

# Intermittent Colored Non-slip Surface Material and Structural Integrated Design and Experimental Research

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**Abstract.** Colored non-slip surface coating has an important role in the prevention of traffic accidents and obtains more and more attention and application. This paper based on chemical reaction principle of polymethyl methacrylate with a curing agent to produce a fast secondary crosslinking reaction coating mix. On the basis of the principle, test measures are designed to test performance of bond strength of polymethyl methacrylate material. Then the planer structure of intermittent colored non-slip surface is designed. Intermittent colored non-slip surface structure and material have broad application prospects on highways and city roads.

## 1. Introduction

Europe, America and Japan and other developed countries have already carried out research and development in colored non-slip surface coating. Color non-slip pavement has been used in parking lot, bus lanes, bicycle lanes, accident-prone points. Traditional colored pavement more often uses continuous laying method which is uneconomic. Plane structure is shown in figure 1. Currently the application of colored non-slip surface of our country is not a lot. Our research for skid technology began in the 1970s and colored asphalt mixture Discussion began in 1980s[1][2]. Due to the constraints of various technical conditions, colored non-slip surface technology of our country than in other countries is also behind a lot.



Fig. 1 Plane structure of continuous colored non-slip surface

## 2. Chemical reaction mechanism of two-component material coating of polymethyl methacrylate

Polymethyl methacrylate polymer binder is a two-component material. The curing agent is added in the construction of another resin component. The curing agent makes methacrylic acid MMA monomer (molecular weight 100) to produce fast secondary crosslinking reaction and ultimately the formation of high-strength film[3]. Methyl methacrylate endows polymer greater cohesive strength. So it belongs to a hard monomer which is shown in Figure 2[4]. Performance of methacrylic resin depends on the selected size of the resin monomer structure and molecular weight [5]. Thea

position of methyl methacrylate is substituted by the vinyl, eliminating the breaking point of oxidized to ensure the good weatherproof and durability[6]. The curing time can be artificially controlled which is shown in Figure 3.



Fig. 2 The monomers and polymers schematic diagram and polymer chemistry formula

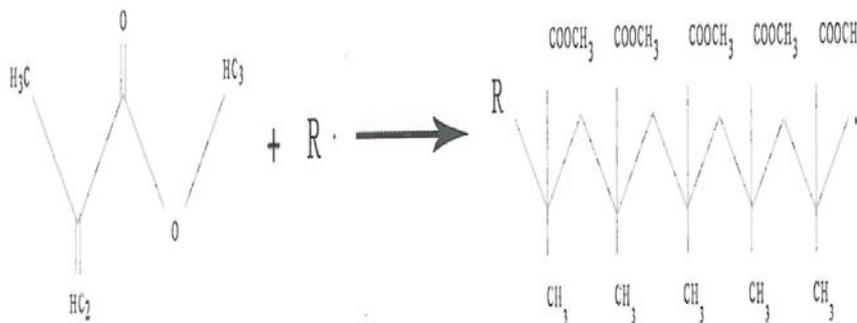


Fig.3 Two-component resin polymerization reaction schematic diagram

Based on the above physical and chemical properties, the main advantages of polymethyl methacrylate resin color slip coating are below[7][8]:

- (1) the opening to traffic fast, small impact on traffic and excellent slip resistance;
- (2) no ramaway, no security risks and green environmental protection;
- (3) applies to a variety of substrates such as cement, asphalt, metal, wood, ceramics, stone.

### 3. Material composition design and bond strength test

Performance testing is done to polymethyl methacrylate adhesive of adding the curing agent of 1%, 2%, 3%, 4%, 5% different proportions. The specific design of the material composition is shown in Table 1.

Tab.1 Material composition design table of two component polymethyl methacrylate

| The number of groups | the main agent/g | curing agent/g |
|----------------------|------------------|----------------|
| 1                    | 100              | 1              |
| 2                    | 100              | 2              |
| 3                    | 100              | 3              |
| 4                    | 100              | 4              |
| 5                    | 100              | 5              |

The experiment was bond strength test after two-component of the main agent and curing agent solidification which is shown in Figure 4. Two cement test blocks of 4cm wide and 1cm in thickness was used. Laboratory equipment and materials were tensile testing machine, tensile

special fixtures, temperature and humidity conservation tank, cement block making molds, cement, gravel, curing agents, Polymethyl methacrylate, scraper and so on.



Fig. 4 Tensile test site graph

Different tensile results of polymethyl methacrylate materials are shown in Table 2.

Tab. 2 Tensile test results of polymethyl methacrylate

| Curing agent content /% | 1    | 2    | 3    | 4    | 5    |
|-------------------------|------|------|------|------|------|
| Force value /KN         | 5.40 | 5.38 | 5.30 | 5.22 | 5.12 |
| Displacement/mm         | 1.20 | 1.29 | 1.36 | 1.33 | 1.28 |

According to formula (1) ,polymethyl methacrylate adhesive strength can be calculated in table 3. The value of bond strength ranges from 32Mpa to 35Mpa. From the experimental data, it can be seen that the best mechanical properties can be obtained when the main agent with a curing agent mass ratio of 100: 1.

$$C = 1.8QT / 0.7 \tag{1}$$

QT- tensile strength (KN)

C- bond strength (Mpa)

Tab.3 Polymethyl methacrylate bond strength results

| Curing agent content /% | 1     | 2     | 3     | 4     | 5     |
|-------------------------|-------|-------|-------|-------|-------|
| Bond strength /Mpa      | 34.71 | 34.59 | 34.07 | 33.58 | 32.92 |

#### 4. Planar structure design of the intermittent colored non-slip surface

Roads will be paved using the batch method. Different lanes use different colors .Bus lanes use red, left turn lanes use yellow, straight lanes use blue and right turn lanes use green. Different colors better play its instruction and sight induced effect. According to the city colored non-slip pavement specification, each color slip road length is set to 1m, width is set to one lane width 3.5m and thickness is set to 2mm. The interval between each colored non-slip surface is 0.8m which is shown in figure 5. This kind of laying scheme induces a variety of colors. It can not only make the drivers slow down before the intersection to keep driving safety, but also more economical.

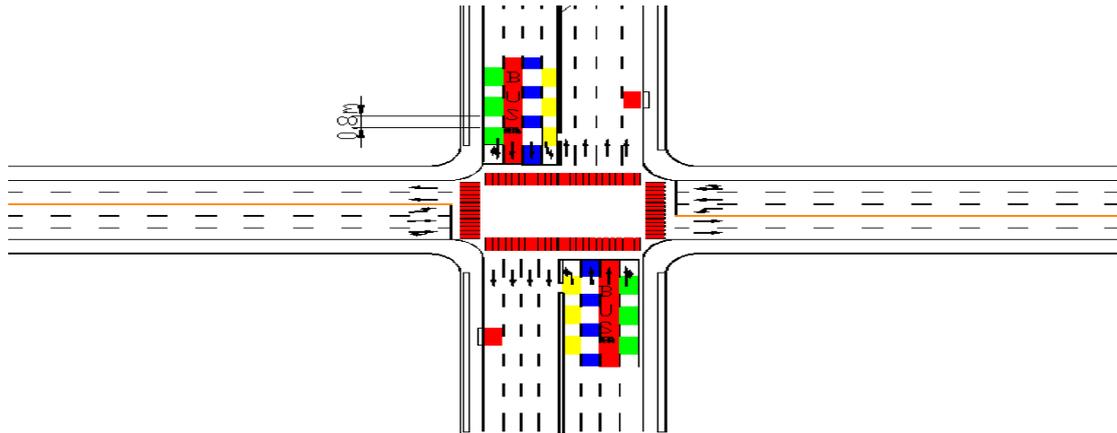


Fig. 5 Intermittent colored non-slip surface design at the intersection

## 5. Conclusions

When the binder is added 1%, 2%, 3%, 4%, 5% curing agent, the value of bond strength ranges from 32Mpa to 35Mpa. From the experimental data, it can be seen that the best mechanical properties can be obtained when the main agent with a curing agent mass ratio of 100: 1. Laying different colored non-slip surface plane of the road depends on the application condition. The laying form is also different. Intermittent laying method is provided with multi-color appearance and the economy is good. Induce sight and deceleration action induced an important role to ensure the safety. It will receive attention and more and more applications.

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