

# LISBOA 2010 MAY 25/28 16th World Meeting

## STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

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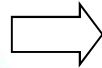
Santiago Gil Redondo ( Ditecpesa, Spain)  
José Ignacio Amor ( Universidad de Alcalá, Spain)  
Jesús Felipo ( Pavasal , Spain)  
Andrés Costa ( Asfaltos y Construcciones Elsan, Spain)  
Christian Cortés ( Servià Cantó , Spain)  
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Fernando Valor ( CIESM, Spain)  
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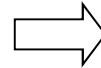
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# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Background



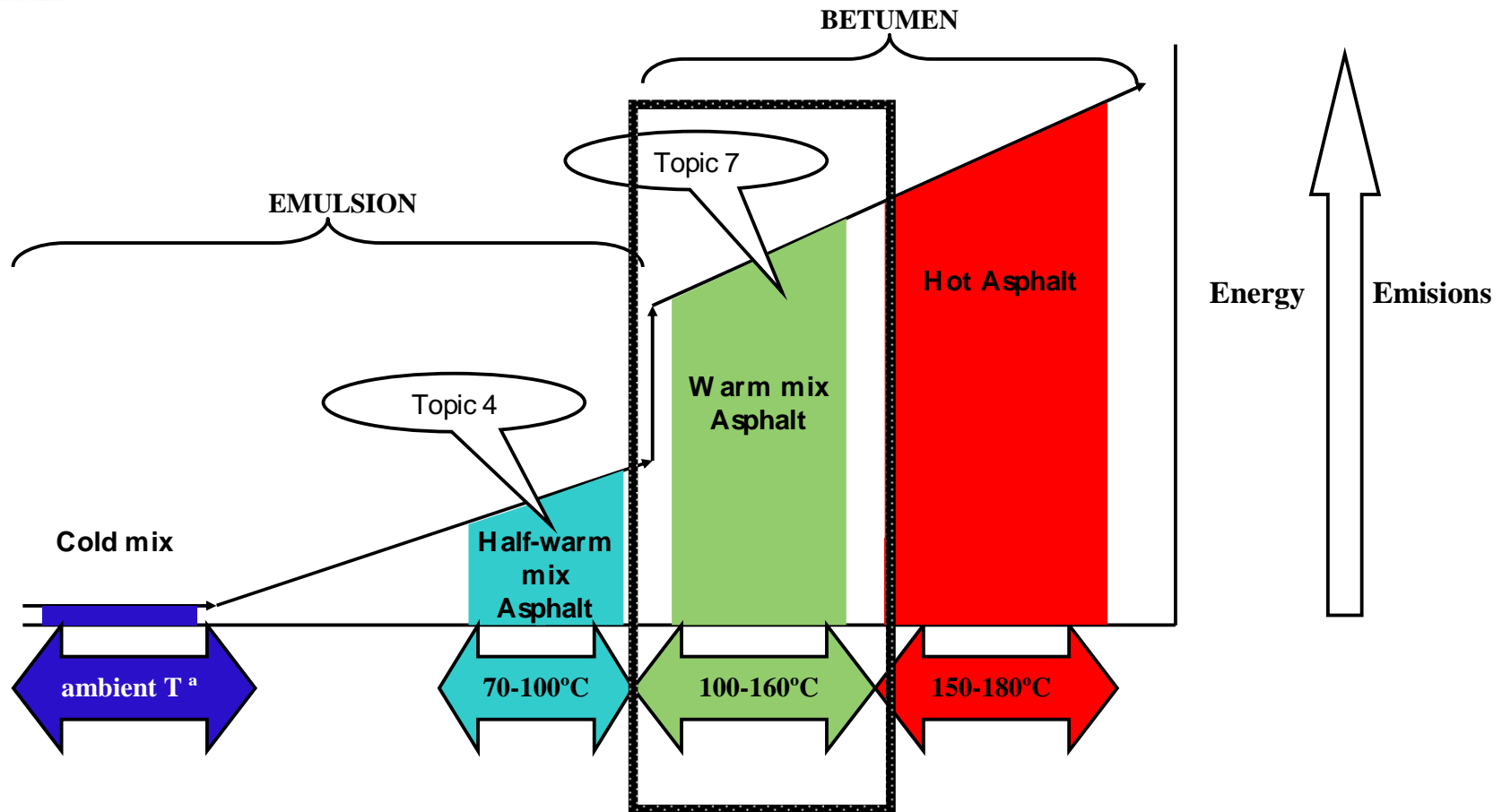
Topic 7:  
Warm bituminous mixtures



## Structure

1. Topic 7 - Fenix Project: Warm bituminous mixtures
2. Waxes
3. Techniques used: DSC and DSR
4. Results
5. Conclusions

## Topic 7 - Fenix Project: Warm bituminous mixtures

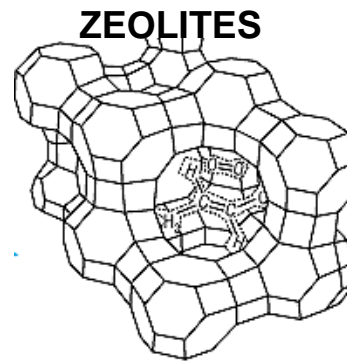
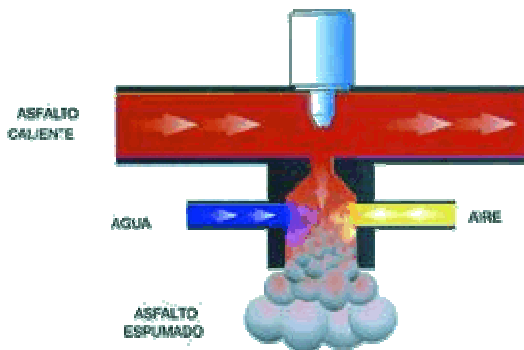


## Topic 7 - Fenix Project: Warm bituminous mixtures

Waxes: affect bitumen viscosity

Additives: affect the bitumen-agregate contact angle

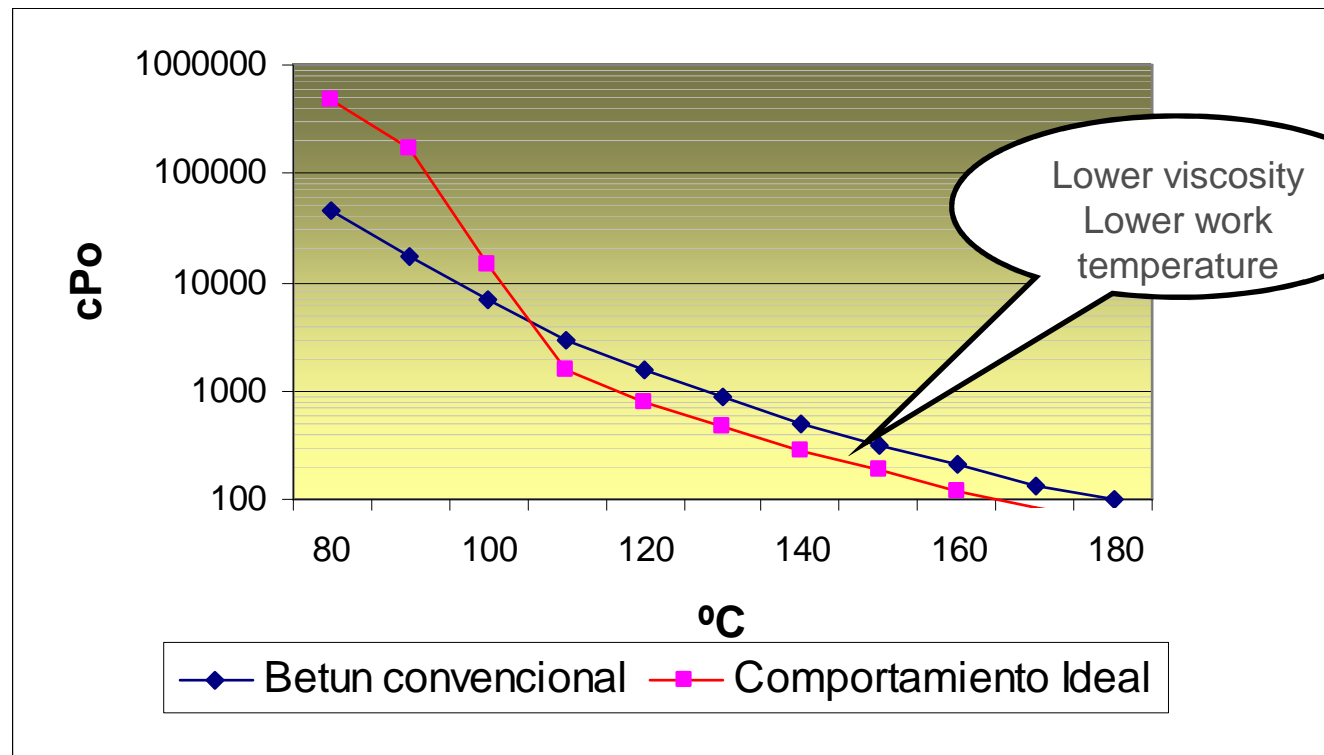
Foam process



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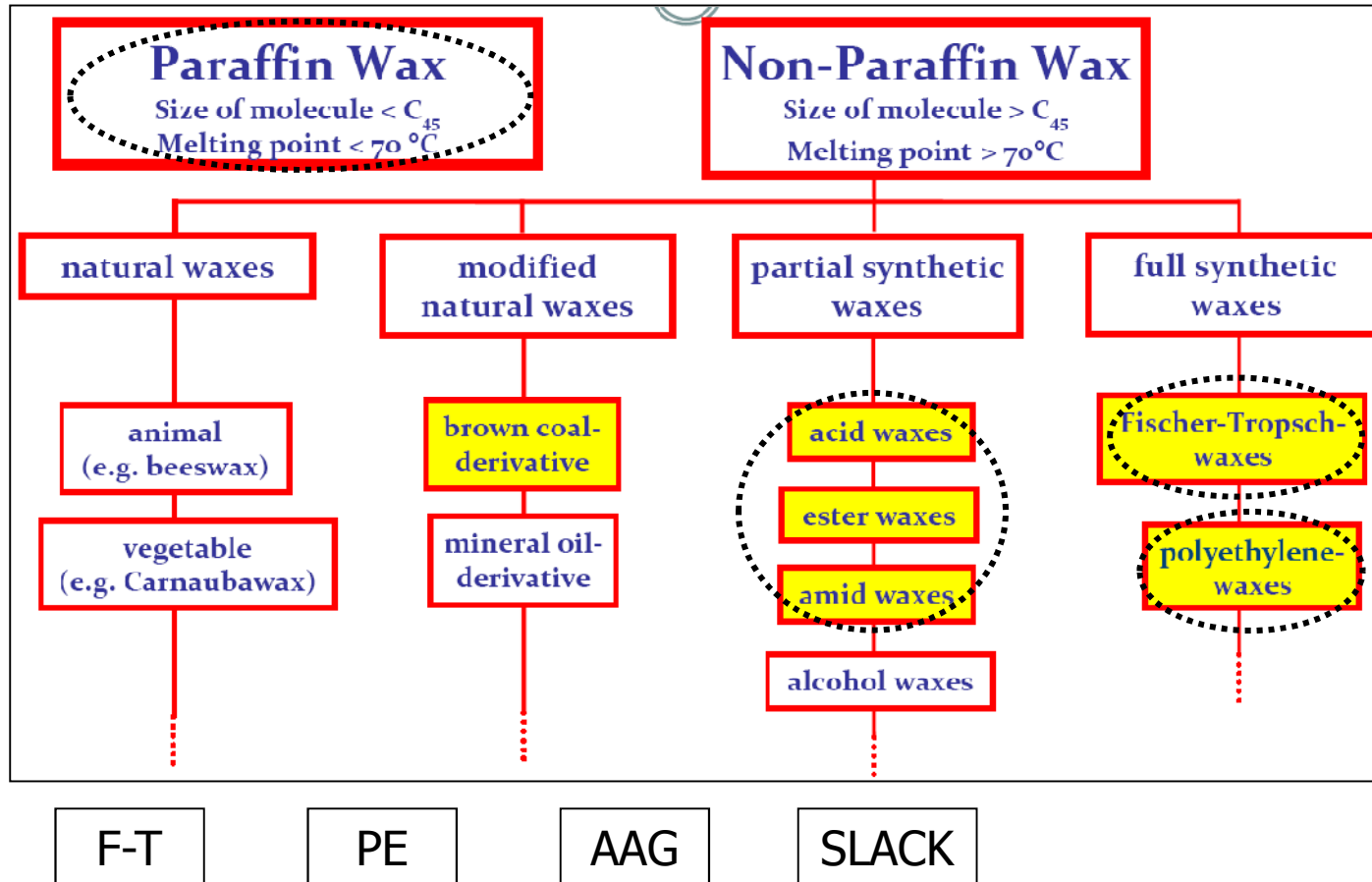
## Waxes

Waxes modify the bitumen rheology



# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Waxes

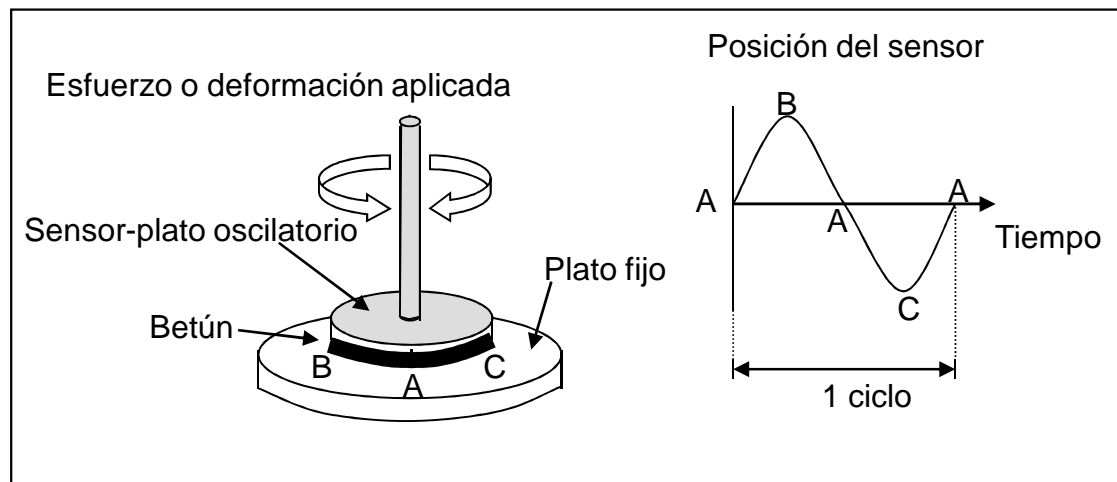
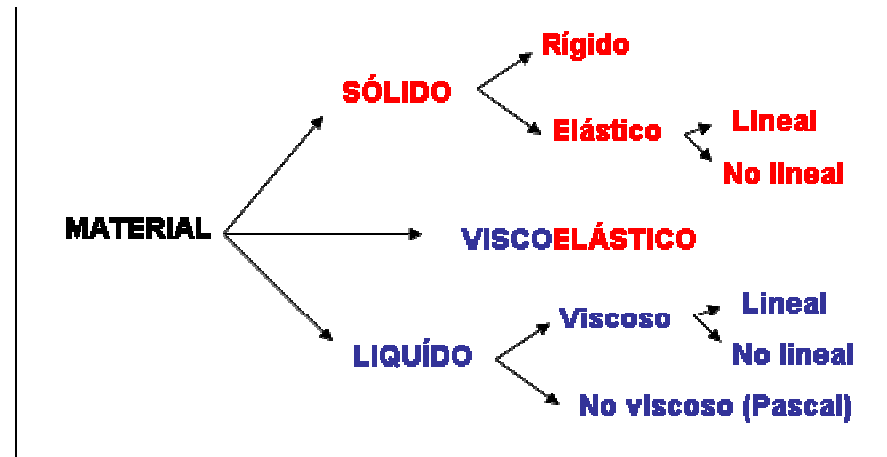


# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Techniques: DSC y DSR

### DYNAMIC SHEAR RHEOMETER (DSR)

Rheology is defined as the science of the deformation and flow of matter



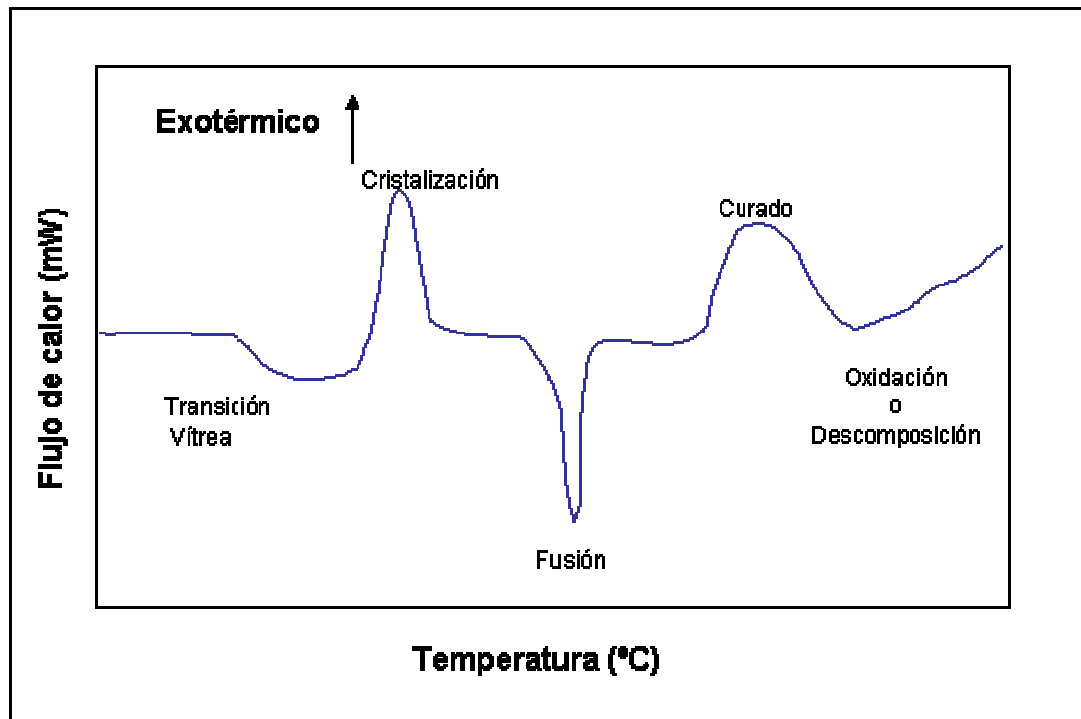
# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Techniques: DSC y DSR

### DIFERENTIAL SCANNING CALORIMETRY (DSC)

DSC is a thermoanalytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature

The equipment measures heat flow that are connected with physical-chemical phenomena that happen in the bitumen when it is heated or cooled



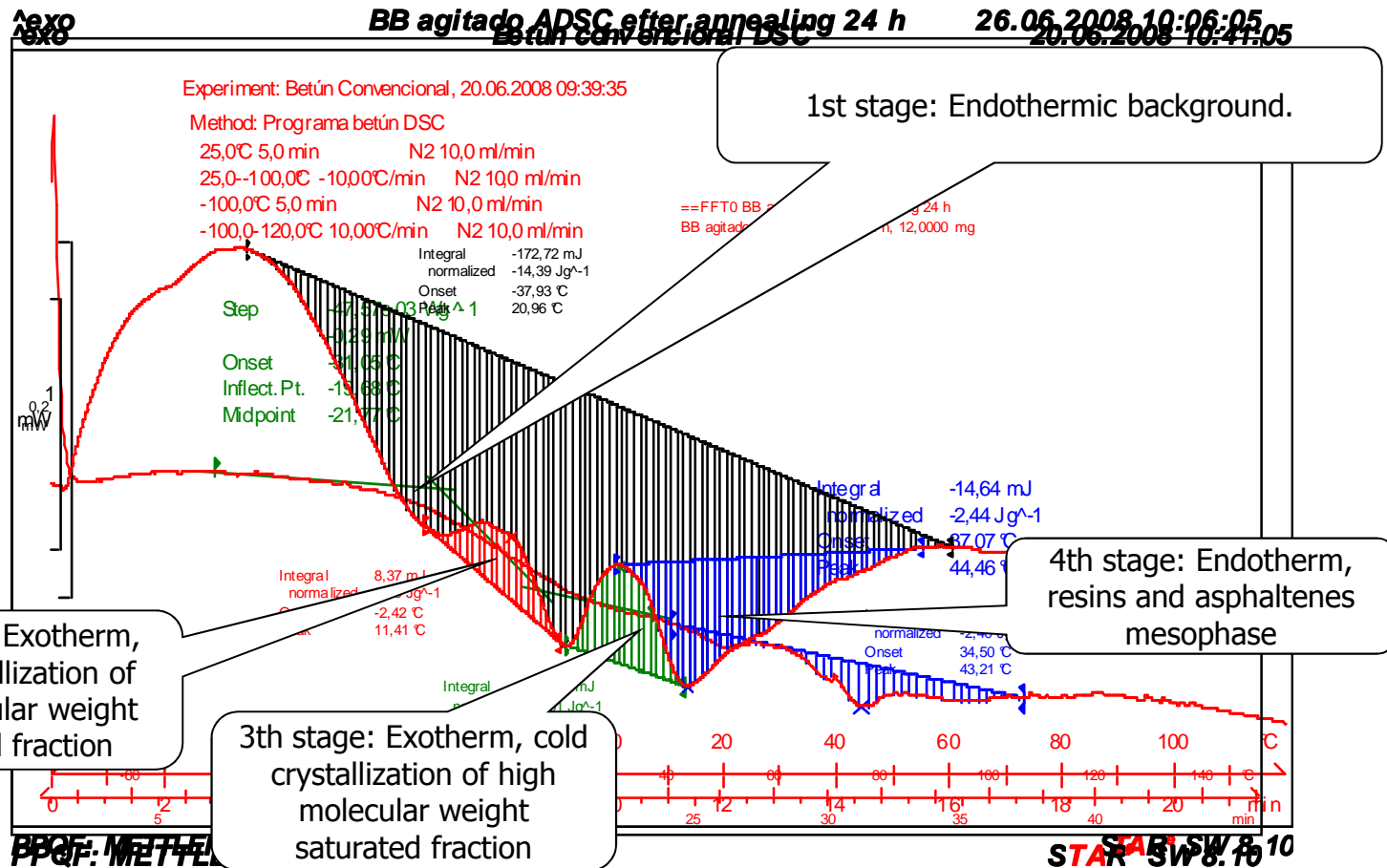
MDSC: modulated DSC  
Remove reversing transitions from non-reversing ones

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## Techniques: DSC y DSR

B 60/70

J-F. Masson, G.M. Polomark

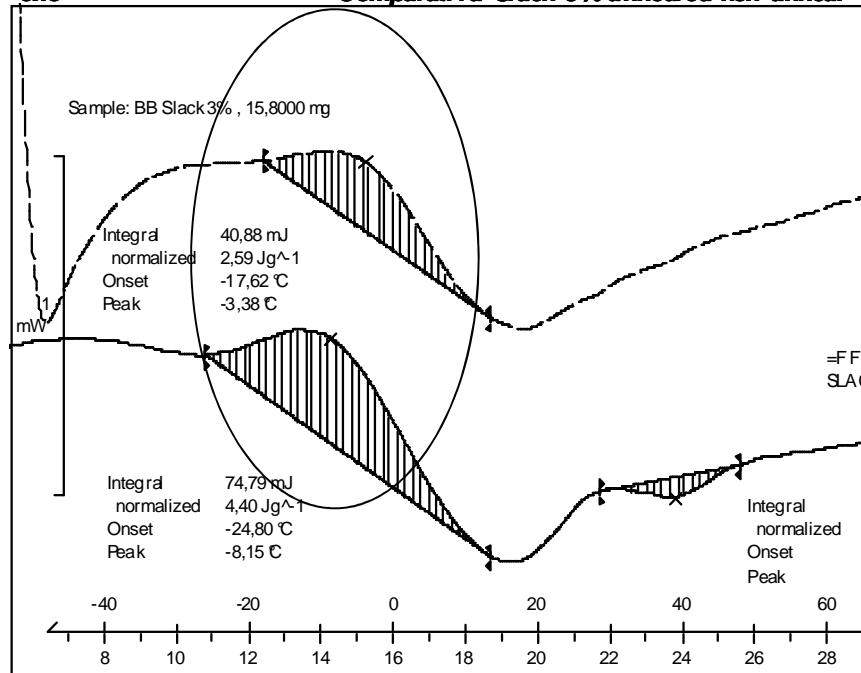


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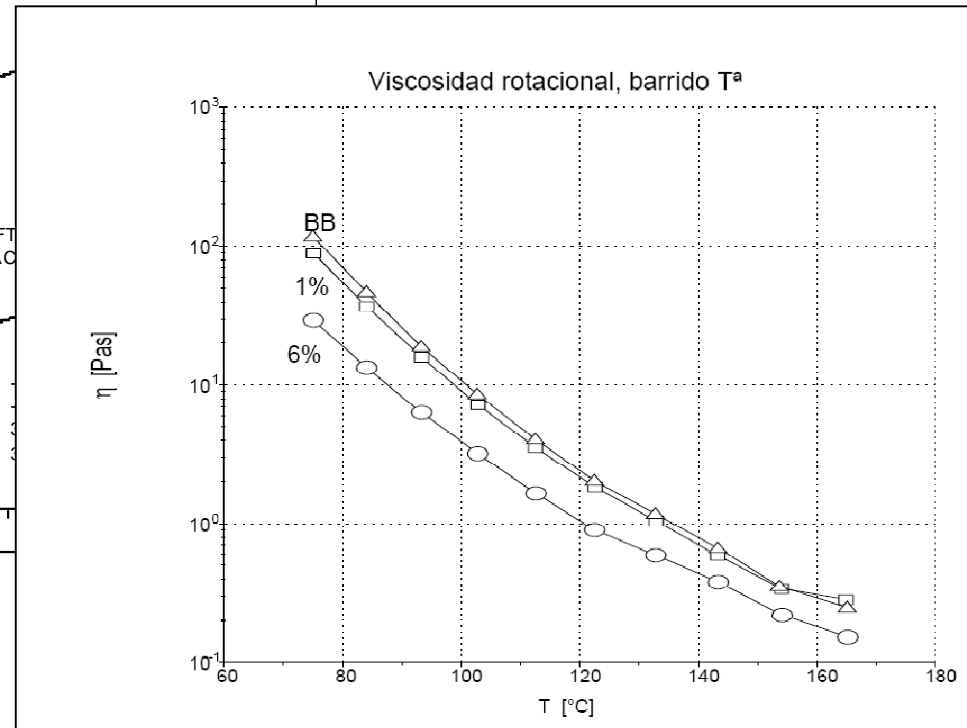
## Results

Slack wax

Comparativa Slack 3% annealed non anneal 11.07.2008 11:16:10



PPQF: METTLER



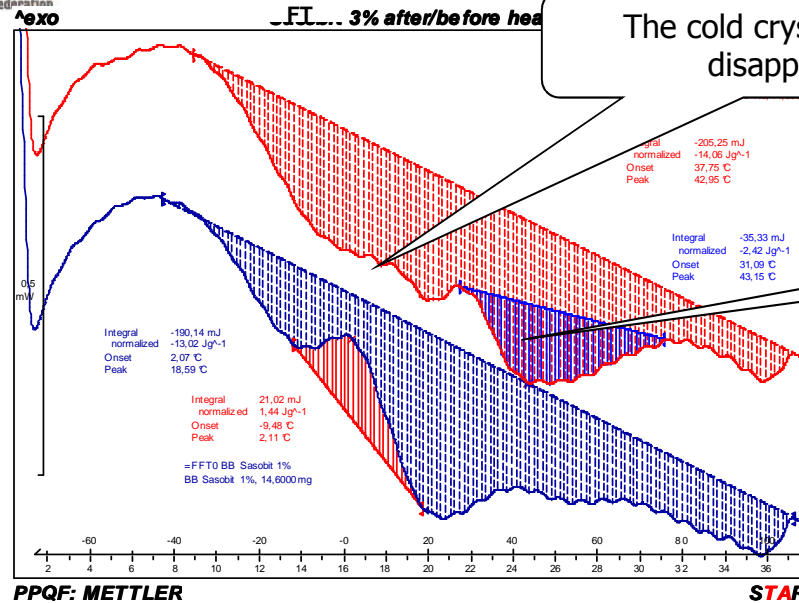


Sharing the road

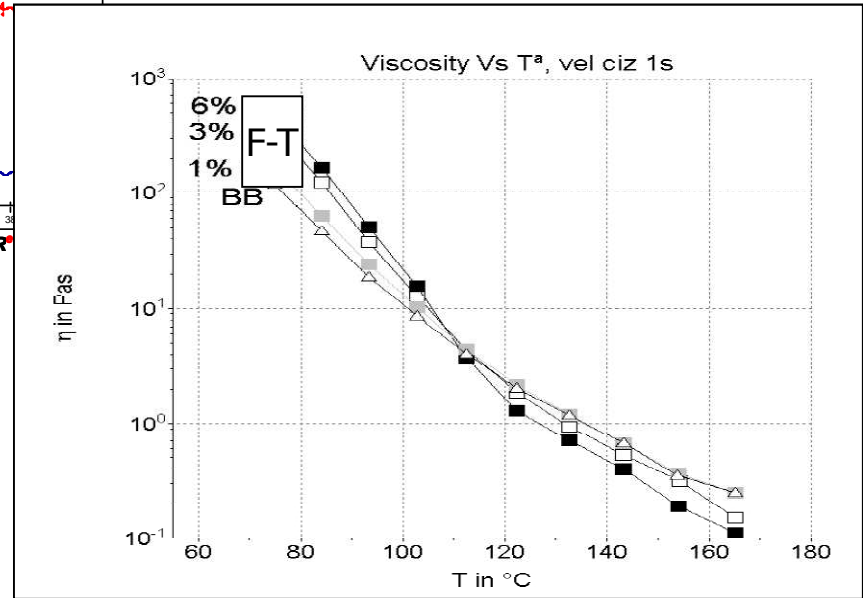
16th World Meeting  
International Road Federation

# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Results



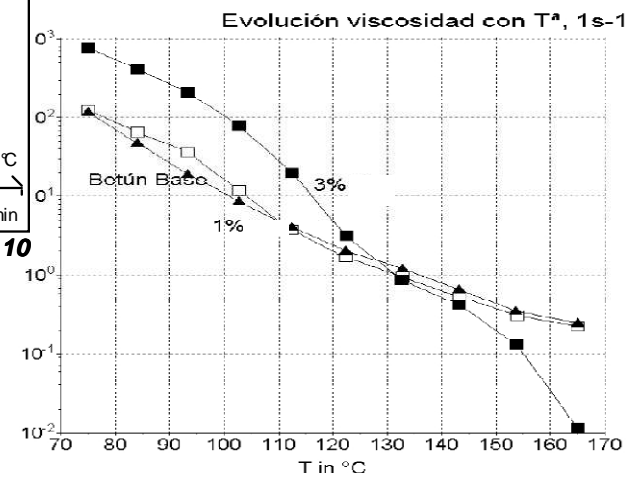
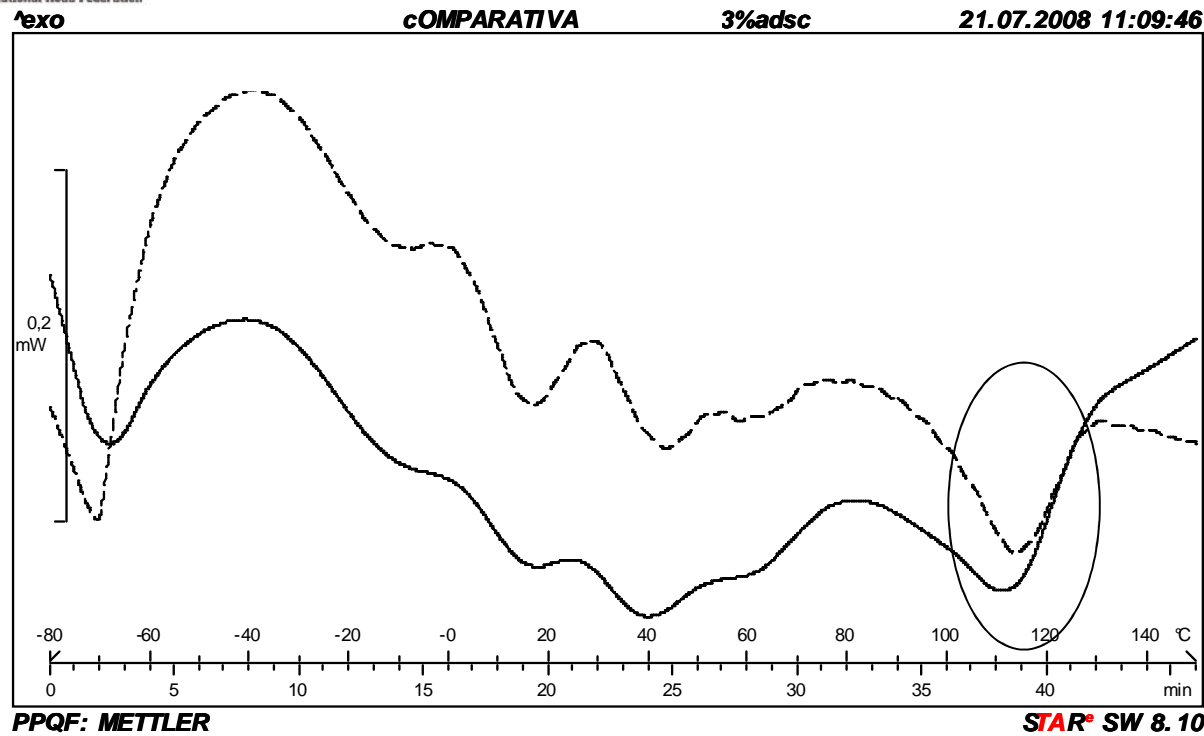
F-T wax



# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Results

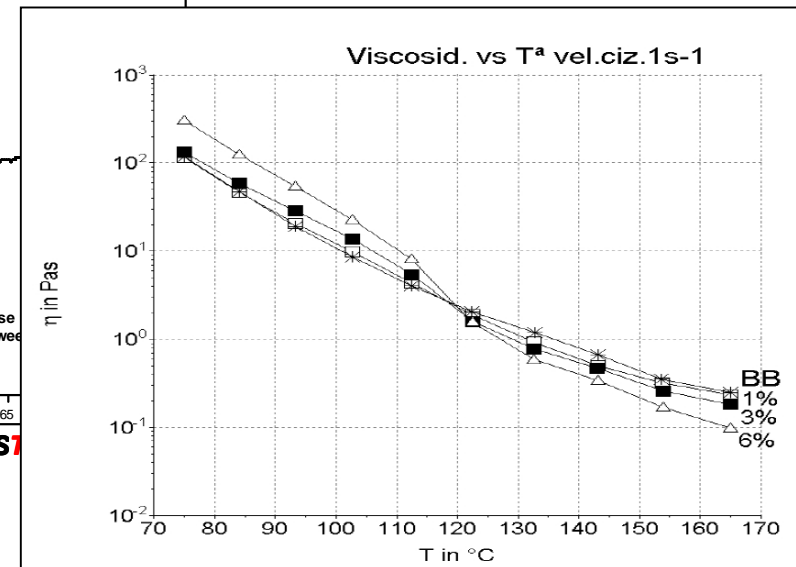
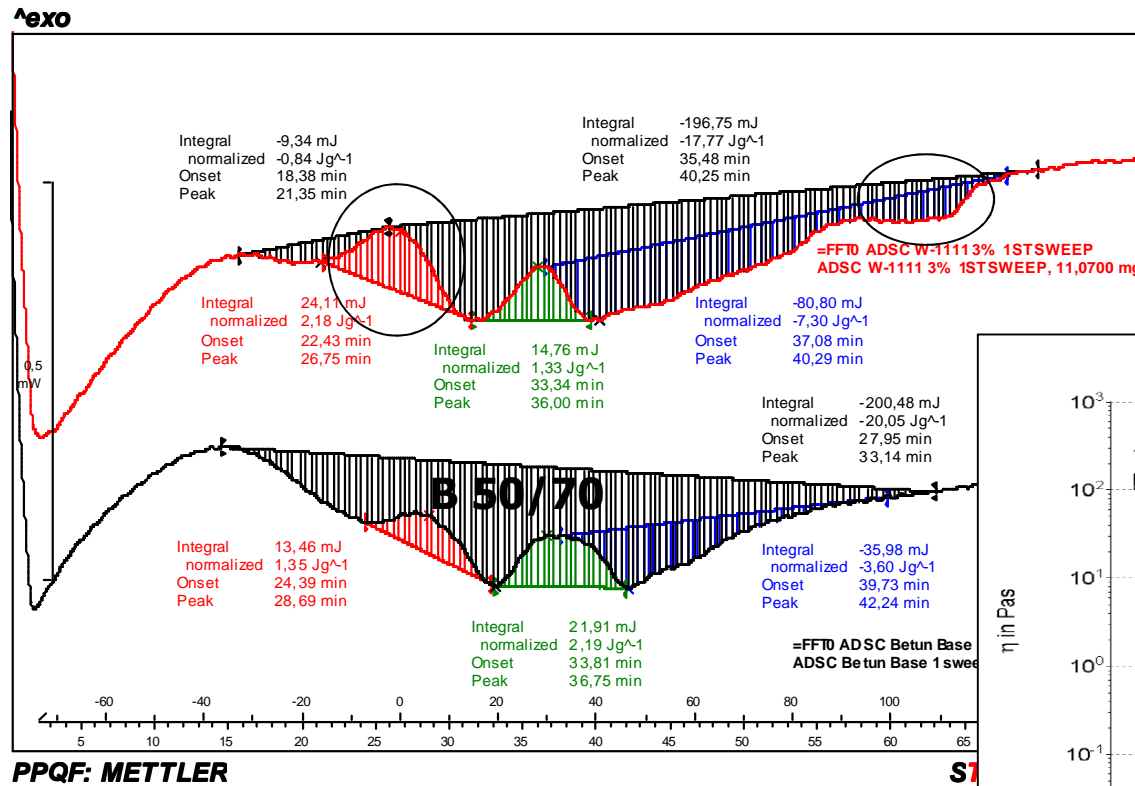
AAG wax



# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Results

PE wax



# STUDY OF ADDITIVES TO REDUCE THE VISCOSITY OF THE BINDER AT HIGH TEMPERATURES

## Results

Cera	wt%	$[G^*]/\text{sen}\delta$ a max T <sup>a</sup> , $[G^*]/\text{sen}\delta =$ 60°C (Pa)	$[G^*]/\text{sen}\delta =$ 1kPa (°C)	EVT 1 (°C) 0,1 rad/s	EVT 2 (°C) 0,00063 rad/s	S <sub>25-60</sub> x10 <sup>-2</sup>	G* (25°C) x10 <sup>5</sup>	G* (60°C) x10 <sup>2</sup>
Slk	0	7016	71,3	52,8	53,2	-7,41	2,14	7,23
	1	9417	73,5	56,0	56,3	-	-	-
	3	4517	68,3	51,8	52,0	-7,68	2,00	6,23
	6	2055	63,7	47,0	47,5	-8,90	1,61	2,00
F-T	1	15276	75,7	60,2	60,8	-7,77	6,05	17,56
	3	26295	81,0	65,0	65,9	-7,36	9,54	37,72
	6	57067	85,1	71,9	75,2	-6,50	20,65	156,00
AAG	1	13118	74,9	59,5	60,4	-7,73	4,07	12,22
	3	32771	82,0	67,0	70,6	-6,86	9,01	51,94
	6	70162	91,5	77,9	85,7	-5,36	11,81	209,70
P.etilenc	1	11176	74,5	57,7	58,4	-7,91	4,61	12,15
	3	10297	73,4	58,4	59,5	-7,12	3,95	18,76
	6	16434	74,9	64,9	67,5	-7,20	8,55	38,56



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## Conclusions

The additives types waxes modify the bitumen rheology, reducing the viscosity at manufacturing, extended and compaction temperatures of the agglomerate, and improving the mechanical behaviour at service temperatures.

The techniques DSC/MDSC and DSR complement each other excellently, being able to make clear the physical - chemical phenomena that take place in the bitumen when we incorporate different additives that modify the rheology of this one.

This studies are a work in progress, obtaining very satisfactory results.





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Thanks for your attention !

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