,44	0,29

Right from the start, the wearing course offered a good micro-texture and the level of the macro-texture was situated more or less at the average of the national envelope.

6.3. Overview of job sites

The site work on RD630 made it possible to put into application the learnings obtained by observing the site on the RD20, which, 3 years after implementation, has behavior under traffic conditions unanimously considered to be satisfactory. The observations made during each projects made it possible to validate the concept of this asphalt mix for moderate traffic roads. With performance that is radically different from cold mixtures based only on hydrocarbons come of it is comparable to a BBSG, without any alteration of the absorption of any significant variations in thickness. Its performance at a young age proved to be satisfactory, and it can be used under good conditions. Regular monitoring will make it possible to evaluate in the course of time, the development of the macrotexture, the adherence: the transverse profiles and above all the fracturing, especially when the support is hydraulic or the risk of cracks rising is high.

7. CONCLUSION

The road industry is in the use or oblique committed to an approach involving conformity alignment with the requirements of sustainable development. This development can be accepted in a long-term strategy which combines technical, economic and social progress and the preservation of the environment. There is no doubt in its commitment to sustainable development. Proof is the move from hot mix techniques to cold mix techniques, including warm mixes asphalt as part of a progression that is compatible with the requirements of involved partners. In a context like this, it is an important technological leap whose goals are based on a compromise designed to preserve the advantage of cold mixes, of achieving a level of performance comparable with that of hot mixes, under economically favorable conditions.

Laboratory studies and experimental tests resulted in the association of properties, somewhat contradictory, obtained by the precise definition of the components in terms of their nature (use of binders with complementary performance capabilities), proportions and mix preparation sequences, enabling them to satisfy conditions of rigidity and flexibility at the same time.

Although It may be essential to optimize the knowledge to control the concept in any possible applications, whatever the conditions of use of a road structure, this material is already suitable for use, as of now, whether in industrial, emerging or developing countries.

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