Tire Testing and Industrial Standard Building in China

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China Automotive Technology and Research Center (CATARC)
National Passenger Car Quality Supervision and Inspection Center
Tianjin Automotive Test Center (TATC)
Contents

- Green tire’s development status quo
- Green tire’s energy-saving & emission-reduction effects and cost-benefit analysis
- Overview of green tire standard regulations
- Research on green tire testing technology
Green tire’s status quo

Green tire

- Low rolling resistance
- Low noise
- Long service life
- Superior wet grip
- Lightening
Green tire’s status quo

When tire’s rolling resistance reduced by 20%, fuel consumption per 100 km can be reduced by 4% ~ 6%.
Green tire’s status quo

Key methods to reduce tire’s rolling resistance – Structural optimization design

Green tire’s tread structure is mainly developing toward double tread and foaming tread directions.
Green tire’s status quo

Key methods to reduce tire’s rolling resistance – **Material selection**

- **Filling material**
  - White carbon
  - Black
  - Silane

- **Framework material**
  - High tenacity rayon
  - New nylon
  - Glass fiber
  - Aramid fiber

- **Rubber material**
  - SSBR
  - SIBR
  - ENR (Epoxidized Natural Rubber)
  - Polyisoprene Rubber

- **Processing aids**
  - Vulcuren®
  - Vulkalink™
  - Antigene FR
Green tire’s status quo

Green tire’s global status quo

<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>In 2006 passed laws containing tire labeling regulation;</td>
</tr>
<tr>
<td>Japan</td>
<td>Since 2010 started to implement voluntary tire labeling system;</td>
</tr>
<tr>
<td>EU</td>
<td>Since November 1, 2012, implemented compulsory tire labeling regulation;</td>
</tr>
<tr>
<td>S. Korea</td>
<td>Preparing to draft similar tire labeling regulation.</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
</tr>
</tbody>
</table>
Green tire’s status quo

The Ministry of Industry and Information Technology has convened round-table conference with EU over green tire issue, and in principle agreed to initiate project for green tire soft subject.

The green tire product self disciplinary standard compilation work organized and initiated by China Rubber Industry Association has been kicked off. The standard will make reference to EU Tire Labeling Law, REACH regulation etc to define the performance indictors such as rolling resistance, wet skid resistance and noise etc.

Target: By the end of the “Twelfth Five Year Period”, 50% of the enterprises are able to manufacture green tire, the tire production of 25% of the enterprises will exceed that of common radial tire.
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Basic data:

Average fuel consumption and car population of passenger vehicles by travel method 10000 sets

<table>
<thead>
<tr>
<th>Classification by usage</th>
<th>Annual average mileage km</th>
<th>Average fuel consumption L/km</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private car</td>
<td>20000 (Petrol) 7.6</td>
<td>6165</td>
<td>7515</td>
<td>11764</td>
<td>20310</td>
<td></td>
</tr>
<tr>
<td>Car for public use</td>
<td>40000 (Petrol) 8.0</td>
<td>913</td>
<td>984</td>
<td>1238</td>
<td>1510</td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td>73000 (Diesel) 30</td>
<td>45</td>
<td>47</td>
<td>55</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Taxi</td>
<td>120000 (Petrol) 7.5</td>
<td>126</td>
<td>135</td>
<td>145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7249</td>
<td>8675</td>
<td>13192</td>
<td>22033</td>
<td></td>
</tr>
<tr>
<td>Civilian use car</td>
<td></td>
<td>9356</td>
<td>10815</td>
<td>15480</td>
<td>25164</td>
<td></td>
</tr>
<tr>
<td>Private car</td>
<td></td>
<td>7327</td>
<td>8752</td>
<td>12916</td>
<td>21775</td>
<td></td>
</tr>
</tbody>
</table>

Note: Car population forecast data come from the car population forecast model of CATARC. Car for public use refers to vehicles used for public purpose such as those in government, enterprises and public institutions, hospitals, its data is obtained by deducting the number of private-small and compact passenger vehicles from the number of civilian small and compact passenger vehicles.

By taking advantage of the data of cars for different purposes and future car population forecast data at key development nodes, calculate green tire energy-saving and emission-reduction effects.
Assume all existing passenger cars for different purposes are replaced with green tire, make calculation based on tire rolling resistance down by 20%, and fuel consumption down by 4%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Private car</th>
<th>Car for public use</th>
<th>Bus</th>
<th>Taxi</th>
<th>Total fuel saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>84.79</td>
<td>271.94</td>
<td>32.01</td>
<td>28.60</td>
<td>4.1824 million tones</td>
</tr>
<tr>
<td>2012</td>
<td>91.38</td>
<td>331.49</td>
<td>33.60</td>
<td>29.87</td>
<td>4.8643 million tones</td>
</tr>
<tr>
<td>2015</td>
<td>114.97</td>
<td>518.92</td>
<td>34.95</td>
<td>34.95</td>
<td>7.0410 million tones</td>
</tr>
<tr>
<td>2020</td>
<td>140.22</td>
<td>895.88</td>
<td>35.26</td>
<td>35.26</td>
<td>11.1719 million tones</td>
</tr>
</tbody>
</table>

Green tire’s fuel saving effects
Calculate energy-saving & emission-reduction effects - 2

Green tire’s CO₂ emission reduction effects
Select standard tire configuration of typical vehicles to calculate overall cost benefit of different vehicle models within tire service life.
The extra cost for private cars to replace green tires will be offset by saving in fuel consumption at less than 20000km mileage, within one year it can reach breakeven point.
### Basic data:

#### Population and forecast of passenger vehicles in Shanghai

<table>
<thead>
<tr>
<th>Category</th>
<th>2011</th>
<th>2012F</th>
<th>2015F</th>
<th>2020F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private car, 10000 sets</td>
<td>117</td>
<td>123</td>
<td>142</td>
<td>182</td>
</tr>
<tr>
<td>Car for public use, 10000 sets</td>
<td>31</td>
<td>33</td>
<td>39</td>
<td>45</td>
</tr>
<tr>
<td>Taxi, set</td>
<td>51007</td>
<td>52027</td>
<td>55212</td>
<td>58591</td>
</tr>
<tr>
<td>Bus, set</td>
<td>17280</td>
<td>17453</td>
<td>17982</td>
<td>18527</td>
</tr>
</tbody>
</table>

#### Method and distribution of motorized travel by Shanghai residents

Person time:

- A. Self-drive: 67
- B. Take bus: 47
- C. Take taxi: 25
- E. Railway transport: 96
- F. Other methods: 52

- **A. Self-drive** (23%)
- **B. Take bus** (16%)
- **C. Take taxi** (9%)
- **E. Railway transport** (34%)
- **F. Other methods** (18%)
Green tire can be used in OEM or in after-sales replacement, if all passenger vehicles in Shanghai are replaced with green tires, its fuel-saving effect is quite considerable.
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Overview of green tire standard regulations

International standard regulations - 1

EU tire labeling directive (EC) No 1222/2009 requires that beginning from this year, all C1, C2, C3 tires imported into EU must be marked with categorized indicators for fuel efficiency, wet grip and noise.

Countries like USA, Japan, South Korea all have similar standards.

Countries like Brazil are making preparations to adopt similar standards.
# Overview of green tire standard regulations

## International standard regulations - 2

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Standard name \ Test item</th>
<th>Dimension &amp; appearance</th>
<th>Low atmospheric pressure</th>
<th>Speed</th>
<th>Destructive energy</th>
<th>Bead unseating resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>ECE R30 Tires-Motor vehicles and their trailers</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECE R54 Tires-Commercial vehicles and their trailers</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECE R64 Uniform Provisions Concerning The Approval Of Vehicles Equipped WITH Temporary-use Spare Wheels/Tires</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>FMVSS109 New pneumatic and certain specialty tires</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td></td>
<td>FMVSS117 Retreaded Pneumatic Tires</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
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<tr>
<td></td>
<td>FMVSS119 (New Pneumatic Tires for Motor Vehicles with a GVWR of More Than 4,536 kgs (10,000 lbs))</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td></td>
<td>FMVSS129 Non Pneumatic Tires for Passenger Cars</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
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<tr>
<td></td>
<td>FMVSS139 New Pneumatic Radial Tires for Light Vehicles.</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Japan</td>
<td>JISD4230-1998 &quot; Automobile Tires&quot;</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Gulf</td>
<td>GSO Gulf 51, 52, 53/1986 “Sedan Tire”</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>South Africa</td>
<td>SABS VC8056 “Pneumatic Tires For Passenger Cars And Trailers”</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
<tr>
<td></td>
<td>SABS South Africa VC8059 Pneumatic Tires For Commercial Vehicles And Their Trailers</td>
<td>✓ ✓</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ ✓</td>
</tr>
</tbody>
</table>
Overview of green tire standard regulations

Domestic standard regulations - 1

National regulatory inspection standards for car tires
GB 9743-2007 Passenger Car Tires
GB 9744-2007 Truck Tires

Green tire related standards: rolling resistance, tire noise, grip on wet and slippery road surface
GBT 18861-2002 Test Methods of Rolling Resistance for Motor Vehicle Tires
GBT 22036-2008 Coast-by Methods for Measurement of Tire-to-road Sound Emission
GBT 21910-2008 Method for Measuring Relative Wet Grip Performance of Passenger Car Tires
Overview of green tire standard regulations

**Domestic standard regulations - 2**

In response to EU tire labeling directive, China Rubber Association held a corresponding meeting in Yantai on September 15, 2011, The Green Tire Self-Discipline Standard is being drafted, which mainly requires:

Using eco-friendly, toxic-free and hazard-free raw materials which conform to EU REACH regulation;

The production process should ensure low energy consumption, low noise, low dust, low fume;

Products should have low rolling resistance, low fuel consumption, superior operation stability, shorter braking distance, better wear-resistance and capacity for multiple times of retreading etc.
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**Physiochemical property test**

Test the tensile property of vulcanized rubber and thermoplastic rubber

Tear test

Hardness test

Test vulcanized rubber’s low temperature brittleness _ single specimen method

Test vulcanized rubber’s wear resistance (using Akron Abrasion Testor)

Vulcanized rubber sliding wear testing method

......
Research on green tire testing technology

Regulatory inspection items

1. Dimension inspection
2. Strength inspection
3. Bead unseating inspection
4. Endurance test
5. High speed test
Research on green tire testing technology

Rolling resistance test

Test of rolling resistance is conducted on indoor 2-meter, 1.7-meter rotary drum equipment, the measured data will be converted into rolling resistance value exerted on tire and rotary drum contact surface. The four measuring methods are as follows:

a) Force measurement method: Measure the reaction force on the axle;
b) Torque method: Measure the input torque of rotary drum;
c) Power method: Measure the input power of rotary drum;
d) Deceleration method: Measure the deceleration of rotary drum and tire vehicle combined unit at the time of coasting.
Research on green tire testing technology

Noise test

Driving middle line
Speaker position
A-A, B-B E-E and F-F are reference lines

1—行驶中心线；
●—传声器位置；
△—A-A, B-B, E-E 及 F-F 是参考线。

Note: Vehicle (See Appendix A) or trailer (See Appendix B) should run at prescribed speed

GB/T 22036—2008/ISO 13325; 2003

Figure 1 Measuring zone and speaker position

Unit: meter
Research on green tire testing technology

Grip test on wet and slippery road surface

a) Test car method: Install one set of tires directly onto test car to conduct test;

b) Trailer method: Install the tire on trailer or special tire testing vehicle to conduct test.
Research on green tire testing technology

Planning of CATARC tire testing center

China Automotive Technology And Research Center (CATARC) has long been engaged in automobile safety and environmental protection work; for tires, which is a key component of cars, CATARC also attaches great importance to its testing, in the next one year or two it will develop testing ability to satisfy EU tire labeling directive (EC) No 1222/2009 requirements.

Rolling resistance testing zone
Research on green tire testing technology

Planning of CATARC tire testing center

The CATARC Test Ground in Yancheng, Jiangsu Province is now under construction
Thank you!

Your comments and corrections are welcome