



# Nanostructured Bitumen, better mechanical performance and for extreme climates



Source: Ferrovial Highways – 407 ETR, Toronto, Canada

**Leticia Parra Rodríguez, Ditecpesa Technical Manager**

Nanostructured Bitumen, better mechanical  
performance and for extreme climates

ditecpesa  
asphalt products



Improve a  
property

No higher  
price



# What could be an agent which mainly damage pavements ?



- When snow and salt had been spreaded, the pavement is plenty of detached aggregates.

- ✗ ICE
- ✗ High salt concentration
- ✗ Snowplows which have blades.
- ✗ Water resistance



- It is demonstrated that the effect of spread salt on the pavements is very negative.



# How is it possible to improve this situation?





- The water effect and more if the effect is made by water with salt, produce the lack of cohesion between bitumen and aggregates.

✗ Result: aggregates stripped around the pavements.



Source: Ferrovial Highways, Burgos, Spain.



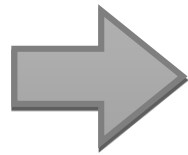
- It is necessary to improve the bitumen-aggregate bonds
- A physical mix achieved by temperature and mechanic energy, due to bitumen and aggregates do not work well.



Source: Ferrovial, London, UK.



- Amines are currently used.
- They link by ionic bonding which is not strong enough.



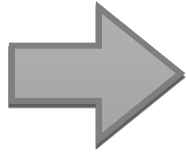
**Covalent bonds are  
stronger**

- ✓ Solution: Modification with nanomaterials and special polymers.





# How can we see this interaction?



Submit deeply by the water action  
pavement specimens

Conventional  
Bitumen

Nanostructured  
Bitumen



# What have we improved?



✓ Salt attack

✓ Water attack

✓ Ice attack



Source: Ferrovial Highways – 407 ETR, Toronto, Canada



- The better interaction between aggregate – bitumen, the better compaction.

- ✓ Higher density
- ✓ Lower period of time, to achieve the optimum density



Source: Ferrovial – Amey, UK





# Nanostructured Bitumen



Source: Ferrovial Highways – M4-M6, Kilcock, Ireland



# Nanostructured Bitumen

- Helps compacting in cold weather conditions and improving asphalt properties.
- Same quality and way of working as with conventional bitumen.
- Improved properties:
  - ✓ Cohesion
  - ✓ Adhesion
  - ✓ Better workability
  - ✓ Better Immersion – Compression Test results (ASTM D1075)
  - ✓ Better Boiling Water Test results (ASTM D3625)



# Nanostructured Bitumen

- ✓ Boiling test (ASTM D3625)
  - AC16Surf 50/70S



Conventional Bitumen



Nanostructured Bitumen





# Nanostructured Bitumen

- ✓ Boiling test (ASTM D3625)
  - BBTM11B PMB 45/80-60



Conventional Bitumen



Nanostructured Bitumen



# Nanostructured Bitumen

- Help in Challenges:

- ✓ Transport to projects: Distances are very important, with this bitumen is possible to cover longer distances or manufacture at lower temperatures with same distances.
- ✓ Compaction: It is easier to compact with this bitumen due to the compaction will be fine in less time. Are only needed less passes to compact as with a conventional bitumen.
- ✓ Salt/Ice/Water resistance: pavements life become longer, due to the better involve bitumen-aggregate.



Nanostructured Bitumen, better mechanical performance and for extreme climates

ditecpesa  
asphalt products



# 31.08.2017 Project



Ferrovial @ferrovial · 31 ago.

Ditecpesa develops an asphalt bitumen specifically tailored to resist extreme climates. [bit.ly/2bBGUhh](https://bit.ly/2bBGUhh)



Ferrovial  
@ferrovial

Seguir

Through #innovation our subsidiary Ditecpesa has developed an asphalt bitumen that resists extreme climates 🌨️❄️☀️



Ditecpesa develops an asphalt bitumen specifically tailored...  
Ditecpesa, the Ferrovial subsidiary, has developed an asphalt bitumen specifically tailored to resist extreme weather conditions.  
[ferrovial.com](https://ferrovial.com)

RETWEET

1

ME GUSTA

3



23:35 · 12 sept 2016





# Navacerrada Project

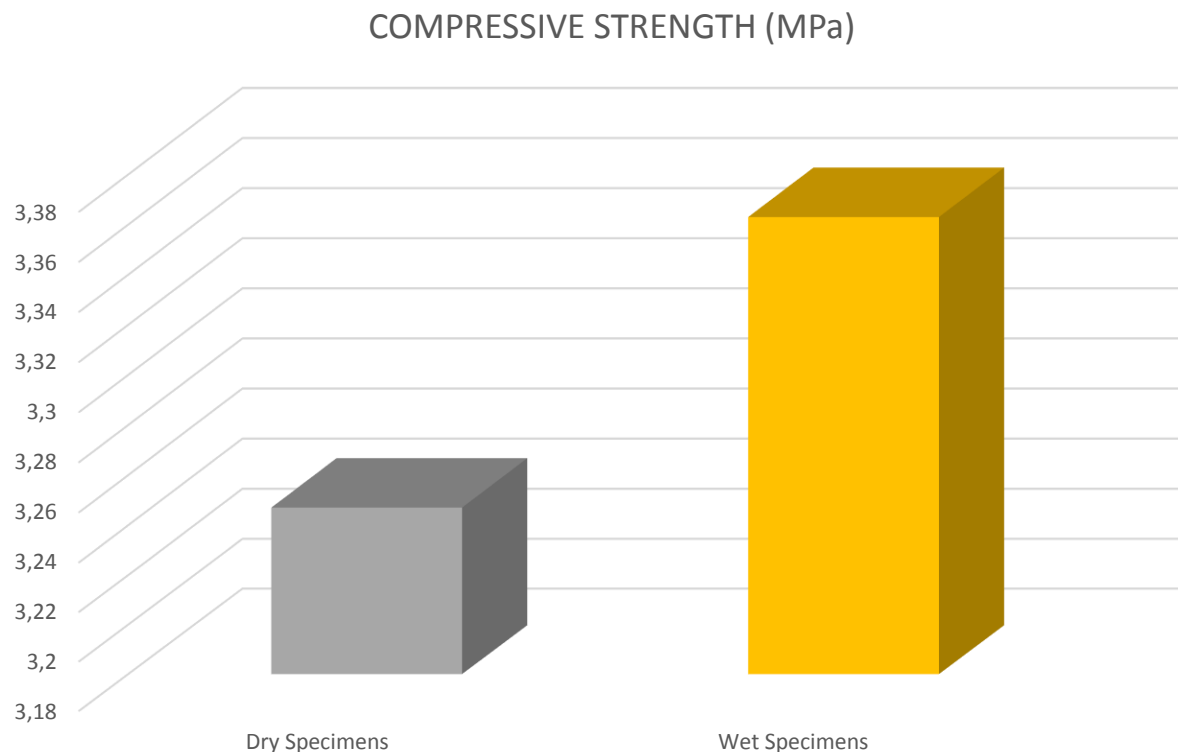
- M-601 Road - Navacerrada  
Mountain Ski port. (1880 m)  
26 Octobre '16.
- Project carry out with  
Nanostructured Bitumen.
- Area in Green with big slope.





# Nanostructured Bitumen

✓ Immersion – Compression Test (ASTM D1075) – Navacerrada Ski Port

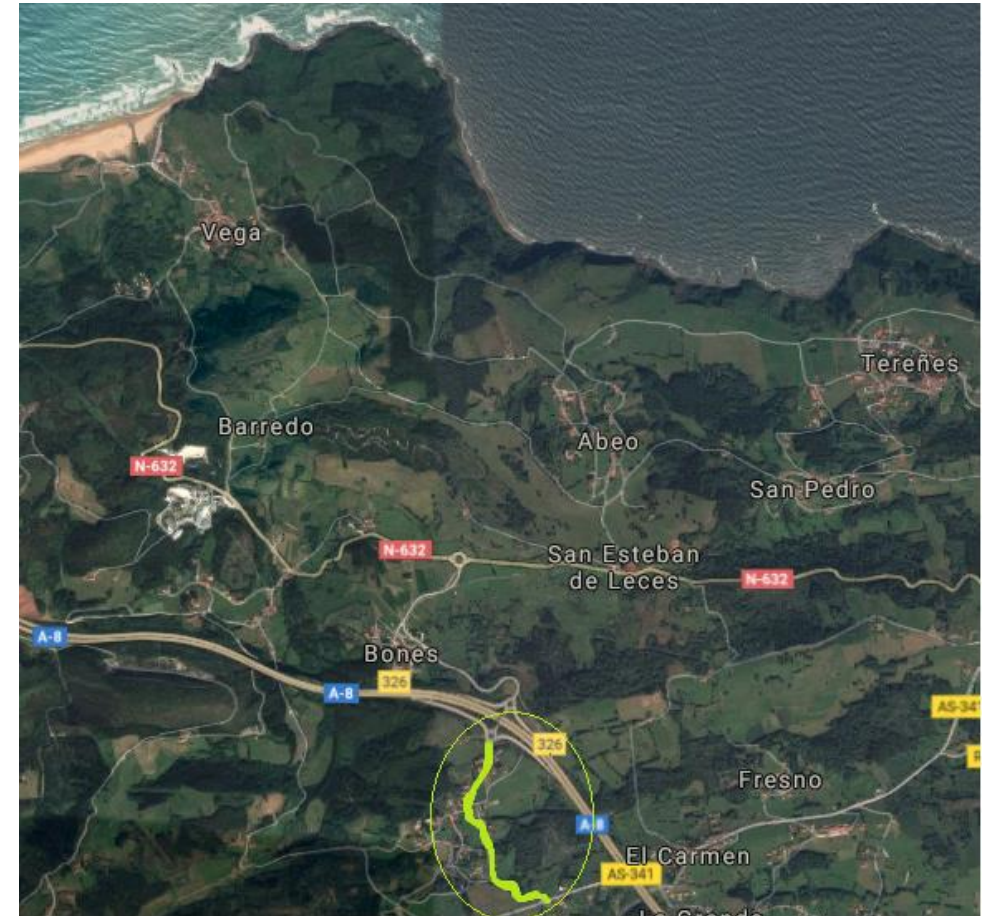






# Ribadesella Project

- North of Spain Road, Asturias, between mountains and near the Cantabric Sea.
- Carried out under Winter conditions (22 January '17)

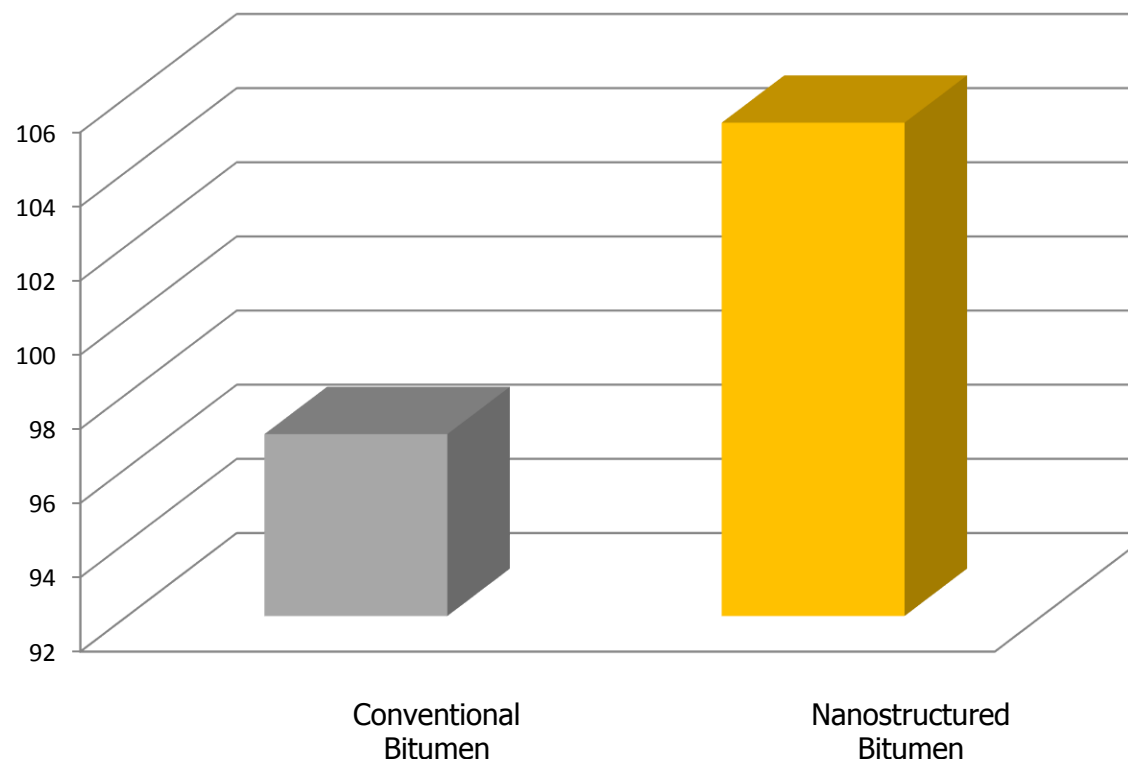




# Nanostructured Bitumen

✓ Immersion – Compression Test (ASTM D1075)

- AC16 Surf 50/70S

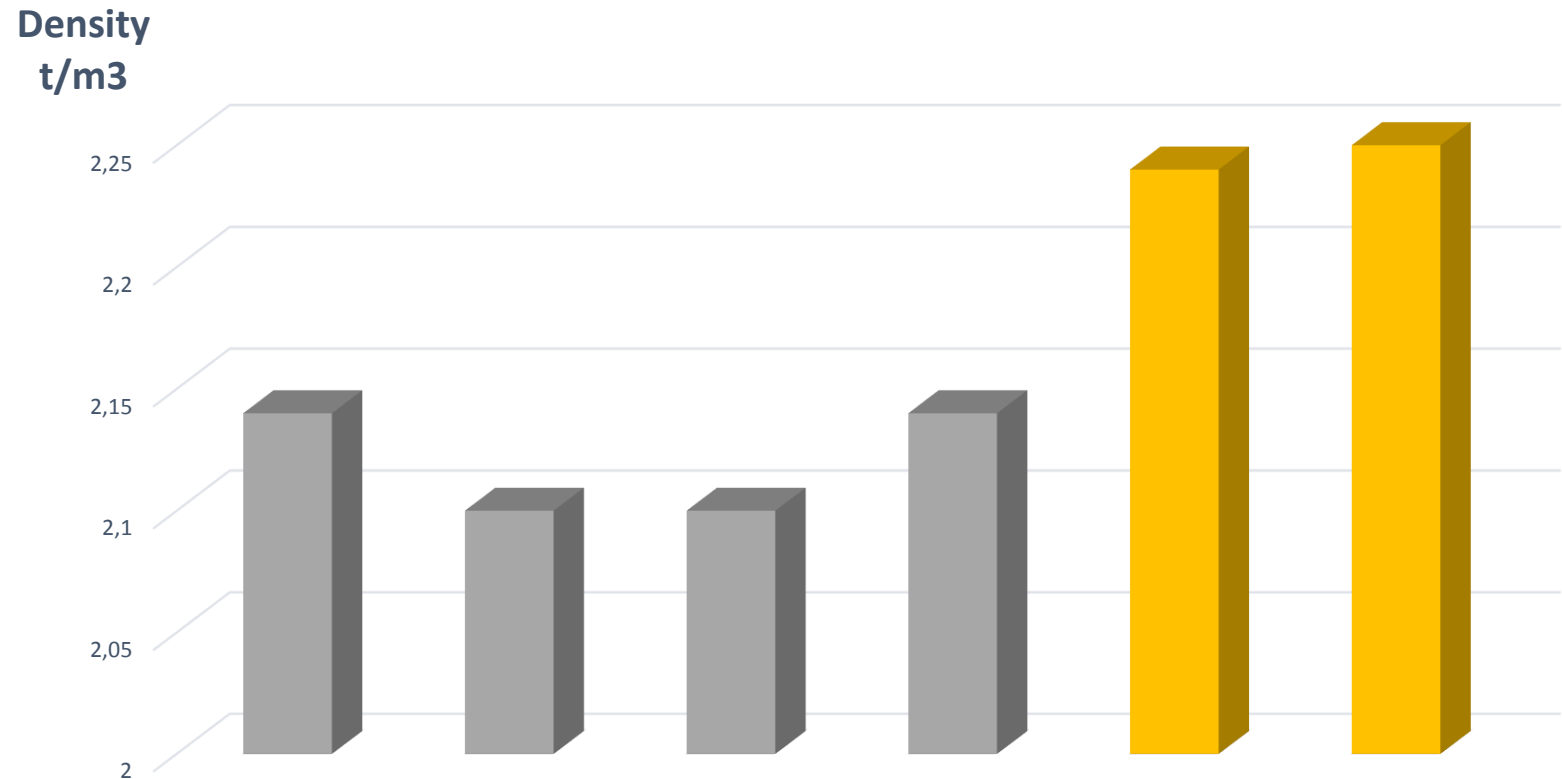






# Ribadesella Project

- Compaction test:
  - Grey: Conventional
  - Yellow: Nanostructured Bitumen
- AC 16 Asphalt Mix





# A2-Highway Project

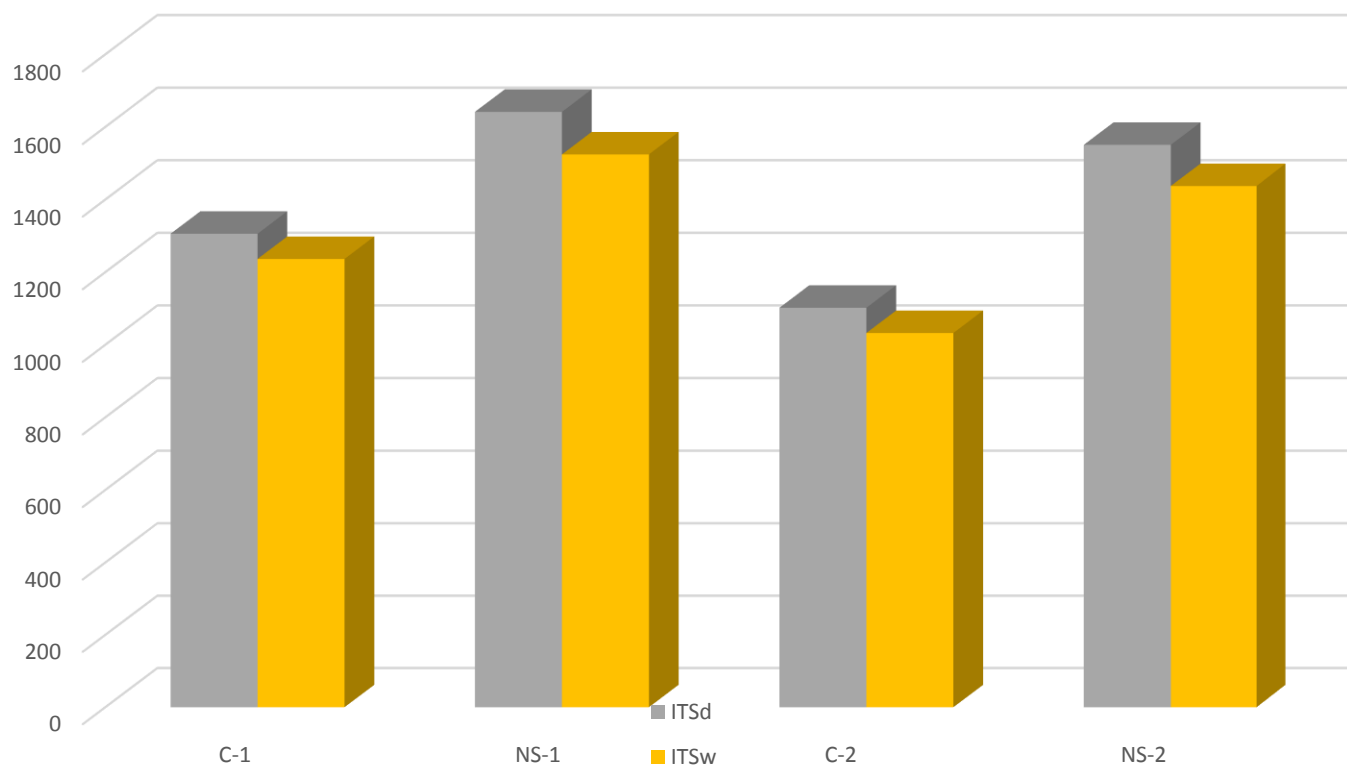
- A2 Highway, Zaragoza, (Spain).
- Applied June '17





# Nanostructured Bitumen

✓ Immersion – Compression Test (ASTM D1075) – A2 Highway



@jjavier\_garciap / @Leticia\_ParraR



# Canadian tests

- Developed on August, 2017, to Projects in Canada.
- Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage – AASHTO T 283-07 (2011)

Moisture Sensitivity Data							AASHTO T-283
Mix: Ditecpesa/AME SP12.5FC1 D12 Cat D							exp. Global Number: 276720-1
Sample Remarks: Lab. Crushed Stone - 0.05% Ditecpesa Compound							Date sampled: July 31, 2017.
Sample		1	2	3	4	5	6
Diameter,mm	D	150	150	150	150	150	150
Thickness,mm	t	95.0	95.0	95.0	95.0	94.9	94.9
Dry mass,g	A	3900.2	3904.3	3906.8	3902.2	3905.5	3905.7
SSD mass, g	B	3923.0	3928.1	3928.2	3923.9	3928.1	3927.1
Mass in water,g	C	2293.0	2292.1	2293.4	2288.0	2294.0	2294.3
Volume, cc (B-C)	E	1630.0	1636.0	1634.8	1635.9	1634.1	1632.8
Bulk Sp Gravity (A/E)	F	2.393	2.386	2.390	2.385	2.390	2.392
Max Sp Gravity	G	2.562	2.562	2.562	2.562	2.562	2.562
% Air Voids (100(G-F)/G)	H	6.6	6.9	6.7	6.9	6.7	6.6
Vol Air Voids (HE/100)	I	107.7	112.1	109.9	112.8	109.7	108.3
Load,N	P	X	X	X	15938.9	15741.0	15938.9
Saturated/Conditioned							
Thickness,mm	t <sup>I</sup>	94.9	94.9	94.9			
SSD mass, g	B <sup>I</sup>	3981.2	3989.6	3989.7			
Mass in water,g	C <sup>I</sup>	2350.8	2353.2	2354.6			
Volume, cc (B <sup>I</sup> -C <sup>I</sup> )	E <sup>I</sup>	1630.4	1636.4	1635.1			
Vol Abs Water, cc (B <sup>I</sup> -A)	J <sup>I</sup>	81.0	85.3	82.9			
% Saturation (100J <sup>I</sup> /I)		75.2	76.1	75.4			
% Swell (100(E <sup>I</sup> -E)/E)		0.025	0.024	0.018			
Load,N	P <sup>I</sup>	16532.5	16268.7	16796.3			
Dry Str. (2000P/(tDp))	Std				712.1	704.0	712.8
Wet Str. (2000P <sup>I</sup> /(t <sup>I</sup> Dp))	Stm	739.4	727.6	751.2			
Visual Moisture Damage (0 to 5)		1	1	1	slight stripping observed		
Cracked/Broken Aggregate ?		< 2%	< 5%	< 3%	slightly cracked aggregates		
Average Dry Strength (kPa)		709.6					
Average Wet Strength (kPa)		739.4					
TSR,%		104.2					





# Conclusions

- ✓ Specific Bitumen for extreme climate
- ✓ Improved properties, big resistance at salt chemical attack.
- ✓ Increase box flow return.
- ✓ Reinforcement could be delayed in time.
- ✓ Compaction design is reached before.
- ✓ Reduction of laying times.







# Worldhighways



## BITUMEN TECHNOLOGY

**RIGHT** Ditecpesa developed a special grade of PMB asphalt for use on a Spanish race track **VAL DE LEP**. A special coloured binder has helped deliver a light coloured asphalt for two road tunnels in Luxembourg **VAL DE LEP**. Ditecpesa has completed work on its new laboratory

teams," explained Michael Feist of contractor Karp-Kneip.

Shell Bitumen supplied a low temperature version of its clear synthetic binder Shell Moghale C to pave the 2,966m-long Grotti Tunnel and the 1,850m-long Stäffler Tunnel, both of which are twin-bore. The lower temperature formulation allows a decrease in laying temperature of up to 30 °C; this in turn reduces emissions from the asphalt significantly, providing a more comfortable working environment for those laying the pavement.

In total Karp-Kneip laid 90,000m<sup>2</sup> of the



## BITUMEN TECHNOLOGY



Ditecpesa has had success with special bitumen types for specific applications in challenging conditions

Extreme Climate Bitumen contains small amounts of nanomaterials, chemical additives and special polymers which give it reduced sensitivity to water. Ditecpesa says that it has improved the bond between the bitumen and aggregate, improving the performance of the pavement.

"We are working hard to know and deeply understand the chemical interactions between aggregates and bitumen. That is the way to get a technology jump in a very competitive market, bringing a huge improvement in performance," said Paredilla.

The next steps will see the Madrid regional government and Ditecpesa carrying out ongoing testing and monitoring of the trial section of road. Ditecpesa sees the use of Extreme Climate Bitumen in parts of the US, Canada, Northern Europe and in the Mediterranean, South America, Asia and Pacific Oceania.

Nanostructured Bitumen, better mechanical  
performance and for extreme climates

ditecpesa  
asphalt products



Many thanks  
[www.ditecpesa.com](http://www.ditecpesa.com)  
[ditecpesa@ferrovial.com](mailto:ditecpesa@ferrovial.com)

