



European perspective of binder characterisation

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CEN – Comité Européen de Normalisation

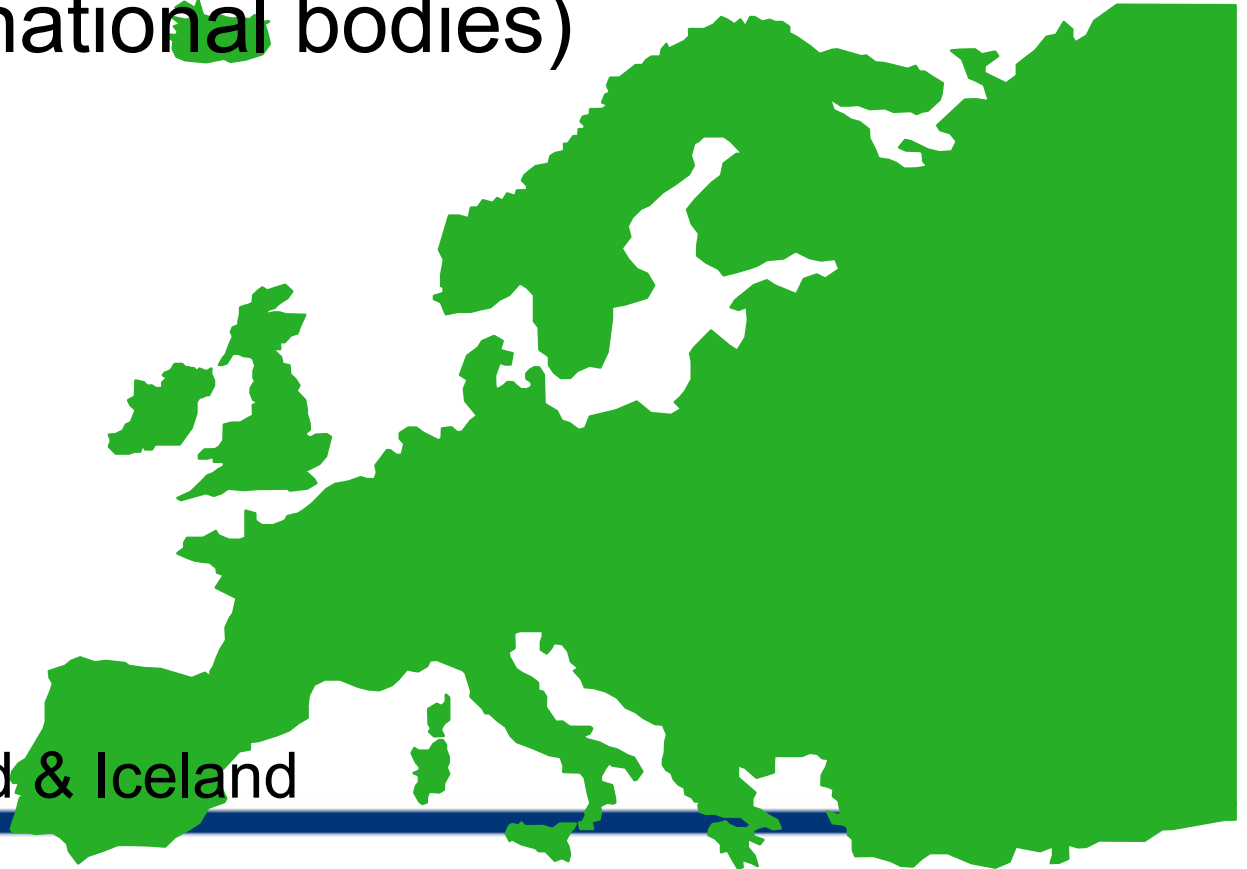


- European organisation created in 1961, based in Brussels
- Responsible for planning, drafting & adoption of European standards
- Principles :
 - *openness and transparency*
 - *consensus*
 - *national commitment*
 - *Independence of committees from any single interest group*
 - *integration with other international work*



CEN Membership

- 30 national members : national standardisation bodies (27 EU and three EFTA* national bodies)
- Affiliates



* Norway, Switzerland & Iceland

CEN in figures

- In **2009**, CEN produced **1454** documents
- Number of documents produced in **2010**: 560 (end June 2010).
- The **total** number of living documents to date is **13966** (end June 2010).
- CEN currently has 1939 Technical Bodies, whereof:
 - **292** active Technical Committees
 - **33** active CEN Workshops
 - **62** Sub-committees
 - **1395** Working Groups



CEN\TC336 - Bituminous binders

- 1998 : Mandate for Road Construction Products
 - 6 Essential requirements (of which 4 relevant to binders)
 1. Mechanical resistance and stability
 2. Safety in case of fire
 3. Hygiene, health and the environment
 4. Safety in use
- 2000 : TC 336 formed as a TC specifically for bituminous binders
 - *1st generation*: harmonisation of existing national standards
 - Based on conventional (empirical) test methods



CEN/Technical Committee 336
Bituminous Binders

Working Group 1
Bituminous binders for paving

Working Group 2
Fluxed bitumen and bituminous emulsions

Paving Bitumens
EN 12591

Hard Paving Grade
Bitumens
EN13924

Polymer Modified
Bitumens
EN14023

Cationic
Bituminous
Emulsions
EN13808

Cutback &
Fluxed Bitumens
EN15322

Industrial Bitumens
(Formerly Working Group 5,
now merged with WG1)

Oxidised Bitumens
EN 13304

Hard Industrial Bitumens
EN 13305

- TG 1,2,3 : Test Methods
- TG 4 : CPD, Annex ZA, CE Marking
- TG 5 : Performance Related Specifications
- TG 6 : Revision EN 12591
- TG 7 : Special Binders



Performance Related Specifications

Motivation

- European harmonisation: “no barriers to trade”
- Construction Products Directive: *“Harmonised technical specification should be performance based”*
- Increasing performance requirements for roads and new contract types
- Improved binder evaluation
- Overseas developments: Superpave/SHRP in USA



CEN/TC336 WG1 TG 5 Activities

- TR15352 : Bitumen and bituminous binders – Development of performance related specifications: status report 2005
- Outlined a process for the development of second generation standards. The basic sequential steps:
- **Step 1:** identify the binder properties linked to the performance requirements of asphalt pavements,
- **Step 2:** select and standardise appropriate (new) test methods to measure these properties,
- **Step 3:** collect data and ensure field validation for establishing (new) binder specifications,
- **Step 4:** review the grading system according to the (new) specification.



CEN PRS activities

- TR15352 provided a framework for a data collection exercise
 - Incorporating test methods being standardised
 - Proposing a project for data collection
 - Aligned with the output from the BiTSpec and BiTVal projects



BiTSpec output

Performance Requirements for Pavement/ Mix	Binder Properties
Resistance to permanent deformation	Rheological property at elevated service temperature
Resistance to surface cracking due to binder ageing	Ageing behaviour: short term and long term
Structural strength	Rheological property: complex modulus
Resistance to low temperature cracking	Combination of rheological and failure properties
Resistance to fatigue cracking	Failure property
Manufacturing and laying	Viscosity vs temperature Storage stability



BiTVal Overview



- The Bitumen Test Validation (BiTVal) project was set up by FEHRL
 - in response to a request from TC 336, Bitumen and bituminous binders (CEN)
 - together with other stakeholders in the industry
 - to assess the relevance of the results of bitumen tests on the required properties of asphalt mixtures.
- Phase 1 - A review of existing data on bitumen tests used by TC336 WG1 – **complete**
- Phase 2 - A study of the gaps in the knowledge identified in Phase 1
- Phase 3 - A study of any bitumen test methods missing from the original list



BiTVal: a co-operative project

Chairman

Ian Carswell (TRL, UK)

Organisations

CEN
EAPA
Eurobitume

FEHRL
Laboratories



arsenal Research, Austria
www.arsenal.ac.at



TKTI, Lithuania
www.tkti.lt



BRRC, Belgium
www.brcc.be



INRR, Luxembourg



CRBL, Bulgaria



RWS DWW, Netherlands
www.minverw.nl/rws/dww



IGH, Croatia
www.igh.hr



NPRA, Norway
www.vegvesen.no



CDV, Czech Republic
www.cdv.cz



IBDiM, Poland
www.ibdim.edu.pl



DRI, Denmark
www.roadinstitute.dk



LNEC, Portugal
www-ext.lnec.pt



TECER, Estonia
www.teed.ee



CESTRIN, Romania
www.cestrin.ro



LCPC, France
www.lcpc.fr



IP, Serbia-Montenegro
www.highway.co.yu



BAST, Germany
www.bast.de



VUD, Slovakia
www.vud.sk



KEDE, Greece



ZAG, Slovenia
www.zag.si



KTI, Hungary
www.kti.hu



CEDEX, Spain
www.cedex.es



PRA, Iceland
www.vegagerdin.is



VTI, Sweden
www.vti.se



NRA, Ireland
www.nra.ie



LAVOC, Switzerland
lavoc.epfl.ch



ANAS, Italy
www.enteanas.it



TRL, United Kingdom
www.trl.co.uk



LAD, Latvia
www.lad.lv



www.fehrl.org

Validation - Project BiTVaI



FEHRL

- Objective
 - Correlate binder tests & specifications with asphalt mix & pavement performance
- Scope
 - High & low Temperature properties
 - Durability
 - Subsequently; Adhesion, Cohesion, Fatigue
- Deliverables
 - Databank of European experience
 - Report on performance correlations
 - Recommendations for binder specifications



BiTVaL Report

- Free download
- <http://bitval.fehrl.org/>



Key outputs of BiTVaI Phase 1

- Database of publications relating bitumen properties to asphalt properties, or road performance
- FEHRL report to TC 336 summarising performance related aspects by test method and recommendations for use
- The report assesses bitumen tests in terms of the following critical performance characteristics, in asphalt mixture tests and/or pavement performance assessments:



BiTVaI Report

Recommendations 1/3

- Permanent Deformation
 - ZSV by oscillation DSR is the preferred method
 - More (correlation) work needed on EVT approach
- Structural Strength / Stiffness
 - Best options are:
 - Penetration, or
 - DSR stiffness (esp. for PmBs)
 - Work on durability effects recommended



BiTVaI Report

Recommendations 2/3

- Low temperature cracking
 - Best options are
 - BBR limiting temp, and/or a DTT parameter
 - Longer term: a fracture property (e.g. Fracture Toughness)
- Fatigue cracking
 - Further research is required on relationship of binder fatigue to mixture fatigue
 - Best criteria currently remain:
 - Penetration/R&B/rheology before & after aging



BiTVaI Report

Recommendations 3/3

- Adhesion
 - Much research, BUT conclusions not straightforward
 - Tests need to involve an aggregate
 - Work on ‘standard’ aggregates is suggested



CEN Ad Hoc Group Adhesion

- Project included representatives of TC336 (binders), TC 227 (bituminous mixtures), Eurobitume, EAPA and FEHRL.
- 4 commercial 50/70 bitumens, 1 PMB, 1 'Lab Blend'
- Standard silica sand used as reference 'aggregate'
- Target to identify a suitable test for binder adhesivity and durability of adhesion



Adhesion test criteria

The Ad-hoc Group formulated requirements for the test that was needed. The test method for adhesion should:

- Be simple (i.e. not require complex test equipment)
- Differentiate between bitumens
- Be reproducible
- Be quick < 7 days
- The samples to be tested need access of water to interface voids
- The test should reflect what is happening in the field
- The test or test samples should be capable to include the development of ageing



Tests evaluated

Based on the findings in the literature and the experience of the Ad-hoc Group members the following test methods were selected for the (first) evaluation:

1. Vandskak test (Sweden – Nynas)
2. Munich Shake test (Germany – University of Munich)
3. Indirect Tensile Test (Netherlands – VBW)
4. Duriez (UK, France – BP, Total, Colas)
5. Wet attrition in Deval (UK – Tarmac)
6. Cantabro (UK – BP to check)
7. Water stripping test: XPT 66-043 (France – GPB)
8. PATTI test (USA – FHWA)
9. Visualisation test (MoD stripping test) (UK – BP)



Conclusions

- All asphalt mixture tests in this study measure variables on macroscopic scales
- Many 'so called' adhesion tests are not measuring adhesion only and some are perhaps not measuring adhesion at all
- Most of the tests are measuring the rate at which a specific binder is separated from the aggregate, i.e. the kinetics
- For future test method development it is recommended that thermodynamic and kinetic aspects of binder adhesion and the relative importance of each component is considered
- The kinetic aspect becomes important for those tests which are carried out at elevated temperature in order to accelerate stripping.
- Binder viscosity is important in interpreting results of asphalt tests



Eurobitume Data Collection Final Report

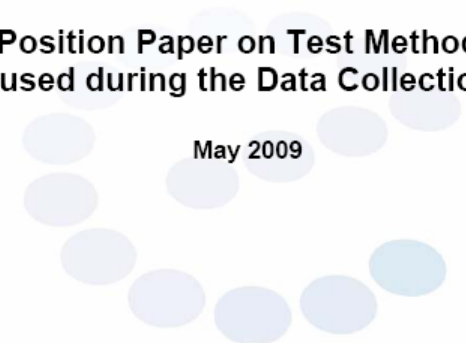
The full report is available
and can be downloaded
from Eurobitume website:

www.eurobitume.eu



Eurobitume TF Data Collection
Position Paper on Test Methods
used during the Data Collection

May 2009



Eurobitume Data Collection

The process



1. Companies confidentially selected a range of bituminous binders providing a sub-set of binders available to the paving industry.
2. Each binder was systematically tested using the proposed test methods creating a data set for each binder.
3. Eurobitume analysed this database for correlations between test methods across the binders.
4. A position paper on the test methods has been prepared.

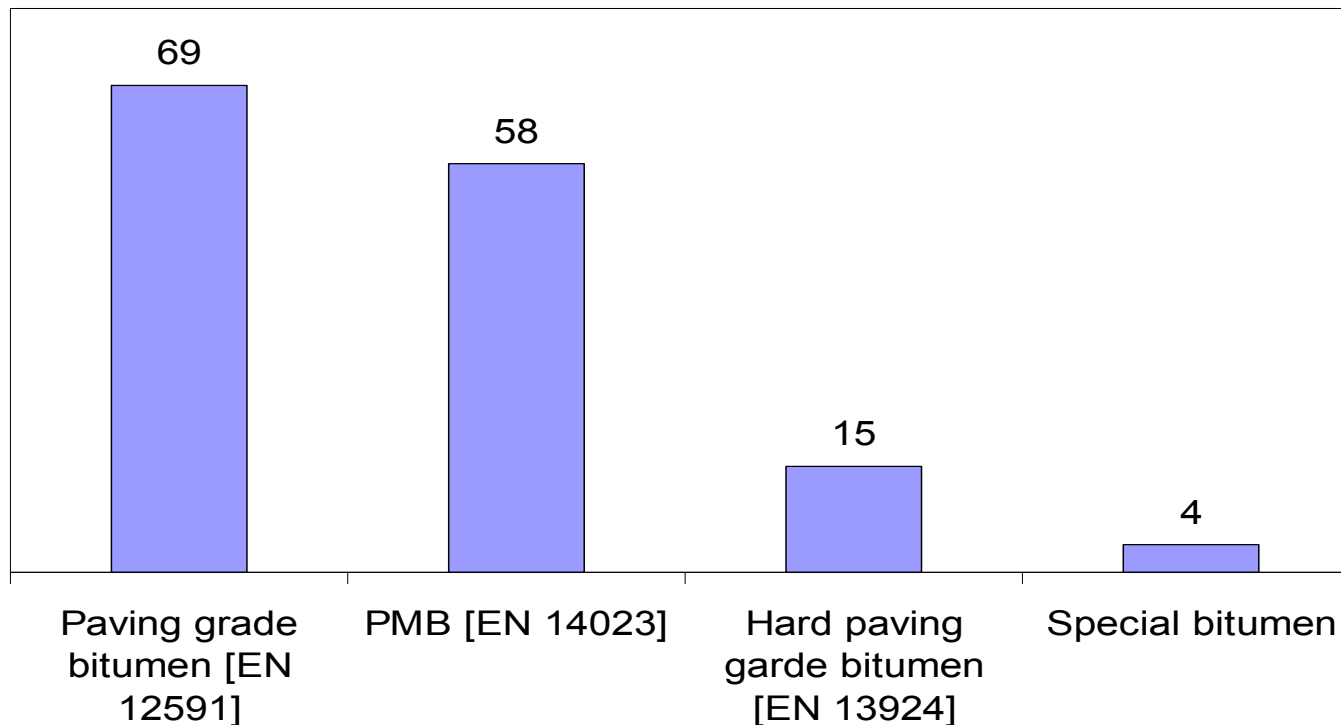


Eurobitume Data Collection

The Database



- A data base of 146 data sets of various bituminous binders from all over Europe; each data set contains about 400 data points (values).



Eurobitume Data Collection

The Data are in an Excel spreadsheet



Microsoft Excel - Bitumen Data Collection v3.0 BETA

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1			Data Series Set Nr (1 or 2)		1	1	1	1	1	1	1	1	1	1	1
2			Column Nr		6	9	11	12	18	23	24	26	27	30	31
3			Normal Paving Grades												
4			Product Type												
5	1		Normal Paving Grade		x	x	x	x	X	X	X	X	X	X	X
6	2		Hard Grade												
7	3		PMB												
8	4		Special Bitumen												
9	5														
10	6		Long Term Ageing procedure temperature		100.0	100.0	100.0	100.0		100.0	100.0	100.0		100.0	
11	7		PAV at ... °C [EN 14769]												
12	8		RCAT [pr EN 15323]												
13	9														
14	10														
15	11		DATA PART 1												
16	12														
17	13		Fresh Binder												
18	14														
19	15		Nominal penetration range		35/50	160/220	70/100	70/100	70/100	70/100	50/70	70/100	70/100	50/70	70/100
20	16														
21	17		Penetration @ 25 °C		44	204	79	76	85	70	52	70	76	60	70
22	18		Softening point R&B		50.3	35.4	45.6	43.4	45.0	47.0	49.5	47.0	47.2	49.0	45.8
23	19		Penetration index		-1.41	-2.23	-1.29	-2.07	-1.30		-1.20		-0.90		-1.50
24	20		Dynamic viscosity @ 60 °C		284	51	156	101	94	220	257	125	163	258	164
25	21		Kinematic viscosity @ 135 °C		421	218	465	280	200	245	360	165	350	253	310
26	22		Fraass breaking point		-10	-21	-12	-13	-11	-7	-4	-7	-16	-6	-10
27	23														
28	24		Elastic recovery @ 10 °C (1)												
29	25		Elastic recovery @ 25 °C (1)												
30	26		Storage stability (1)												
31	27														
32	28		Flash point		>310	263.0	> 310	>310	292.0	300.0	310.0	290.0	352.0	290.0	336.0
33	29		Solubility		99.3	100.0	99.8	99.1	99.9		99.9		99.9		99.9
34	30		Density		1033.0000	1018.0000	1016.0000	1025.0000	1040.0000		1048.0000		1019.0000		1038.0000
35	31														
36	32		After Short Term Ageing												
37	33														
38	34		Penetration @ 25 °C		30.0	127.0	51.0	49.0	40.0	30.0	33.0	35.0	44.0	40.0	48.0
39	35		Softening point R&B		55.2	39.4	50.0	49.6	52.4	54.0	56.0	54.0	52.2	53.0	48.8
40	36		Penetration index		-1.1	-2.1	-1.2	-1.4	-1.1		-0.7		-1.0		-1.6
41	37		Dynamic viscosity @ 60 °C		736	98	318	221	247	1005	602	805	260	750	246

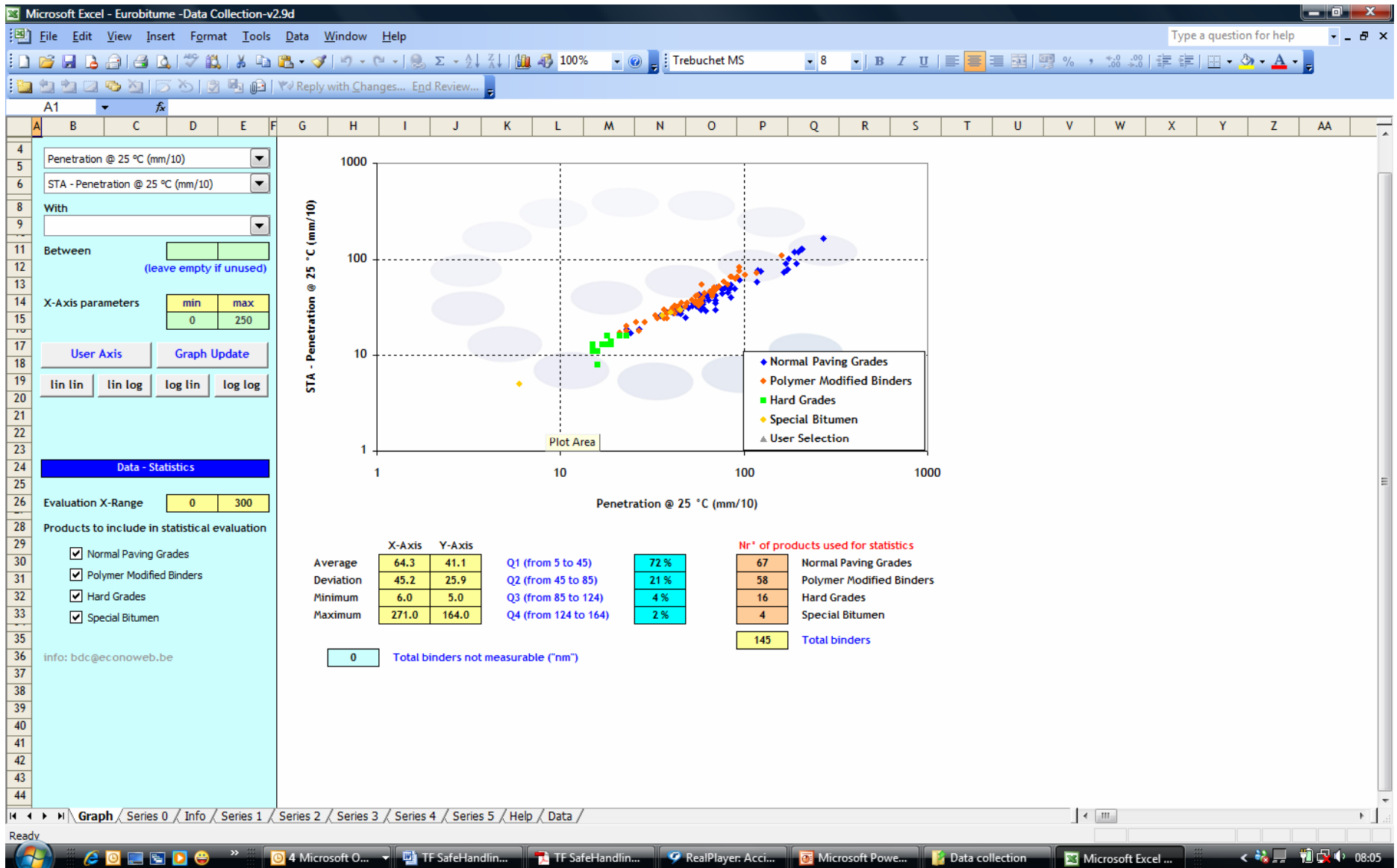
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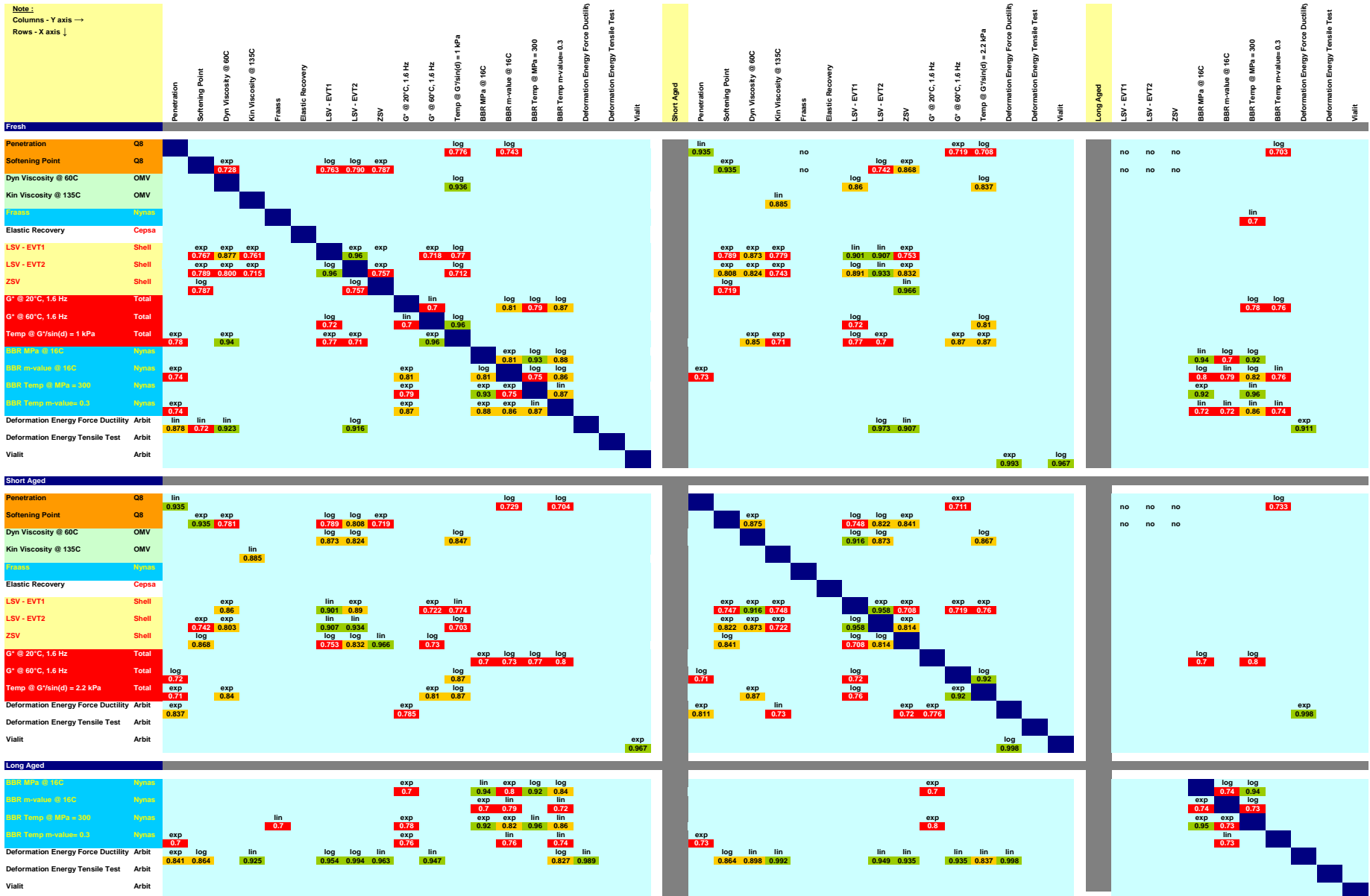
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Eurobitume Data Collection The Database Analysis Tool



Eurobitume Data Collection

The Outcome



Eurobitume Data Collection Challenges



- To preserve confidentiality and to comply with competition law, data was anonymised.
- The project methodology and process was complex.
- Creation and management of a database of 60 000 points required intensive effort.
- Corrections are difficult to do due to anonymity of data submissions.



Eurobitume Data Collection

Key Learnings



- The data collection assessed **test methods**, not binder qualities.
- All tests must be carried out under the same test protocols (including same version of a standard).
- Transcription and amendment of the database should be done by one person only.
- Strict version control is essential.
- Only few data are available for certain tests.
- It's the little things that cause big problems!



Eurobitume Data Collection Conclusions



1. We found some good correlations between test methods.
2. Some correlations are dependent on the type of binder.
3. Practicality of test methods is important.
4. Some simple tests appear to be performance related for some binder types.



Eurobitume Data Collection Conclusions



5. Simple tests are applicable for simple binders.
6. Needle penetration is a suitable test for all types of binders
7. The interpretation of ring and ball softening point is different for paving grade and hard paving grades than for PMB.
8. DSR equipment offers the possibility to replace several traditional test methods for PMB.



CEN Data Collection project



- Follow on from Eurobitume project
- Approximately 35 further datasets will be made available
- Datasets will be added into Eurobitume database
- Correlations identified in the Eurobitume database will be re-assessed following additional datasets incorporation.



European development of PRS



- Lengthy process, constrained by CEN rules
- Process in place and being followed, but...
 - Lacking a good indicator for permanent deformation for complex binders (including strain dependency)
 - Lacking a definitive long term ageing protocol
 - Lacking a good indicator for adhesion and durability of adhesion

