Study on the variation law of the thickness of spraying quick-setting waterproof coating materials with time and temperature

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Abstract. In this paper, by testing the different waterproof coatings (including spraying quick-setting polyurea waterproof coating, spraying quick-setting rubber asphalt waterproof coating and spraying quick-setting acrylate waterproof coating) in three kinds of temperature environment(0~5°C,20°C, 35°C), the variation law of initial spraying thickness with time and temperature is obtained. The final rates of change of the thickness of the three waterproof coatings in the three temperature environments are 0.5%, 2.2%, 6.2%; 1.1%, 11%, 9.7%; 8.8%, 20.6%, 25.2%.

1. Introduction

Waterproof work is an important part of construction engineering, which is related to the service life and safety performance of buildings [1-3]. Construction waterproofing mainly refers to the waterproofing of buildings, which is generally classified into structural waterproofing and material waterproofing. Structural waterproofing relies on the compactness of materials and some structure measures to achieve the purpose of building waterproofing. Material waterproofing is to make different waterproof materials through construction to form an integral waterproof layer, which is attached to the water-facing surface or the back surface of the building to achieve the purpose of building waterproofing [4]. Construction waterproofing materials are not widely used in buildings, but their functions occupy a prominent position in the whole building [5-6]. In this paper, three kinds of coating materials, namely, spraying quick-setting acrylate waterproofing coating, spraying quick-setting polyurea waterproofing coating and spraying quick-setting rubber asphalt waterproofing coating, are tested under the temperature environment of 0~5, 20 and 35°C, respectively. The variation of their initial spraying thickness is measured, and then the variation law of coating thickness with time and temperature is studied.

2. Test equipment

2.1Concrete blocks

C35 waterproof concrete is used to make 36 concrete blocks with a size of 200×200×100mm. Each material has 12 blocks and each temperature condition has four blocks.

2.2Concrete blocks

The temperature control equipment used in the test:

Refrigerator: to provide 0~5°C temperature environment. The refrigerator is equipped with a temperature regulator, which can provide a wide temperature range of -38~10°C. It can be divided into four areas: refrigeration, soft refrigeration, freezing and quick-freezing. During the test, the temperature control knob is rotated to the refrigeration area, and a thermometer is placed in the refrigerator. When the temperature of the refrigerator reaches the preset temperature below 5°C, the test block can be put in.

High temperature aging box: to provide a temperature environment of 35°C. The high temperature aging box can precisely set the temperature and time, and automatically stop when the time is up and temperature arrives.

Warm air blower: to provide a temperature environment of 20°C. It is an open type, without temperature control equipment and conditions. Through an attempt, a simple heating space is constructed by using wooden cardboard boxes and so on. The thermometer shows that the required temperature can be exactly reached.

3. Test conditions and steps

3.1Test conditions

Three coating materials: acrylate coating, polyurea coating, rubber asphalt coating.

Three temperature environments: 0~5°C, 20°C and 35°C.

Initial spray thickness: all materials are sprayed to a thickness of 2 mm.

Each waterproof coating test block is set in groups of 4 at the same temperature and maintained at a constant temperature for 14 days. The working conditions are shown in Table 1.

Table 1. The variation of the thickness of the spraying quick-setting waterproof coating with time and temperature

temperature / coating	0~5°C	20°C	35°C
acrylate coating	4 blocks	4 blocks	4 blocks
polyurea coating	4 blocks	4 blocks	4 blocks
rubber asphalt coating	4 blocks	4 blocks	4 blocks

3.2 Test steps

(1) After the initial solidification of the spraying coating, the coatings about 5 mm×5 mm in size are cut off with a knife and used as measuring points for the thickness of the coating. There are 9 measuring points for each block.

(2) Using vernier calipers to measure the initial coating thickness at the incision, recording the data and calculating the average thickness.

(3) 12 test blocks are divided into three groups, which are put into high temperature aging box, warm air blower and refrigerator respectively.

(4) Recording the thickness values at fixed time daily, and each block gets 14 sets of data. During the test, the acrylate waterproof coating test pieces need to be maintained under water-containing conditions. Wet cloth is used regularly to cover the coating surface to ensure wetness. The other two coatings test pieces need not be maintained by water-containing, and can be placed directly in temperature control equipment.

4. The making of test blocks

The concrete blocks are sprayed after pouring and curing. The thickness of the coating is 2 mm. After spraying, the test is carried out.


Acrylate block


Polyurea block


Rubber asphalt block

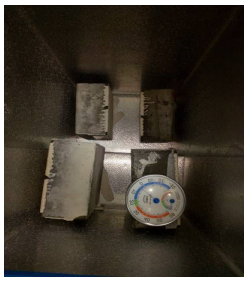
Figure 1. Test block spraying

5. Test process

The test process and experimental conditions are shown below:


Acrylate 35°C


Acrylate 20°C


Acrylate 5°C


Polyurea 35°C


Polyurea 20°C


Polyurea 5°C


Rubber asphalt 35°C


Rubber asphalt 20°C

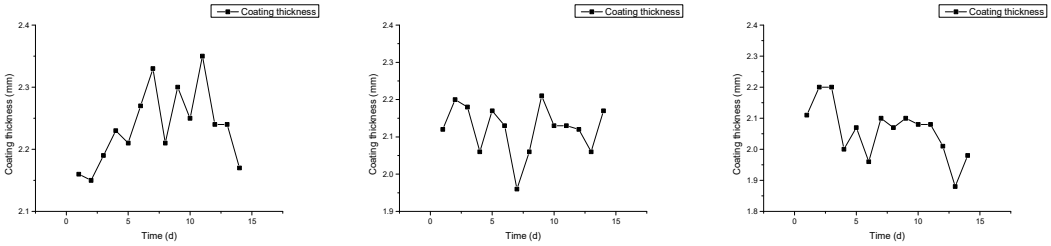

Rubber asphalt 5°C

Figure 2. Test process

6. Test results

The measured coating thickness data are averaged per day, and then the curves of the average coating thickness with time are drawn as follows:

6.1 Thickness change of spraying acrylic coating

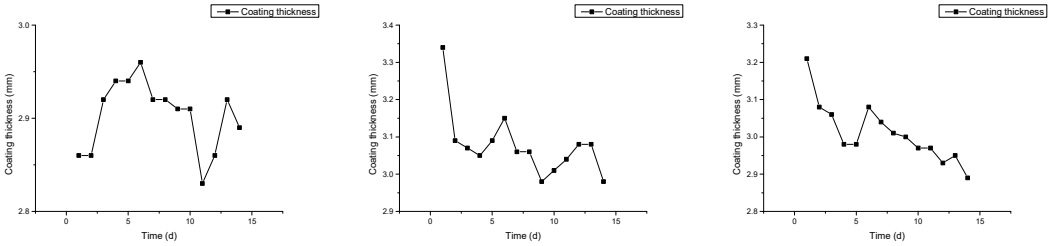


(a) 5°C (b) 20°C (c) 35°C

Figure 3. Thickness curves of spraying acrylate coating

According to the above three curves, it can be concluded that the thickness of acrylate coatings fluctuates greatly at 5~20°C, which may be due to the need for water curing of acrylate, so the measurement error is large, but there is no obvious change trend in the whole, the final change rate is 0.5% and 2.2% respectively; at 35°C, the thickness of acrylate coatings fluctuates greatly. Thickness is decreasing, and the fluctuation in the middle may be caused by the error caused by water conservation, and the final change rate is 6.2%.

6.2 Thickness change of spraying polyurea coating

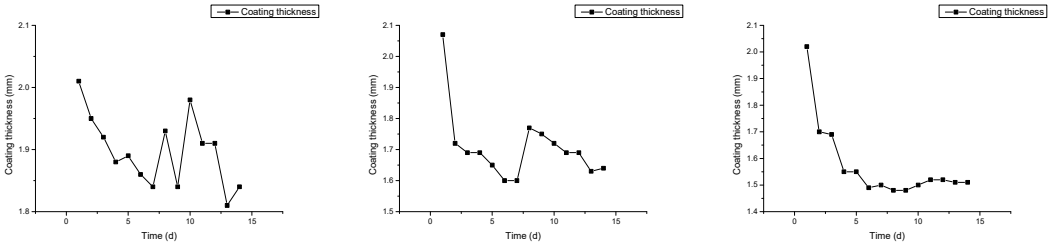


(a) 5°C (b) 20°C (c) 35°C

Figure 4. Thickness curves of spraying polyurea coating

According to the above three curves, it can be concluded that the thickness of the spraying polyurea coating does not change significantly within two weeks at 5°C, and the final thickness change rate is about 1.1%. However, at 20~35°C, the thickness of the coatings decreased significantly in the first five days, with the change rates of 7.5% and 7.0%, and then decreased slowly, with the final thickness change rates of 11% and 9.7%.

6.3 Thickness change of spraying rubber asphalt coating



(a) 5°C (b) 20°C (c) 35°C

Figure 5. Thickness curve of spraying rubber asphalt coating

According to the above three curves, it can be concluded that the thickness of asphalt declines continuously in the first week, with a change rate of 8.7%, and fluctuates greatly in the following time. It may be due to the slow solidification at 5°C and some measurement errors, with a final change rate of 8.8%. The thickness of the coating decreases obviously in the first five days at 20°C and 35°C, with the change rates reaching 20.1% and 23.1%, and remains unchanged in the following five days, with the final change rates of 20.6% and 25.2%.

7. Conclusion

In this paper, the variation of thickness of three kinds of spraying quick-setting waterproofing materials with time and temperature under different temperature environments is measured, and the corresponding variation rules are obtained. It has certain practical guiding significance for the application of three kinds of coating materials in engineering.

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