# Application of anti-fatigue agent AF28 in tire - Guarantee of high performance and safety

**Shanghai Powerflex New Material Co., Ltd（under Sane Zen Group）**The anti-fatigue agent **AF28** developed by Powerflex effectively improves the dispersion of carbon black, and the highly active groups on its surface can react with the corresponding groups at the end of the natural rubber molecular chain, thereby significantly reducing the dynamic heat generation of the natural rubber carbon black system. Performance, it can improve the dynamic mechanical properties of the rubber and reduce rolling resistance. It can improve the heat aging resistance of the tire, reduce compression heat generation, and extend the service life. Adding an appropriate amount of anti-fatigue agent **AF28** can improve the hardness, elasticity, and elongation of the rubber. stress without significantly changing the tensile strength.

At the same time, it can prevent the vulcanized rubber from returning to its original state after high temperature or long-term use, that is, the cross-linked network of the vulcanized rubber is degraded, resulting in a decrease in physical properties. The anti-fatigue agent **AF28** can reduce the thermal degradation of some polysulfide bonds. Degradation occurs, thereby improving the thermal stability of the vulcanized rubber.

The use of anti-fatigue agent **AF28** is crucial to improving the quality, safety and life of tires.

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**Main function：**

- 1. Reduce heat generation: the end of the molecular chain is modified, the hysteresis loss of vulcanized rubber is improved significantly, and the dynamic heat generation is reduced.
- 2. Improve elasticity: significantly improve rubber elasticity.
- 3. Reduce rolling resistance: It can improve the dynamic mechanical properties of the compound and reduce rolling resistance.
- 4. Prevent vulcanization reduction reaction: Prevent reversion of vulcanized rubber after prolonged use or exposure to high temperatures.
- 5. Speed up vulcanization: Improve production efficiency.

**Suggestions for use:**

1. Suggestions for use: Only applicable for natural rubber or primarily natural rubber-based compounds, with a recommended dosage of 1 to 1.6 phr.
2. The anti-fatigue agent AF28 must be added during the first mixing stage using Natural Rubber (NR) as the raw material to effectively achieve maximum performance.

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| No. | Raw material | Formula 1 (None) | Formula 2 (With anti-fatigue agent) |
|---|---|---|---|
| 1 | SCR 10 | 100 | 100 |
| 2 | N234 | 47 | 47 |
| 3 | ZnO | 3 | 3 |
| 4 | SA | 3 | 3 |
| 5 | Wax | 1 | 1 |
| 6 | 4020 | 1.2 | 1.2 |
| 7 | RD | 1 | 1 |
| 8 | S | 1.5 | 1.5 |
| 9 | NS | 1.1 | 1.1 |
| 10 | AF28 | | 1 |
| Total: | | 158.8 | 159.8 |

| Test | Formula 1 | Formula 2 |
|---|---|---|
| ML(dN.m) | 1.92 | 2.56 |
| MH(dN.m) | 18.1 | 17.01 |
| T10 (min) | 3.66 | 3.26 |
| T50 (min) | 4.91 | 3.88 |
| T90 (min) | 10.21 | 7.21 |
| TS2 (min) | 3.92 | 3.35 |

Vulcanization condition of rubber:
151℃ ×60min
Test standard: GB/T 16584-1996

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| Project | Test | | Formula 1 | Formula 2 (+AF28) | Test condition | Standard |
|---|---|---|---|---|---|---|
| Physical property | Mooney | ML(1+4)100℃ | 62 | 75 | 100℃ | ASTM D1646 |
| | Hardness | Shore A | 65 | 66 | 151℃*30min | ASTM D2240 |
| | M100% | Mpa | 2.9 | 3 | | ASTM D412 |
| | M300% | Mpa | 14.8 | 15.5 | | |
| | Tensile Strength | Mpa | 33.3 | 32.9 | | |
| | Elongation | % | 551 | 529 | | |
| | Tear Strength | m/kN | 95 | 94 | | ASTM D624 |
| | Rebound % | | 43 | 49 | 151℃×30min | GB/T 1681-2009 |
| Aging performance | Hardness | Shore A | 70 | 69 | 100℃*48hrs | ASTM D2240 |
| | M100% | Mpa | 3.5 | 3.2 | | ASTM D412 |
| | M300% | Mpa | 16.6 | 15.8 | | |
| | Tensile Strength | Mpa | 25.4 | 26.9 | | |
| | Elongation | % | 438 | 456 | | |
| | Tear Strength | m/kN | 52 | 55 | | ASTM D624 |
| | Rebound % | | 48 | 51 | | GB/T 1681-2009 |
| Function | the volume of abrasion /$cm^3$ | | 0.141 | 0.144 | 151℃×30min | ISO-23337 |
| | E'/MPa | 0℃ | 22.01 | 17.67 | DMA 151℃×30min | ISO-23337 |
| | | 60℃ | 12.45 | 10.57 | | |
| | tanσ | 0℃ | 0.129 | 0.126 | | |
| | | 60℃ | 0.098 | 0.08 | | |
| | | Improvement rate % | 100 | 81.6 | | |

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