

# Experimental Study on Color Durability of Color Asphalt Pavement

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**Abstract.** Aiming at the poor Color durability and the lack of research on Color asphalt pavement, spraying an anti-tire trace seal resin emulsion on the surface, a Color durable asphalt pavement was proposed. After long-term rolling and long-term aging test, the Color durability was evaluated by RGB function in Photoshop and trace residue rate formula. Test results proved that the Evaluation method was simple and effective. After long-term rolling, the Color of the road surface tends to a constant value. Spraying the emulsion on the road surface can resist tire traces. After long-term aging test, the resistance to tire traces was increased by 26.6% compared with the conventional type, while the former was 44.1% higher than the latter without long-term aging. The Color durable asphalt pavement can effectively improve the ability of Color asphalt pavement to resist tire traces, and significantly improve the Color durability of Color asphalt pavement.

## 1. Introduction

Color asphalt mixture is widely used in municipal roads parking lots and toll stations, the color pavement forms a beautiful landscape [1~2]. However, due to the repeated rolling of vehicle tires, the color of the pavement gradually fades.

The research on color pavement was mainly focused on the design of mixture, functional tests and construction technology [3~5], what makes the color pavement durable is keeping the color bright. So it is very important to research on color durability of the pavement.

A thermosetting acrylic resin is introduced in this paper, which is polymerized from acrylic monomer, initiator and distilled water. Spraying the thermosetting acrylic resin on the surface of color pavement, it can not only reduce the residual traces of tires, but also increase the surface water tightness, and improve the color durability of the pavement.

In this paper, tire rolling test is adopted to simulate the long-term vehicle rolling, 1000, 2000, 5000, 10000 and 20000 rolling times are chosen. Long-aging oven heating method is adopted to study the long-term aging performance of color.



## 2. Test conditions

### 2.1 Preparation for Color asphalt mixture

Aggregate gradation design for AC-13 modified asphalt mixture from technical specification for asphalt pavement construction in china the composition list in table 1. The asphalt-aggregate ratio 5.1% is determined by test.

**Table 1** Gradation composition of AC-13 color asphalt mixture

Sieve size (mm)	16	13.2	9.5	4.75	2.36	1.18	0.6	0.3	0.15	0.075
Upper limit	100	100	85	68	50	38	28	20	15	8
lower limit	100	90	68	38	24	15	10	7	5	4
Optimum	100	96	77.5	42.5	25.5	21	15	12.5	8	4.5

### 2.2 Test on anti-sliding performance of Color asphalt mixture

Anti-sliding tests with and without protection film were carried out, the values of anti-sliding performance were measured by pendulum friction meter listing in table 2.

**Table 2** Skid resistance value of color asphalt mixture

Indexes	Skid resistance value	Evaluation				
traditional	82	excellent	good	Medium	secondary	bad
spraying seal	74	$\geq 42$	37-42	32-37	27-32	$< 27$

The anti-sliding performance with protection film is lightly lower than the traditional asphalt pavement, but the performance can meet china's requirements from specification.

## 3. Evaluation method

The original bright color of the pavement gradually turned black because of the tire trace residue between the pavement and the tires. The tire trace residual rate is evaluated by the changing rate of the color pavement the calculation of the color changing rate can be solved by the image processing technology in Photoshop software. RGB color space in three pixel combinations (R, G, B), different RGB pixel values can represent different depths of color, the original RGB value is(x, y, z), The RGB value after the test is defined as(x1, y1, z1), the value decrease in pace with the test times increasing.

The trace residual rate I is calculated by Formula 1.

$$i = \frac{x-x_1}{x+y+z} + \frac{y-y_1}{x+y+z} + \frac{z-z_1}{x+y+z} \quad (1)$$

The residual rate I value is between 0 and 1, the greater the value of me, the more serious traces residue. The wheel tracking test simulate vehicle loading, the following test parameters are simplified:

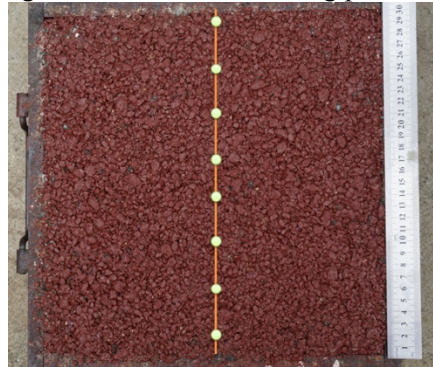
- (1)The tire of rutting test machine simulate the tire of car,
- (2)Constant tire speed,
- (3)Test at room temperature only.

## 4. Test scheme

### 4.1 Specimens

The rutting test specimens were made according to the requirements of Chinese specification, the surface of the specimen was divided into two parts averagely the acrylic resin emulsion seal is sprayed on the lower half of the surface in the figure 1.

Eight points are located along the tire moving direction, marked on 2cm, 6cm, 10cm, 14cm, 17cm, 21cm, 25cm and 29cm. Every half part has 4 points. Take the marked points pictures using a HD digital camera every 1000 rolling times. The camera has 18 million pixels and the image resolution is 5184 x 3456. Every marked point RGB values were calculated in Photoshop software. It is noteworthy that backlight is useful for calculating RGB values when taking pictures.



**Fig.1** Trace residue mark

#### 4.2 Test process

Three rutting test specimens of color pavement were made, spraying and marking on the specimen according to test scheme.

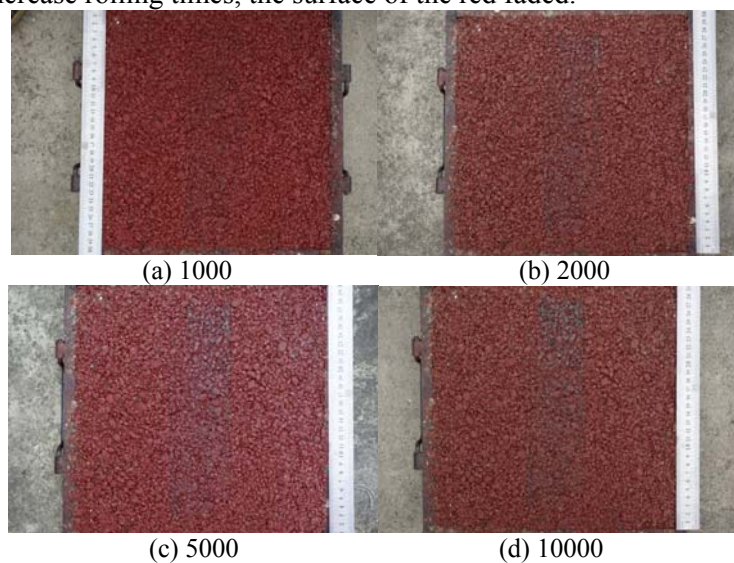
One of the specimens was subjected to wheel tracking test at ordinary temperature, another was heating in Long-aging oven 5 days at 85°C. The last one was keeping in ordinary temperature 5 days for comparison.

Taking the surface of each specimen pictures every 1000 rolling times. Each picture was processed by Photoshop software, the RGB values were calculated. The trace residual rate  $I$  for every picture was obtained.

### 5. Test results and analysis

#### 5.1 Relationship between Colour durability and rolling times

The Figures 2 were taken after 1000, 2000, 5000 and 10000 rolling times. As can be seen from the pictures, with the increase rolling times, the surface of the red faded.



**Fig.2** Tire trace residue degree

**Table 3** Trace residue rate for every marking point under different rolling times

Trace residue rate		Marked pints	1000	2000	5000	10000	20000
Types							
Durability	2cm		0.036	0.048	0.136	0.255	0.311
	6cm		0.040	0.054	0.104	0.202	0.303
	10cm		0.047	0.066	0.126	0.195	0.340
	14cm		0.033	0.064	0.137	0.221	0.328
	17cm		0.089	0.166	0.265	0.368	0.473
Ordinary	21cm		0.110	0.179	0.298	0.404	0.455
	25cm		0.133	0.181	0.284	0.375	0.462
	29cm		0.115	0.193	0.275	0.393	0.489

As seen in Table 3, the results show that trace residue rates increase with the adding times, but the spraying seal part has lesser trace residue rates. The emulsion seal can significantly improve the tire trace residue. When the number of rolling times up to 10000, the residual rate of traces of the two kinds of color asphalt mixture will increase sharply with the increase of rolling times, However, when the number is more than 10000 times, the increasing rate of trace residual rate of the two kinds of color asphalt mixture has slowed down, the curve is relatively stable, and the color durability is slightly higher than that of the ordinary type. When the color asphalt pavement with protection film reaches a certain residual rate, its surface color will tend to a constant value. Obviously, the color asphalt pavement with protection film to the constant value of the corresponding number of rolling times is much larger than ordinary color asphalt pavement. The acrylic resin emulsion seal can be more effective and long-term resistance to the traces of tire tracks, improve color asphalt pavement color durability.

### 5.2 Relationship between Colour durability and long-term aging

Two specimens of the red color mixture were prepared and tested according to the above methods. One of the specimens was put into the oven for long-term aging test. Another was keeping in ordinary temperature.

According to the formula of trace residual rate, the residual rates of color asphalt mixture were calculated under the different conditions, the relationship between two keeping conditions and residual rates of color asphalt mixture was drawn, as shown in Table4.

**Table 4** Trace residue rate after long-term aging

Types		Trace residue rate (%)							
Durability	2cm		6cm		10cm		14cm		
	B	A	B	A	B	A	B	A	
	0.069	0.061	0.072	0.067	0.076	0.063	0.086	0.084	
	17cm		21cm		25cm		29cm		
Ordinary	B	A	B	A	B	A	B	A	
	0.127	0.089	0.136	0.091	0.139	0.094	0.141	0.100	

Type B is before long-term aging, Type A is after long-term aging.

As can be seen from Table4, whether or not after a long period of aging, the tire residue rate of color asphalt mixture spraying seal was significantly lower than the ordinary color asphalt pavement.

In the case of the ordinary color asphalt mixture, after the long-term aging, the residual rate of tire trace was significantly reduced. This may be due to the aging of the mixture resulting in a decrease in

the color of the asphalt in the composition of the resin, and the color of the asphalt adhesion is also reduced, thereby reducing the black tire marks on the surface of the color asphalt adhesion.

In the case of the color asphalt mixture spraying seal, there was little change in tire trace residue rate before and after aging, the rates after aging were slightly lower than those before aging.

In conclusion, the color durability of the ordinary type of color asphalt mixture is influenced greater than that of mixture with protection under long-term aging. The color durability of asphalt pavement can effectively resist by the resin emulsion

## 6. Conclusions

In order to improve the color durability of asphalt pavement, a kind of thermosetting acrylic resin emulsion was sprayed on the surface of pavement to form a color durable asphalt pavement.

The residual traces of the specimen surface were processed by the Photoshop software, and the residual traces on the surface of the color asphalt pavement were quantified and evaluated by the RGB function and the residual rate formula. In addition, two kinds of methods of long-term aging were used to study the color durability of color asphalt pavement.

The following conclusions are obtained:

(1) A tire trace residual test method is proposed, which can be used to evaluate the color durability of the color asphalt pavement

(2) Trace residual tests under different rolling times compared the residual rates between color durability and ordinary of asphalt pavement, the color durability of the former is obviously higher than the latter.

(3) In addition, trace residual tests were carried out between color durability and ordinary of asphalt pavement after long-term aging, the color durability of the former compared to later type increased by 26.6%, the tests results without long-term aging show that the former resistance traces compared to latter one increased by 44.1%. It can be seen that the anti-tire resin seal coating emulsion can effectively improve the color durability of color pavement.

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