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Evaluation of Uncertainty in Determination of Soluble Content of Plastic Body Modified Asphalt Waterproof Coil

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Abstract

Plastic body modified asphalt waterproof rolling material should be tested for soluble substance content in accordance with the provisions of 5.3 Material performance clause in GB 18243-2008 Plastic Body Modified Asphalt Waterproof Rolling Material, and the corresponding minimum soluble substance content requirements are given according to the type and thickness of the rolling material. Soluble substance content detection shall be conducted according to the method specified in GB/T 328.26-2007 Test Method for Building Waterproof Roll Part 26 Soluble Substance Content of Asphalt Waterproof Roll (impregnated Material Content). In this assessment, the soluble matter content of APP I PY M PE 3 10 products produced by an enterprise was determined according to the corresponding standards, and the measurement uncertainty of this test was assessed according to the test process and results. The results were calculated as follows: The relative standard uncertainty of soluble content of the plastic body modified asphalt waterproof coil is μ= 34.42g/m2, and the extended uncertainty is U=(2482 ± 69) g/m2. The data is taken as an integer according to the standard, so the extended part certainty is 69g/m2. It can be seen from the process of evaluating measurement uncertainty that its main source is the introduction of weighing mass before and after specimen individual differences.

Keywords

Plastic Body Waterproof Coil; Soluble Substance; Measurement Uncertainty.

1. Introduction

Figure 1. APP Plastic body waterproof coil

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In Material performance clause 5.3 of GB 18243-2008 "Plastic Body Modified Asphalt waterproof Rolling Material", the minimum content limit of soluble matter in waterproof rolling material is given according to different materials and thicknesses. It can be seen that soluble matter content is one of the important indexes to evaluate the product quality of plastic body modified asphalt waterproof rolling material. In this paper, according to GB/T 328.26-2007 "Test Method for Building waterproof Coils, Part 26, soluble content of asphalt waterproof coils (content of dipped coating materials), the product of APP I PY M PE 3 10 produced by an enterprise is studied. The method specified in "is used to determine the content of soluble matter and evaluate the uncertainty of measurement in the whole test process, so as to provide a basis for inspection and testing institutions to further improve the reliability and consistency of inspection and testing quality assurance test data. The picture of asphalt material is as follows(Figure 1).

2. Standard of Test Principles and Methods

2.1. Principle of Test

The specimen was extracted in the analysis of pure trichloroethylene reagent until completely removed, so that the solvent volatilized, and then dried to get soluble content, the rest of the drying through the sieve for the quality of the filling material, the rest of the sieve for the quality of the isolation material, after removing the powder on the tire base to get the tire base quality.

2.2. Test Methods

This test was conducted in accordance with Article 8 of GB/T 328.26-2007 "Test Method for Building Waterproof Coil Part 26 Soluble Content of Asphalt Waterproof coil (Content of impregnated Coating Material)". In order to extract the specimen completely, the surface of each specimen was treated before the specimen was weighed, and the upper and lower surfaces of each specimen were evenly cut with a wallpaper knife, so that the surface isolation materials were evenly separated, so that the extraction reagent could better contact with the asphalt under the isolation surface and reduce the influence of the isolation layer on the extraction process. After the surface isolation layer was well treated, the specimen was wrapped with a good dry filter paper. Bind with cotton thread, weigh its mass (M_0), put the wrapped specimen into Soxhlet extractor, add 1/2 ~ 2/3 trichloroethylene reagent into flask, and carry out heating extraction. After extraction, remove the filter paper package carefully, do not break, and place it in the air for more than 30 minutes to make the solvent volatilize. Then put it in a blast drying oven at (105 ± 2) ℃ for 2h, and then take it out and cool it to room temperature in a dryer. Then take the filter paper bag out of the dryer and weigh it (M_1).

2.3. Main Instruments and Equipment, Measuring Instruments

(1) Electronic analysis balance, Model: BS224S, accuracy 0.1mg;

(2) Sault Extractor 500mL;

(3) Electric heating constant temperature blast drying oven, model: 302, 10℃ ~ 300℃, accuracy ±1℃;

(4) Extraction reagent: trichloroethylene, analytically pure;

(5) Filter paper: slow quantitative filter paper, diameter 150mm.

2.4. Mathematical Model

$$P = (M_0 - M_1) \times 100$$

P-- soluble content, g/m^2;

M_0-- sample mass before extraction, g;

M_1 -- Mass of sample after extraction, g.

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2.5. Test Data

According to GB/T 328.26-2007 "Test Method for Building Waterproof Coils Part 26 Content of soluble matter of Asphalt waterproof Coils (Content of impregnated materials)", eight pieces of waterproof coils of APP I PY M PE 3 10 in the same direction were continuously extracted, and the test data were shown in Table 1.

3. Evaluation of Uncertainty

3.1. Analysis of Sources of Uncertainty

In the process of measuring the content of soluble matter, the sources of uncertainty mainly include the difference of product performance, the extraction effect of chemical reagents, the difference of drying results in drying oven and the uncertainty of electronic analysis balance. According to the parallel sample adopted in this uncertainty assessment, the main influencing factors are as follows:

Table 1. Waterproof coil test data table

Specimen number	M_0(g)	M_1(g)	Soluble content (g/m^2)	Average value(g/m^2)
1	34.2905	9.3385	2495.20	2432.70
2	34.5128	9.6474	2486.54	
3	34.0527	9.2102	2484.25	
4	34.1167	10.1312	2398.55	
5	32.6725	8.6158	2405.67	
6	34.0542	10.0984	2395.58	
7	34.9005	10.8941	2400.64	
8	33.6785	9.7269	2395.16	

3.1.1. The Uncertainty of the Measurement Results μ_1 was the Main Factor Introduced When the Sample was Weighed before Extraction

(1)The quality of the specimen itself is different, and the uncertainty component caused by measurement repeatability is μ_{11};

(2)The uncertainty component μ_{12} caused by the uncertainty of the electronic analysis balance.

3.1.2. Extraction and Drying Processes Introduced the Main Factor of Uncertainty of Measurement Results μ_2

(1) The component of uncertainty caused by chemical reagents in the extraction process μ_{21};

(2) The uncertainty component μ_{22} introduced in the drying process of the oven.

3.1.3. The Main Factor of Uncertainty of Measurement Results μ_3 was Introduced When the Specimen was Weighed after Extraction

(1) The quality of the specimen itself is different, and the uncertainty component caused by measurement repeatability is μ_{31};

(2) The uncertainty component μ_{32} caused by the uncertainty of the electronic analysis balance.

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3.2. Avaluation of Class A Uncertainty

In this evaluation, repeatability limits given by standard methods were adopted for statistical analysis of the evaluation results. Freedom of freedom=n-1=7, average soluble content = 2432.70g/m^2, and standard deviation of single measurement =46.56g/m^2. After 8 parallel experiments, the standard uncertainty of the mean value of repeated measurement was: = 16.46g /m^2.

3.3. Avaluation of Class B Uncertainty

3.3.1. The Uncertainty of the Measurement Results Introduced When the Sample was Weighed before Extraction: μ_1

(1) Uncertainty caused by individual differences of specimens and measurement repeatability. The average mass of 8 specimens before extraction was 34.077 1g, the standard deviation caused by mass difference of specimens and measurement repeatability was 0.64g, and the uncertainty component caused by the difference of specimens and measurement repeatability was $\mu_{11} = S_0/\sqrt{8}$= 0.23g, and μ_{11} = 23g /m^2 after unit area conversion.

(2) The accuracy of the balance and the uncertainty caused by the error of indication value μ_{12} the accuracy of balance weighing given on the certificate of balance is ±0.01%, K=2, then the standard uncertainty of balance calibration: μ_{12} = 0.01%×43.07712 = 0.0017g, μ_{12} =0.17g/m2 after unit area conversion.

3.3.2. Uncertainty of Measurement Results Introduced During Extraction and Drying: μ_2

(1) Component of uncertainty caused by chemical reagents in the extraction process. The uncertainty of trichloroethylene reagents in the extraction process of specimens is caused by the actual concentration of reagents, the amount of reagents, and the extraction time of specimens. According to experience, this part of uncertainty can be ignored.

(2) The uncertainty component introduced in the drying process of the drying oven is ±0.2% according to the relevant provisions of the standard. The allowable error from drying to constant weight is =0.2% ×29.2556= 0.0093g, and the uncertainty generated in this process is =0.93g after conversion of unit area.

3.3.3. The Uncertainty of the Measurement Result Introduced When Weighing the Specimen after Extraction : μ_3

(1) Uncertainty caused by individual differences and measurement repeatability of specimens μ_{31} after extraction, the average mass of 8 specimens M_1 = 9. 255 6g, standard deviation S_1 = 0.67g caused by specimen quality difference and measurement repeatability. The uncertainty component caused by specimen difference and measurement repeatability after extraction was $\mu_{31} = S_1/\sqrt{8}$=0.24g, and the unit area was μ_{31} =24g/m^2 after conversion.

(2) The accuracy of the balance and the uncertainty caused by the error of indicating the value. The accuracy of the balance weighing given in the verification certificate is ± 0.01%, K = 2, then the standard uncertainty of balance calibration: = 0. 01% × 9.25562 = 0.000 5g, unit area =0.05g /m^2 after conversion.

4. Synthetic Uncertainty Evaluation

According to the above uncertainty components, the standard uncertainty of soluble matter content (P) can be synthesized into:

$$\mu = \sqrt{\mu_{(p)}{}^2 + \mu_{11}{}^2 + \mu_{12}{}^2 + \mu_{22}{}^2 + \mu_{31}{}^2 + \mu_{32}{}^2} = 34.42\text{g/m}^2$$

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5. Expanded Uncertainty

The inclusion factor was taken $K = 2, U = 2 \times \mu = 68.84 g/m^2$, and the result was retained as an integer, $U=(2482\pm69)g/m^2$, in accordance with the requirements of GB 18243-2008 plastic body Modified asphalt waterproof coil.

6. Conclusion

Through the uncertainty evaluation results of the plastic body modified asphalt waterproof coil, it can be seen that the plastic body modified asphalt waterproof coil soluble content.

The main source of uncertainty of quantity measurement is the introduction of weighing quality before and after specimen individual differences. Therefore, the quality of the product itself will seriously affect the accuracy of test results. Enterprises should pay attention to the control of production process in actual production activities to improve the quality balance of the product itself. At the same time, as a testing institution, in daily testing activities and relevant consulting and service for enterprises, it should also help enterprises to solve practical difficulties in production, and help enterprises to improve process and product quality through its own technical advantages.

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