The Iso test track: COLAS Group’s experience

Presented by
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Outline

• ISO test track :
  • Definitions
  • Standard ISO 10844 : Evolutions
• Mix design
  • Standard to mix design
  • Two microphones impedance tube
• Experiences of Colas group Since 2006
  • Sacer, Colas, Sreg Subsidiary
• Conclusions
The Iso test track

- **Specific tracks**: Standard ISO 10844
  - Characterize the noise emissions
    - Cars or trucks
    - Tires (tires manufacturers)
- **Measurement of vehicle noises**
- **Same values between the different measurement sites**
  - Very high level of specifications for a relatively small area
Test track ISO 10844 standard: Evolutions

- Dense Asphaltic concrete
- September 1994
  - Straight bitumen
  - Informative sieve
  - Voids content ≤ 8% or $\alpha \leq 0.1$ on the 400-1600 Hz frequency (Core measurements)
  - Mean Texture Depth ≥ 0.4 (sand patch)
- February 2011
  - Modified binder allowed
  - $\alpha \leq 0.08$ on the 315-1600 Hz frequency (In situ Measurement)
  - Mean Texture Depth: Machine fulfilling ISO 13473-1 0.5mm± 0.2
Diagram ISO test Track

- Small size construction
- Geometrical parameter
Grading Curves

![Grading Curves Graph](image)

**% Passing**

**Sieve (mm)**

- lower grading envelope 1994
- upper grading envelope 1994
- lower grading envelope 2011
- upper grading envelope 2011
Mix Design

- Standard to mix design
  - Dense asphalt mix 0/6 to 0/10 mm
  - Rotary Shear Press (PCG 3 : EN 12697-10/ EN 12697-31)
    - Void content ≤ 8% at V80
  - Acoustic Absorption measured by Impedance Tube
    - Specimens from Gyropac Ø= 100mm (gyrator shear compactor)
    - Thickness : 30 à 55 mm
Impedance Tube

- Two microphones

Impedance Tube Method:

- Wideband sound signal, measure of acoustic pressure (FFT) and calculation of transfer function

- Stationary random signal which is split into an incident acoustic pressure $P_i$ and a reflected acoustic pressure $P_r$

- $P_i$ & $P_r$ are determined by relation between the acoustic pressures in a 2 microphones impedance device.

Fonction de transfert entre les 2 microphones

$$H_{12} = \frac{P_2}{P_1} = \frac{e^{jkh} + \Re(-jkh)}{e^{jk(h+s)} + e^{-jk(h+s)}}$$

$h$: distance between micro-sample
$k$: wavenumber
$s$: space between 2 micros

Reflexion Factor

$$R = \frac{H_{12} - e^{-jks}}{e^{jks} - H_{12}}$$

Absorption factor

$$\alpha = 1 - |R|^2$$
Impedance Tube on core samples

- Used for ISO mix design
  - Laboratory or core samples
- Used for low noise asphalt mixes
- Different kind of fitting
Colas group experience Since 2006

- 2006-2007 : Sacer Sud Est Project
- 8 different mixes studied in laboratory
  - Sometimes outside from the envelope
  - ISO 10844 : 1994
- Test sections on the acceleration and braking lane
- Extraction of core samples
  - MTD, void content and absorption coefficient
Results Sacer Sud Est Project

• 2 kinds of compaction
• In situ measurements

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<thead>
<tr>
<th></th>
<th>D</th>
<th>F</th>
<th>G</th>
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<tbody>
<tr>
<td>Compaction mode</td>
<td>1,2</td>
<td>1,2</td>
<td>1,2</td>
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<tr>
<td>MTD</td>
<td>0,53</td>
<td>0,45</td>
<td>0,3</td>
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<tr>
<td>% voids</td>
<td>6,2</td>
<td>5,9</td>
<td>4,3</td>
</tr>
<tr>
<td>$\alpha$ (400-1600 Hz)</td>
<td>0,097</td>
<td>0,086</td>
<td>0,068</td>
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- Mix Design D
- Comply with the ISO 10844:1994

<table>
<thead>
<tr>
<th>Spec</th>
<th>Results</th>
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<tbody>
<tr>
<td>Thickness</td>
<td>&gt; 30 mm</td>
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<tr>
<td>MTD</td>
<td>&gt; 0,4 mm</td>
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<tr>
<td>Void Content</td>
<td>&lt; 8%</td>
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<tr>
<td>15 core samples</td>
<td>Mean 38,8 mm</td>
</tr>
<tr>
<td>12 measurements</td>
<td>Mean 0,66 mm</td>
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<tr>
<td>4 core measured</td>
<td>6,7%</td>
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Colas group experience Since 2006

- 2008 : Colas IDFN Project

- 3 mixes
  - Sacer Sud Est mix, ISO Mix and outside from the envelope
  - ISO 10844 : 1994

- Test sections on the acceleration and braking lane

- Extraction of core samples
  - MTD, void content and absorption coefficient

- Specifications :
  - Void content & absorption coefficient
  - Using 10844:1994 and draft !!
2008 : COLAS IDFN

- Trial sections
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<tr>
<td>MTD (mm)</td>
<td>0.36</td>
<td>0.54</td>
<td>0.41</td>
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<tr>
<td>Void Content</td>
<td>2.4</td>
<td>3.5</td>
<td>6.5</td>
</tr>
<tr>
<td>$\alpha$ (400-1600Hz)</td>
<td>0.061</td>
<td>0.069</td>
<td>0.075</td>
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Colas group experience Since 2006

- 2009: Sreg Sud Est Project

- Mix design
  - Local aggregate: problem with basaltic aggregate
  - High filler content sand
  - ISO 10844: 1994

- Trial sections allowed

- Extraction of core samples
  - MTD, void content and absorption coefficient
Worksite Screg Sud Est Project

- Drive lane and propagation area

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<tbody>
<tr>
<td>$\alpha$ (315-1600Hz)</td>
<td>0,101-0,069</td>
<td>0,093-0,059</td>
<td>0,0113-0,055</td>
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<tr>
<td>Void content</td>
<td></td>
<td>9,6</td>
<td>11,1</td>
<td>6,5</td>
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<tr>
<td>MTD</td>
<td>0,37</td>
<td>0,46</td>
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<td>0,45</td>
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<tr>
<td>$\alpha$ (315-1600Hz)</td>
<td>0,077</td>
<td>0,089</td>
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<td>0,058</td>
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Colas group experience Since 2006

- 2011 : Colas Rhône Alpes Project
- 5 different mixes
  - Local aggregates and specific aggregates
  - Sometimes outside from the envelope
  - ISO 10844 : 2011
  - Laboratory : acoustic measurement with Impedance tube
    - Selection of mix design
- Test sections on the acceleration and braking lane
- In situ measurement
  - MTD and absorption coefficient
In situ impedance tube ISO 10844:2011

- Selection of mix design with laboratory impedance tube
  - 315-1600 Hz
- Validation with In situ impedance tube
  - ISO 13472-2
  - 250 – 1600 Hz

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<tr>
<td>α(315-1600Hz)</td>
<td>0.091</td>
<td>0.098</td>
<td>0.083</td>
<td>0.102</td>
<td>0.139</td>
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<tr>
<td>MTD</td>
<td>0.29</td>
<td>0.32</td>
<td>0.37</td>
<td>0.4</td>
<td>0.54</td>
</tr>
<tr>
<td>α(250-1600Hz)</td>
<td>0.053-0.115</td>
<td>0.023-0.071</td>
<td>0.036-0.085</td>
<td>0.02-0.061</td>
<td>0.038-0.084</td>
</tr>
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Conclusion

- **ISO test tracks:**
  - Small surface areas
  - Very technical with compromise between some criteria
    - MTD
    - Absorption
  - Preliminary work in laboratory
  - Trial sections recommended

- **Expertise of Colas group:**
  - 6 ISO test tracks since 2006
  - Recognized by several major vehicle and tire manufactures