THE *NATURAL BITUMEN SELENIZZA®SLN THE PERFECT ADDITIVES FOR HIGH-PERFORMANCE ASPHALT MIXES*

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Selenice Bitumi

Summary

1. Analogies and distinctions between different natural bitumen

2. Characterization of natural bitumen Selenizza ® SLN

3. Environmental impact assessment

4. Implementation examples

5. Formulation of new binders using natural bitumen modified with waste oils

6. Conclusions

Analogies and distinctions between 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, **Gilsonite, Trinidad & Selenizza**:

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**

Analogies and distinctions between 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**

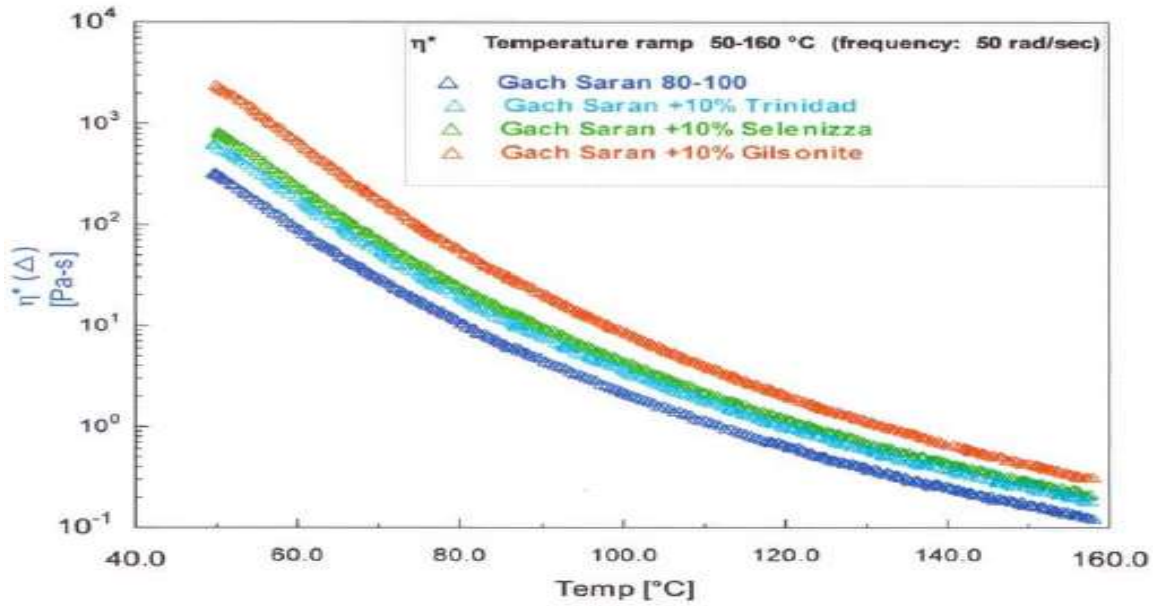
Effect on Penetration and Softening Point

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*

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**

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

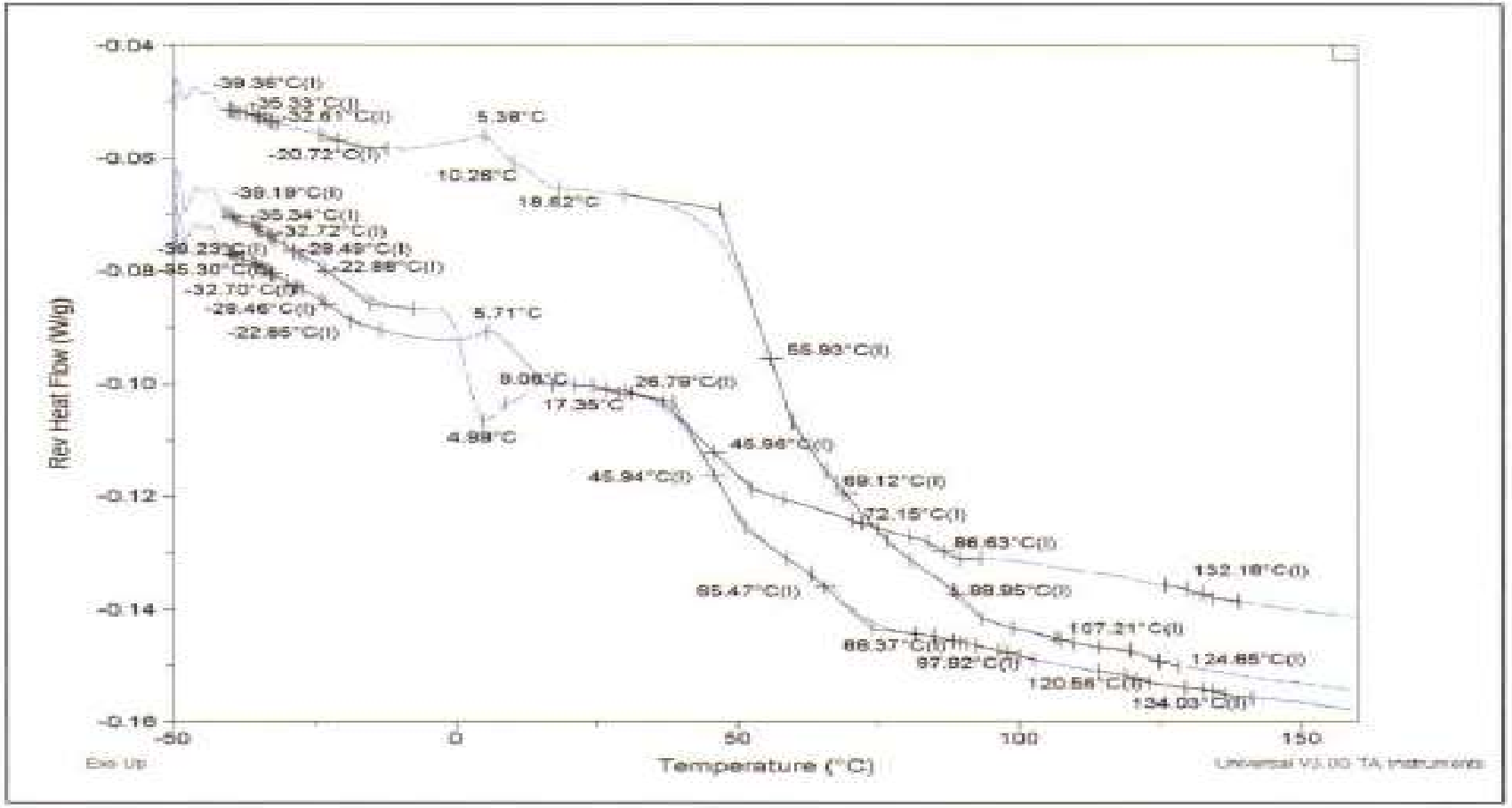
$$dQ/dt = C_p \beta + f(T, t)$$

Temperature range: [-50 °C, + 160 °C]

For the bitumen, the **reversing curve** ≈ 1/ C_p is **more indicative:**

- **vitreous transitions**
- **fusions**

Reversing curves of the mixed samples



Results of MDSC analysis

The MDSC analysis shows that the **rheological behavior** of the **petroleum 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.

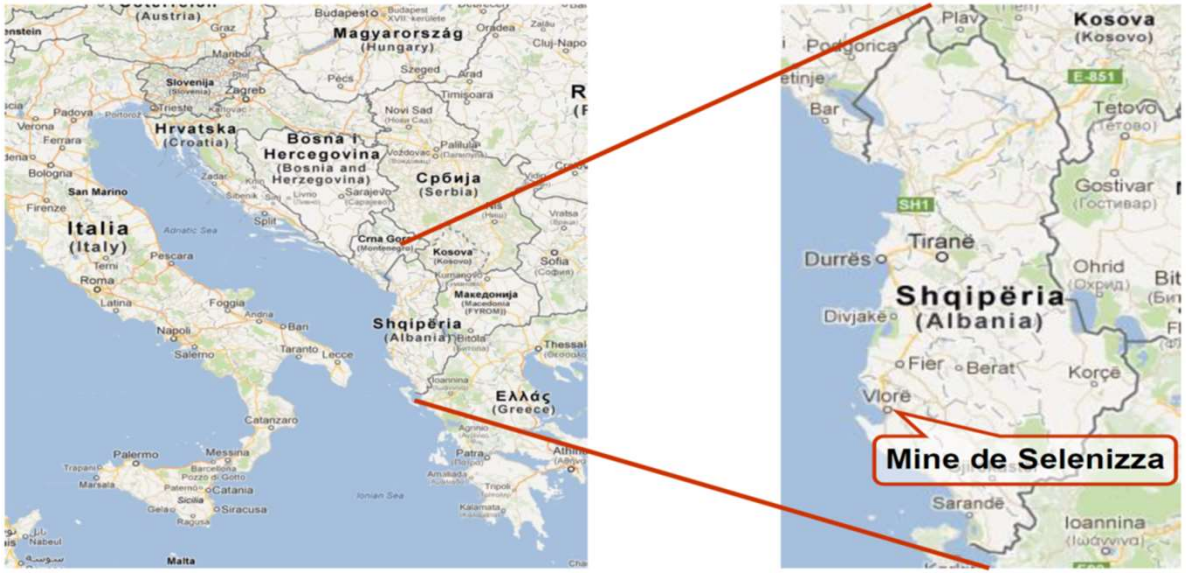
Gilsonite, does not act as a diluent, but **expands the softening** range to **higher temperatures.**

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.

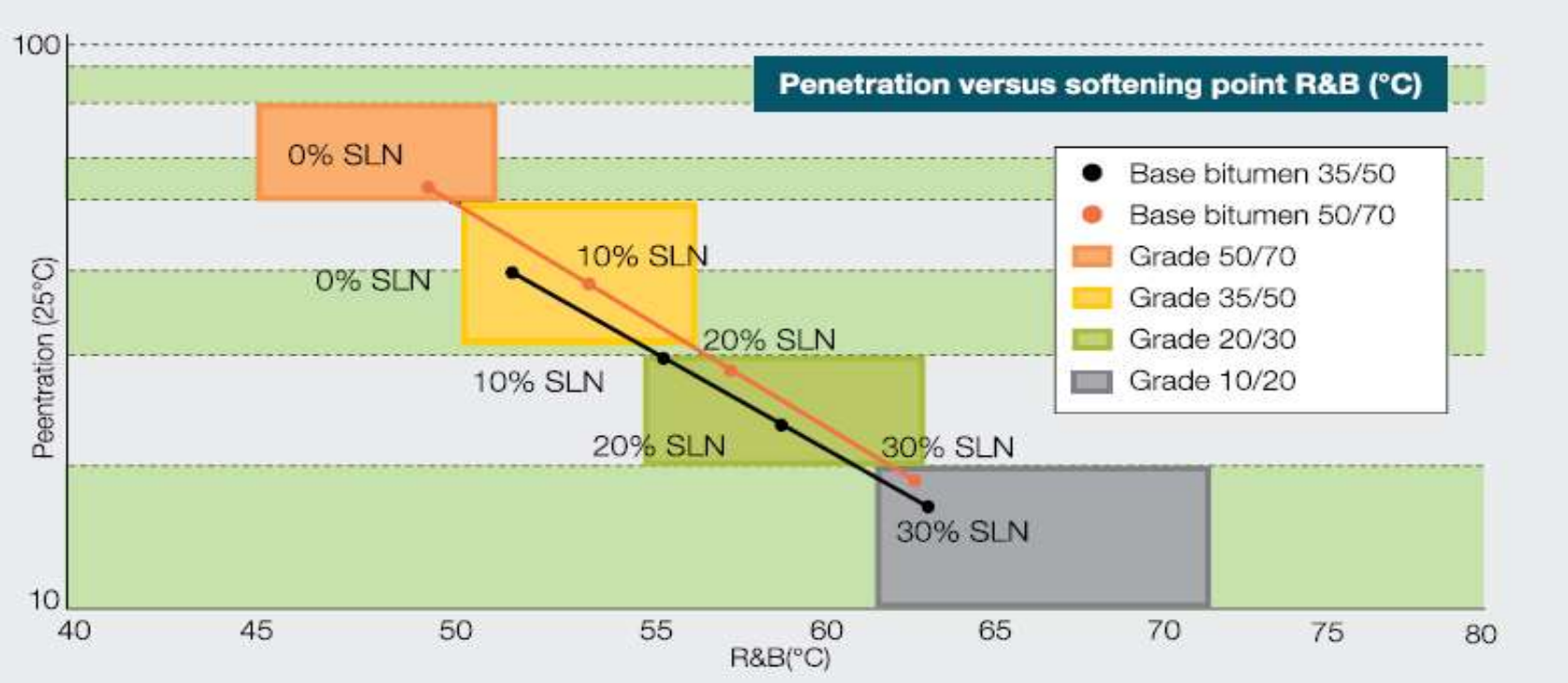
Characterization of natural bitumen Selenizza®SLN

The mine of **Selenice** is located in southeast **Albania. It has been mentioned** since ancient times **by Aristotle** and has been actively exploited by the Romans. After centuries of silence, in **1868,** The French **geologist Coquand** published for the first time a **geological description of** the Albanian bitumen deposit. The ottoman government transferred the mine operating rights to the French (1871), followed by the **Italians** (1919-1943). After the Second World War, the mine was exploited by the Albanian government.

Since 2001, the mine is managed and operated by the **French company KLP Industries** and the modern bitumen production, with open pit mine operations, has witnessed a remarkable progress.



Characterization of natural bitumen Selenizza® SLN



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

Principal characteristics of *Selenizza®SLN*

Penetration at 25°C (1/10 mm)	EN 1426	≤ 2
Softening point temperature (R&B °C)	EN 1427	≤ 120
Acidity Index (mg KOH/g)	EN 14104	3,5
Density at 20°C (g/cm³)	EN ISO 3838	1,16
Asphaltene content (% wt.)	ASTM D2007-11	> 50
Mass loss at 163°C, 5 hours (%)	EN 13303	0,08

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** [0,1 mm] +R&B **increases** 7-9 °C

35/50 base bitumen + 15 % of Selenizza®SLN => (penetration **decreases 15-20** [0,1 mm] +R&B **increases** 5-7 °C

In **term of binder** in a mix design, **15%** of Selenizza®SLN represents some **0.9 to 1 %** of Selenizza®SLN in a global binder content of **5.8 to 6 %** in the asphalt mix.

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

Characterization of natural bitumen Selenizza®SLN

- A **PhD thesis** was recently presented at the University of Strasbourg in France, on the **potential of using** natural bitumen in the production of **hard penetration grade binders** and **high modulus asphalt mixes** that lead to implementation **of cost-effective** pavements (thin and long-lasting pavement layers)

- **The study,** in line with the strategy of **sustainable industrial development**, **proposes an alternative method** using natural bitumen, to produce HMA **aging resistant** and relatively **efficient at low temperatures**.

- These researches are **very topical at this time ,** considering the **problems encountered** while using **hard petroleum bitumen** such **as the risk of cold cracking, rapid aging, supply difficulties,** as well as the **inability to produce hard bitumen** from certain crude oils…

Physical-chemical characterization

➢The natural bitumen consists of a very complex mixture of hydrocarbons containing generally from 80-88% by weight **carbon**, 8-12% **hydrogen** and other hetero atoms such as **sulfur** 1-9% wt.%, **nitrogen** 0-1,5% **oxygen** 0,5-1,5% and traces of elements such as vanadium and nickel.

➢In order to better characterize the natural bitumen quality throughout the entire volume of the deposit, were analyzed.

Type of sample	Saturated	Aromatic	Resin	Asphaltene	I_c
Purified sample –depth	1.7	24.8	35.1	38.4	0.67
Purified sample -surface	1.5	22.7	37.2	38.6	0.67
Raw sample -depth	1.16	23.8	34.6	40.01	0.71
Raw sample -surface	1.6	19.7	37.9	40.8	0.73

➢The colloidal instability index I_c values, **indicate** that the organic phases of the asphaltite Selenizza® SLN have a **sol** or **sol-gel** character**,** with enough resins to peptize the asphaltenes

Aging effect and low temperature behavior of Selenizza®SLN

- *The analysis of mechanical behavior at low temperatures comparing a **35/50 modified** bitumen (**50/70 + 5% Selenizza)** with a **petroleum bitumen** having the same penetration grade 35/50, showed that the **glass transition temeprature** of modified bitumen (typically ranging from -50 to -10°C), was* $\mathbf{T_g = -23.1°C}$ *versus* $\mathbf{T_g = -19.3°C}$ *for the petroleum bitumen, which indicates **a better resistance** of natural bitumen **to brittle fracture***

- *To evaluate the **aging behavior,** different hard bitumen specimens obtained by modification with natural bitumen, have been submitted to **accelerated aging RTFOT** tests (to simulate oxidation of bitumen during mixture manufacturing) as well as **PAV** (to simulate in-service ageing)*

- *It was observed that the **aging leads** to bitumen **hardening** which is evidenced by the decrease of penetration and increase softening point temperature TR&B. It is also manifested in an increase of **complex modulus** and **elasticity** (phase angle decrease)*

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Selenizza®SLN -Aging Inhibitor

Aging effect was quantified using the following mathematical expression:

$$EVx = \frac{|x^{RTFOT+PAV} - x^{New}|}{x^{New}} * 100$$

EV_x: the evolution of mechanical property X

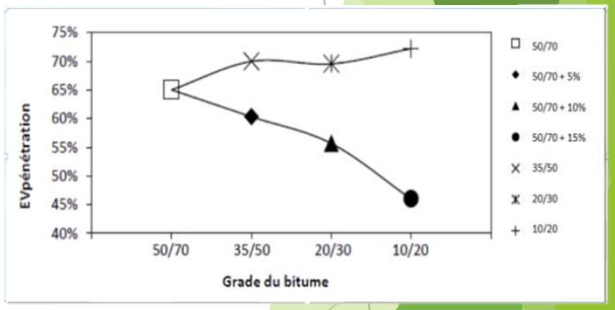
Changes of modified specimens were lower than those of 50/70

Changes are attenuated with the increase of % SLN

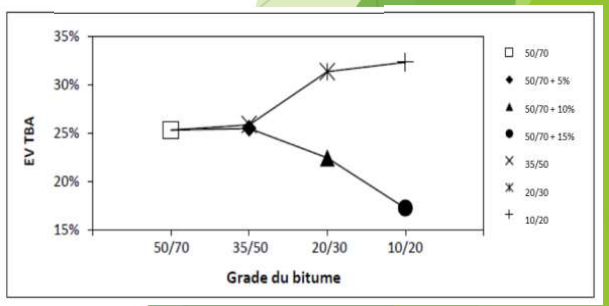
Modified bitumen are characterized by minor changes compared to petroleum bitumen of equivalent grades

Description	Penetration (dmm)					TR&B (°C)				
	New binder	After RTFOT	Δ_1 (%)	After PAV	Δ_2 (%)	New binder	After RTFOT	Δ_1 (%)	After PAV	Δ_2 (%)
Petroleum 50/70	54	37	31.5	19	64.8	49	53.4	8.9	61.4	25.3
Mixed with 5%	38	27	28.9	15	60.5	52.6	57.2	8.7	66.0	25.4
Mixed with 10%	28	21	25	13	53.5	56.2	60.8	8.1	68.8	22.4
Mixed with 15%	20	14	30	11	45	61.6	65.4	6.1	72.2	17.2
Petroleum 35/50	40	27	32.5	12	70	52.6	56.8	7.9	66.2	25.8
Petroleum 20/30	23	12	47.8	7	69.5	60.0	67.0	11.6	78.8	31.3
Petroleum 10/20	18	9	50	5	72.2	65.0	72.6	11.7	86.0	32.3

Changes in penetration



Changes in R&B



Environmental impact assessment

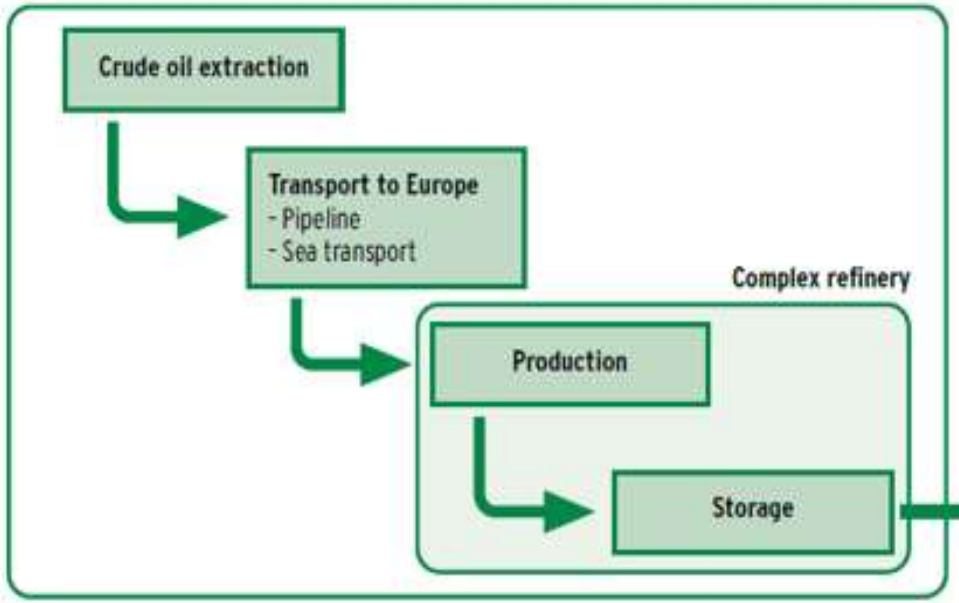
- Worldwide economical crisis and environmental awareness have created the need for **bituminous binders** that meet **Life Cycle Assessment constraints**.

- 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.

- The study was carried out **in accordance** with the guidelines of **EU regulations** (ISO 1440 and 14044) for environmental assessment, called **LCA** (Life Cycle Assessment) and **LCI** (Life Cycle Inventory), and data have become available from **relevant bodies** and **specialized agencies** such as for example, **Eurobitume & EAPA** (European Asphalt Pavement Association).

The production chain of Straight-run bitumen

(The Life Cycle Inventory (LCI) for **straight-run bitumen**, has evaluated all the **resources & inputs** (raw materials, electricity, fuel, etc.)



4 stages of production:

Crude oil extraction

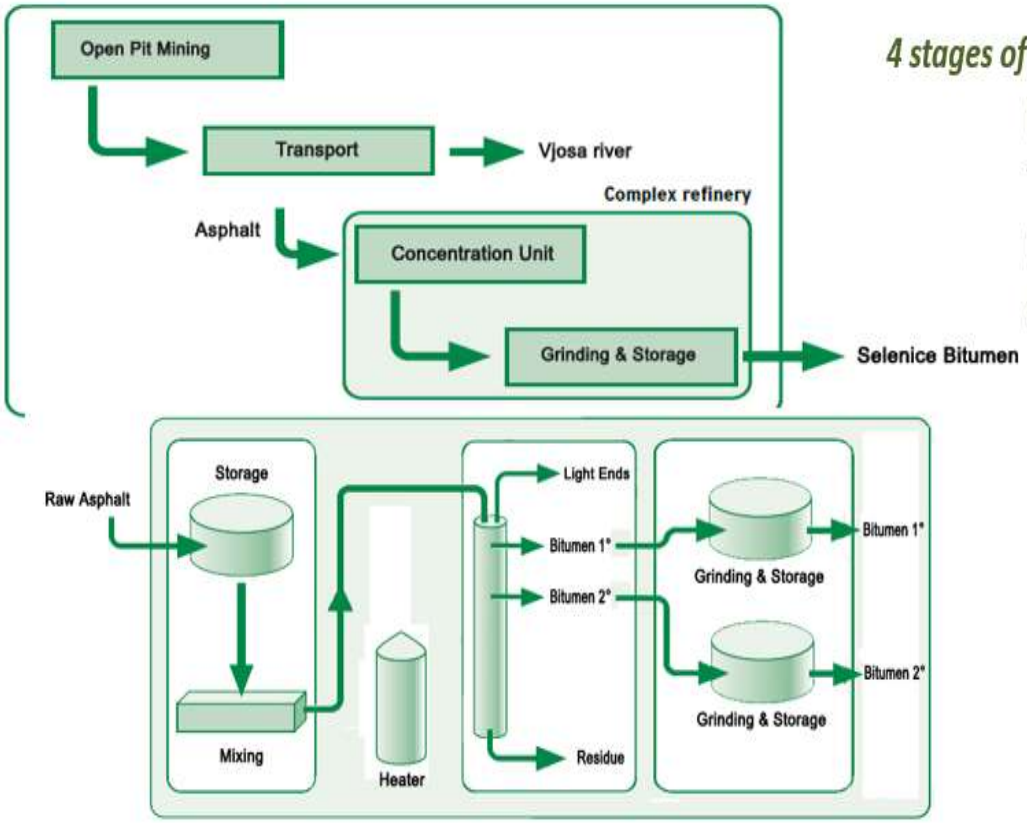
Transport

Refining

Storage

The production chain of natural bitumen Selenizza® SLN

*The production process is **far simpler** with a direct **impact on the energy saving**; also, the **transport cost is reduced to minimum** because the processing unit is **located close** to the deposit.*



4 stages of production:

Extraction

Transport

Processing

Grinding & Storage

Comparing the results

Petroleum bitumen

Total	MJ/t					4,71
CO_2	g	144563	37422	7831		226 167

Natural bitumen Selenizza

Total	MJ/t					2,376
CO_2	g	59300	4500	59145		127 298

Selenizza's production cycle has an **environmental impact** approximately **44% less** than the distillation bitumen.

Energy consumption is also **lowered** by around **50%** compared to bitumen produced from crude oil.

Ways of introduction in the asphalt plant

Added in the ***mixer*** during the asphalt mixing process, in the **asphalt batch mix plants.**

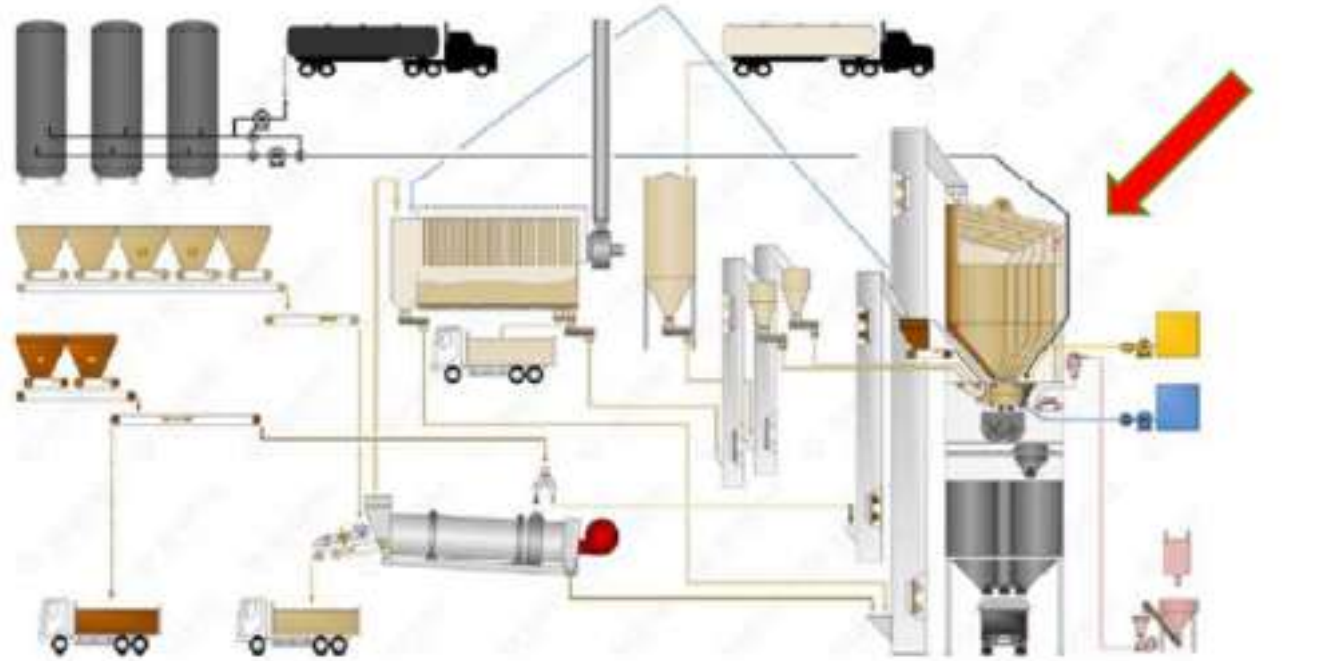
Inserted into the ***recycling ring*** during the asphalt mixing process, in the **continuous** asphalt plants.

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

Asphalt Batch Mix Plants

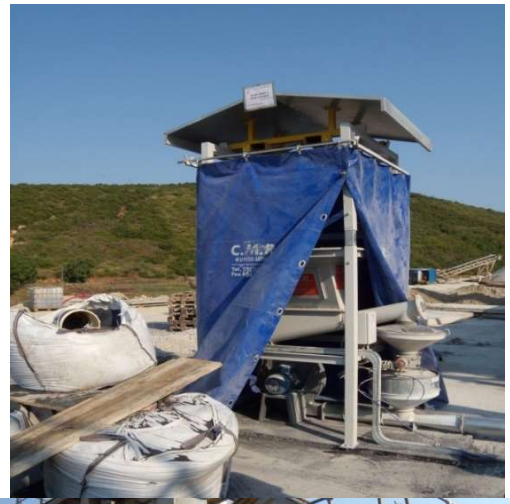
DRY PROCESS

Incorporated directly into the mixer



Asphalt Batch Mix Plants

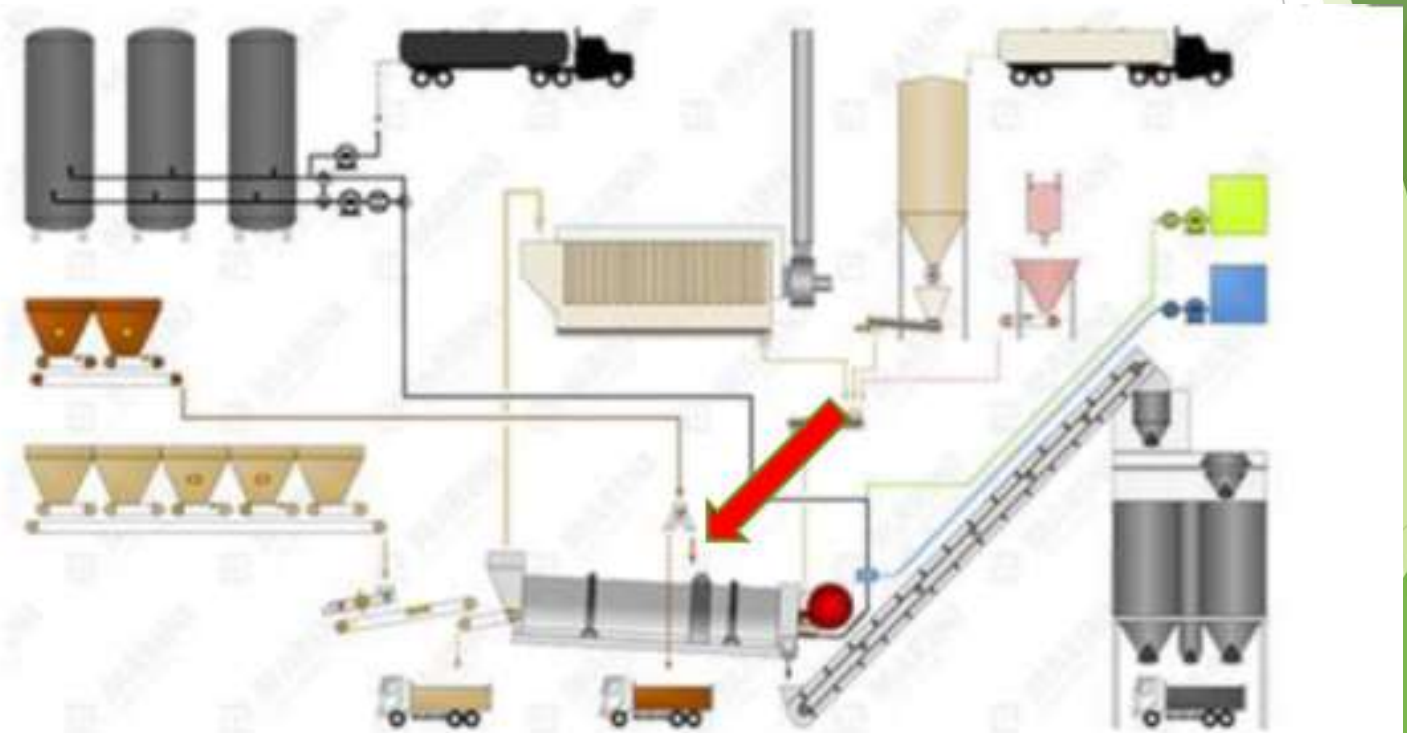
DRY PROCESS



Continuous Mix Plants

DRY PROCESS

Incorporated into the mixer through the recycling ring

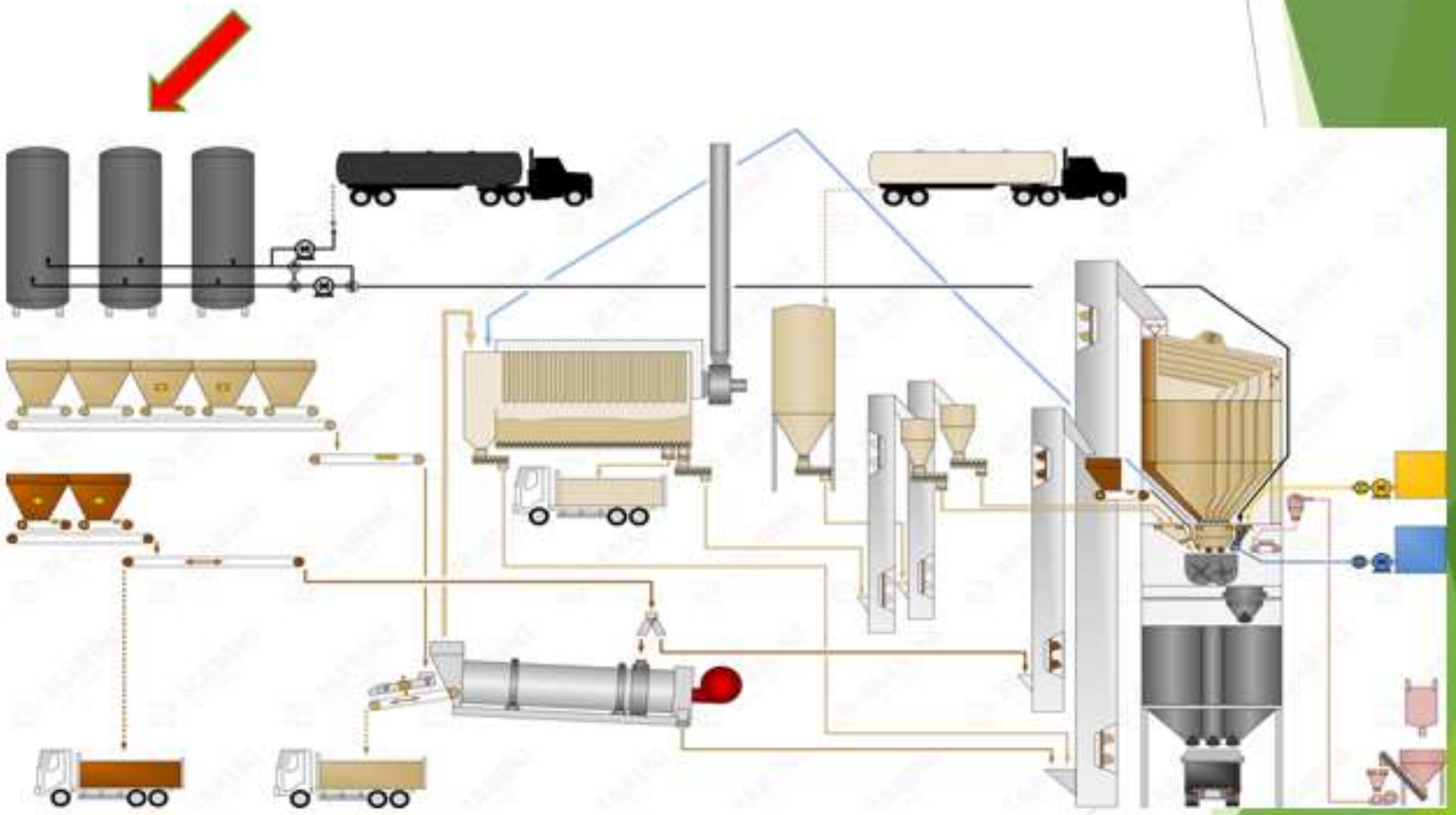


Continuous Mix Plants

DRY PROCESS

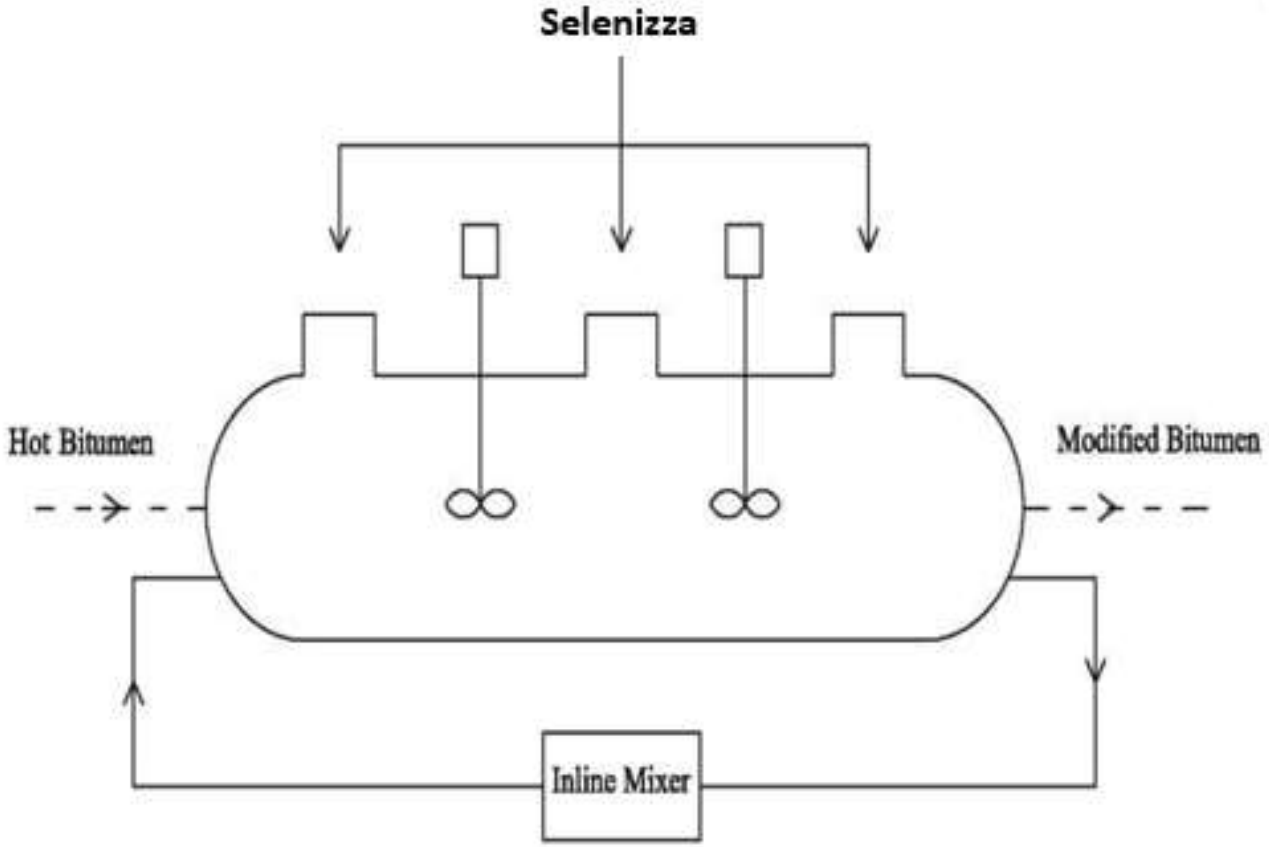
Added directly to the bitumen tank

WET PROCESS



Added directly to the bitumen tank

WET PROCESS



Added directly to the bitumen tank

WET PROCESS

Implementation in road construction projects

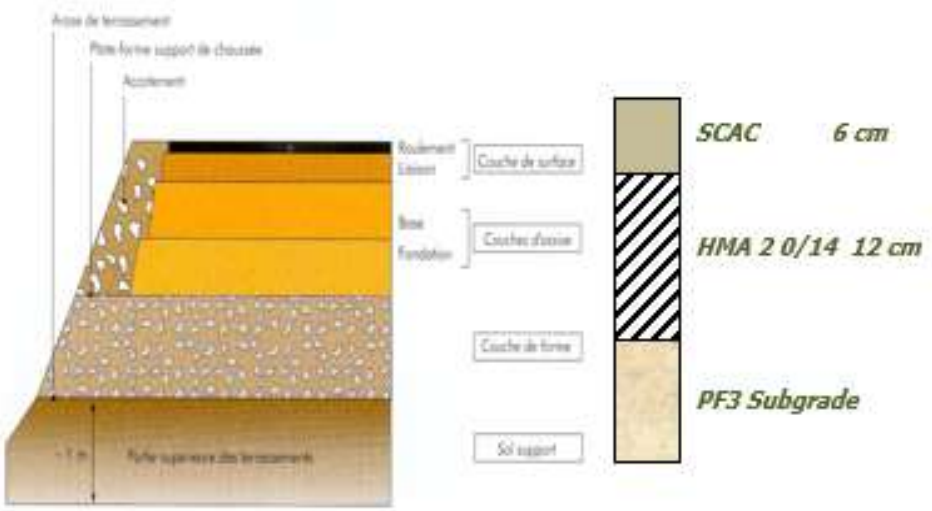
Since the early 1980s, began to appear in the road construction sector, the **hot mix asphalt** structures with **high modulus** (> 12 000 MPa)**,** which ensure **better resistance** to road **fatigue** and **permanent deformation** and facilitate the **reduction** of the road layer **thickness.**

Regarding **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.

Highway A 150 in France

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***



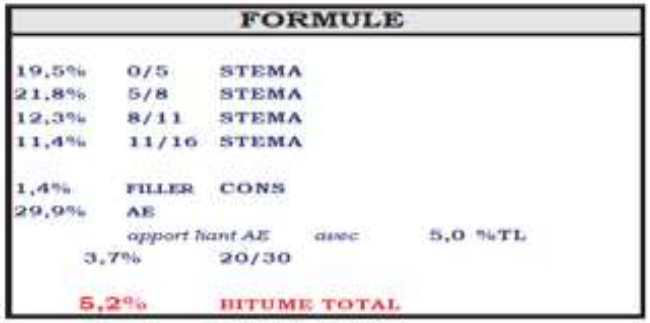
Highway A 150 in France

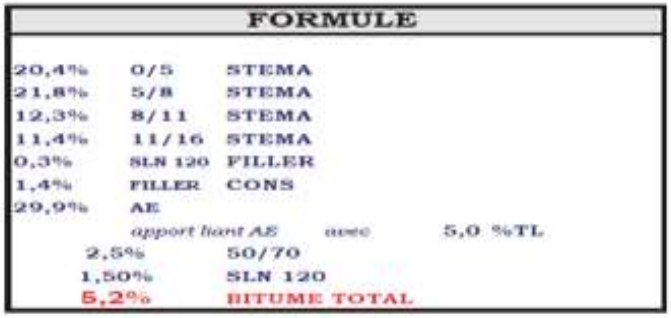
*For **the manufacture** of the recycled hot mix asphalt, **two types of binders** were analyzed:*

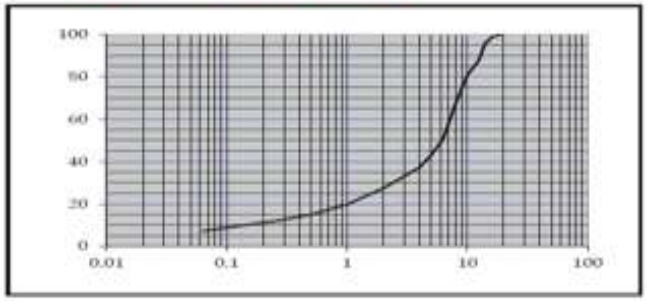
The basic HMA mix design: **30% AE** (asphalt aggregates) + **20/30** penetration grade bitumen.

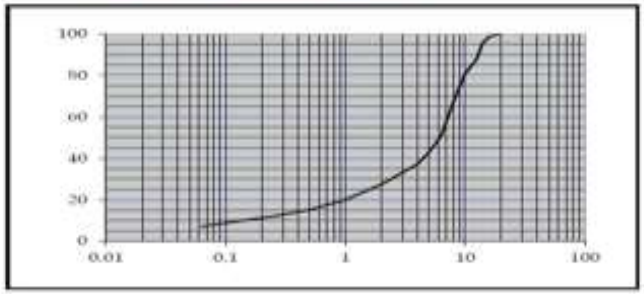
Alternative studied: **30% AE** (asphalt aggregates) + **50/70** grade bitumen **+ 1,5 %** Selenizza.

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









Testing results

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/m³	2,767	C_W à 18° kPa	17250
MVR t/m³ *	2,545	*i*/C (%)	**96,3**
MVA t/m³	2,416	K	3,45

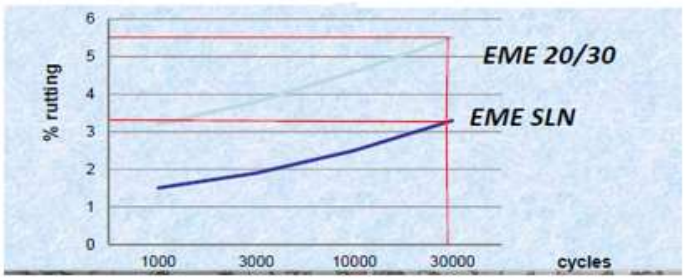
HMA SLN

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/m³	2,766	C_W à 18° kPa	20178
MVR t/m³ *	2,544	*i*/C (%)	**97,8**
MVA t/m³	2,418	K	3,46

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%



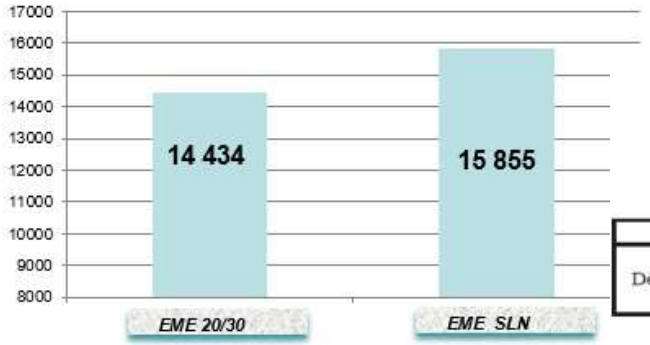
T = 60°C

Testing results

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



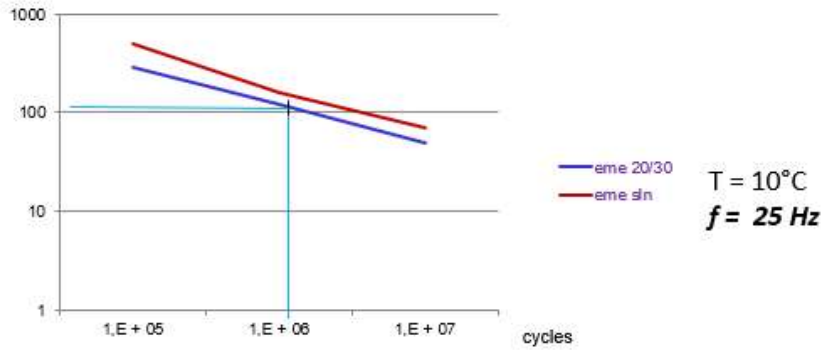
Fatigue

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



Highway A 150 in France

The study results validated the approach which consists in manufacturing the recycled HMA using a straight run bitumen **50/70 + 1,5 %** of natural bitumen *Selenizza®SLN*.

High Performance Asphalt Mixtures in Switzerland

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.
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 [0.1 mm].**

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%**

HMA in Switzerland

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

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, **the definitive job mix formula** implemented was:

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

With

Stiffness Modulus (15°C/10 Hz) **= 15 100 MPa**

Fatigue resistance $\varepsilon_6 \approx$ **150 µdef**


E35
E43
2
13
San Gottardo
San Bernardino
Lugano Nord
1000 m
N 49

Highway A8 “Olimpia Odos” Greece

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)** and anti-skid TAC (thin asphalt concrete) **wearing course (2.5 cm).**

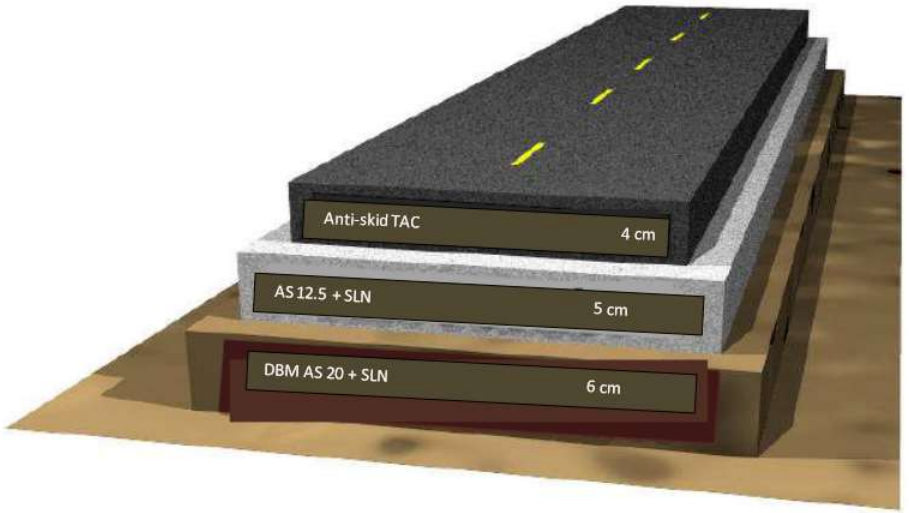
Several trial mix designs for the **base** and **binder** courses were tested using 4 different kind of binders :

bitumen **50/70**

bitumen **50/70 + 8% Selenizza**

bitumen **30/50**

PR PLAST modified bitumen

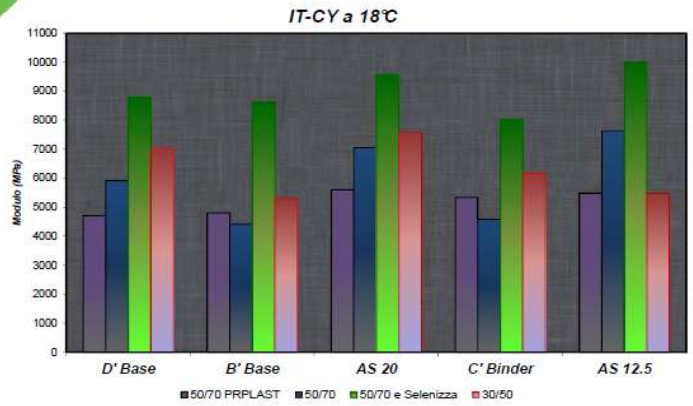


STIFFNESS MODULUS (Indirect Tensile Test & Two Point Bending test)

SELENIZZA

Dott. Ing. Luca Noferini
Laboratorio prove materiali Elletipi srl

LABORATORY TEST RESULTS
STIFFNESS MODULUS

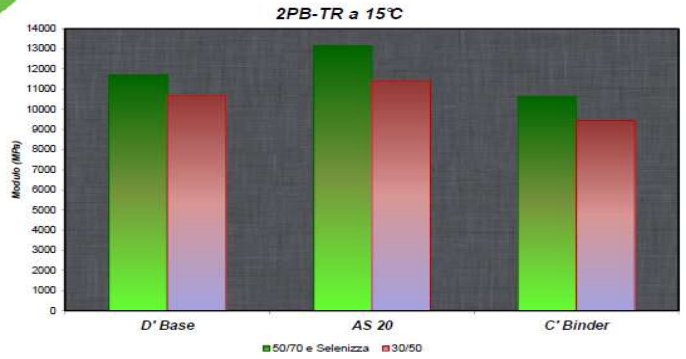


The graphic bars corresponding to Selenizza are in green color

SELENIZZA

Dott. Ing. Luca Noferini
Laboratorio prove materiali Elletipi srl

LABORATORY TEST RESULTS
STIFFNESS MODULUS



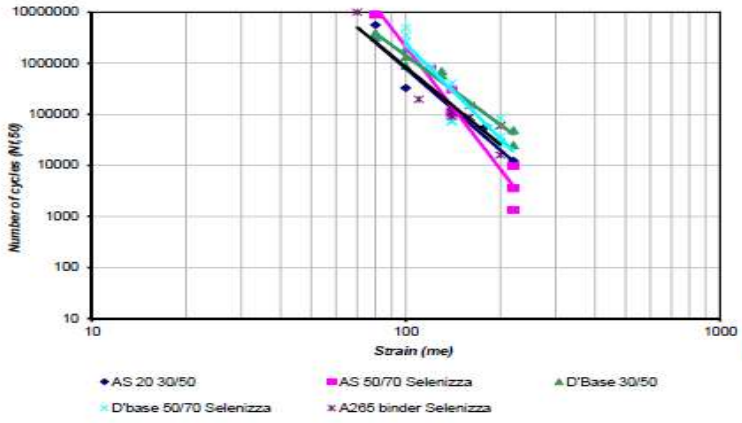
Fatigue test

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
ν	0,35	0,35	0,35	0,35	0,35	0,35
Kc	-	-	1,3	1,3	1,3	1

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.**

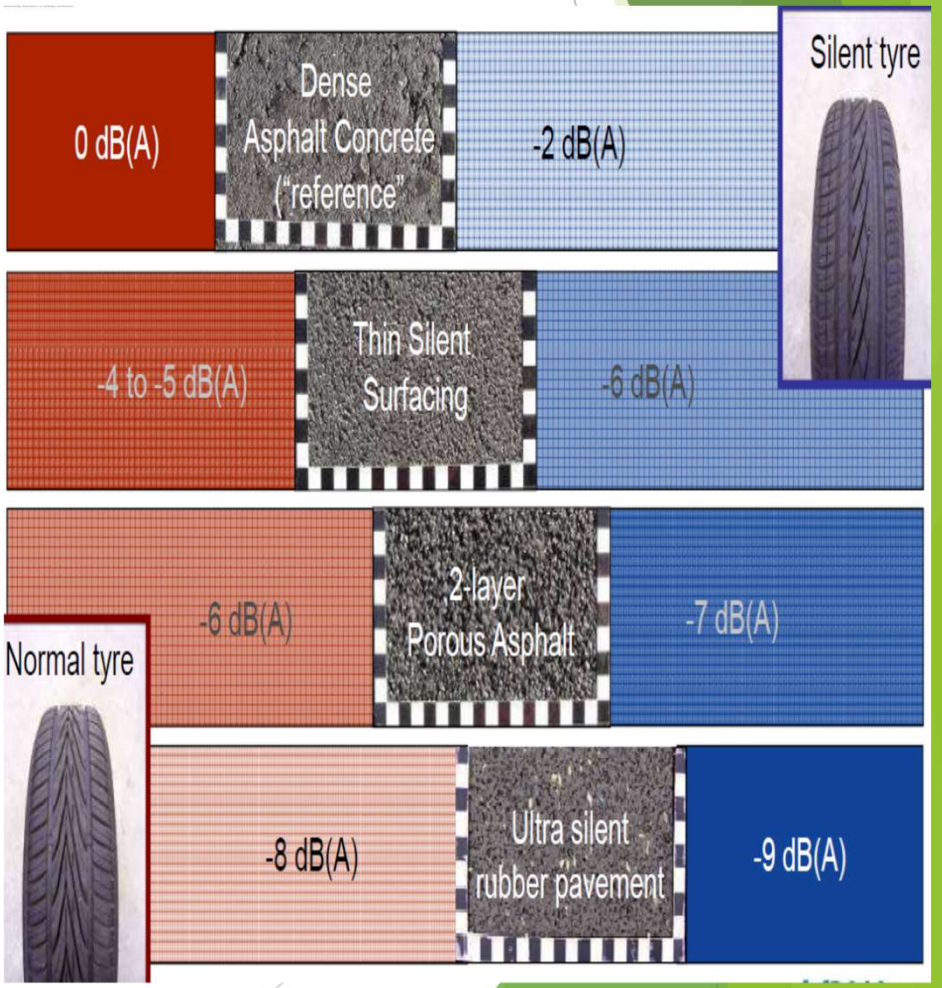
A8 “Olimpia Odos” Greece

SELESTRADE FOR NOISE REDUCTION

Granules of preactivated fine elastomeric rubber + SELENIZZA

The **pneumatic/road** noise reduction capabilities of the wearing course vary **depending on** the type **of aggregate,** the maximum **particle size**, the **bitumen content** and the **percentage of air voids**. Hot-mix **asphalt low-noise** surfacing **reduces** the noise that occurs due to interactions between tires and road surfaces mainly using **three** main **components**:

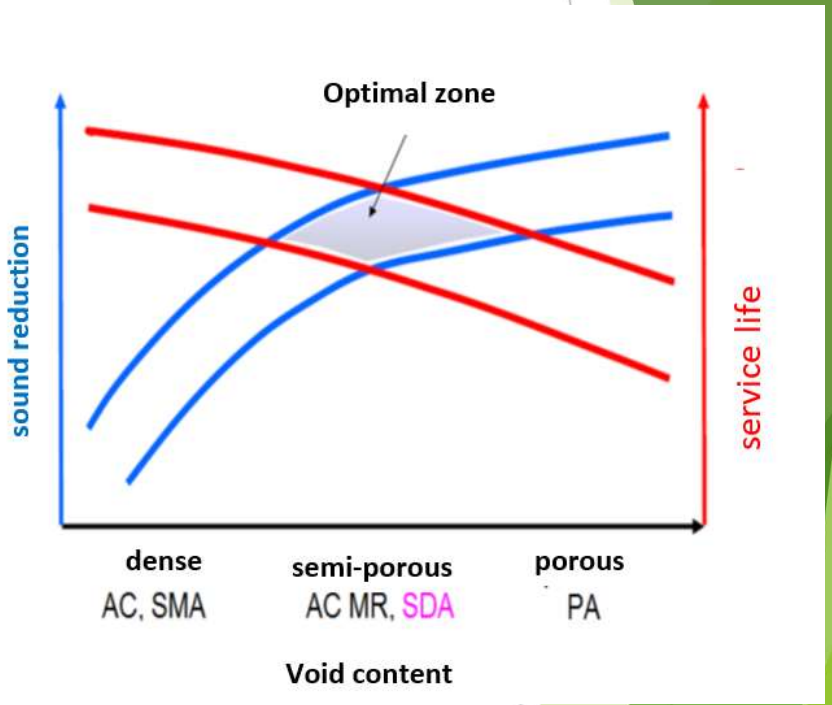
1. **elastomeric additive** with dumping effect of acoustic frequencies,
2. **low roughness** of the pavement,
3. a **high content** of **voids** in the pavement.



SELESTRADE FOR NOISE REDUCTION

A **high void content** significantly reduces noise emissions.

For a void **content > 12%,** it is necessary to use **modified bitumen** or **specific additives** that improve the **DURABILITY** of the flooring



SELESTRADE FOR NOISE REDUCTION

Selestrade is an elastomeric **bitumen modifier**, which improves conventional bitumen by **increasing** its **service temperature**, **resilience** and **elastic recovery** properties. Selestrade can be **added to any type of asphalt** to improve performance properties and durability.
Selestrade is composed of:
1. natural bitumen of type **SELENIZZA,**
2. granules of fine **elastomeric rubber** preactivated with special chemicals.

The **preactivation of the rubber** allows several advantages including:
1. avoid **swelling of the rubber powder** as it is already pre-swollen by absorption;
2. reduce **contact surface tension** and improve **bitumen/powder adhesion**;

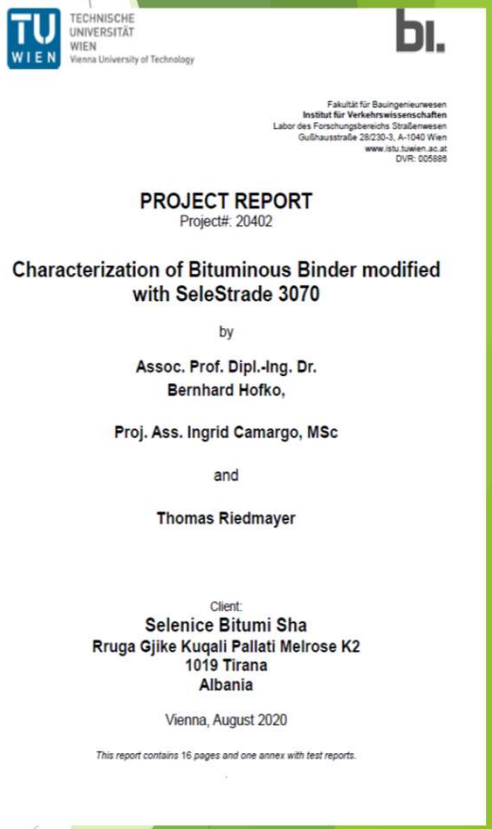
SELESTRADE FOR THE MODIFICATION OF BITUMEN AND ASPHALT MIXES

SELESTRADE allows the **modification of the basic bitumen** generating a "**high modulus**" bitumen, **without affecting the aging** properties of the binder. The performance of bitumen is thus significantly increased:

- **DURABILITY,**
- **RESILIENT MODULUS**
- **RUTTING**
- **EMBRITTLEMENT TEMPERATURES**
- **PG 82-28**

Table 6: PG grading according to AASHTO A320-17

Parameter	Condition	Specification	PG			
			Reference	Mix 90:10	Mix 85:15	Mix 80:20
Viscosity	unaged	<= 3 Pa*s at 135°C	OK	OK	OK	Too high
G*/sin(δ)	Unaged	>= 1 kPa at 1.59 Hz	70	76	82	>82
G*/sin(δ)	RTFOT-aged	>= 2.2 kPa at 1.59 Hz	64	82	>82	>82
		Resulting upper PG	**64**	**76**	**82**	**>82**
G*.sin(δ)	RTFOT+PAV-aged	<= 5000 kPa at 1.59 Hz	25	19	22	22
		Resulting intermediate PG	**25**	**19**	**22**	**22**
S	RTFOT+PAV-aged	<= 300 MPa at 60 sec	-28	-34	-34	-40
m-Value	RTFOT+PAV-aged	>= 0.3 at 60 sec	-28	-28	-28	-22
		Resulting lower PG	**-28**	**-28**	**-28**	**-22**
		PG	**64-28**	**76-28**	**82-28**	**82-22**



TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

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Labor des Forschungsbereichs Straßenwesen
Gußhausstraße 28/230-3, A-1040 Wien
www.istu.tuwien.ac.at
DVR: 005886

PROJECT REPORT
Project#: 20402

Characterization of Bituminous Binder modified with SeleStrade 3070

by

Assoc. Prof. Dipl.-Ing. Dr. Bernhard Hofko,

Proj. Ass. Ingrid Camargo, MSc

and

Thomas Riedmayer

Client:
Selenice Bitumi Sha
Rruga Gjike Kuqali Pallati Melrose K2
1019 Tirana
Albania

Vienna, August 2020

This report contains 16 pages and one annex with test reports.

SELESTRADE FOR NOISE REDUCTION

- Asphalt mixes **modified** with **SELESTRADE** are ideal for **noise reduction**, whatever the surface layers, for example **SMA**, traditional **wearing course**, **porous asphalt** or **special asphalt recipes** for noise reduction.

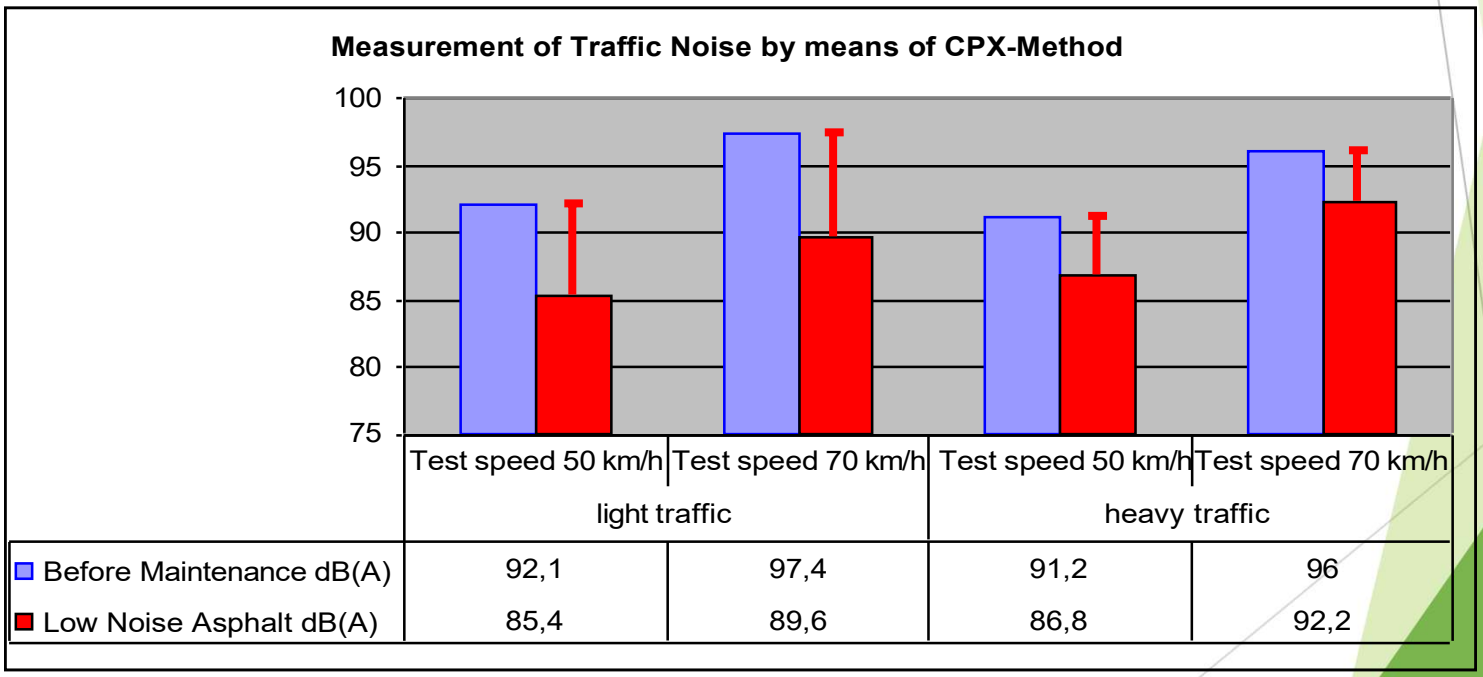
- **SELESTRADE**, as a modifier for asphalt paving materials, **improve**s the **high-temperature** and **low-temperature** performance of the asphalt binder and thus **improves durability**, but it is also useful for **noise reduction and skid resistance** of the pavement.

- The influence of **SELESTRADE** on the asphalt mixture has been studied by many researches that show that the **high elasticity of elastomer powder** increases the **damping capacity** of the pavement by **reducing vibrations** caused by tires, as well as **pavement and noise emission**.

SELESTRADE makes it possible to obtain **porous asphalt mixes** with a **void content** greater **than 10%,** significant **noise emission reductions** and high **durability**. The use of this additive is required both for the **"damping"** function generated by the **elastomeric component** and by the **natural bitumen** component that allows to achieve **high durability**

SELESTRADE FOR NOISE REDUCTION

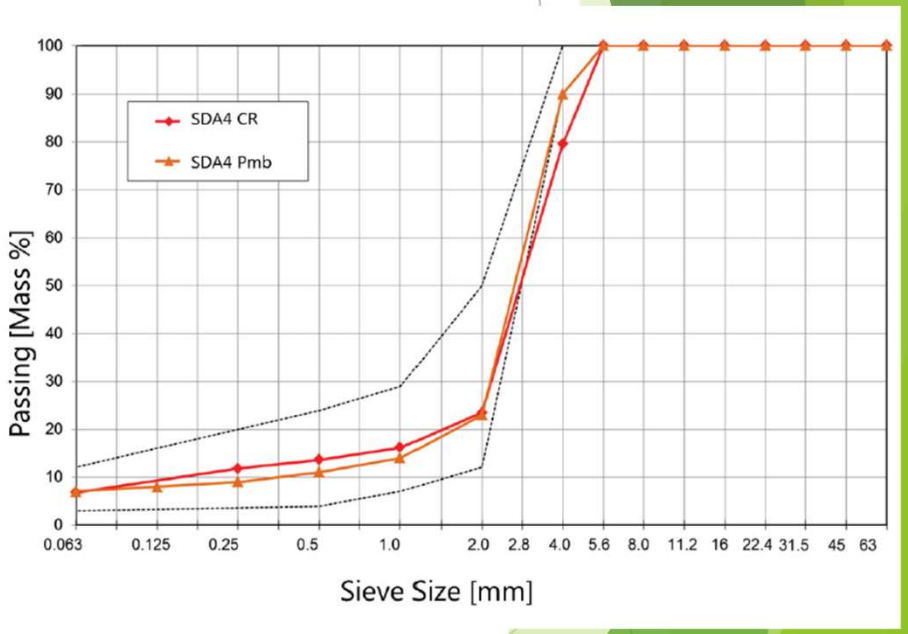
In urban and extra-urban roads, the **noise-reducing** effect of sound-absorbing pavements modified **with SELESTRADE** allows a noise reduction of between **6 and 9 dB (A).**



SELESTRADE FOR NOISE REDUCTION

EXPERIMENTAL TESTS IN Fribourg, Switzerland

In some construction sites in Switzerland, the use of **modified hard bitumen** has been **replaced** with a traditional bitumen **type 50/70** with the addition of **SELESTRADE** at **2%** on the weight of the mixture. In the plant were produced mixtures of **semi-dense asphalt SDA** with a maximum aggregate size of **4 mm** and expected **void content** between **14% and 18%**. According to the standard, conventional **polymer modified bitumen** was used to prepare the reference mixture (SDA4-PmB). For the experimental one, the compound **SELESTRADE**, composed of a mixture of **SELENIZZA** and fine powder of **preactivated rubber** was added in a mixture with traditional **bitumen 50/70**.
The mechanical results for both mixtures were optimal. **Phonic property measurements** will only be carried out at the beginning **of 2022.**



SELESTRADE FOR NOISE REDUCTION

Semi-porous asphalt mixes have **excellent mechanical properties**, **high fatigue resistance** and **low water sensitivity**; such characteristics make them **suitable to reduce** all the phenomena of **reflective cracking**, **fatigue cracking and thermal cracking** and reduced levels of **noise emissions**.

From **extensive monitoring** carried out in Switzerland, the **SDA** pavements allows a noise **reduction included in the range: 6 to 9 dB (A).**

Table 1 - Decision-matrix for the selection of low-noise pavements

Pavement type	**4 mm pavements** semi-dense asphalts, or own products similar design (with 4 mm aggregate size)	**8 mm pavements** semi-dense asphalts, or own products similar design (with 8 mm aggregate size)	**conventional asphalts** dense asphalt concrete DAC 11
Chosen when…	large noise reductions are required or when the noise limits have been substantial-ly exceeded.	average noise reductions are required or the noise limit values are exceeded to a medium extent	
Recommended void content*	approx. 14%	approx. 12%	<6%
Noise reduction**:			
- after construction	-6 to -9 dB	-5 to -3 dB	-2 dB
- after 5 years	-4 dB	-2 dB	0 dB
- at the end of the acoustic service life	-3 dB	-1 dB	+ 1 dB
Expected service life	10 to15 years	15 to 20 years	20 to 25 years
Cost per ton in relation to DAC 11	133%	128%	100%
Area of application	- All road types in urban and overland areas	- All road types incl. nation-al roads	- All road types incl. nation-al roads

SELESTRADE FOR NOISE REDUCTION

EXPERIMENTAL TESTS IN Fribourg, Switzerland

SELESTRADE FOR NOISE REDUCTION

EXPERIMENTAL TESTS IN Fribourg, Switzerland

ON - GOING -TESTS

Use of Selenizza® SLN for SMA & Pavement Sealers

Selenizza® characteristics is successfully used to produce solvent based and emulsion pavement sealers that **dry quicker** and **last longer** by **rejuvenating** the pavement being sealed. It confers to the pavement **excellent bonding** properties.

In recent years Selenizza® has demonstrated that it is particularly **well suited** for use in modern **thin coating systems**. It is commonly used for the manufacture of **SMA** (Stone Mastic Asphalt), **Bituminous Concrete** (AC), **Gussasphalt** and **Mastic Asphalt** (MA).

NORME EUROPÉENNE **EN 12970**

EUROPÄISCHE NORM

EUROPEAN STANDARD Septembre 2000

ICS 91.100.50; 93.080.20

Version Française

Asphalte coulé pour étanchéité - Définitions, spécifications et méthodes d'essai

Gußasphalt und Asphaltmastix für Abdichtungen - Definitionen, Anforderungen und Prüfverfahren

Mastic asphalt for waterproofing - Definitions, requirements and test methods

La présente Norme européenne a été adoptée par le CEN le 5 juillet 2000.

Les membres du CEN sont tenus de se soumettre au Règlement Intérieur du CEN/CENELEC, qui définit les conditions dans lesquelles doit être attribué, sans modification, le statut de norme nationale à la Norme européenne. Les listes mises à jour et les références bibliographiques relatives à ces normes nationales peuvent être obtenues auprès du Secrétariat Central ou auprès des membres du CEN.

La présente Norme européenne existe en trois versions officielles (allemand, anglais, français). Une version dans une autre langue faite par traduction sous la responsabilité d'un membre du CEN dans sa langue nationale et notifiée au Secrétariat Central, a le même statut que les versions officielles.

Les membres du CEN sont les organismes nationaux de normalisation des pays suivants: Allemagne, Autriche, Belgique, Danemark, Espagne, Finlande, France, Grèce, Irlande, Islande, Italie, Luxembourg, Norvège, Pays-Bas, Portugal, République Tchèque, Royaume-Uni, Suède et Suisse.

4.1.3 Bitumes naturels

Bitumes en provenance de gisements naturels, contenant des fines.

Tableau 2 — Caractéristiques des bitumes naturels

Composants	Teneur minimale requise en bitume soluble en masse
Bitume naturel soluble	≥ 50 %
Granulat minéral	≤ 50 %

NOTE Ces matériaux en provenance de gisements naturels sont par exemple le bitume Gilsonite et le Selenizza. Le bitume naturel le plus couramment utilisé est le bitume du lac Trinidad (d'abréviation courante TLA).

4.2 Liants bitumineux

La pénétrabilité du bitume couramment utilisé pour l'asphalte coulé doit être comprise entre 6 et 220, 1/10 mm.

MA and Pavement Sealers

Selenizza®SLN *Recommended by the European Standard EN 12970*

France - Selenizza® SLN for SMA

SMA is a relatively thin (12.5–40 mm) **gap-graded**, densely compacted, HMA that is used as a surface course on both **new construction** and **surface renewal.** It is a mixture of asphalt cement, coarse aggregate, crushed sand, and additives. These mixes are different from normal dense grade HMA mixes in that there is a much greater amount of coarse aggregate in the SMA mix. It can be used on major highways with **heavy traffic volumes**. This product provides a rut-resistant wearing course and resistance to the abrasive action of studded tires. This application also provides a slow aging and good low-temperature performance.

Companies **in the North of France** usually manufacture mastic asphalt for waterproofing buildings, structures, and pavements, blending **Selenizza®** with a **35/50 bitumen** from Nynas according to the following recipe :

1000 kg aggregates
Binder content=**7. 5 %**
69 kg bitumen 35/50 + **6 kg** de Selenizza SLN **(8 %** of the binder wt.)

The addition of Selenizza® allows the bitumen hardening by one grade to obtain **a final binder of 20/30 penetration grade.**

France - Selenizza®SLN for SMA

COMMON PAVEMENT ASPHALT MIX DESIGN AC1

BITUMEN 35-50A	69.425 Kg	7.6%
BITUMEN SELENIZZA (1 BAG FOR 2T)	6.275 Kg	
LIMESTONE FILLER	250.000	
HARD GRAVEL 2/6.3	344.000	
SAND 0/2 (OR 0/4)	330.000	
	1 000 Kg	

The bitumen percentage may be increased up to 8% by adding 35/50 (if necessary).
The road surface is chipped and rolled eventually in order to reach a greater roughness if necessary.

* Nota: in this construction site, were used bags of Selenizza SLN weighing 12 kg .

France - Selenizza®SLN for SMA

COMMON PAVEMENT ASPHALT MIX DESIGN AC2 (NF EN 13108-6)

Used in France for **heavy duty pavement** and **channeled traffic**, urban roads, **bus** and express lanes, spaces between rails tramways, etc.

Thickness from 25 to 40 mm, with regards to the aggregate gradation: 0/6.3, 0/10 or 0/14
Indentation NF EN 12697-21 TYPE B = 5 to 15 [0,1 mm]T°C <= 260.
May require gravelling and roller compaction.

35/50A	62.50	7.5%
Selenizza	12.50	
Limestone filler	275.00	
Hard Gravel 2/6.3	200.00	
Hard Gravel 6.3/10	200.00	
Sand 0/4	250.00	

1 000KG thickness 30mm

France - Selenizza®SLN for SMA

Smooth flooring - DESCAT ROUBAIX Television Division

Examples of Gussasphalt with Selenizza® in Switzerland

CO.MI.BIT
COMIBIT SA 6807 TAVERNE — SIGIRINO 091 935 70 10

Valori nominali della miscela bituminosa

Specie: ASFALTO FUSO MAT 8S PMB — Codice: 9170
Data della ricetta: 01.01.2006 — Laboratorio: COMIBIT

Cantiere:
Cliente:
Impresa:

Legante: Genere/Specie: PMB , Dosaggio 7.90 Massa-%, parte solubile 7.80 Massa-%

Additivi: Genere/Quantità ASFALTO NATURALE 1 %

Inerti: Provenienza: SALTRIO, FRANTO
Categoria grani frantumati C 95/1
Grani riciclati 0 Massa-%

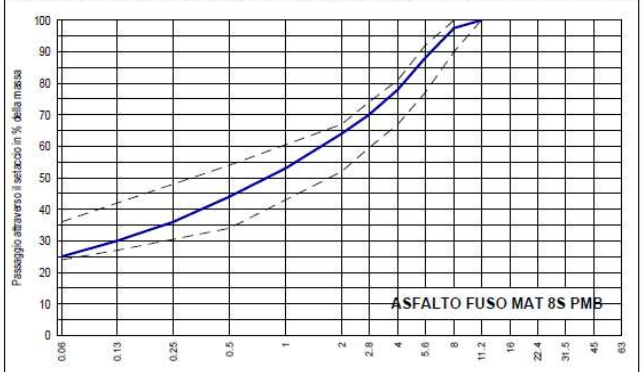
Valori-Marshall:
Massa volumica apparente — kg/m³ — **Stabilità** — **SM** — kN
Massa volumica — kg/m³ — **Scorrimento** — **FM** — mm
Vuoti residui — **VM** — Vol-% — Sensibilità all' acqua ITSR — %
Grado di riempimento vuoti — VFB — % — Vuoti nel minerale VMA — %

Altre prove:
Ormaiamento — cicli — valore — %
Compressione ciclica — cicli — valore — %
Commento: Impronta dinamica 2500 cicli 2.5 mm

Osservazioni: Impronta statica 2.5 mm

Ripartizione granulometrica

Vagli	0.06	0.13	0.25	0.5	1	2	2.8	4	5.6	8	11.2	16	22.4	31.5	45	63
Passante massa-%	25.0	30.0	36.0	44.0	53.0	64.0	70.0	78.0	88.0	97.5	100.0					



Osservazioni:
Spedito al cliente il 05.04.2011
Data / Firma

CO.MI.BIT
COMIBIT SA 6807 TAVERNE — SIGIRINO 091 935 70 10

Valori nominali della miscela bituminosa

Specie: ASFALTO FUSO MAT 11H PMB — Codice: 9273
Data della ricetta: 01.01.2006 — Laboratorio: COMIBIT

Cantiere:
Cliente:
Impresa:

Legante: Genere/Specie: PMB , Dosaggio 8.00 Massa-%, parte solubile 7.90 Massa-%

Additivi: Genere/Quantità ASFALTO NATURALE 1 %

Inerti: Provenienza: SALTRIO, FRANTO
Categoria grani frantumati C 95/1
Grani riciclati 0 Massa-%

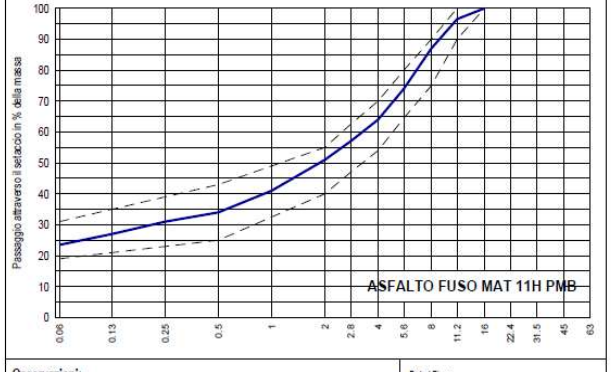
Valori-Marshall:
Massa volumica apparente — kg/m³ — **Stabilità** — **SM** — kN
Massa volumica — kg/m³ — **Scorrimento** — **FM** — mm
Vuoti residui — **VM** — Vol-% — Sensibilità all' acqua ITSR — %
Grado di riempimento vuoti — VFB — % — Vuoti nel minerale VMA — %

Altre prove:
Ormaiamento — cicli — valore — %
Compressione ciclica — cicli — valore — %
Commento: Impronta dinamica 2500 cicli 2 mm

Osservazioni: Impronta statica 2 mm

Ripartizione granulometrica

Vagli	0.06	0.13	0.25	0.5	1	2	2.8	4	5.6	8	11.2	16	22.4	31.5	45	63
Passante massa-%	23.5	27.0	31.0	34.0	41.0	51.0	57.0	64.0	74.0	87.0	96.5	100.0				



Osservazioni:
Spedito al cliente il 05.04.2011
Data / Firma

CO.MI.BIT
COMIBIT SA 6807 TAVERNE — SIGIRINO 091 935 70 10

Valori nominali della miscela bituminosa

Specie: ASFALTO FUSO MAT 16S PMB — Codice: 9370
Data della ricetta: 01.01.2006 — Laboratorio: COMIBIT

Cantiere:
Cliente:
Impresa:

Legante: Genere/Specie: PMB , Dosaggio 8.10 Massa-%, parte solubile 8.00 Massa-%

Additivi: Genere/Quantità ASFALTO NATURALE 1 %

Inerti: Provenienza: SALTRIO, FRANTO
Categoria grani frantumati C 95/1
Grani riciclati 0 Massa-%

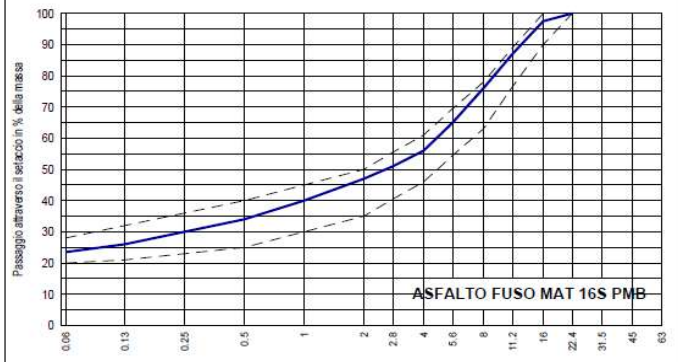
Valori-Marshall:
Massa volumica apparente — kg/m³ — **Stabilità** — **SM** — kN
Massa volumica — kg/m³ — **Scorrimento** — **FM** — mm
Vuoti residui — **VM** — Vol-% — Sensibilità all' acqua ITSR — %
Grado di riempimento vuoti — VFB — % — Vuoti nel minerale VMA — %

Altre prove:
Ormaiamento — cicli — valore — %
Compressione ciclica — cicli — valore — %
Commento: Impronta dinamica 2500 cicli 2.5 mm

Osservazioni: Impronta statica 2.5 mm

Ripartizione granulometrica

Vagli	0.06	0.13	0.25	0.5	1	2	2.8	4	5.6	8	11.2	16	22.4	31.5	45	63
Passante massa-%	23.5	26.0	30.0	34.0	40.0	47.0	51.0	56.0	65.0	76.0	87.0	97.5	100.0			



Osservazioni:
Spedito al cliente il 05.04.2011
Data / Firma

Selenizza®SLN ➔ **12,5 % of binder weight.**

Examples of Gussasphalt with Selenizza® in Switzerland

2011 : Bridge in Valle Verzaska, Ticino

Examples of Gussasphalt with Selenizza® in Switzerland

Mastic asphalt Bern

Examples of Gussasphalt with Selenizza® in Switzerland

Mastic asphalt Bern

Examples of Gussasphalt with Selenizza® in Switzerland

Sidewalk mastic asphalt paving Bern

Examples of Gussasphalt with Selenizza® Italy

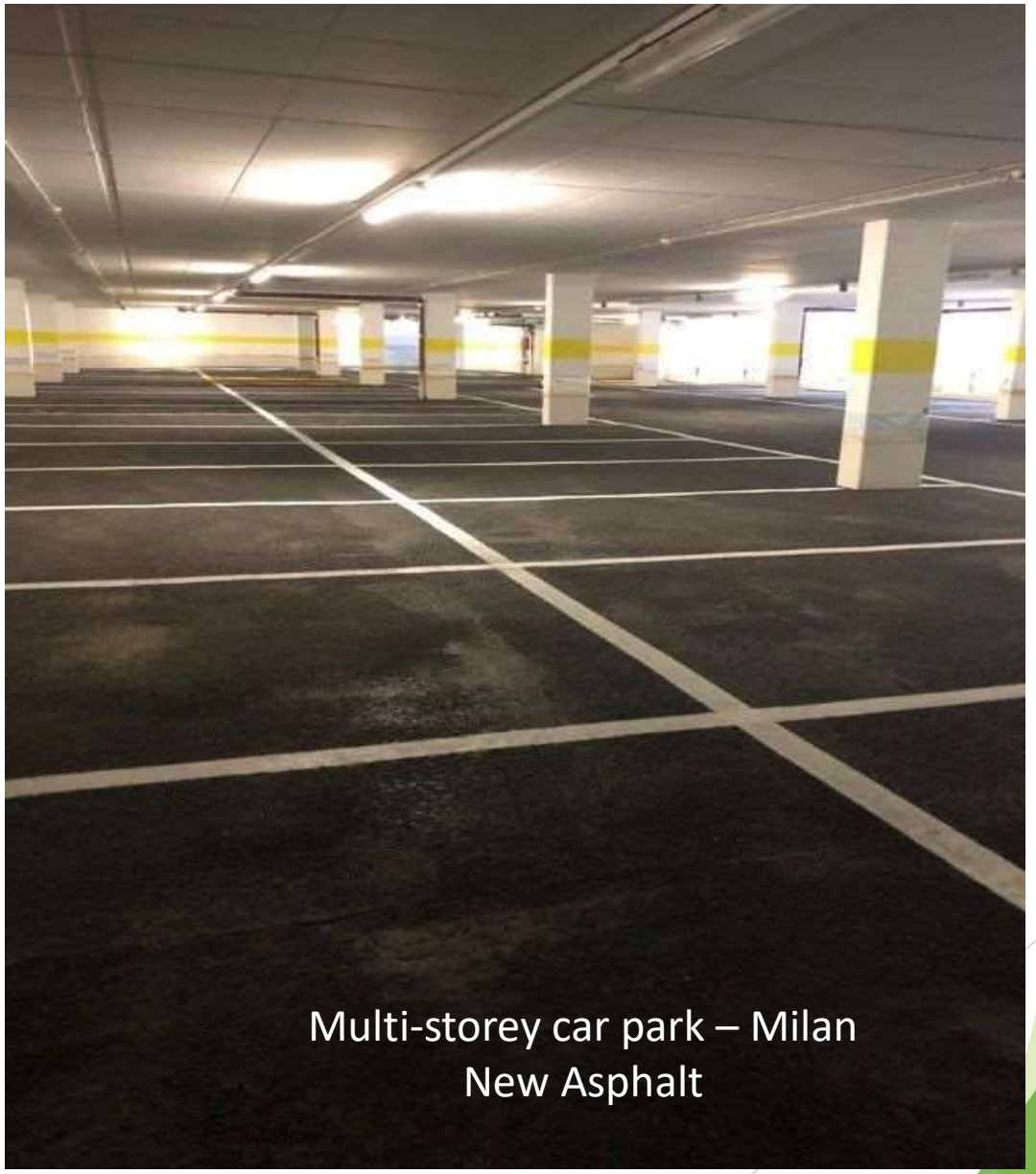
Examples of Gussasphalt with Selenizza® Italy

Milano
New Asphalt

Examples of Gussasphalt with Selenizza® Italy

Mastic asphalt roofing by the
Company Cappello Ragusa - Sicily

Examples of Gussasphalt with Selenizza® Italy

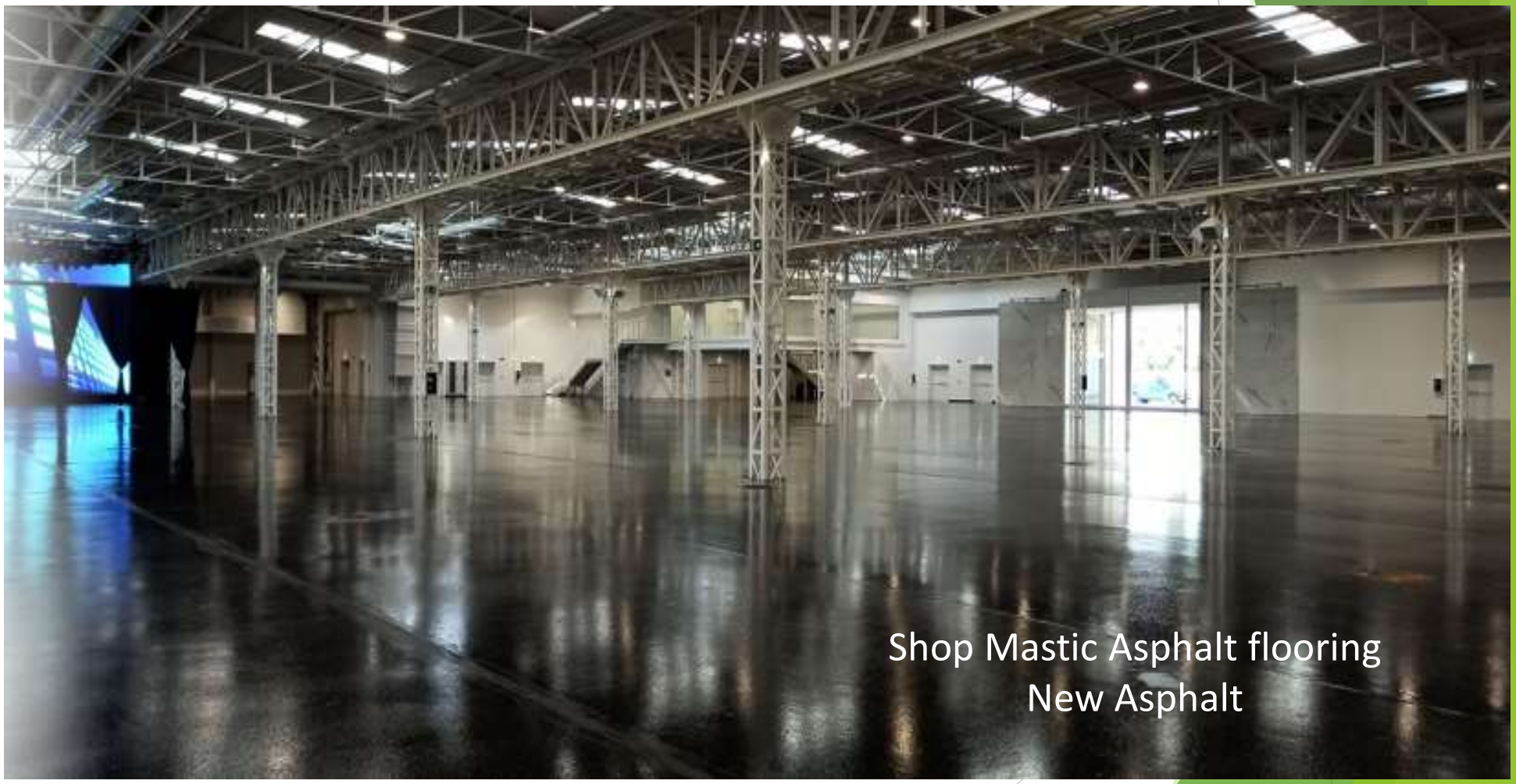


Multi-storey car park – Milan
New Asphalt

Examples of Gussasphalt with Selenizza® Italy

Shop Mastic Asphalt flooring
New Asphalt

Examples of Gussasphalt with Selenizza® Italy



Lithuania - Examples of Gussasphalt with Selenizza®

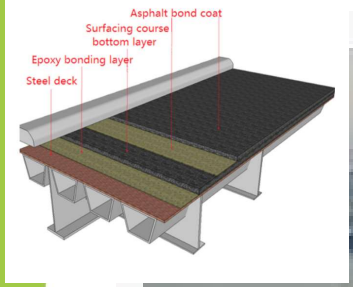
Parking in the OZAS shopping center – Vilnius

Rutting problems solved thanks to 2 cm of SMA 5 top layer with Selenizza, on 2 cm of stress absorption interlay membrane

Use of Selenizza®SLN for Bridge Decks

GussAsphalt (GA) and **Mastic Asphalt** (MA) are two types of asphalt concrete with **excellent properties** primarily used in **steel deck bridge pavement** construction.
The solution to improve pavement **rutting resistance** is the use of **hard grade asphalt binder** by the addition of Selenizza®SLN.

Use of Selenizza for Bridge Deck Pavement



GussAsphalt based on **Selenizza**, thanks to its excellent properties, able to **directly withstand** the traffic even of **heavy vehicles**, with performance and resistance to aging often higher than normal asphalt mixes, is **used for the coating of steel bridges**.

EXEMPLE : Hong-Kong-Zhuhai-Macao Bridge Project open on October 23, 2018 :

Modified bitumen used in the project:

30% Pen 60/70 + 70% TLA

Formulation alternative with Selenizza:	Gradation Passing sieve [mm]	% By Weight
	Coarse Aggregate (45 %)	
	7.8 – 12.7	15
	4.5 – 7.8	15
	3.2 – 4.5	15
	Fine Aggregate	
	2.36 – 3.2	0
	0.6 - 2.36	7
	0.212 – 0.6	9
	0.075 – 0.212	10
	Filler	
	0 – 0.075	21
	Binder	
	64 % (50/70) + 36 % (Selenizza)	8
Binder qty per 1 ton Mixture	80 kg = 56 kg 50/70 + 24 kg Selenizza SLN **Penetration** (25°C, 100 g, 5s) = **19 [0.1 mm]** **Ring & Ball** Temperature = **68°C** **Solubility** (TCE) = **94%**	

Use of Selenizza for Bridge Deck Pavement

2020 New Genoa Bridge

Bridge paving works by CISA company

C. I. S. A. Srl Compagnia Italiana Strade Asfalti

Via Don Minzoni 4 20090 Settala (MI)

Pacchetto impermeabilizzazione impalcati con cappa di mastice di asfalto sintetico

L'applicazione di cappa asfaltica per protezione ed impermeabilizzazione di impalcati viene effettuata per spessori di circa 10 mm.

La miscela del mastice impiegato è ottenuta mediante mescolamento a caldo di aggregati minerali con un bitume di penetrazione 35/50 e Selenizza (bitume naturale) . Il bitume sarà dosato in ragione del 15%-19% in peso sulla miscela degli aggregati (corrispondenti al 13%-16% in peso sulla miscela finale). Il filler contenuto sarà tra il 29-35% in peso della miscela degli aggregati .

La sabbia , fornita dalla Milano Bitumi, sarà derivante da frantumazione graduata da 0,075 a 3 mm per il 65-70% in peso sulla miscela degli aggregati.

La cappa asfaltica è prodotta presso il nostro impianto di conglomerati bituminosi di Via Don Minzoni a Settala (SS PAULLESE). Il trasporto in cantiere viene effettuato con apposite caldaie mescolatrici, di nostra proprietà da 10 a 20 ton che mantengono per tutta la durata del trasporto la temperatura del materiale a circa 200° C.

The **asphalt mixture** was obtained using a high percentage (about **13%-14%** of the weight of the mixture) of a blend of low-penetration synthetic bitumen (**35-50)** and natural bitumen **Selenizza** (0-1) which, thanks to the **high content of asphaltenes** present in the Selenizza bitumen (> 50%), allow a **rapid hardening** of the surface, an excellent **mechanical resistance** and an **excellent impermeability,** making thus possible **the passage** of vehicles over the surface, **about 12 hours** after the laying.

Use of Selenizza®SLN for
Tirana - Elbasan Highway *Tunnel*

Asphalt Wearing course 4cm. Job Mix Formula with **Selenizza®SLN** resulted with an **increased stability** thanks to the greater consistency of 50/70 road paving bitumen modified with Selenizza. The addition of Selenizza resulted in the **increase** of **aggregates adhesiveness** (**20-25%**) and granted to the asphalt mixture **greater resistance** to the **rutting and punching.**

Characteristic of bitumen utilized 50/70 dmm Pen. + Selenizza + Iterlene PE 31 F

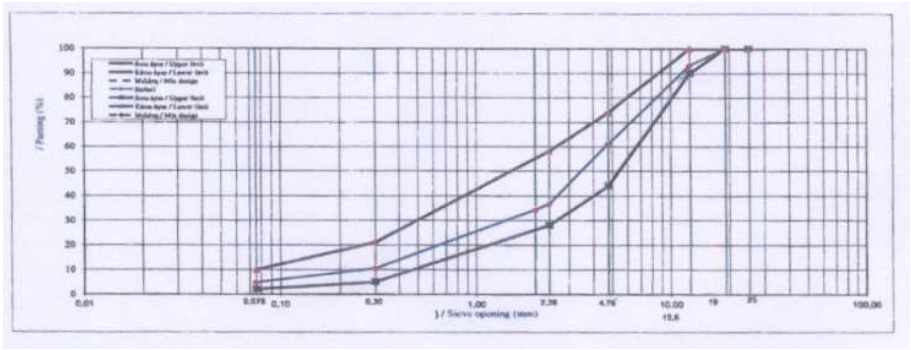
Bitumen Type	Observed penetration	Softening Point	Penetration Index
50/70 dmm + Selenizza + Iterlene PE 31 F	39 dmm	60 C°	+ 0.5

Marshall's Rigidity

1513/3.12 = 485 N/mm

Optimum bitumen content

5,4% on dry aggregate grading



Use of Selenizza® SLN for Airport runways

Airport runway mix design case study (Piarco International Airport, Trinidad, West Indies, 1983 & J.F. Keneddy International Aiport, 1984):

1. Base layer, Dense Graded Asphalt (ADI) 0/25 mm; thickness 50 mm; binder = 5,5 %

2. Wear layer DGA 0/12.5 mm; thickness 50 mm; binder = 5,7 %

Modified binder 60/70 :

67% (180/200) + 33% (TLA)
or
80% (180/200) + 20% (Selenizza)

Stability Marshall ∈ [11 -14 KN] Air voids ∈ [3,5 -3,7 %]

Similar formulation cases to solve the problems of deformations that occur at the intersection of taxiways and runways, from heavy jets turning to take off on the runway : aircraft parking area (New York, La Guardia Airport, New Wark International Airport, New Jersey, 1981)

Use of Selenizza®SLN for airport parking areas in Ukraine

Works in Kiev International Airport (Zhuliany)

Repair works on taxiways in the aircraft parking area and car parks

Use of Selenizza®SLN for airport parking areas in Ukraine

The standard formulation of the asphalt mixture was applied with a binder content of 6.3% and 0.4% Selenizza SLN of the total weight of the mixture

10 years after the repairs, no cracks or fissures were observed

Selenizza-bitumen emulsions

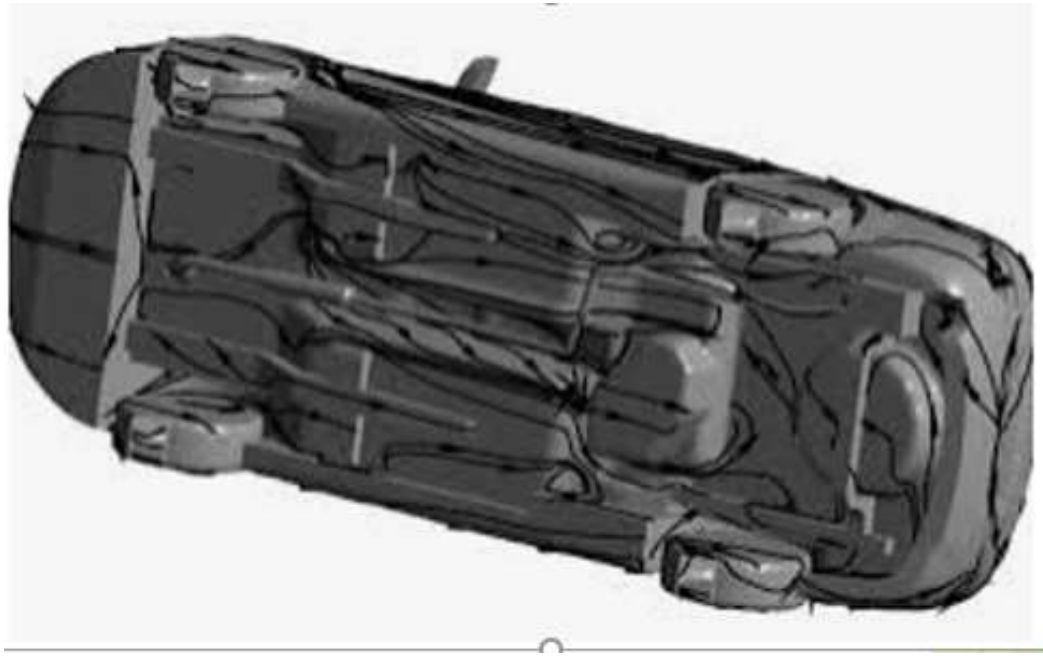
*The **Selenizza-bitumen composition** consists of a blend of **Selenizza**, **bitumen** and a **latex** or rubber. Selenizza and bitumen are blended in a wide range of ratios depending on the use and desired properties. Preferably, Selenizza is present in amount of at least 5%. For most **paving compositions**, latex (or solid rubber) amounts **up to about 10**% are sufficient.*

*The rubbers or elastomers are **melted** into a hot **bitumen-Selenizza blend** at a suitable temperature* ≥ rubber melting point.

Example slurry emulsions:

Bitumen with **penetration 50/70** is heated to a temperature **≥ 160°**C and **Selenizza** is **added gradually** and mixed until blending is completed. Once the hot bitumen and Selenizza have been thoroughly blended, the **latex is mixed** with the **hydrocarbon blend**. This mixture, constitutes the **base stock** which is **added to water** containing a desirable amount of **emulsifying agent**. The ratio of the hydrocarbon blend to the water will depend on the final use. Normally the **ratios of hydrocarbon/water phases** being between about **1/2 and 1/3,** respectively by weight.

Automotive Industry



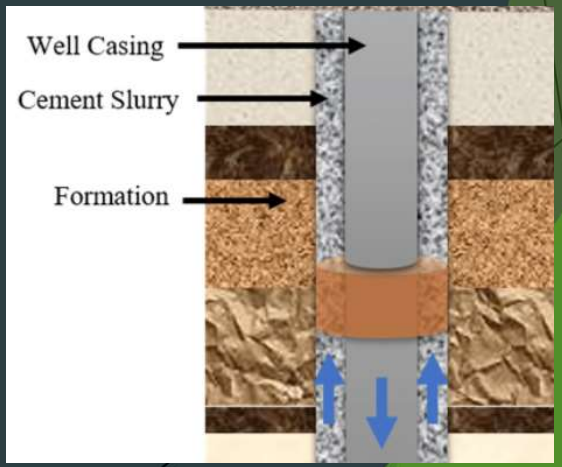
Protection of **underbody carriages** and internal **joints** and **seams**, from **rust** and **corrosion**. The Selenizza-based is an acoustic **sealant** obtained by **blending Selenizza® SLN** and **inorganic fillers.**

Oil producing industry

Selenizza® SLN is used in drilling mud fluids and oil well cementing

Adding Selenizza® during oil well cementing **enhances the isolation** characteristics while **decreasing** the **Gas flows**. **Slurry** with Selenizza is characterized by **exceptional bridging properties**, **low weight**, and relatively **high compressive strength**. The drilling fluid blended with Selenizza is **optimal to stabilize shale** (oil well walls).

Selenizza SLN in Cementing



Paint Use of Selenizza® SLN

Bituminous Black Paint for anti corrosive Pipe coating

In paint applications, Selenizza is used **in combination** with **bitumen**
Paints with Bitumen alone ➔ **tacky** if **penetration>10 [0,1 mm]** and **brittle if penetration< 4 [0,1 mm].**

Air-blowing soft road paving bitumen down to **penetration = 5 [0,1 mm]** , is a common practice but this is an **advanced aging process** which damages the bitumen.

The best solution is adding about **45 to 60 % Selenizza** to **an 50-70 penetration** bitumen to obtain a **5–10 penetration** bitumen, suitable for paint making.

Selenizza SLN as Foundry Sand Additive

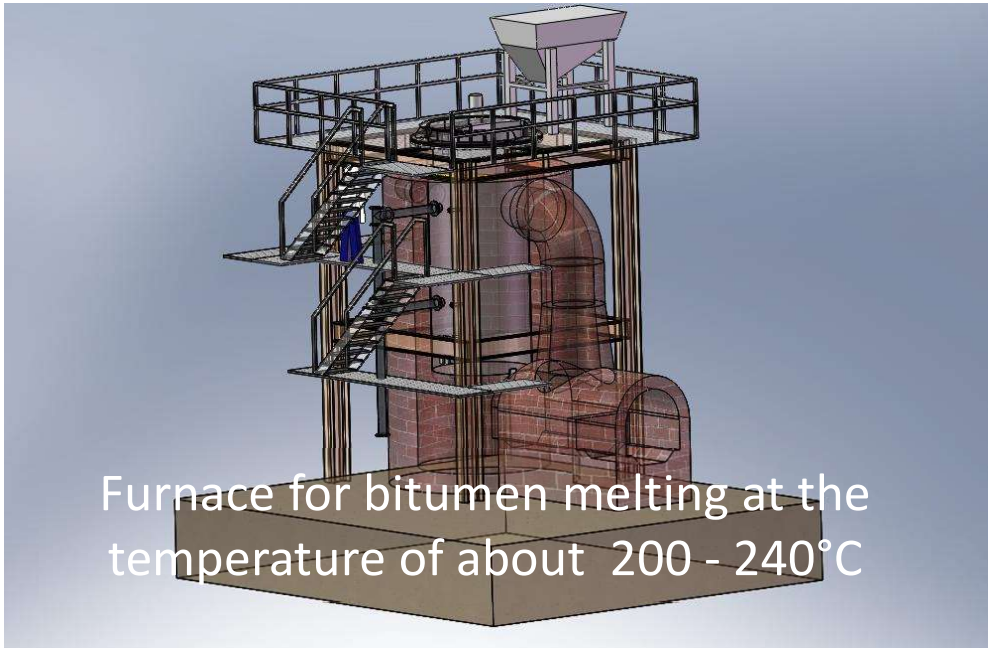
Adding Selenizza® to **sand foundry** will make **adhesion** between sand and other materials.
This adhesion after filling the mold causes the gassing out of the Selenizza sublimation to squeeze the material so that it is **easier to separate** the mold from the casting material.
Meanwhile, the mold surfaces **remain highly polished**.

Production of Selenizza® SLN

open-pit exploitation


KOMATSU
D
65EX

The blocks of asphalt are selected before the melting

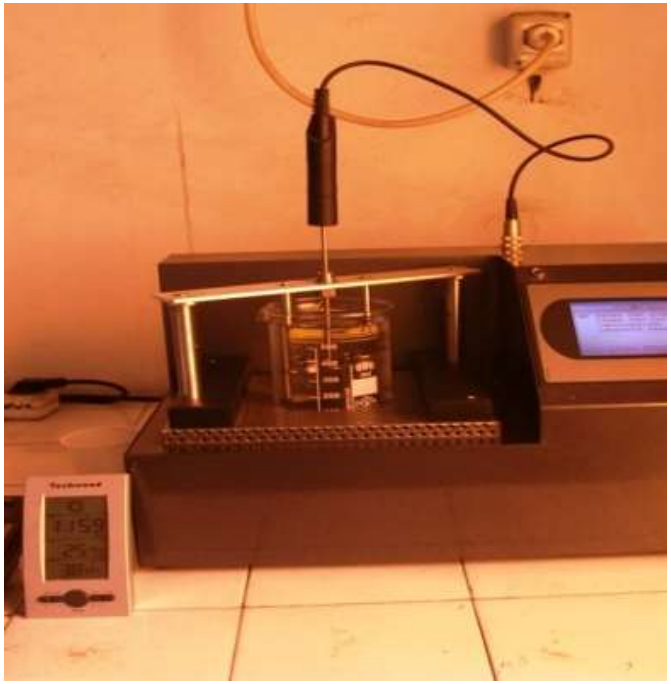


Furnace for bitumen melting at the temperature of about 200 - 240°C

Transport into the furnace via conveyor belt

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

The hexagonal blocks of clean bitumen are grinded in powder 0/6mm or in granular form 6/12 mm ad packed in big bags of 500 /1 200kg or melting plastic bags 15/25 kg



Corporate Name: **SELENICE BITUMI Sha** (to be named)

Adress: Po Box 4326
Vlore - ALBANIA
Tel: 00.355.69.20.99.743
Fax: 00.355.42.25.95.67
Mail: contact@advancedbitumi.com
Web: www.advancedbitumi.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	≥ 295	≥ 295
Mass Loss at 163°C, 5 hours	-	%	≤ 0.08	≤ 0.08
Insoluble	EN 12592	%	15 a 3%	12+ - < 15
A/R&B at 15% weight in S270		°C	5 to 9	
Humidity	-	%		
Sulphur Content	-	%	< 5	2.90 < - < 5.00
Asphaltenes Content	-	%	> 50	50≤ - ≤ 60

Trailer Plate Number :

	Numéro	TSA	N. Scellé		Numéro	TSA	N. Scellé		Numéro	TSA	N. Scellé
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 Laboratorie: Vangjel BOMBAJ

Surface Transport RID/ADR : Class/Etiquette/Packing: Not Concerned
Codes danger/Goods: Not Concerned

ICMQ Certified Selenizza®SLN

ICMQ

INSPECTION CERTIFICATE

CERTIFICATE N°

059/21/ISP

COMPANY

Selenice Bitumi Sh.a.

Head Quarter:
Po Box 4326 Vlora • ALBANIA

OBJECT OF THE CERTIFICATE

Selenizza® SLN bitumen
Conformity verification of the activities carried out by SELENICE BITUMI SH.A. with the internal procedure "Quality Plan for the production and supply of Selenizza® SLN bitumen and Selenizza® ONAT bitumen"

RESULT OF THE CERTIFICATION

The conformity verification of the activities carried out by Selenice Bitumi SH.A. with the internal procedure "Quality Plan for the production and supply of Selenizza® SLN bitumen and Selenizza® ONAT bitumen", was successful.

This examination is described in the Inspection Report n. 058/21/ISP, which is the technical annex to this certificate.

ISSUE DATE
April 01, 2021

EXPIRY VALIDITY DATE
March 31, 2022

THE PRESIDENT AND GENERAL MANAGER
ING. LORENZO ORSENIGO

Rev. 0

1 of 1

ICMQ S.P.A. – VIA G. DE CASTILLIA, 10 – 20124 MILANO – WWW.ICMQ.ORG

Verification of the compliance of the activities carried out by Selenice Bitumi Sh.a. to the internal procedure "Quality plan for the production and supply of bitumen Selenizza SLN and Selenizza ONAT from an **independent accredited certification body ICMQ** that operates in accordance with the UNI CEI EN ISO / IEC standard.

Maritime transport : cargo loading

Bitumen transport aboard cargo plane

Transport by truck

Maritime transport :Vlore port (Al)

Reference construction projects

Construction by EIFFAGE Guyana of the for the new ARIANE VI rocket launcher.

Reference construction projects

ARIANE VI rocket launching site
Kourou French Guyana

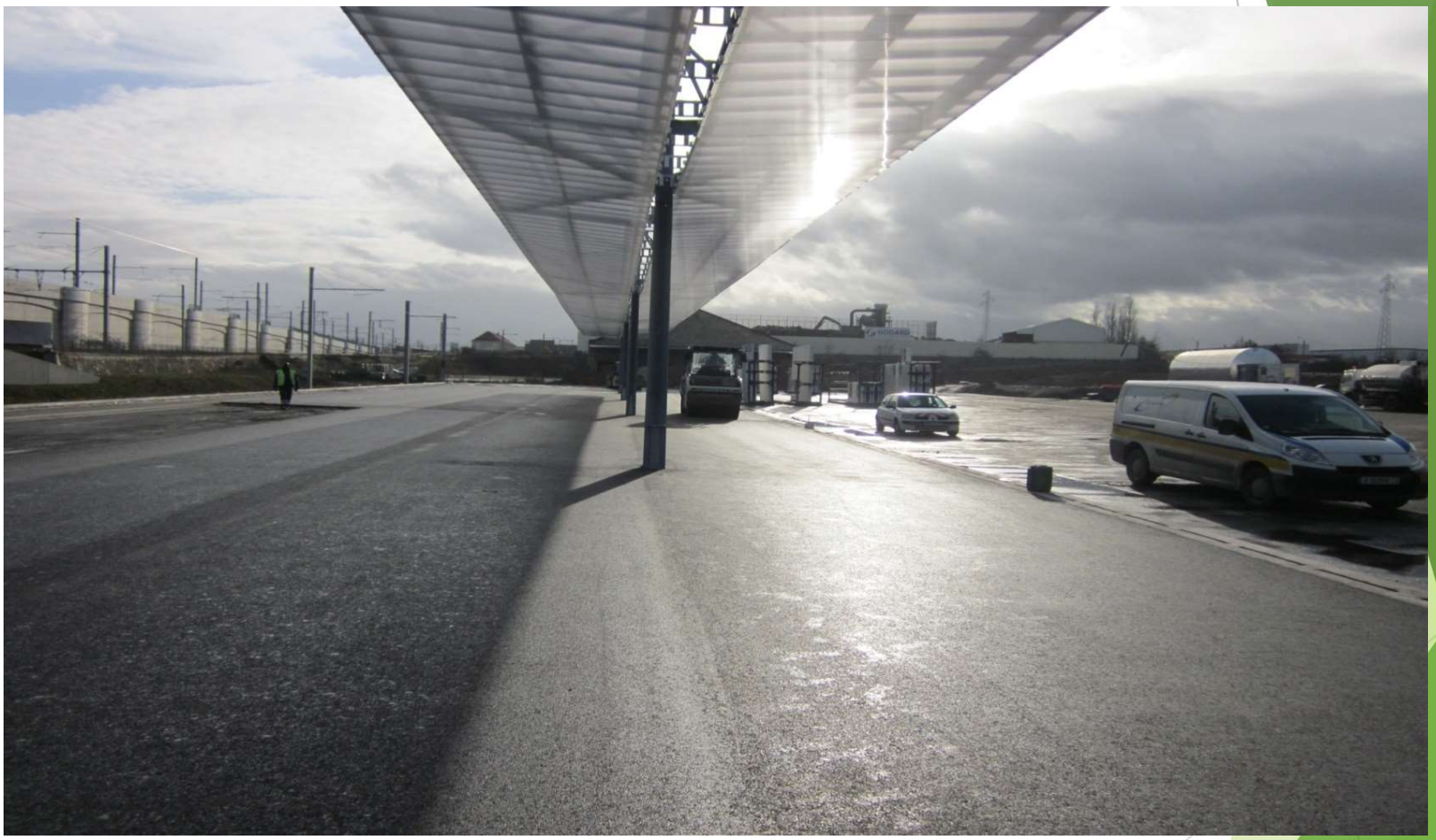
Reference construction projects

2011 : Bern motorway ring -Switzerland

Reference construction projects

Bus lane Chartres France

Reference construction projects



Tramway Dijon(France)

Reference construction projects

Highway Ticino- Switzerland

Reference construction projects

2014: Port Le Havre - France

Reference construction projects

2014: Motorway Stylida - Greece

Reference construction projects

Ring road Kiev (Ukraine)

Reference construction projects

National Road Mykolaiv (Ukraine)

Reference construction projects

Port Le Havre 2 000 (France)

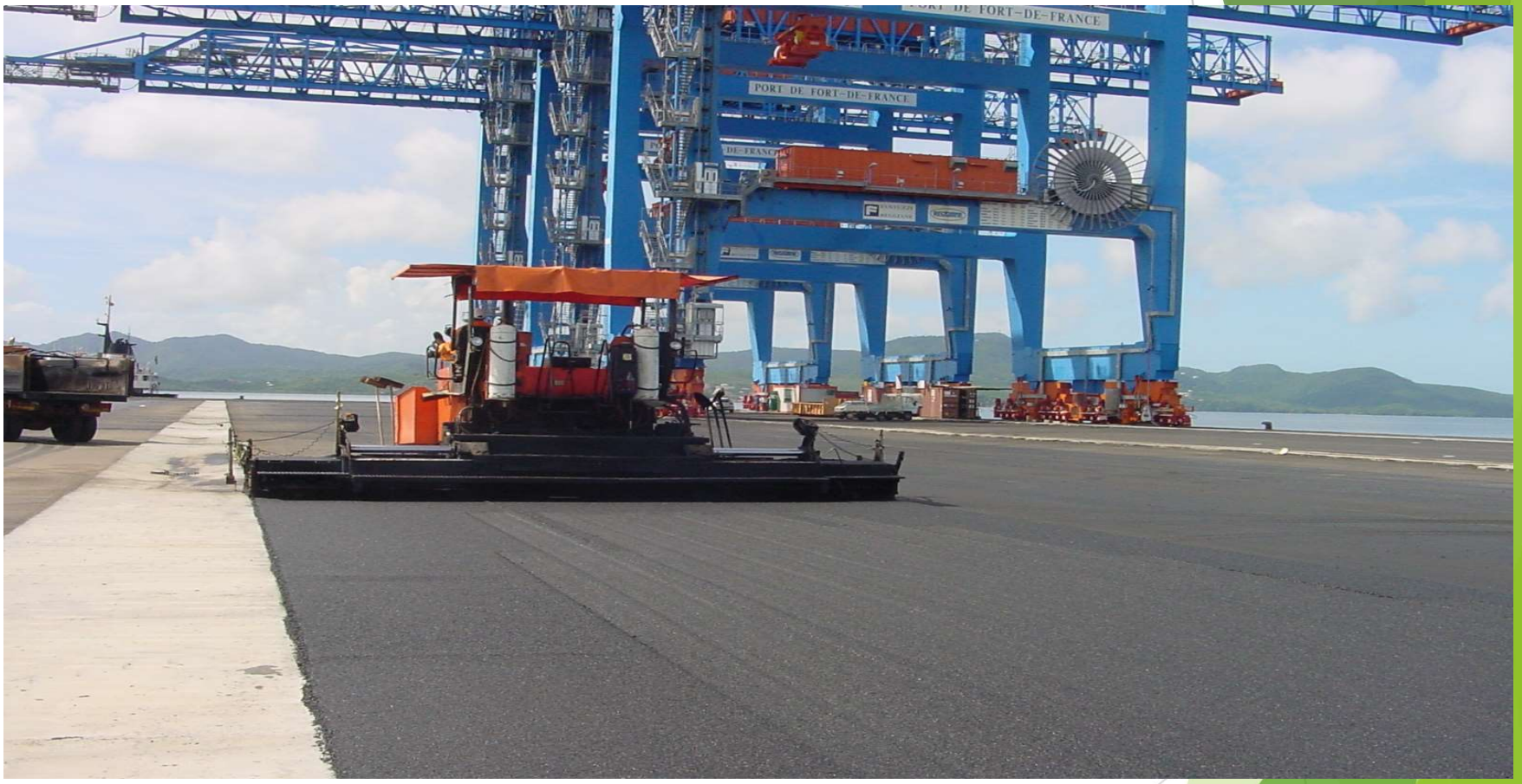
Reference construction projects

Road junction (France)

Reference construction projects

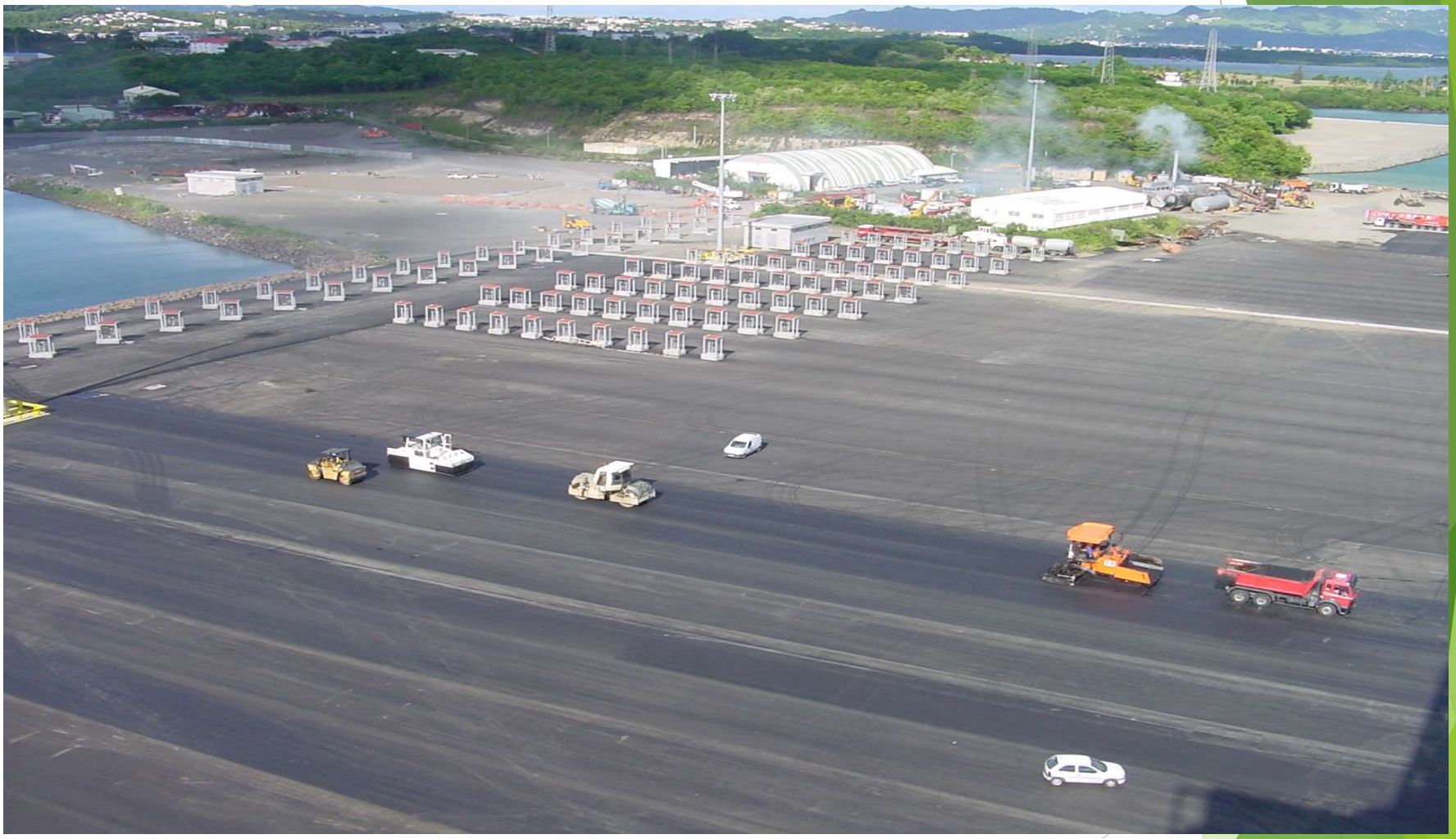
Port of Martinique (France)

Reference construction projects



Port French Antilles

Reference construction projects

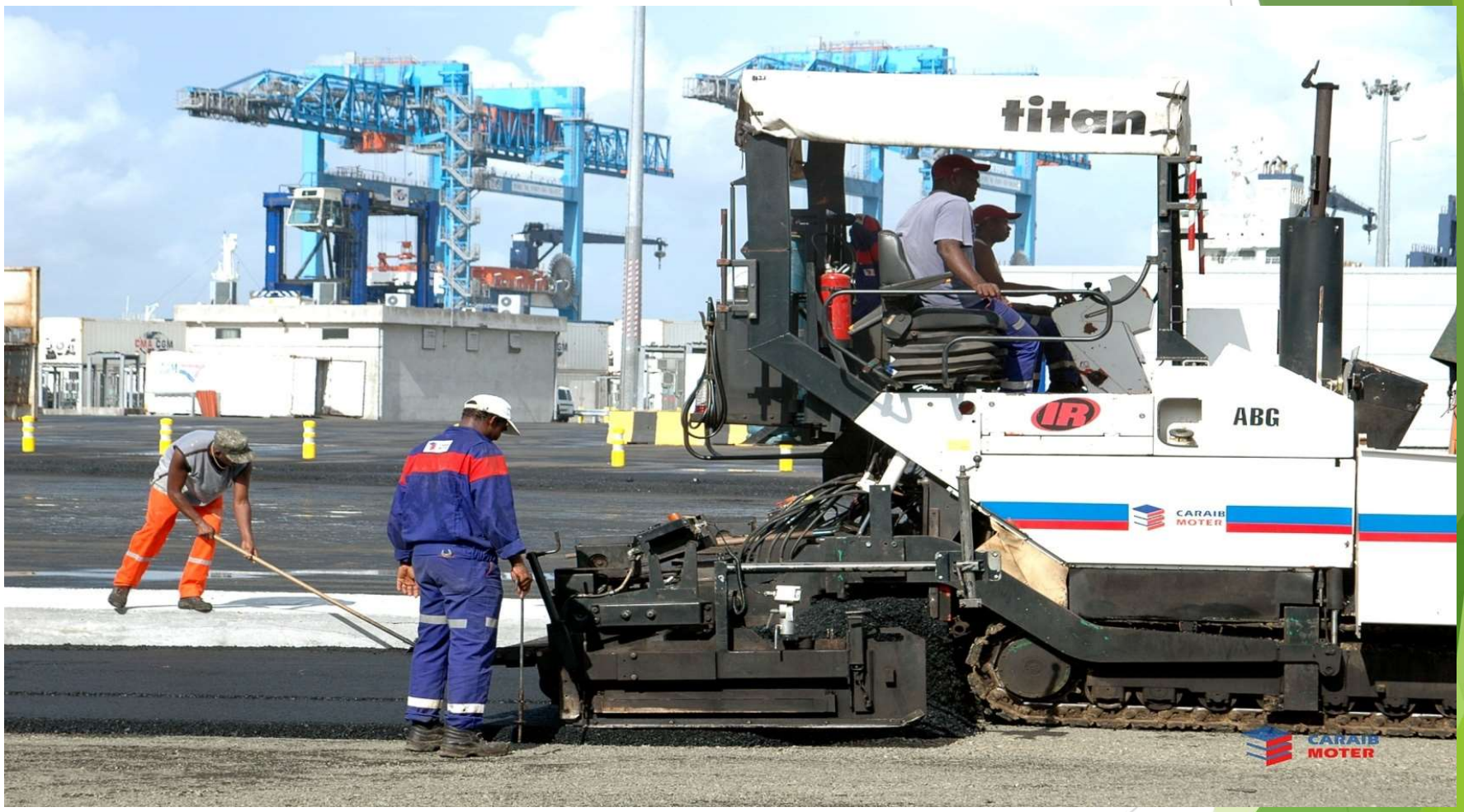


Port platform (France)

Reference construction projects

Airport Fort de France

Reference construction projects



Port Martinique (France)

Conclusions

The natural bitumen additive Selenizza® SLN

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


Thank you for your attention!