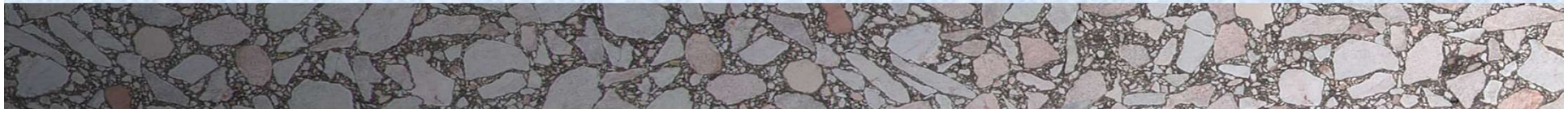
The solution
for your high modulus asphalt mixes

(*High Modulus Asphalt* **HMA,** *High Modulus Asphalt Concrete* **HMAC, anti-rutting** *Semi Coarse Asphalt Concrete* **SCAC)**

M. Sc. Eng Edith Tartari
Selenice Bitumi



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5. *Ways of introduction*
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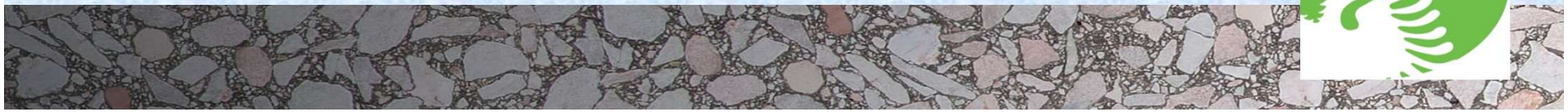
8. *Production & reference sites*
9. *Conclusions*



Selenizza ®SLN specifications

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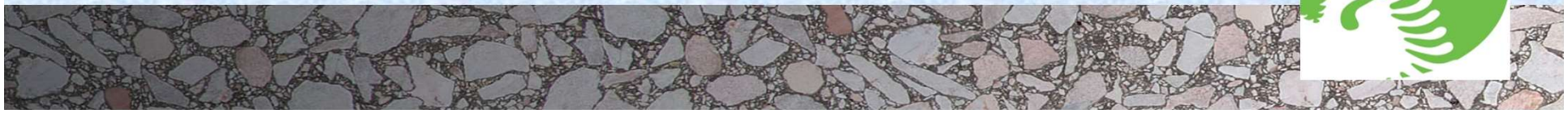
specifications

Penetration at 25°C (1/10 mm)	EN 1426	≤ 2
Softening point (R&B°C)	EN 1427	≤ 120
Penetration Index (IP)	-	> 3,0
Acidity Index (mg KOH/g)	NFT 66 013	3,5
Density at 25°C (g/cm³)	NFT 66 004	1,16
Asphaltene content (wt %)	-	> 50
Mass loss at 163°C, 5 hours (%)	EN 13303	0,08



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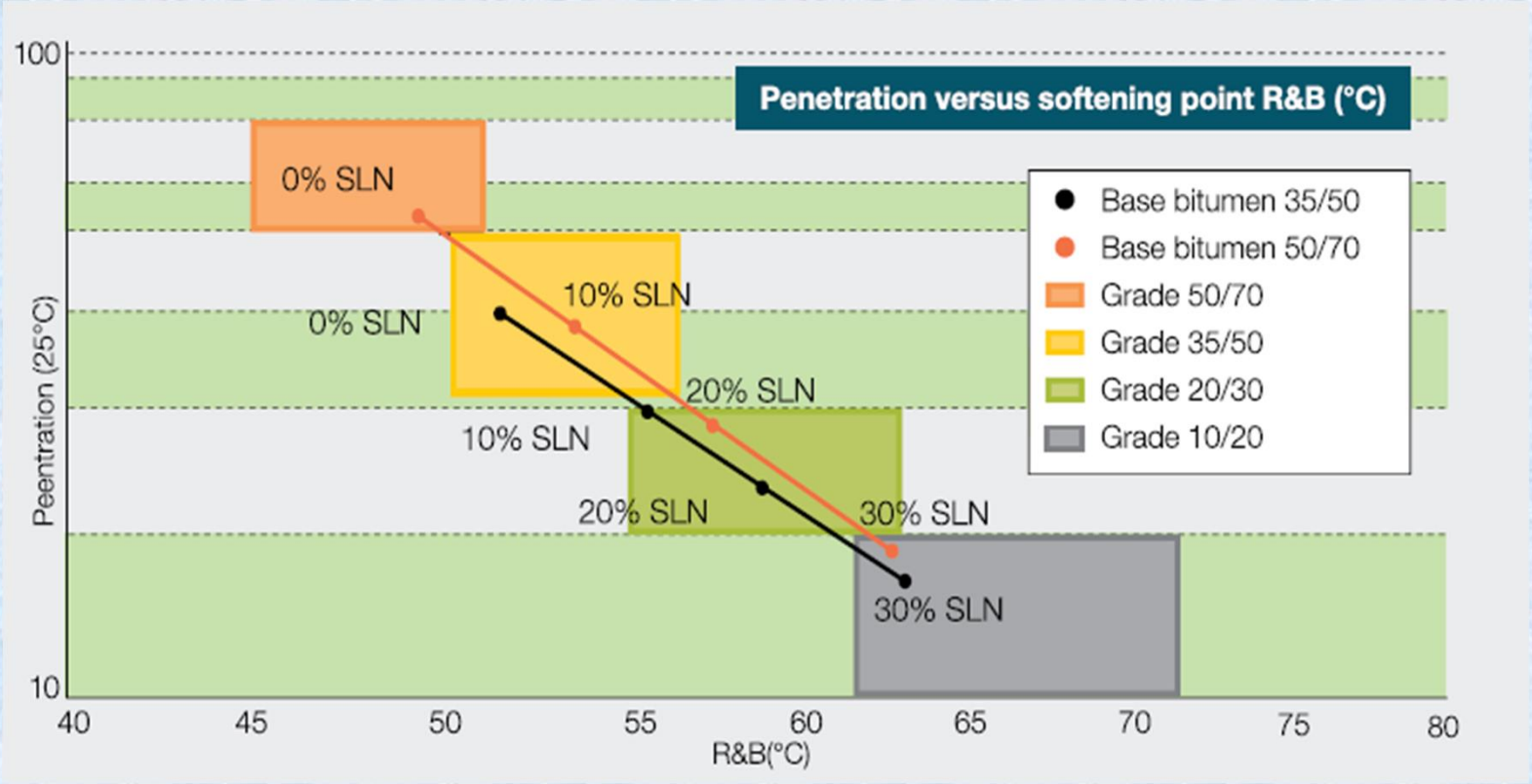
total binder modification



Depending on the added quantity of Selenizza and on the base bitumen, it is possible to **obtain precise penetration** and/or **R&B softening point** value of the resulting binder

total binder modification

Principle : The addition of Selenizza®SLN in a bituminous binder **decreases** the binder penetration and **increases** the binder softening point according to the added content, making their specifications move to the **harder** penetration grade specifications .

Typical examples:

50/70 base bitumen + (5 to 10 %) of Selenizza®SLN = 35/50 base bitumen

50/70 base bitumen + 15 % of Selenizza®SLN => (penetration **decreases 20-25** dmm +R&B **increases** 7-9 °C)

35/50 base bitumen + 15 % of Selenizza®SLN => (penetration **decreases 15-20** dmm +R&B **increases** 5-7 °C)

In **term of binder** in a mix design, **15%** of Selenizza®SLN by binder weight, represents some **0.9 to 1 %** with reference to the total weight of the asphalt mixture, with a binder content in the asphalt mix ranging from **5.8 to 6 %**.

Different sources of penetration grade bitumen could have slightly **different behaviours** against the addition of Selenizza SLN120® and so properties should **be checked** for different cases.

Characterization of different natural bitumen

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Characterization of different natural bitumen

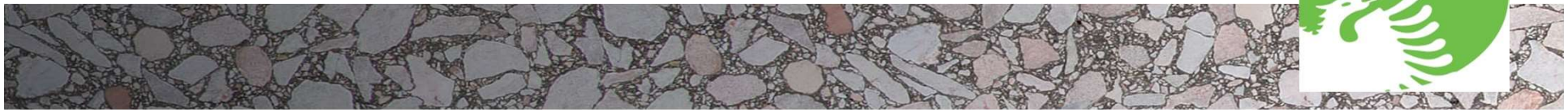
- A study was carried out by the University of Rome ***''LA SAPIENZA"*** *to characterize natural bitumen and evaluate their contribution to the modification of* ***straight-run bitumen***
- *The aim of this research work was* ***to characterize*** *some of the natural asphalts, most diffused commercially and to evaluate their efficiency as modifiers*

➢ Three natural asphalts were selected:

Natural asphalt	Bitumen content (%)	Asphaltènes content(%)	Penetration (à 25°C,1/10 mm)	R&B (°C)
Gilsonite	> 99	70	0	160–170
Selenizza	85-90	42*	0	115
Trinidad	53-55	33-37	1 - 4	93–98

➢ An Iranian *Straight Run bitumen* (Gach Saran) with penetration **80-100,** was **added with each** of the three types of natural asphalts :

by the percentage of **10%** & at a minimum temperature of **150 – 180 °C**



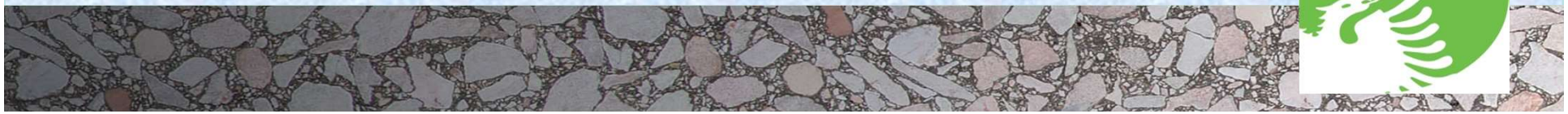
Characterization of different natural bitumen

- *In order to analyze the nature of the modification, two techniques have been used:*
  - ***Dynamic rheological analysis***
  - ***Modulated Differential Scanning Calorimetry*** (MDSC)

- *The **rheological analysis** was carried out with a rotating rheometer under:*

  - ***isochronal conditions,** with temperature scanning, for the assessment of viscoelastic behavior in relatively **high temperatures***
  - ***isothermal conditions,** with frequency scanning, for determining the characteristics **in low temperature range***

- *The trails were performed in the respective linear viscoelastic areas for each* sample in order to apply the temperature-frequency equivalency principle and generate the master curves.



Characterization of different natural bitumen

Effect on Penetration and Softening Point

- As expected, for the three cases, the resulting modified bitumen was characterized by **higher softening point** (R&B temperatures) and **lower penetration values**, compared to the original standard bitumen, due to the presence of high percentages of asphaltenes content in the natural asphalts.

Type of bitumen	Penetration at 25° (1/10 mm)	R&B Temperature °C	Asphaltenes content (%)
Original bitumen	96	44	9,8
+10% Gilsonite	38	58	15,8
+10% Selenizza	67	52	13,0
+10% Trinidad	78	51	12,3

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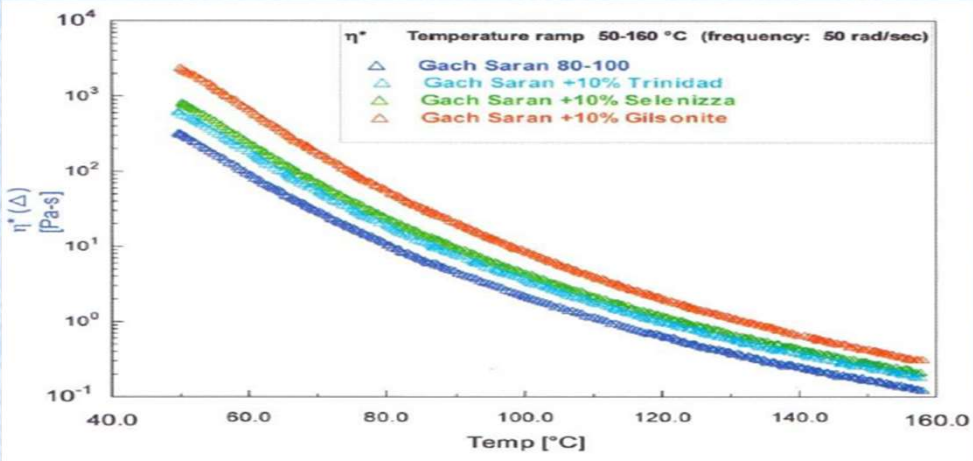
Characterization of different natural bitumen

Effect on viscoelastic properties at high temperatures

- For **medium and high temperatures** (50 – 160°C), the **rheological behavior** whose softening point represent the lower limit, is not a function of the modifier quality and **depends exclusively on the asphaltenes content**



- The **viscosity values increase,** the viscosity curves **shift upwards**, their shape and the slope remain unchanged and parallel for all sample types. The **modifiers don't affect the** internal interactions between the asphaltene components in the modified bitumen, which is a typical phenomenon for the **compatible additives.**

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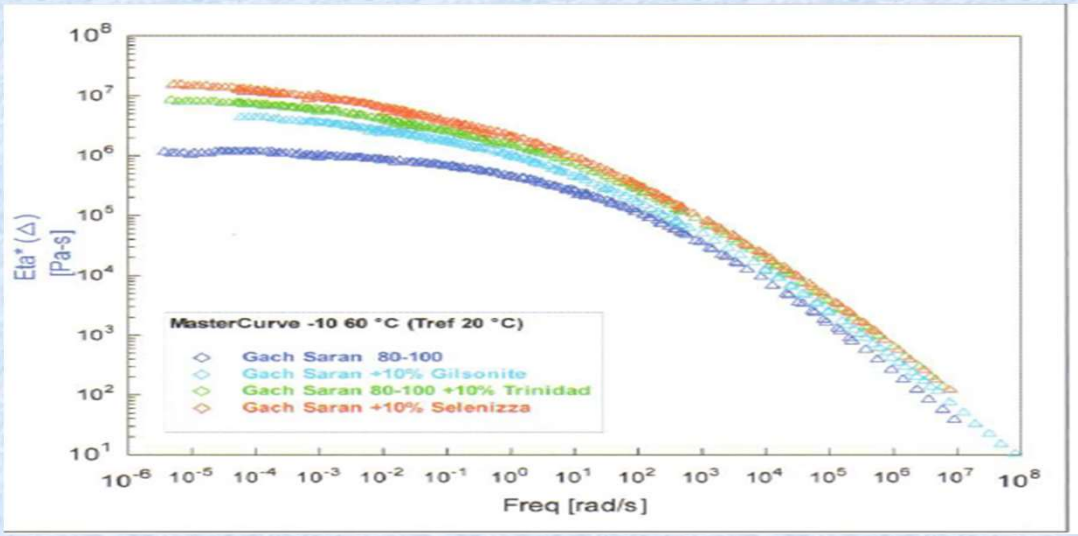
Characterization of different natural bitumen

Effect on viscoelastic properties at low temperatures

- For the **low temperatures (10 - 60°C**), the rheological modifications seem complex and are differentiated.



- **Master curves** η*, G',G'' = f(ω) drawn under reference temperatures **20°C & 60°C**. The **viscoelastic** behavior and the **ductility** of the modified samples are **impacted by the quality of the natural bitumen** (bituminous+inorganic component). At **T=20°, inversion** of the zero shear **viscosity** η_0 (GS) < η_0 (Gil) < η_0 (Trid < η_0 (Sln)

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Characterization of different natural bitumen

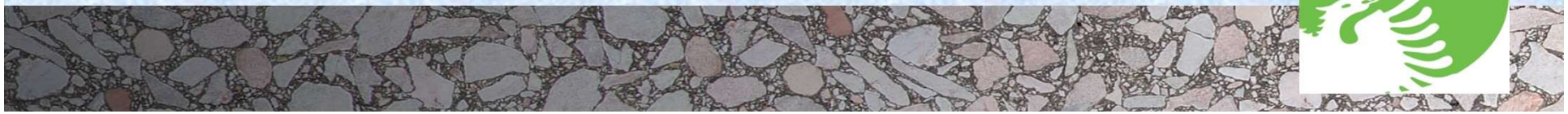
Modulated Differential Scanning calorimetry MDSC:

- The samples (7 – 10 mg), were subjected to **a modulated** heating ramp resulting from a sinusoidal temperature ripple overlaid on a linear temperature ramp

$$dQ/dt = C_p \beta + f(T, t)$$

Temperature range: [-50 °C, + 160 °C]

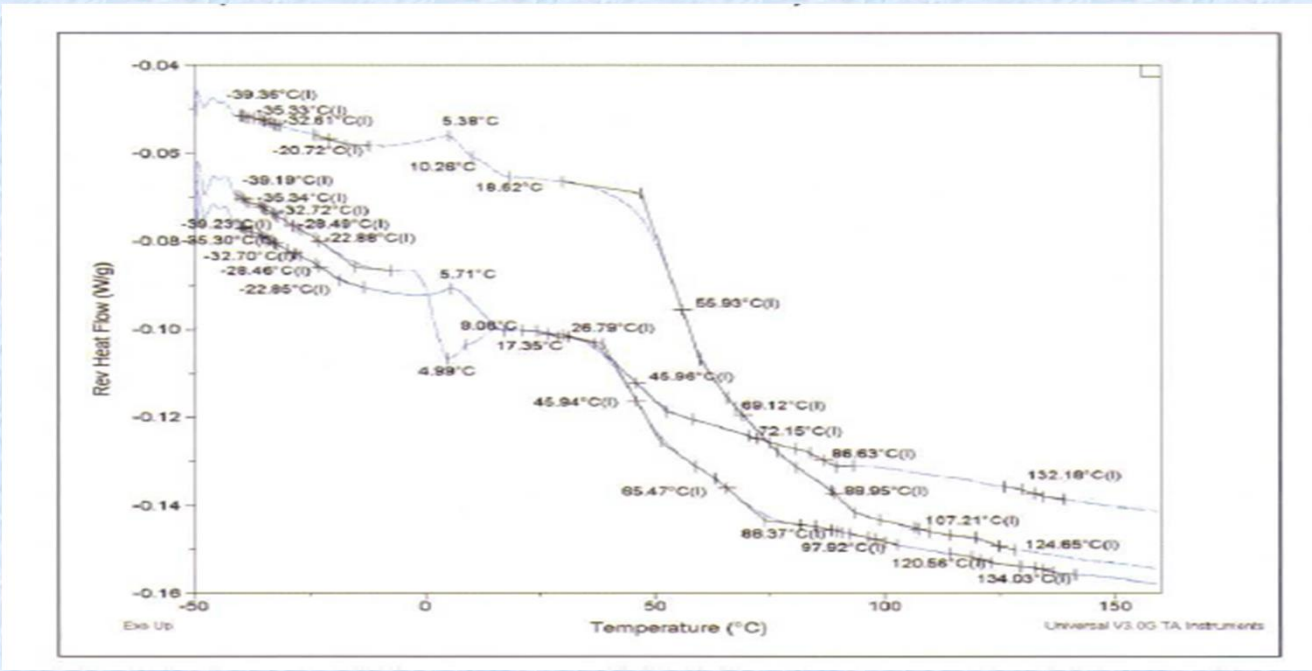
- For the bitumen, the reversing curve ≈ 1/ C_p , is more indicative:
  - **vitreous transitions**
  - **fusions**



Characterization of different natural bitumen

Modulated Differential Scanning calorimetry MDSC:

Reversing curves of the mixed samples



Characterization of different natural bitumen

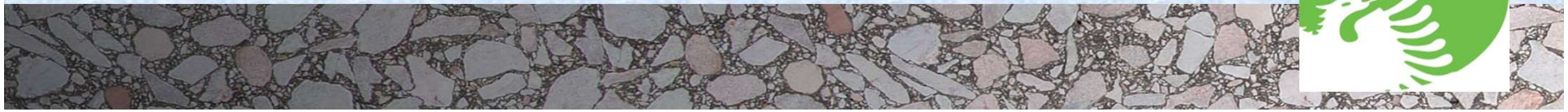
Modulated Differential Scanning calorimetry MDSC:

- The The MDSC analysis shows that the **rheological behavior** of the straight run bitumen is being **modified** by the addition of natural bitumen

- **Trinidad & Selenizza** : affect the **lower limit** of the softening range of the straight run bitumen (+55,8 °C ➔ 45,9°C) **due to the presence** of **different maltenic phases** (of lower molar mass), which **soften at lower temperatures**. The **asphaltenic phases**, result to **behave independently**. A dilution effect of the original bitumen is obtained

- **Gilsonite,** does not act as a diluent, but **expands the softening** range to **higher temperatures**

- The modifications operate in such a way as to increase the **consistency**, **the viscosity** and the **stability** of the original bitumen ➔ natural bitumen represent **an advantageous alternative** to other additives for modifying the road pavement bitumen



High modulus asphalt mixes

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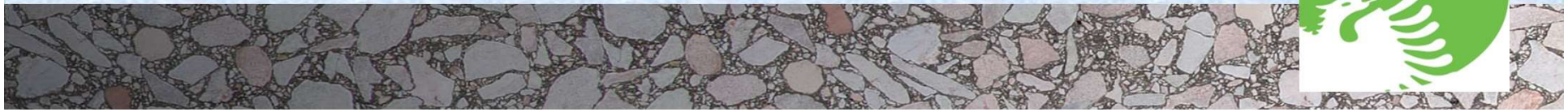
High modulus asphalt mixes

- Since the early 1980s, began to appear in the road construction sector, the **hot mix asphalt** structures with **high modulus** (> 12 000 MPa)**,** which ensure **better resistance** to road **fatigue** and **permanent deformation** and facilitate the **reduction** of the road layer **thickness**

- With regard to **binder**, this mix design is usually obtained with **hard penetration grade** bitumen from **35/50** to **10/20** and/or the use of special additives to harden the bitumen or the mix



High modulus asphalt mixes

HMA **> <u>subbase</u>** **> bearing support**
> mechanical resistance

> **aggregates : 0/10, 0/14 ou 0/20 (most of the time granular 0/14)**

binder : bitumen 10/20, 15/25 or 20/30 @ 5.5 – 6 %

	Road Base Aspalt 1 & 2	Hot Mix Asphalt Category 1	Hot Mix Asphalt Category 2
Duriez	**> 0.65 - 0.70**	**> 0.70**	**>0.75**
Rutting	**< 10% (@ 10.000)**	**< 7.5% (@ 30.000)**	**< 7.5% (@ 30.000)**
Modulus	**> 9.000 MPa**	**> 14.000 MPa**	**> 14.000 MPa**
Fatigue	**> 80 – 90 x 10^{-6}**	**> 100 x 10^{-6}**	**> 130 x 10^{-6}**

Laying of a HMA with Selenizza SLN
on a bank-run gravel for a logistic platform

High modulus asphalt mixes

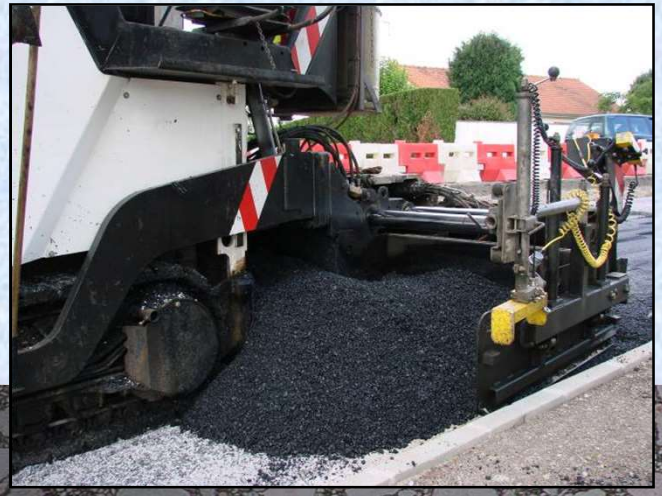
HMAC > <u>wearing course</u>

> skid resistance, drainage capacity
> mechanical resistance and fatigue

> aggregates : 0/10 ou 0/14

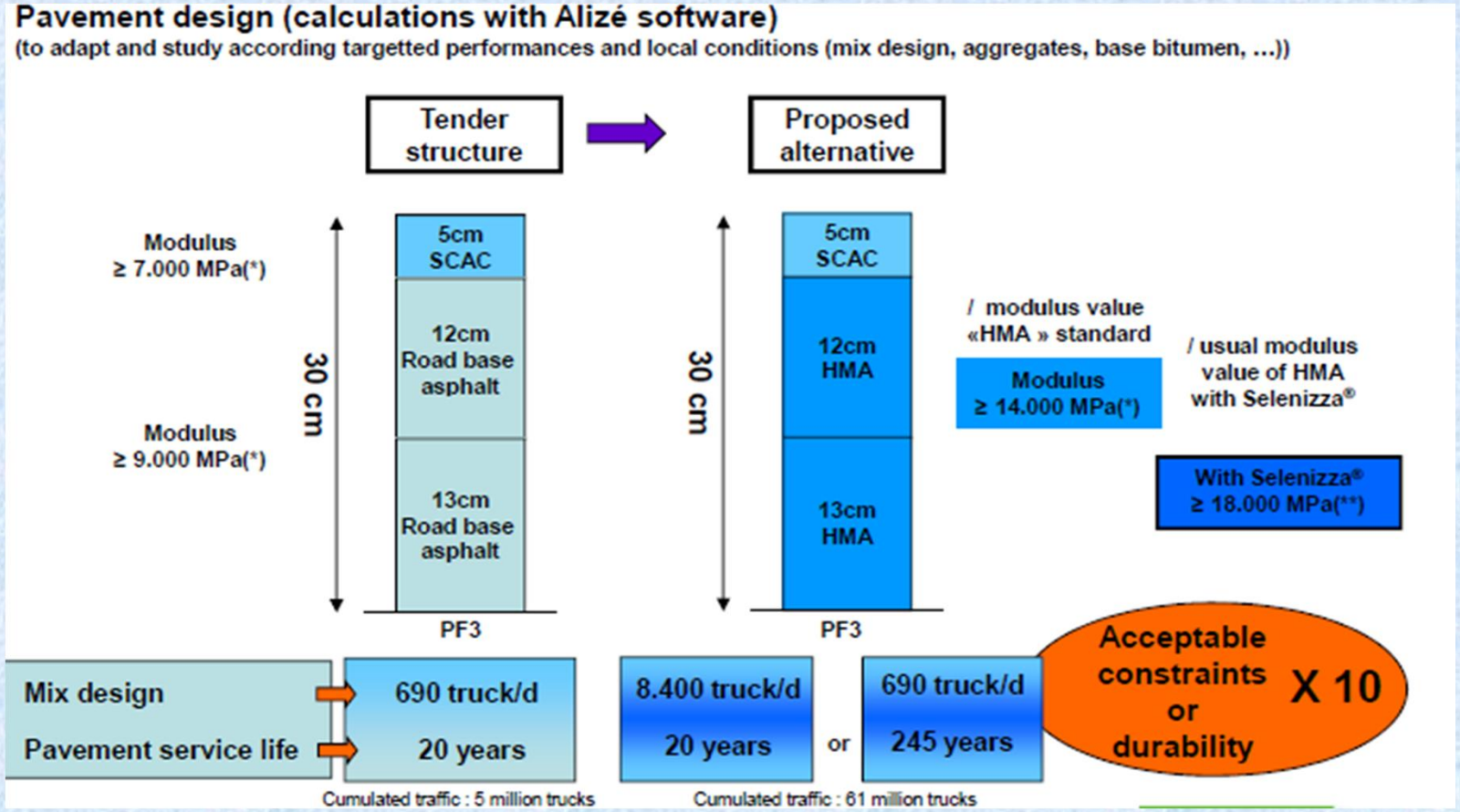
binder : bitumen 20/30 @ 5.5 – 5.8 %

>	Semi Coarse Asphalt Concrete 1, 2 & 3	Hot Mix Asphalt Concrete Category 1, 2 & 3
Duriez	> 0.75	> 0.80
Rutting	< 10 – 7.5 – 5 % (@ 30.000)	< 10 - 7.5 – 5 % (@ 30.000 cycles)
Modulus	> 5.500 - 7.000 MPa	> 9.000 – 12.000 MPa
Fatigue	> 100 x 10^{-6}	> 110 x 10^{-6}

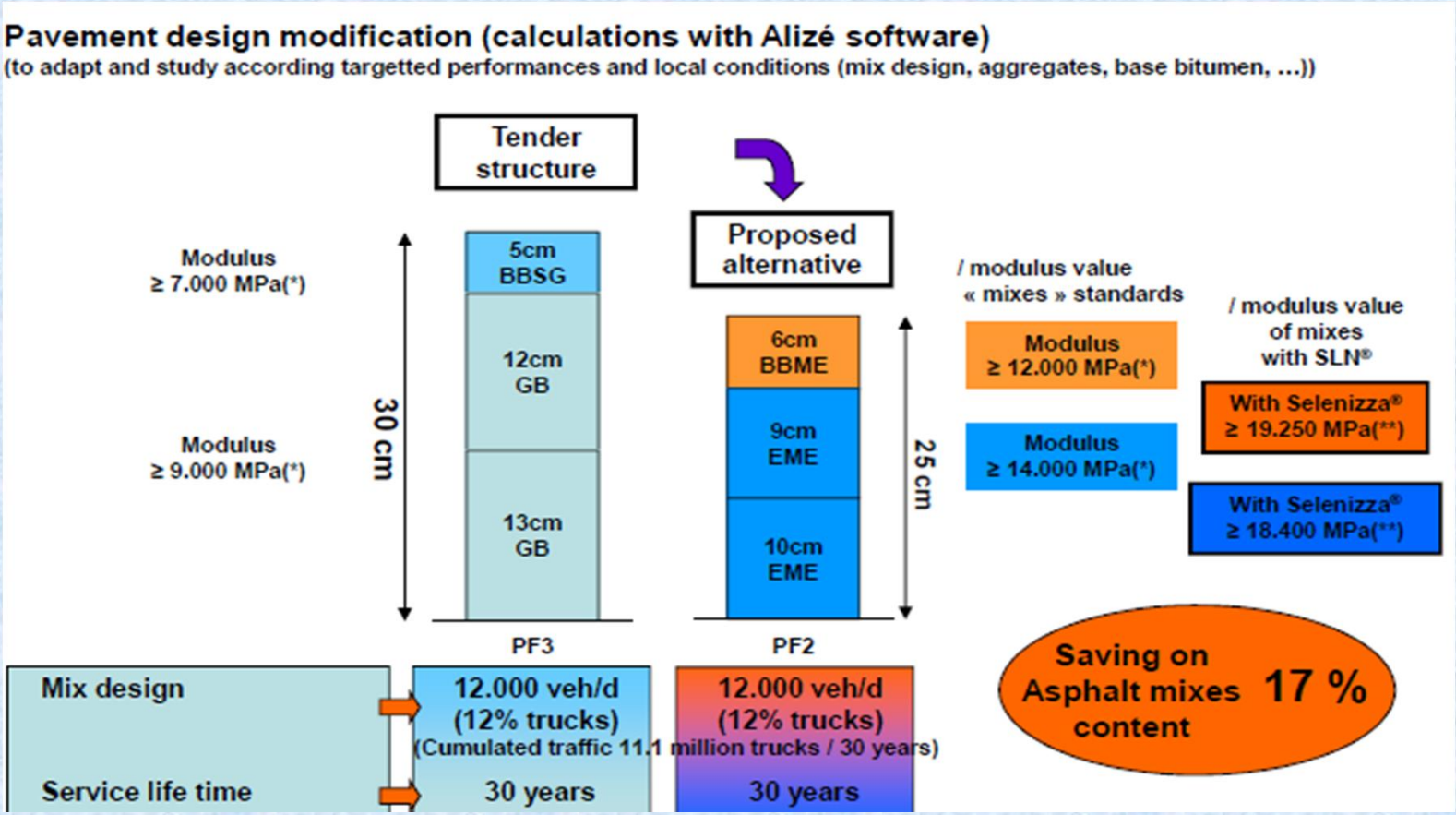


Laying of a HMAC with Selenizza®SLN on a road base asphalt for a city roundabout

High modulus asphalt mixes



High modulus asphalt mixes



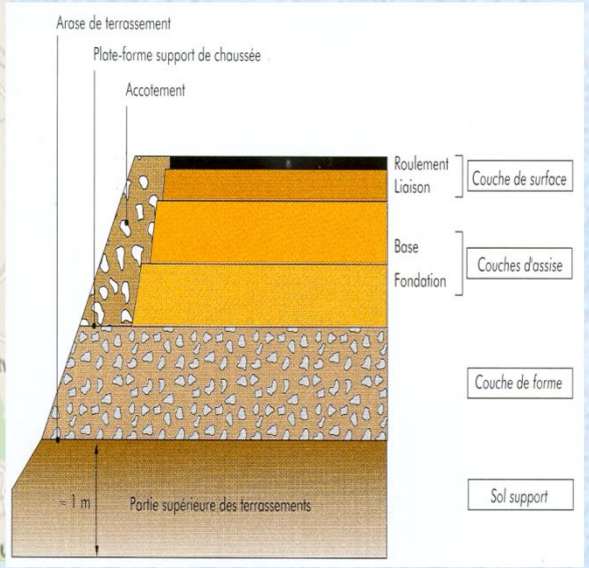
Implementation in road construction projects | 4

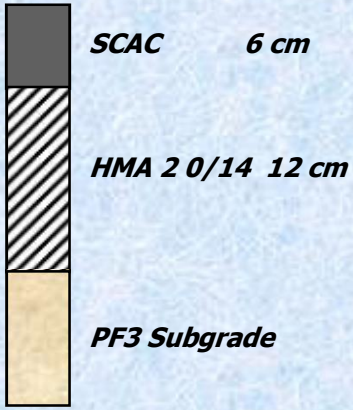
Skopje 2016 – Natural Asphalt Selenizza

Implementations in road construction projects: Highway A 150 (FR)

PROJECT DESCRIPTION
Construction of a 17,5 km new roadway in A 150 Highway (FR)

In order to meet the technical specifications according to the CE standard ***NF EN 13108-1****, the project proposes using a HMA base course EB 14 ASSISE 20/30* ***or HMA (EME) 0/14 class 2***





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Implementations in road construction projects: Highway A 150 (FR)

For the manufacture of the recycled hot mix asphalt, two types of binders were analyzed:

- *The basic HMA mix design*: **30% AE** (asphalt aggregates) + **20/30** penetration grade bitumen
- *Alternative studied*: **30% AE** (asphalt aggregates) + **50/70** grade bitumen **+ 1,5 %** Selenizza

Thresholds for HMA (EME) 0/14 class 2 validation

Type of asphalt mix	G.S.P. Voids content 100 gyrations %	r/R Water sensitivity	Resistance to rutting 60°C 30 000 cycles %	Modulus 15°C 10 Hz MPa	Fatigue 10^6 cycles µm/m
Test method	EN 12697-31	EN 12697-12	EN 12697-22	EN 12697-26	EN 12697-24
HMA class 2	≤ 6	≥ 0.75	≤ 7,5	≥ 14 000	≥ 130 x 10^{-6}

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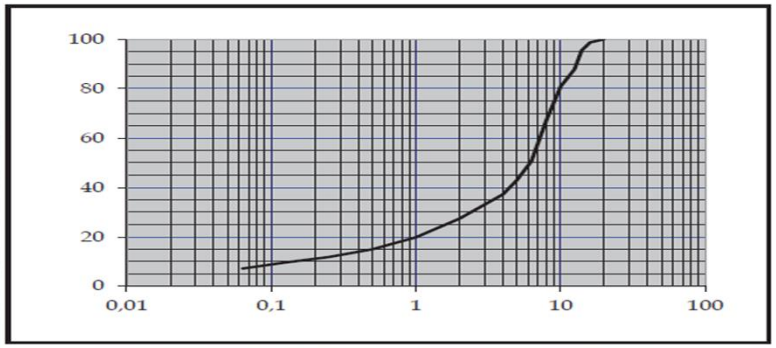
Implementations in road construction projects: Highway A 150 (FR)

For comparision purposes, the HMA have been made with **the same composition** of materials in terms of **particle size distribution** curve and **% of binder** used

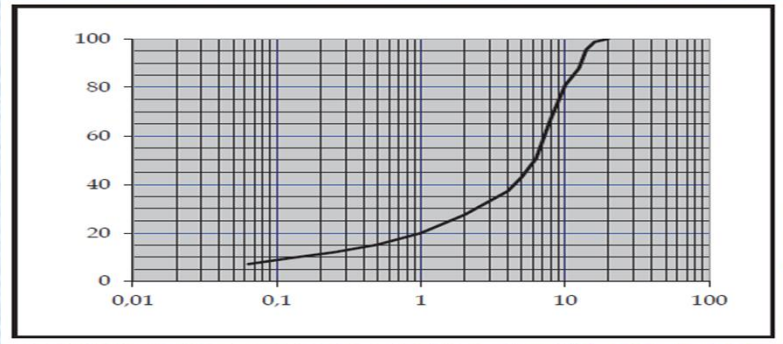
HMA(EME) 2 0/14 (30% recycl aggreg + bitume 20/30)

FORMULE		
19,5%	0/5	STEMA
21,8%	5/8	STEMA
12,3%	8/11	STEMA
11,4%	11/16	STEMA
1,4%	FILLER	CONS
29,9%	AE	
	apport liant AE	*avec* 5,0 %TL
3,7%	20/30	
5,2%	BITUME TOTAL	



HMA(EME)2 0/14 (30% recycl aggreg + SLN + bitume 50/70)

FORMULE		
20,4%	0/5	STEMA
21,8%	5/8	STEMA
12,3%	8/11	STEMA
11,4%	11/16	STEMA
0,3%	SLN 120	FILLER
1,4%	FILLER	CONS
29,9%	AE	
	apport liant AE	*avec* 5,0 %TL
2,5%	50/70	
1,50%	SLN 120	
5,2%	BITUME TOTAL	



Implementations in road construction projects: Highway A 150 (FR)

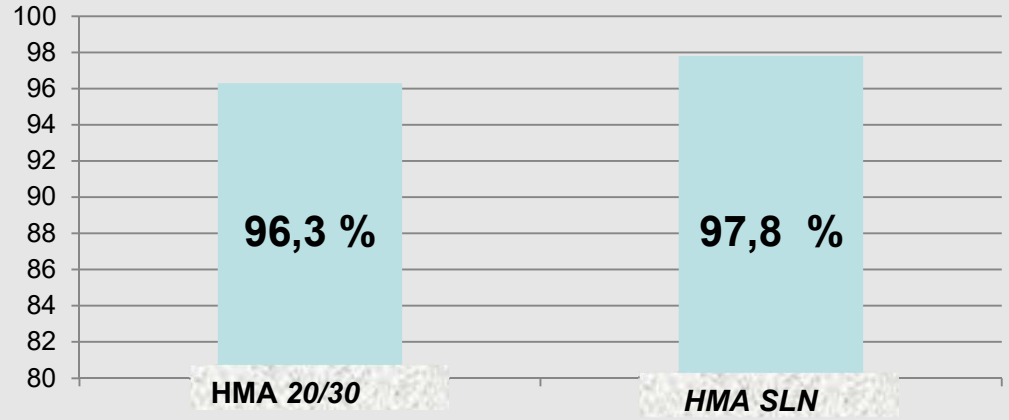
Water sensitivity

HMA 20/30

Sensibilité à l'Eau EN 12697-12 Méthode B			
COMPACITE	94,9%	*ESSAIS MECANIQUES*	
INDICE VIDES	5,1%	C_D à 18° kPa	17918
MVRG t/m^3	2,767	C_W à 18° kPa	17250
MVR t/m^3 *	2,545	*i*/C (%)	**96,3**
MVA t/m^3	2,416	K	3,45

HMA SLN

Sensibilité à l'Eau EN 12697-12 Méthode B			
COMPACITE	95,1%	*ESSAIS MECANIQUES*	
INDICE VIDES	4,9%	C_D à 18° kPa	20623
MVRG t/m^3	2,766	C_W à 18° kPa	20178
MVR t/m^3 *	2,544	*i*/C (%)	**97,8**
MVA t/m^3	2,418	K	3,46



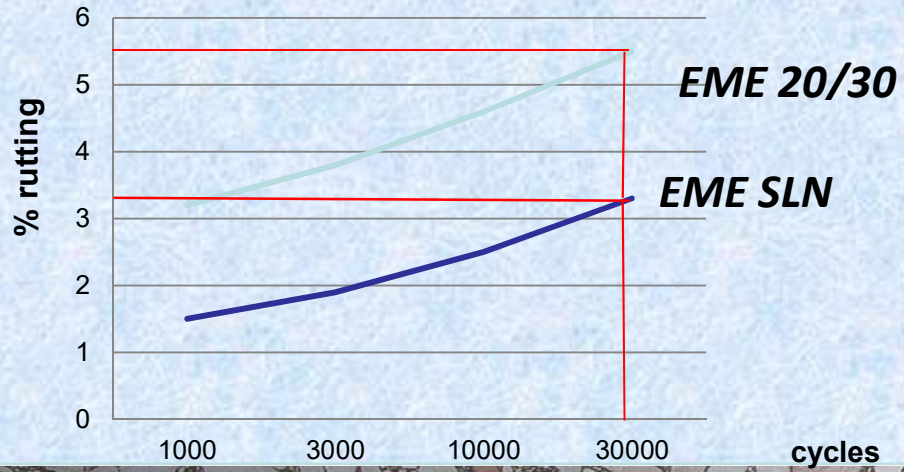
The 2 specimen were compacted at the same void percentage 5%

Implementations in road construction projects: Highway A 150 (FR)

Resistance to rutting

ESSAI D'ORNIERAGE *EN 12697-22*		
% de vides des éprouvettes 4,9 %		
N Cycles	% ornière moyen	Specific.
1 000	3,2%	
3 000	3,8%	
10 000	4,6%	
30 000	5,5%	*< 7,5%*

ESSAI D'ORNIERAGE *EN 12697-22*		
% de vides des éprouvettes 4,7 %		
N Cycles	% ornière moyen	Specific.
1 000	1,5%	
3 000	1,9%	
10 000	2,5%	
30 000	3,3%	*< 7,5%*

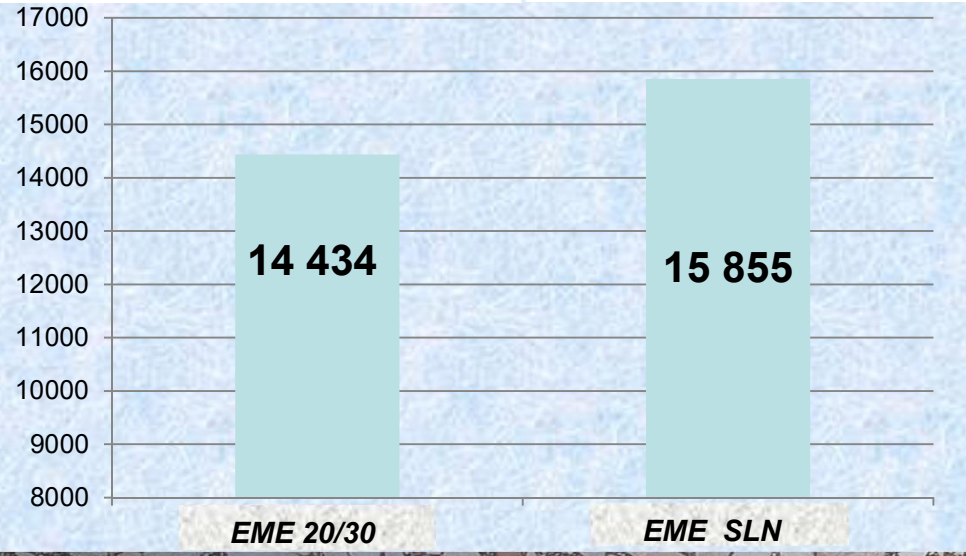


Implementations in road construction projects: Highway A 150 (FR)

Elastic modulus

TRACTION INDIRECTE EN 12697-26 Annexe C	
% de vides	5,1
Module 15°C, 124ms (MPa)	14434

TRACTION INDIRECTE EN 12697-26 Annexe C	
% de vides	5,0
Module 15°C, 124ms (MPa)	15855



T = 15°C

Implementations in road construction projects: Highway A 150 (FR)

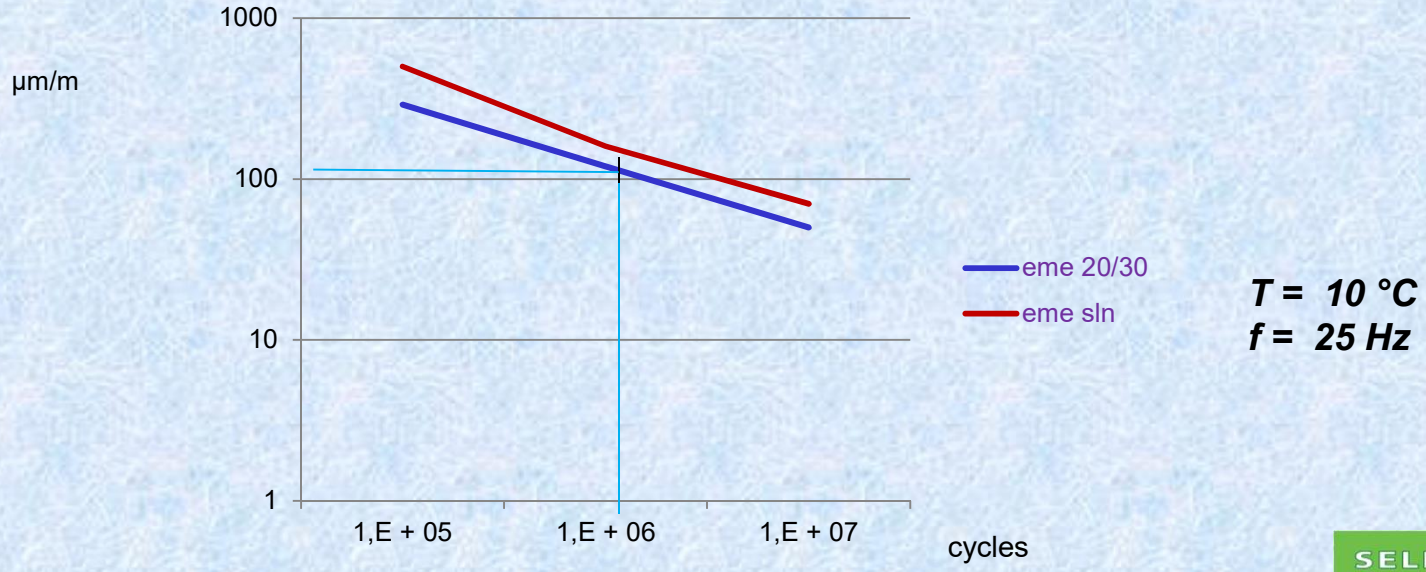
Fatigue

HMA 20/30

ESSAI DE FATIGUE EN 12697-24 Annexe D	
MVA (t/m3) :	5 % de vides
Déformation relative à 10°,25Hz	134,1 µm/m

HMA SLN

ESSAI DE FATIGUE EN 12697-24 Annexe D	
MVA (t/m3) :	5,1 % de vides
Déformation relative à 10°,25Hz	137,3 µm/m



T = 10 °C
f = 25 Hz

Implementations in road construction projects: Highway A 150 (FR)

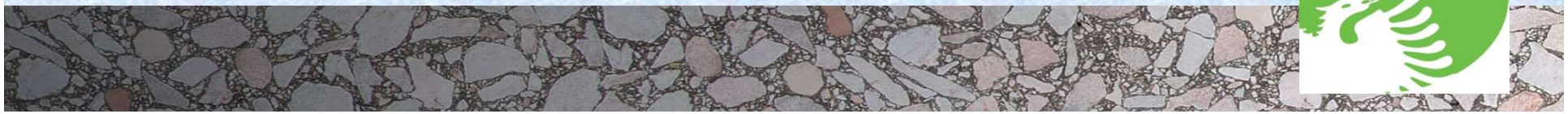
The study results **validaded the** approach which consisits in manufacturing the recycled HMA using a straigt run bitumen **50/70 + 1,5 %** of natural bitumen *Selenizza.*

High Performance Asphalt Mixtures in Switzerland

In order to respond to the technical challenge imposed by:

- High-level of traffic constraints
- Very harsh climatic conditions, with temperatures that oscillate between -20°C to + 40 °C

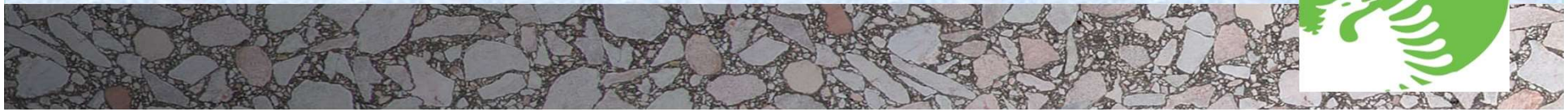
Switzerland incorporated in its national standard the concept of High Modulus Asphalt Mixes HMA.



High Performance Asphalt Mixtures in Switzerland

The Swiss company COMIBIT from Canton Ticino, aiming to minimize the **rutting** and **cracking** phenomena in flexible pavement layers of the road network, characterized by an important traffic of trucks that cross the Alps, increasing from year to year, developed a new mix design of type AC EME 22C2 (class 2).

The new recipe improved **fatigue performance** using a polymer modified bitumen Shell Cariphalte 25 RC, while maintaining a **high modulus stiffness** using Selenizza as hardening additive.



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High Performance Asphalt Mixtures in Switzerland

In Switzerland, the performance **class 1** of HMA, is recommended for improving the resistance to **permanent deformations** (rutting). The performance **class 2,** much harder to reach, has higher requirements of **modulus of stiffness** and **resistance to fatigue**

The Swiss standard specification SN 640 431-1NAB for AC EME 22

	Testing method	AC EME 22C1	AC EME 22C2
Voids content on Marshall specimens (%)	EN 12697-8	≤ 3.0 – 5.0	≤ 1.0 – 3.0
Water sensitivity	EN 12697-12	≥ 70	≥ 70
Binder content as a percentage of total mix weight (%)		≥ 4,6	≥ 5,4
Rutting resistance at 30 000 cycles & 60°C	EN 12697-22		
Rut depth on a slab of 10 cm thickness (%)		≤ 5.0	≤ 7.5
Complexe modulus at 15°C/10Hz (MPa)	EN 12697-26	≥ 11 000	≥ 14 000
Fatigue resistance at 10°C/25Hz (microdeformations)	EN 12697-24	≥ 100	≥ 135

High Performance Asphalt Mixtures in Switzerland

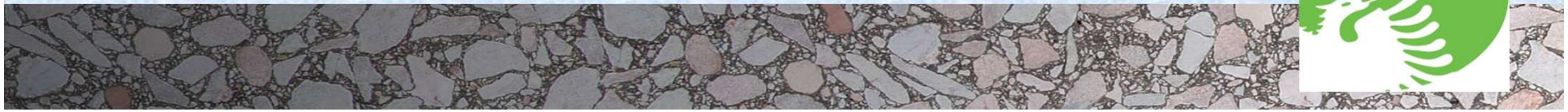
Based on the **same grading curve**, two alternatives of mix design have been tested, containing different dosage levels of Selenizza, to determine its percentage for obtaining a final binder with penetration ranging between **10 to 20 dmm**.

1. First formulation (Selenizza **26%** of the total binder)

   3.9% Shell Cariphalte 25 RC**+ 1.4% SLN = 5.3%**

2. Second formulation (Selenizza **29%** of the total binder)

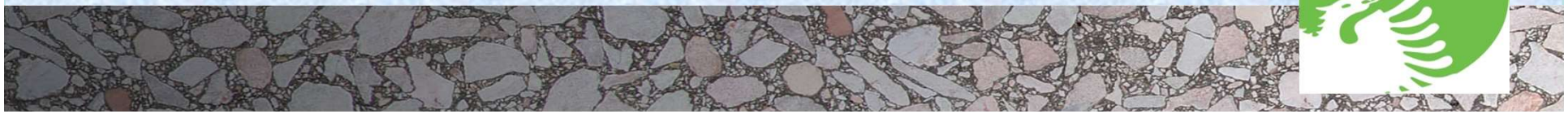
   3.9% Shell Cariphalte 25 RC**+ 1.6% SLN = 5.5%**



High Performance Asphalt Mixtures in Switzerland

Modulus and fatigue Test results

Bonder composition	Unity	Mix design 1	Mix design 2
Shell Cariphalte 25 RC	%	3,9	3,9
Selenizza SLN	%	1,4	1,6
Theoretical binder content (¨% by mix mass)	%	5,3	5,5
Complex modulus at 15°C/10Hz (EN 12697-26)	MPa	19 441	18 336
Hydrostatic voids percentage (%)	%		
Fatigue resistance at 10°C/25Hz (EN 12697-24)	Microdef	139	145



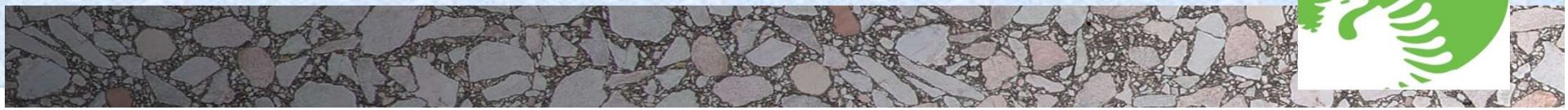
High Performance Asphalt Mixtures in Switzerland

The obtained modulus and fatigue tests results **clearly exceed** the Swiss standard specification for the asphalt mixes AC EME 22 C2 (14 000 MPa and 135 µdef).

To prevent the **cracking risk** at low temperatures, **a new job** mix formula was Implemented, where an **optimum value** of **stiffness modulus** was obtained by Introducing the correct percentage of Selenizza, maintaining a high level of fatigue resistance with a relatively less strong value of the stiffness modulus:

4.7% Shell Cariphalte 25 RC**+ 1.4% SLN = 6.1%**

The tests performed on **extracted binder** indicated that it belonged to a **10/20** paving grade bitumen: **penetration** = **13 dmm** and **TR&B = 86,7°C**



High Performance Asphalt Mixtures in Switzerland

The results of tests performed by the LAVOC Laboratory at the Swiss Federal Institute of Technology Lausanne, confirmed that the new job mix formula met the technical requirements, with significantly higher values

- ε_6 (extrapoled) ≈ **150 µdef** **(Swiss standard ≥135 µdef)**
- **Modulus** (15°C/10 Hz) **= 15 100 MPa** **(Swiss standard ≥ 14 000 MPa)**

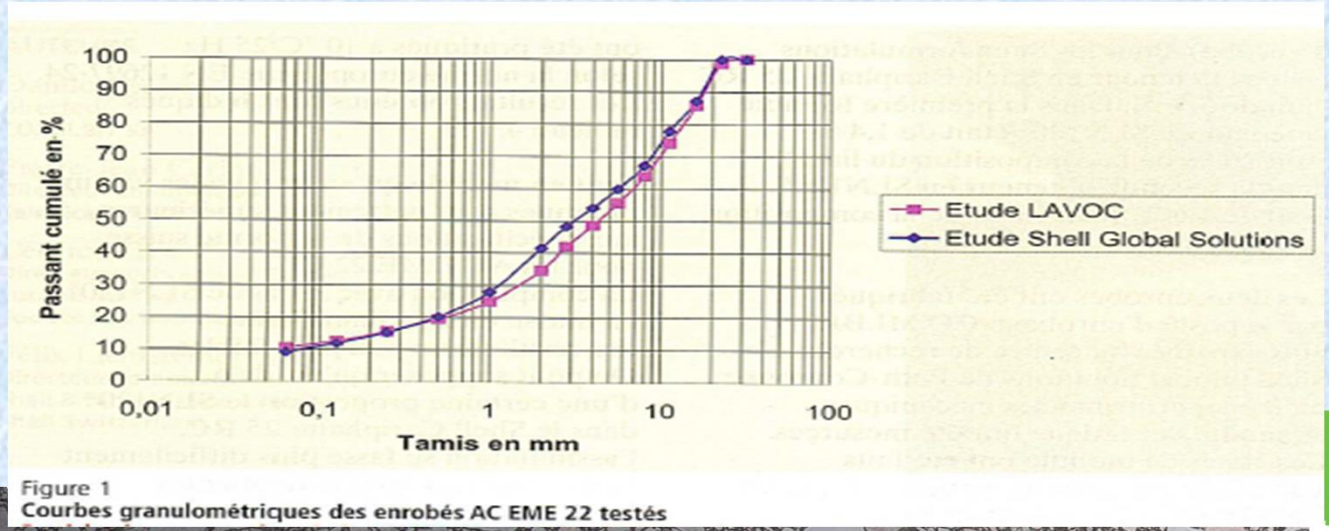


Figure 1
Courbes granulométriques des enrobés AC EME 22 testés

SELENIZZA

High Performance Asphalt Mixtures in Switzerland

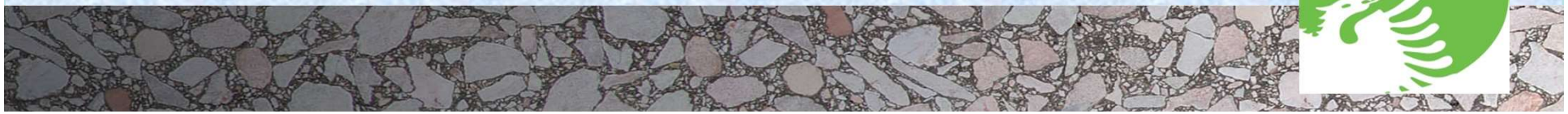
SELENIZZA

Implementations in road construction projects: Highway Fier-Tepelene (Al)

The new road pavement structure, instead of **23 cm**, consisted of **19 cm** paving structure composed of three layers of continuously- graded bituminous mixtures:

- **base course** 9 cm
- **binder course** 6 cm
- **wearing course** 4 cm

For all bituminous mixtures, the natural bitumen Selenizza was used to a percentage of **8%** by weight of the base bitumen



Implementations in road construction projects: Highway Fier-Tepelene (Al)

- **A study** conducted by the **Polytechnic University of Turin** – Italy, on materials sampled from the production plant, as well as on a test session, **evaluated the binder and pavement performance**.
- **The analysis** of compact issues, by referring to binder viscosity and the binder related contribution **to the occurrence of rutting, fatigue and thermal cracking** as well as the assessment of **mixture stiffness**, led to the **conclusion** that the considered bituminous mixtures containing the natural asphalt Selenizza, **were in compliance** with the pavement construction standards and specifications

Implementations in road construction projects: Highway A8 “Olimpia Odos” (Gr)

- The project involved the implementation of 375 km highway and was designed according to the prescription of **French Standards** applied to **Greek reality and experience**.

- The road structure consisted of :
  - DBM (Dense Bitumen Macadam) **base course**
  - anti-rutting **binder course AC (5 cm)**
  - anti-skid TAC (thin asphalt concrete) **wearing course (2.5 cm).**

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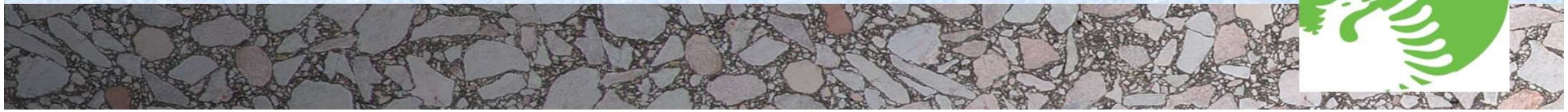


Implementations in road construction projects: Highway A8 “Olimpia Odos” (Gr)

- **Several** trial **mix designs** for the base and binder courses were tested using different kind of binders such as:

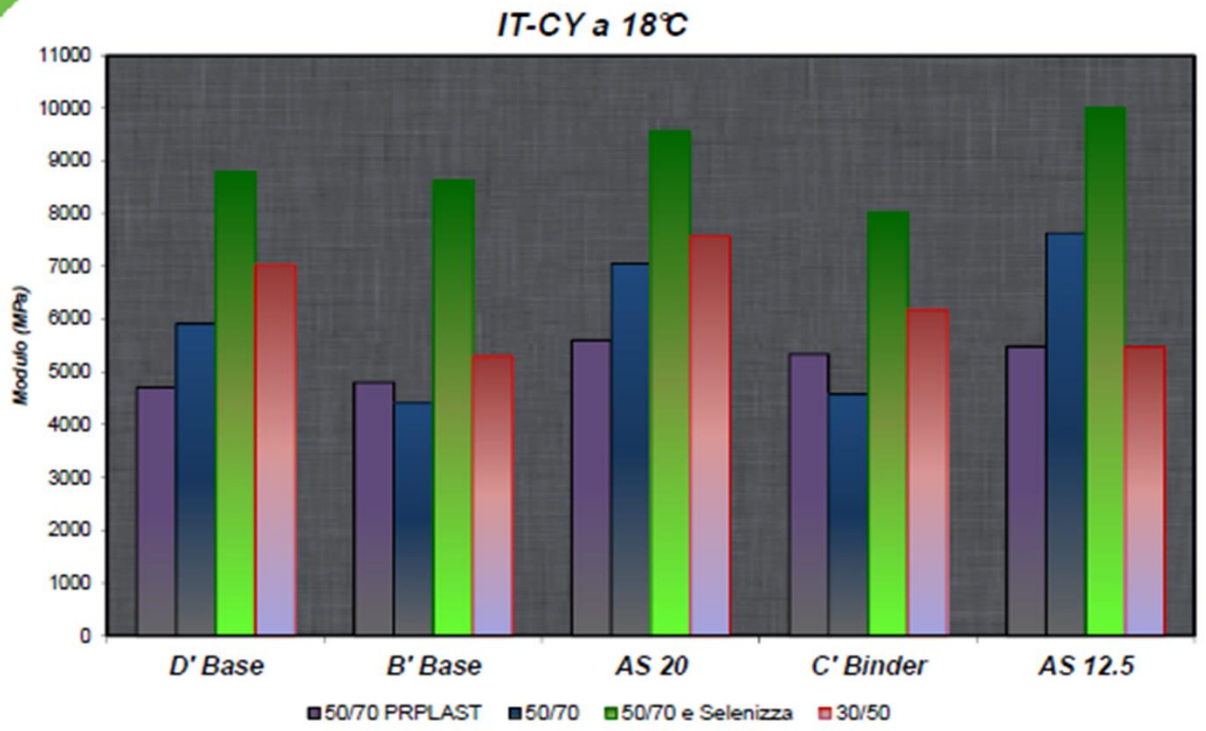
  - bitumen **50/70**
  - bitumen **50/70 + 8% Selenizza**
  - bitumen **30/50**
  - **PR PLAST** modified bitumen.

Highway A8 “Olimpia Odos” (Gr)
STIFFNESS MODULUS (Indirect Tensile Test)

SELENIZZA

Dott. Ing. Luca Noferini
Laboratorio prove materiali Elletipi srl

LABORATORY TEST RESULTS
STIFFNESS MODULUS

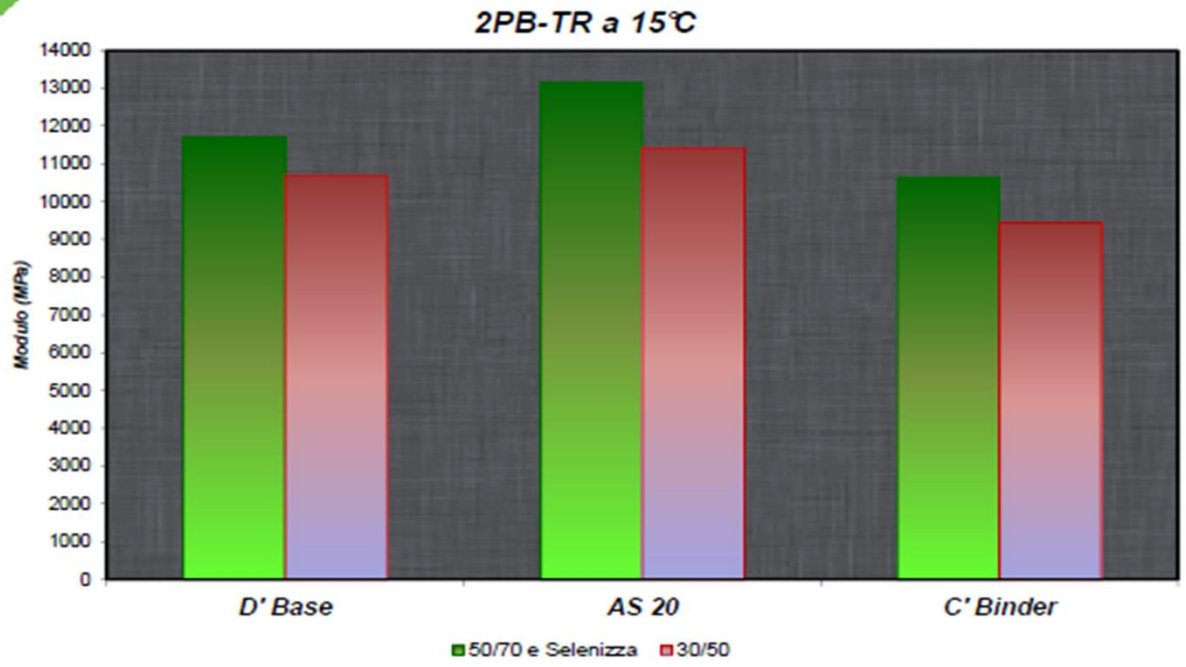


Highway A8 “Olimpia Odos” (Gr)
STIFFNESS MODULUS (Two Point Bending test)

SELENIZZA

Dott. Ing. Luca Noferini
Laboratorio prove materiali Elletipi srl

LABORATORY TEST RESULTS
STIFFNESS MODULUS



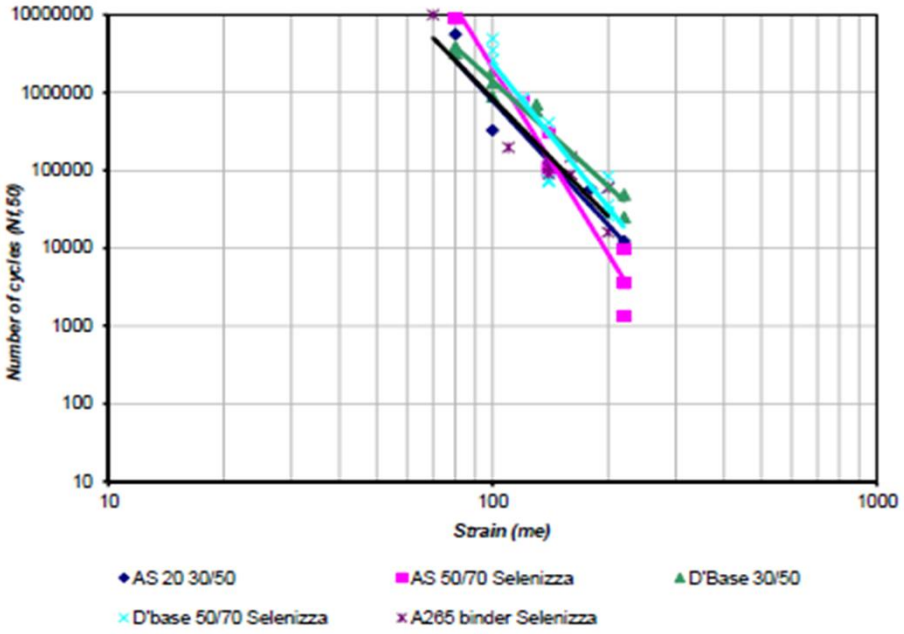
Highway A8 “Olimpia Odos” (Gr)
FATIGUE TEST

SELENIZZA

Dott. Ing. Luca Noferini
Laboratorio prove materiali Elletipi srl

LABORATORY TEST RESULST
FATIGUE RESISTANCE 2PB-TR

SUMMARY OF FATIGUE TESTS 2PB-TR, 10°C, 25 Hz



Material	*Bituminous binder*	*Fatigue ε6 10 °C, 25 Hz*	*Class asphalt mix*
STS A265 B' binder course	50/70 + 8% Selenice Pen = 39	*101.6*	DBM4
STS A 260 D' base course	30/50 Pene = 45	*108*	DBM3
STS A 260 D' base course	50/70 + 8% Selenizza Pen=39	*112*	DBM4
AS 20 base course	50/70 + 8% Selenizza Pen = 39	*110*	DBM4
AS 20 base course	30/50 Pen= 45	*95*	DBM3

	TAC	AC	DBM2	DBM3	DBM4	HDM
10°C	7200	7200	12 300	12 300	14 550	17 000
18°C	**4320**	**4320**	**7500**	**7500**	**8870**	**12200**
ε6	-	-	80	90	100	130
-1/b	-	-	5	5	5	5
SN	-	-	0,3	0,3	0,3	0,25
v	0,35	0,35	0,35	0,35	0,35	0,35
Kc	-	-	1,3	1,3	1,3	1

Implementations in road construction projects: Highway A8 “Olimpia Odos” (Gr)

Laboratory tests on elastic modulus and fatigue showed that the binder with bitumen **50/70 + 8% Selenizza**, had higher results of **stiffness and fatigue** compared to all the other tested binders, allowing to produce an asphalt concrete that belongs to the **higher project category DBM 4**, thereby making it **possible to reduce** the road package **thickness** by at least **4 cm.**

Ways of introduction

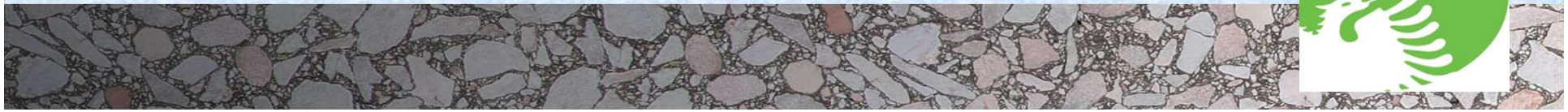
5

Ways of introducing SELENIZZA
in the asphalt plant

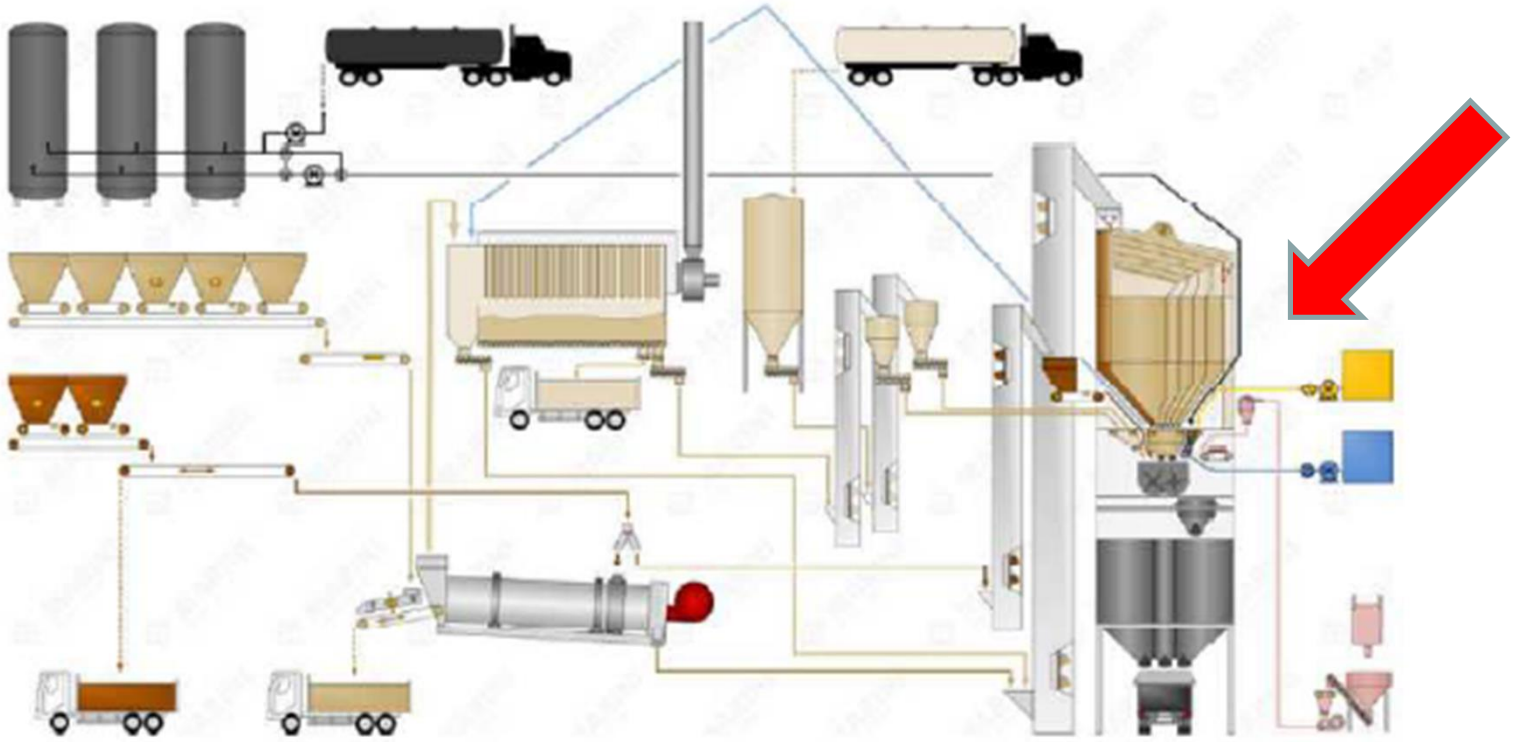
- Added in the ***mixer*** during the asphalt mixing process, in the **dicontinous** asphalt plants

- Inserted into the ***recycling ring*** during the asphalt mixing process, in the **continous** asphalt plants

- Blended directly with the hot bitumen ***in asphalt binder storage tanks***



1. Introduced directly in the mixer of discontinuous asphalt mix plants



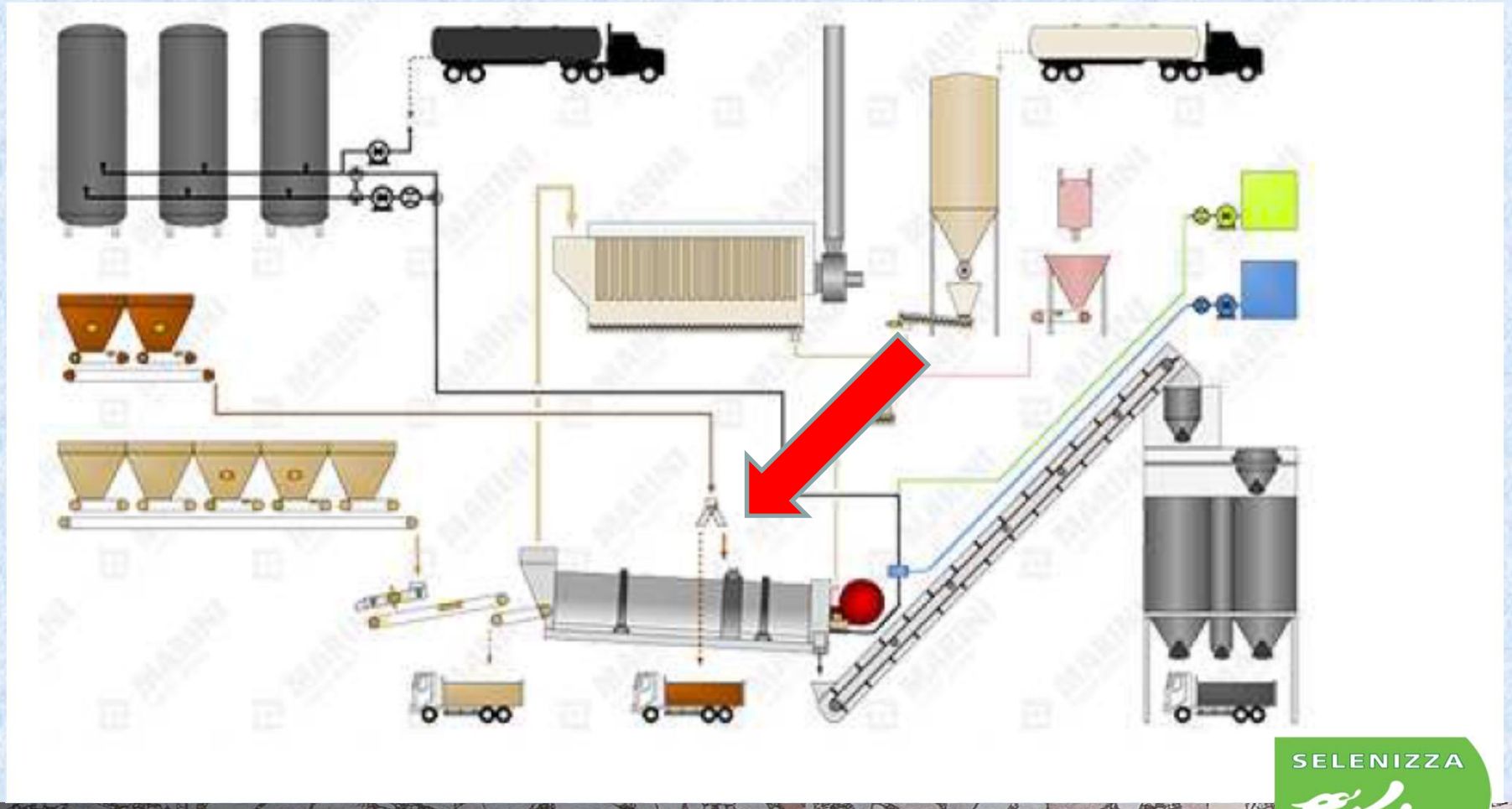
introducing SELENIZZA
in the asphalt plant

pneumatic transport

introducing SELENIZZA
in the asphalt plant

mechanical insertion into the **hopper** via a **belt conveyor** or **screw conveyor**

2. Introduced via the recycling ring in the continuous asphalt plants

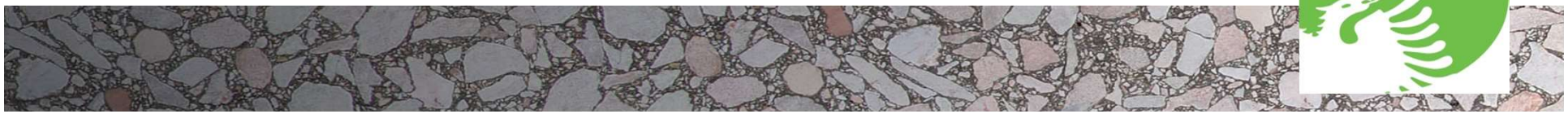


Introducing SELENIZZA
in the asphalt plant

SELENIZZA

introducing SELENIZZA
in the asphalt plant

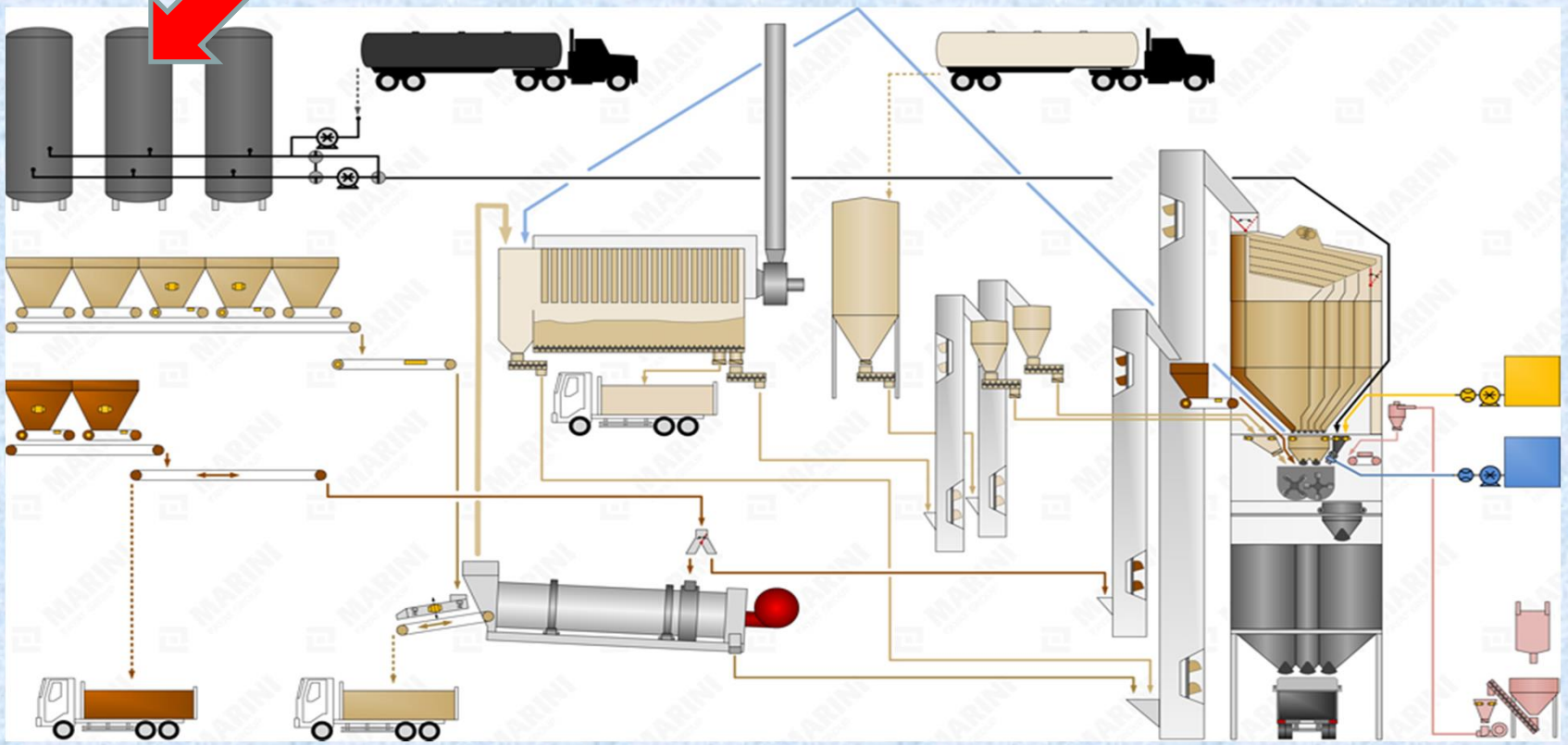
insertion to the ***recycling ring*** during the asphalt mixing process, in the **continous** asphalt plants
(300 tons /hours France) **Recyling + Selenizza**



introducing in the asphalt plant
Recyling + Selenizza

continous asphalt plant
300 tons /hours France

3. Added to the liquid asphalt binder in the stirred storage tank



introducing in the asphalt plant
Recyling + Selenizza

Mixing with **liquid** bitumen (Serbia)

introducing in the asphalt plant
Recyling + Selenizza

Blended directly with the hot bitumen ***in tanks*** *(Serbia)*

introducing in the asphalt plant
Recyling + Selenizza

Mixing with **liquid bitumen**, batch of 100 tons (Albania)

introducing in the asphalt plant
Recyling + Selenizza

Mixing with liquid bitumen direcly in the **tank of polymers** (Greece)

Economic assessment

6

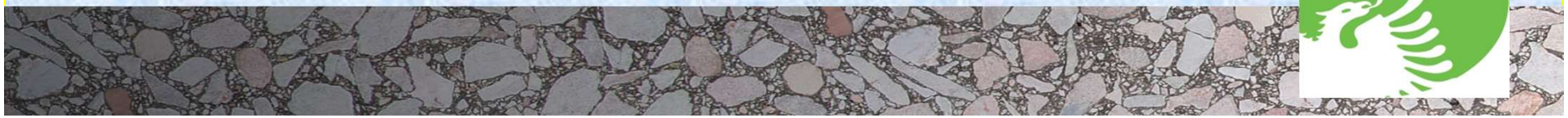
Skopje 2016 – Natural Asphalt Selenizza

ECONOMIC ASSESSMENT
Optimum binder content

Recently, a cost analysis was conducted by the Highway Institute of Belgrade (Serbia). For experimental purposes, were investigated and compared the characteristics and the manufacturing costs of a **carrying layer BNS 22s (A)** based on a conventional road bitumen **BIT 60** (50/70) **and the same mix design** whose **binder was composed of BIT 60** (50/70) + **10%** natural bitumen Selenizza (relative to the total binder weight)
Using the **Marshall method,** was deducted the **optimum binder content** for each mix design:

- **3,5%** for the asphalt mix with conventional binder

- **3,3 %** for the asphalt mix whose binder was modified with Selenizza

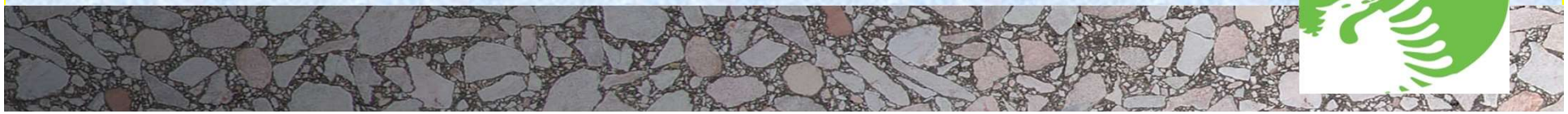


ECONOMIC ASSESSMENT
Marshall Test

- The addition of **Selenizza increases** the **Marshall quotient** (ratio of stability to flow) :

	Stability [kN]	Flow [mm]	S/F [kN/mm]
Standard asphalt mixture	12.8	3.2	4
Asphalt mixture + Selenizza	14.1	2.8	5
Serbian standard	> 8.0	-	> 2.5

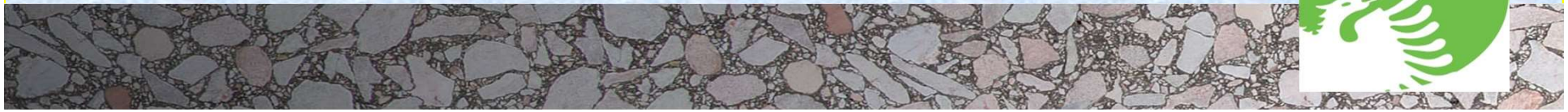
T = 60°C voids= 5.9 %



ECONOMIC ASSESSMENT
Stiffness Modulus

- Test results show that the **addition of Selenizza increases the stiffness modulus by at least 30%** compared to the standard asphalt mixture

	Module E* [MPa]	**Norme [MPa]**
Standard asphalt mixture	6 585	≥ 3 600
Asphalt mixture + Selenizza	8 472	≥ 3 600

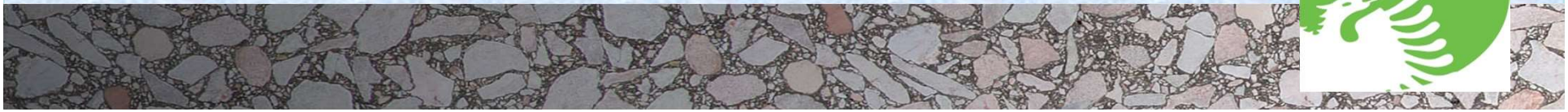


ECONOMIC ASSESSMENT
Prices constituent materials & production

- Economic analysis was carried out based on the analysis of the prices of **constituent materials** and the prices of **asphalt mixtures production** with and without the addition of natural asphalt SELENIZZA.

- **Prices** of the **constituent materials** and **production costs** of asphalt mix were taken from **asphalt plant** AD "ROADS" Uzice in October 2014, without VAT.
- The flexible pavement structure under analysis was composed of the following layers :

• Surface Asphalt Concrete layer (AB 11s)	thickness = 5 cm
• **Bituminous bearing course layer (BNS 22s A) (with and without addition of SELENIZZA)**	**thickness = 8 cm**
• Unbound gravel layer 0/31.5 mm	thickness = 15cm
• Unbound gravel layer 0/63 mm	thickness = 35cm



ECONOMIC ASSESSMENT
Thickness reduction

The results of calculation, using the pavement design software **BISAR show that** the addition of **natural bitumen** SELENIZZA, increases the stiffness modulus allowing thus a **thickness reduction** of the layer from **8 cm to 6.5 cm**

Layer type	Stiffness Modulus E (MPa)	Poisson's ratio	Layer thickness (cm)
AB 11s	4400	0.35	5
BNS 22s(A)	**6585**	**0.35**	**8**
0/31,5 mm	152	0.40	15
0/63 mm	80	0.40	35

Standard asphalt mixture

Layer type	Stiffness Modulus E (MPa)	Poisson's ratio	Layer thickness (cm)
AB 11s	**4400**	**0.35**	**5**
BNS 22s(A)	**8472**	**0.35**	**6.5**
0/31,5 mm	152	0.40	15
0/63 mm	80	0.40	35

Asphalt mixture with Selenizza

SELENIZZA

ECONOMIC ASSESSMENT
Prices of materials

Component	Content (%)	Mass (kg)	Price of components (€/t)	Price per ton of asphalt mixture (€)
filler	3.4	34.0	4.95	
0/4 mm	38.1	381.0	4.95	
4/8 mm	14.5	145.0	4.95	
8/11 mm	13.5	135.0	4.50	**24.60**
11/16 mm	7.7	77.0	4.50	
16/22 mm	19.3	193.0	4.50	
Bitumen 50/70	3.5	35.0	573.20	

Standard asphalt mixture

Component	Content (%)	Mass (kg)	Price of components (€/t)	Price per ton of asphalt mixture (€)
filler	3.4	34.0	4.95	
0/4 mm	38.1	381.0	4.95	
4/8 mm	14.5	145.0	4.95	
8/11 mm	13.5	135.0	4.50	**25.20**
11/16 mm	7.7	77.0	4.50	
16/22 mm	19.3	193.0	4.50	
Bitume 50/70	3.3	35.0	573.20	
50/70 + Selenizza (10 %)	0.3	3.0	560.00	

Asphalt mixture with Selenizza

SELENIZZA

ECONOMIC ASSESSMENT

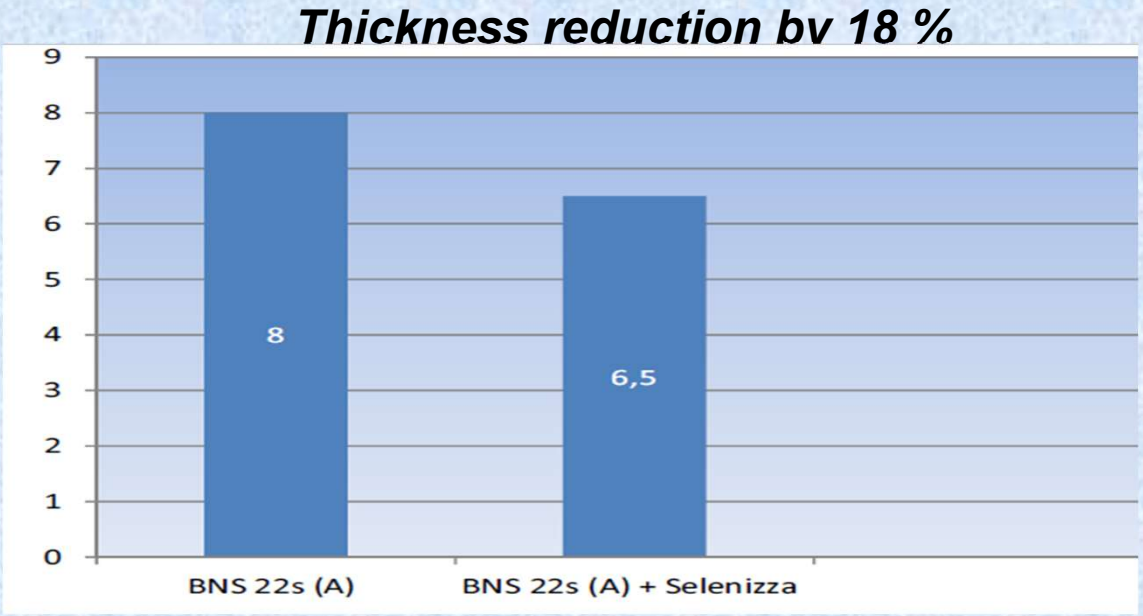
	Standard asphalt mixture	asphalt mixture with SLN
Price of materials (€/t)	24.6	25.2
Production cost (€/t)	24.2	26.6
Total (€/t)	**48.8**	**51.8**
€/ 1m² x 1cm	1.16	1.25

It can be seen that the addition of SELENIZZA increases the cost of the asphalt mix BNS-22s (A) by **about 7%**

Total unit cost of production of asphalt mixtures with and without the addition of natural asphalt "SELENIZZA"

ECONOMIC ASSESSMENT

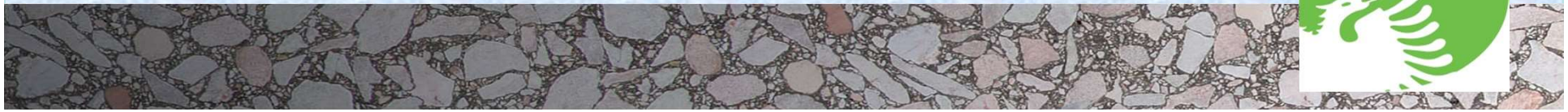
On the other hand, there is a possible **thickness reduction** by about **18%,** by using a layer thickness of **6.5 cm** instead of **8 cm**



ECONOMIC ASSESSMENT

- Consequently, **the ultimate value** of cost of production of a BNS-22s (A) layer, will be reduced by approximately **13%**

- As an example, for the construction of 1 km BNS-22s (A) layer, on a highway12 meter-wide, by using a layer width of 6,5 cm instead of 8 cm, the needed quantity of the asphalt mixture will be reduced by **430 ton /km,** with an ultimate cost saving of **21 000 €/Km** compared to the original project



Environmental friendly

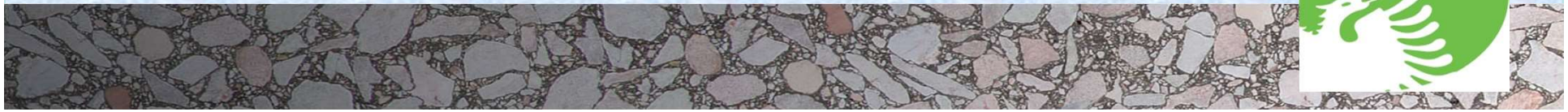
7

Skopje 2016 – Natural Asphalt Selenizza

Natural asphalt & environmental assessment

- Worldwide economical crisis and environmental awareness have created the need for **bituminous binders** that meet **Life Cycle Assessment constraints**.

- As a part of a common commitment to **sustainable development,** the University of Rome in cooperation with the company Selenice Bitumi, carried out e research project, whose aim was to **analyze and compare** for the first time, the production process of the **Albanian natural asphalt** (Selenizza) and on the other hand, the various steps necessary to produce the **conventional bitumen from crude oil**, evaluating the **energy consumption** and **CO_2 emission** for each kind of product.

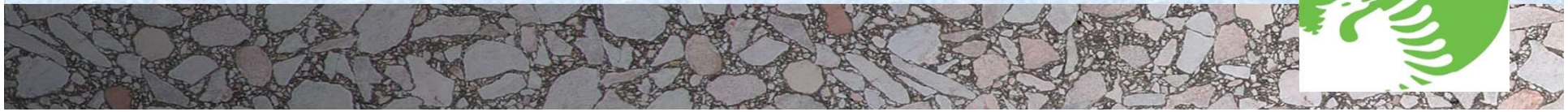


Natural asphalt & environmental assessment

The results of the study showed that:

- The **environmental impact** of the production processes for the bitumen Selenizza (in terms of **CO_2 production**) is about **half** the impact of the road bitumen produced in oil refineries.

- Energy consumption is **reduced** as well, to about **half** the value of the bitumen produced from crude oil.



Production & reference sites

8

Podgorica 2015 – Natural Asphalt Selenizza

Production of Selenizza®SLN

exploitation in an open-pit quarry

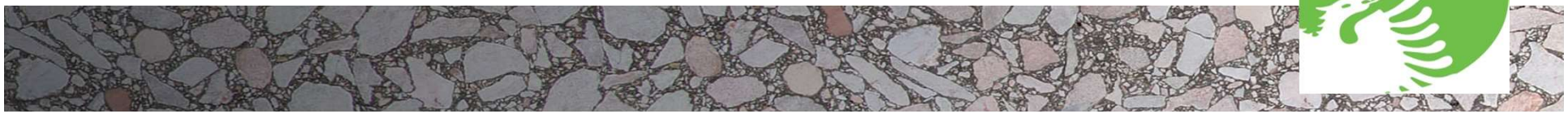
Production of Selenizza®SLN

exploitation in an open-pit quarry

SELENIZZA

Production of Selenizza®SLN

exploitation in an open-pit quarry

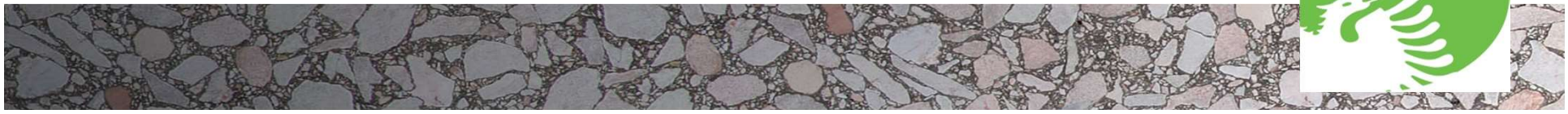


Production of Selenizza®SLN

Crude ore before melting

Production of Selenizza®SLN

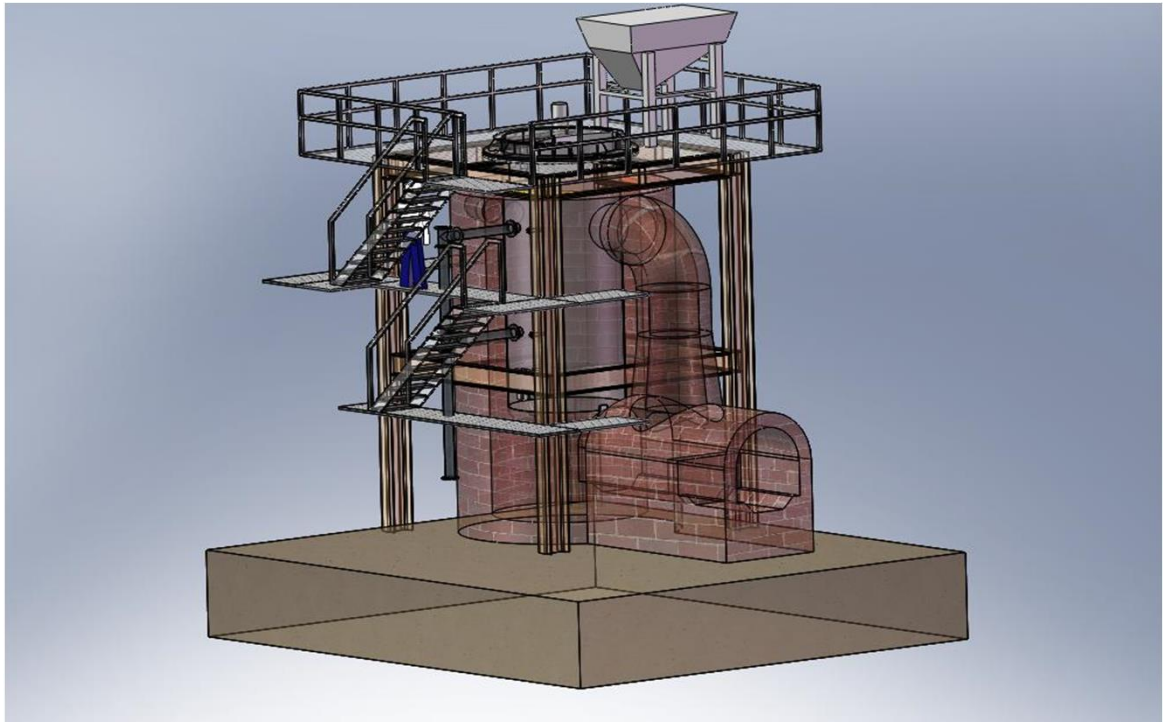
The blocks of asphalt are selected before the melting



Production of Selenizza®SLN

transport into the furnace via conveyor belt

Production of Selenizza®SLN



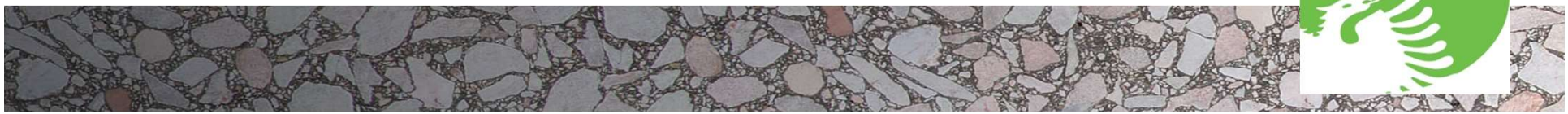
Furnace for bitumen melting at the temperature of about 200 - 240°C

Production of Selenizza®SLN

Production capacity of 7,000 tons per year

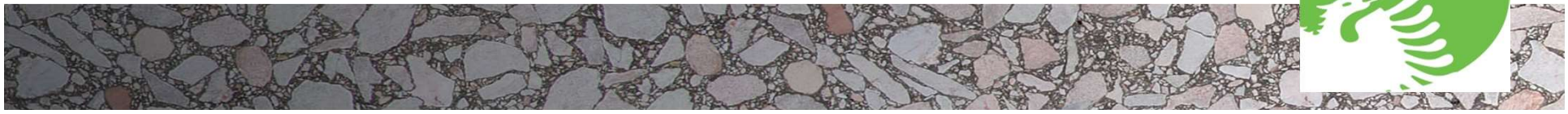
Production of Selenizza®SLN

After melting, the cleaned bitumen is poured into hexagonal moulds



Production of Selenizza®SLN

Each production batch is identified by a lot number



Production of Selenizza®SLN

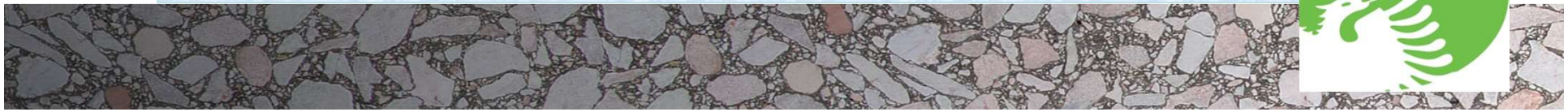
Analysis are carried out, checking and recording the parameters for every batch

Production of Selenizza®SLN

Every single production batch is located in a parcel clearly identifiable

Production of Selenizza®SLN

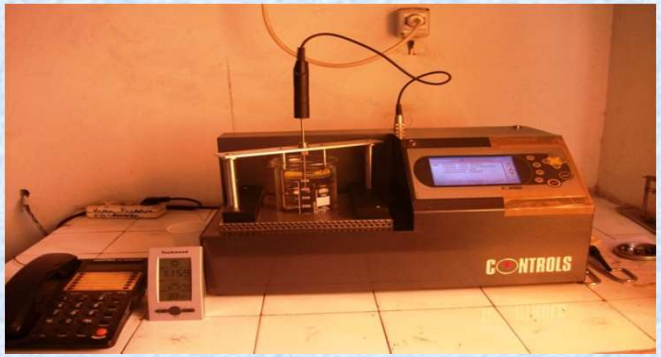
The clean bitumen hexagonal blocks are grinded in powder 0/6mm or in granular form 6/12 mm

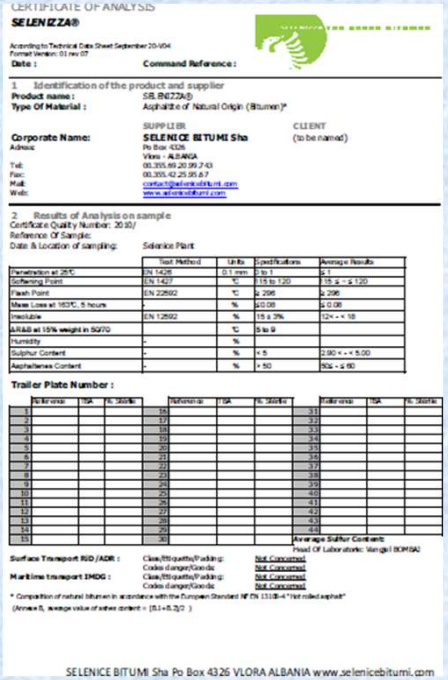


Production of Selenizza®SLN

The Packaging: big bags of about 1 ton and polyethylene, thermofusible bags of 15kg

Transport of Selenizza®SLN





CERTIFICATE OF ANALYSIS

SELENIZZA®

According to Technical Data Sheet September 20-V04
Format Version: 01 rev 07

Date : **Command Reference :**

1 Identification of the product and supplier

Product name : SELENIZZA®
Type Of Material : Asphaltite of Natural Origin (Bitumen)*

	SUPPLIER	CLIENT
Corporate Name:	**SELENICE BITUMI Sha**	(to be named)
Adress:	Po Box 4326 Vlora - ALBANIA	
Tel:	00.355.69.20.99.243	
Fax:	00.355.42.25.95.67	
Mail:	contact@selenicebitumi.com	
Web:	www.selenicebitumi.com	

2 Results of Analysis on sample
Certificate Quality Number: 2010/
Reference Of Sample:
Date & Location of sampling: Selenice Plant

	Test Method	Units	Specifications	Average Results
Penetration at 25°C	EN 1426	0.1 mm	5 to 1	≤ 1
Softening Point	EN 1427	°C	115 to 120	115 ≤ – ≤ 120
Flash Point	EN 22592	°C	≥ 296	≥ 296
Mass Loss at 163°C, 5 hours		%	≤ 0.08	≤ 0.08
Insoluble	EN 12592	%	15 ≤ 3%	12+ – + 18
ARAS at 15% weight in SOTO		°C	5 to 9	
Humidity	-	%		
Sulphur Content	-	%	+ 5	2.90 + – + 5.00
Asphaltenes Content	-	%	+ 50	50≤ – ≤ 60

Trailer Plate Number :

	Rotterdam	TSA	N. Stecche		Rotterdam	TSA	N. Stecche		Rotterdam	TSA	N. Stecche
1				16				31			
2				17				32			
3				18				33			
4				19				34			
5				20				35			
6				21				36			
7				22				37			
8				23				38			
9				24				39			
10				25				40			
11				26				41			
12				27				42			
13				28				43			
14				29				44			
15				30				**Average Sulfur Content:**			

"Head Of Laboratorio: Vangjel BOMSA"

Surface Transport RID/ADR :	Class/Etiquette/Packing:	Not Concerned
	Codes danger/Kemler:	Not Concerned
Maritime transport IMDG :	Class/Etiquette/Packing:	Not Concerned
	Codes danger/Kemler:	Not Concerned

* Composition of natural bitumen in accordance with the European Standard NF EN 13108-4 "Hot mixed asphalt"
(Annex B, average value of wtwo content = (5,1+5,2)/2)

SELENICE BITUMI Sha Po Box 4326 VLORA ALBANIA www.selenicebitumi.com

SELENIZZA

Transport of Selenizza®SLN

Transport by truck

Transport of Selenizza®SLN

Maritime transport :Vlora port (Al)

Transport of Selenizza®SLN

Maritime transport : cargo loading

Transport of Selenizza®SLN

Bitumen transport aboard cargo plane

Reference sites Selenizza®SLN

Bus lane Chartres France

Reference sites Selenizza®SLN

Tramway Dijon(France)

Reference sites Selenizza®SLN

2011 : Bridge in Val de Verzaska, Ticino - Switzerland

SELENIZZA

Reference sites Selenizza®SLN

Mastic asphalt Switzerland

Reference sites Selenizza®SLN

Mastic asphalt sidewalk Berne - Switzerland

Reference sites Selenizza®SLN

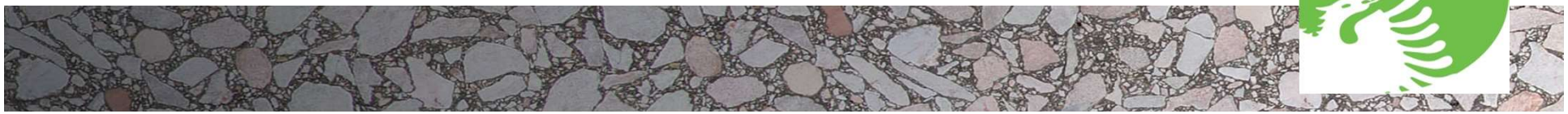
Mastic asphalt Berne - Switzerland

Reference sites Selenizza®SLN

Mastic asphalt Milano Italy

Reference sites Selenizza®SLN

Mastic asphalt Milano Italy



Reference sites Selenizza®SLN

Mastic asphalt Milano Italy

Reference sites Selenizza®SLN

Mastic asphalt Milano Italy

Reference sites Selenizza®SLN

Mastic asphalt Milano Italy

Reference sites Selenizza®SLN

Mastic asphalt Milano Italy

Reference sites Selenizza®SLN

Highway Ticino- Switzerland

Reference sites Selenizza®SLN

2014: Motorway A 150 - France

Reference sites Selenizza®SLN

2014: Port Le Havre - France

Reference sites Selenizza®SLN

2014: Motorway Stylida - Grèce

Reference sites Selenizza®SLN

2013 : Motorway Thessalonique - Grèce

Reference sites Selenizza®SLN

2011 : Bern motorway ring -Switzerland

Reference sites Selenizza®SLN

Ring road Kiev (Ukraina)

Reference sites Selenizza®SLN

National Road Mykolaiv (Ukraina))

Reference sites Selenizza®SLN

Port Le Havre 2 000 (France)

Reference sites Selenizza®SLN

Road junction (France)

Reference sites Selenizza®SLN

Port Martinique (France)

Reference sites Selenizza®SLN

Port French Antilles

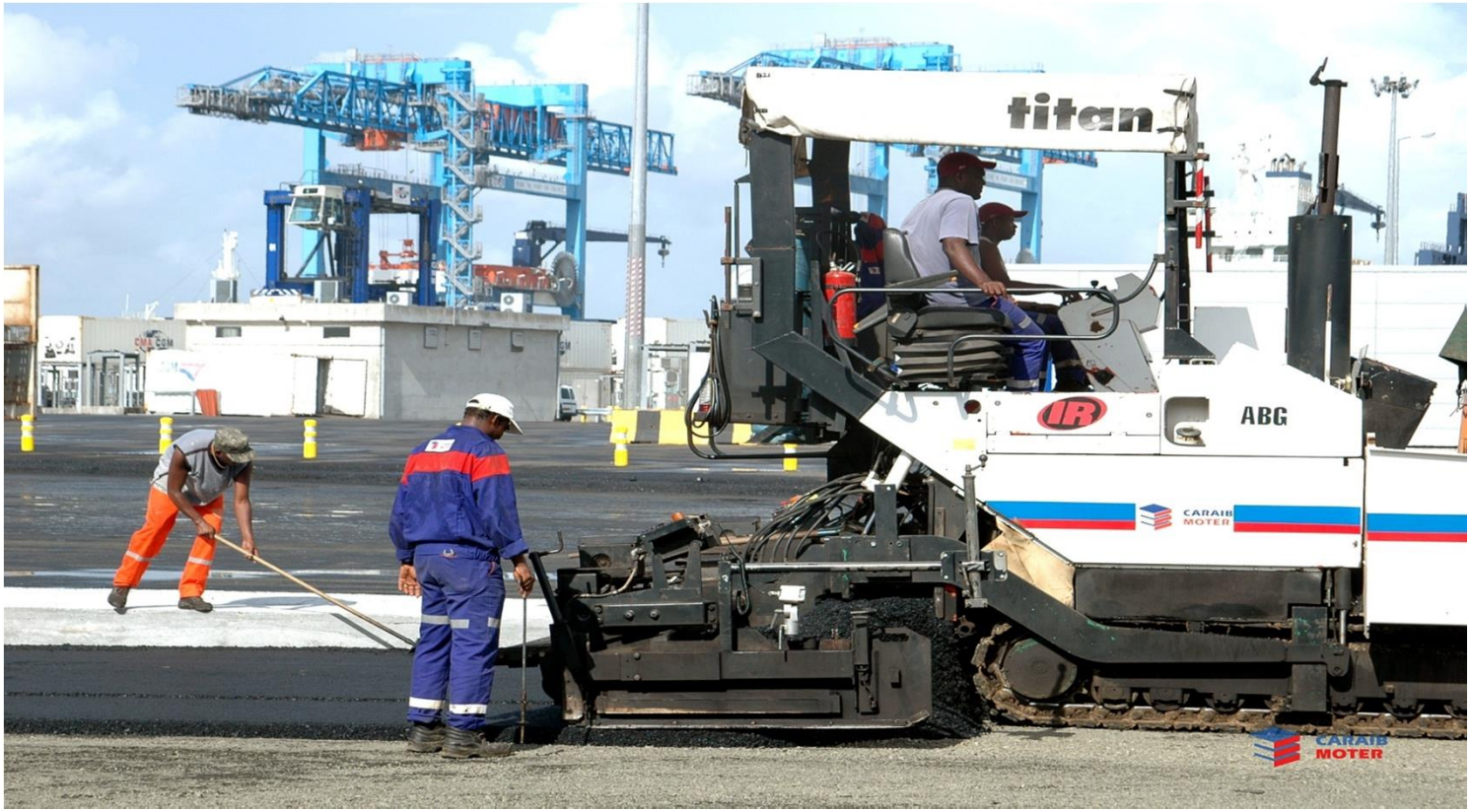
Reference sites Selenizza®SLN

Port platform (France)

Reference sites Selenizza®SLN

Airport Fort de France

Reference sites Selenizza®SLN



Port Martinique (France)

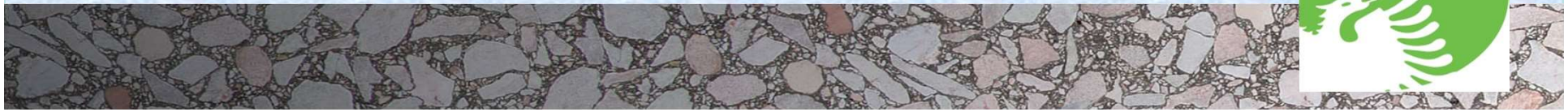
SELENIZZA

Conclusion

9

Conclusion

- **100% compatible** with bitumen from refinery (and polymer modified bitumens)
- High performance **in modulus** & **permanent deformation**
- Better **bitumen-aggregates adhesion**
- Pavement **thickness reduction**
- Better **workability**
- Higher **lifetime** of the pavements



Thank you for your attention!