

## **A new maintenance way on semi-rigid base material**

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**Keywords:** semi-rigid base materials, isothermal bag, maintenance way.

**Abstract.** In many regions, such as Tibet, Qinghai etc, because of its unique climate conditions, continual appear all kinds of road diseases, such as cracks, subsidence and damages. Mainly due to the traditional maintenance ways on semi-rigid base material in these regions are not very well. So based on the characteristics of semi-rigid base material and these areas with ample solar energy, a new maintenance way was proposed. Also this paper selects the best isothermal bags through the designed test, and verified its curing effect well.

### **Introduction**

The semi-rigid base materials have been widely used in pavement base and sub-base of High-grade road, and become an important part of pavement structure [1]. But due to the anti-distortion capacity of semi-rigid base materials is deficient, so it's easy appears all kinds of drying shrinkage cracks and thermal contraction cracks, and then lead to a great deal of reflection cracks in road surface, especially in alpine region with cold climate such as Tibet, Qinghai etc. Concerning these issues, thorough exploration had been done by many experts [2]. All these achievements show that the research on the caring of semi-rigid base material during the early stages after construction is seldom, especially aim at preventing semi-rigid base from generating thermal contraction cracks and desiccation cracks. So this paper put forward the isothermal bag maintenance technique.

#### **The desiccation crack and temperature crack of semi-rigid base materials in frigid highland.**

In extremely cold areas, the temperature always very low, but the sunlight is rich and strong, so lead to the large day-and-night temperature difference. When the temperature plummets at night, the temperature gradient inside semi-rigid base structure also change, so appear many shrinkage cracks [3].

The drying shrinkage cracks of semi-rigid base materials mainly appear during early stage after finishing construction, because in frigid highlands the air is cold and dry, so the water evaporates is intensively, then induce the materials generate large volume shrinkage and appear many cracks.

Also many engineering practices tell us the traditional maintenance way can't well be used in frigid highland.

#### **The fundamental of isothermal bag maintenance technology**

Because there is abundant solar energy can be utilized, so design the isothermal bag could reserve solar energy in the daytime and transfer them to semi-rigid base at night. Also this isothermal bag could reduce water evaporates. The bag be made from high-duty transparent plastic film, so the sunlight can go through its surface and transmit the solar energy into water, also add some air into the bag above water act as insulation layer. Fig.1 shows the sketch of isothermal bag. In order to spread this technology in more regions, this paper also design a new type isothermal bag like Fig.2, the water be stored in the pipeline, the pipeline be installed in the airtight bag, also these are water and air entrance with valve be installed in the pipeline and the bag, so this bag can be used on some uneven ground, and it's easier to operate.

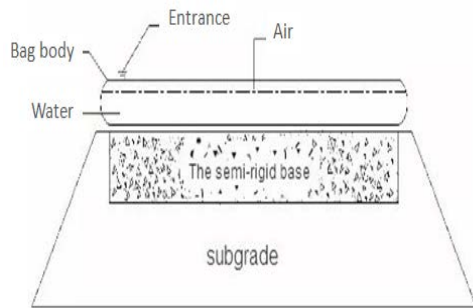


Fig.1 The fundamental of isothermal bag

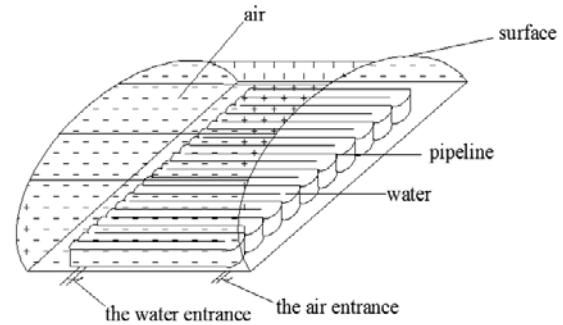


Fig.2 The new isothermal bag type

## Experimental

In order to obtain the best isothermal bag and verify its insulation effect, this paper designs two experiments. The first step is to select the best isothermal bag type from five different kinds of bags; the second step is through uniaxial compressive strength test to verify the best isothermal bag's curing effect.

### Select the best isothermal bags experiment

There are five types isothermal bags have been designed as following: the first bag is transparent and with air inside it; the second bag is transparent but without air inside; the third bag is transparent and with air inside but the water is black; the fourth bag's upper surface is transparent but its bottom is black and with air inside it; the fifth bag is non-transparent and its surface is black and without air inside. Then set one temperature sensors inside the bag and one under its bottom for each type bag, aiming to measure the water temperature inside the bag and the ground temperature under the bag, also set two temperature sensors to measure the air temperature and the natural ground temperature. The detailed parameters of five kinds of isothermal bags can be got in Table.1.

Table.1 The detailed parameters of five kinds isothermal bags

No	Isothermal bag color	Size	Water color	Water depth	Water volume	Air height
1	transparent	3m <sup>3</sup>	transparent	10cm	0.3m <sup>3</sup>	8cm
2	transparent	3m <sup>3</sup>	transparent	10cm	0.3m <sup>3</sup>	/
3	transparent	3m <sup>3</sup>	black	10cm	0.3m <sup>3</sup>	8cm
4	surface is transparent bottom is black	3m <sup>3</sup>	transparent	10cm	0.3m <sup>3</sup>	8cm
5	black and non-transparent	1.5m <sup>3</sup>	transparent	10cm	0.15m <sup>3</sup>	/

At the same time, use the paperless recorder record the temperature that be transmitted from temperature sensors every four minutes. This experiment will last almost three months from November to next January.

### The maintenance effect experiment of the best isothermal bag

According to the result show in above 2.1, we can select the best isothermal bag. Then make three groups cement mortar specimens and each group contains five specimens, next step set them in three different environments to maintain, the first group be maintained under the best isothermal bag; the second group be maintained in constant temperature and constant humidity health preserving box, the last group be placed in natural environment but regular sprinkling like traditional curing way. Then conduct uniaxial compressive strength test, and contrast analysis the specimen intensity between above three groups.

## Results and discussion

### Select the best isothermal bags

We select the typical two days' test data from three months, analysis their water temperature

and ground temperature variation curves, as shown in Fig.2a~Fig.2b.

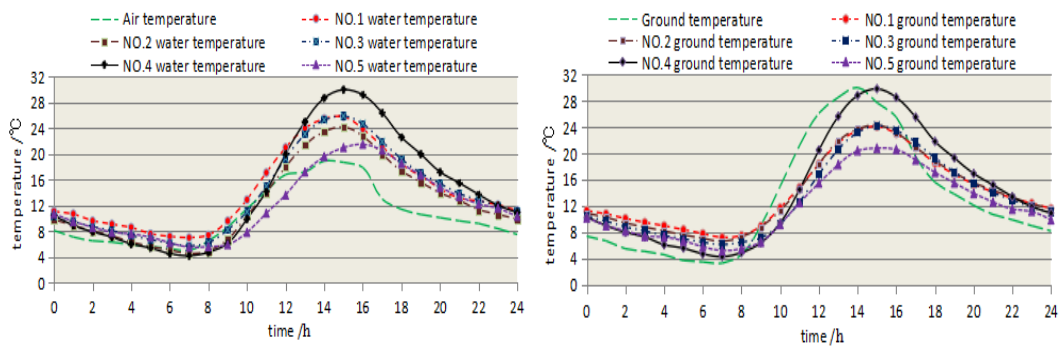


Fig.2a 2015/12/13 The temperature variation curve of water and ground

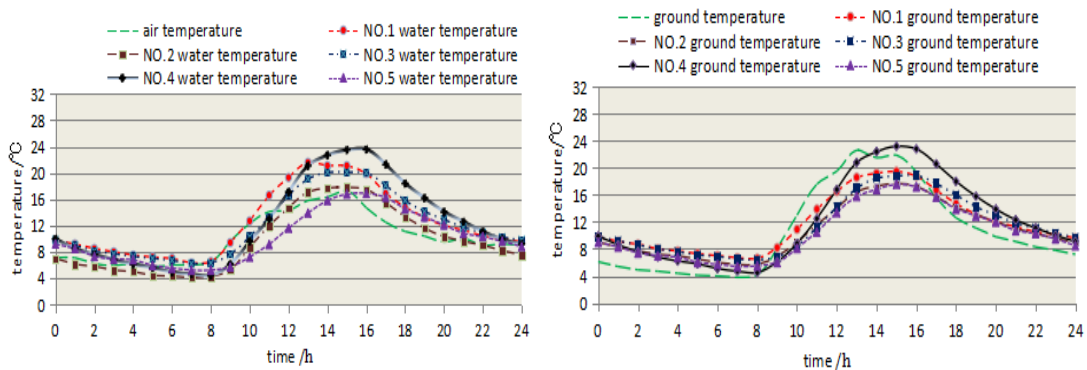


Fig.2b 2015/12/14 The temperature variation curve of water and ground

The following conclusions are drawn from our test results: in daylight, the isothermal bag could transform radiant energy into internal energy and store them in the water, but in the evening the isothermal bag will radiate that stored solar heat into the ground, raise the ground temperature. Thus can know the isothermal bags designed in this paper have well heat preservation property.

Based on a comprehensive consideration about these five isothermal bags' heat transfer results, energy storage effect, temperature difference and other factors, we find No1 isothermal bag has the ideal heat preservation effect, so we select the No1 as the best isothermal bag to continue the following experiment.

### The compressive strength of the specimens curing in different environments

Through above test we can get the 3d, 5d, 7d, 15d, 21d in all five days' compressive strength of the mortar samples that curing in different environments, the variation curve show in Fig.3.

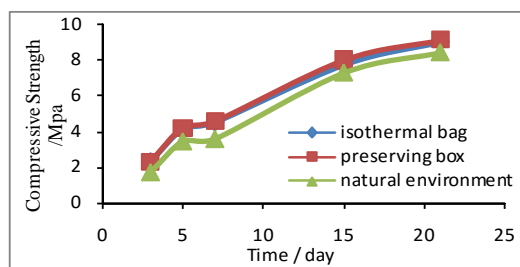


Fig.3 The variation curve of uniaxial compressive strength

Shown in Fig.3, it is easy to find that the uniaxial compressive strength of the samples curing in different environments is different, in the early days, the samples that curing under the best isothermal bag its uniaxial compressive strength growing quickly, the sample curing in constant temperature and constant humidity health preserving box also growing quickly, and the strength of the samples above two also alike, but the last one that curing in natural environment its strength is more lower than the above two, these show that the isothermal bag could facilitate to form the early

strength of the mortar sample, thus enhance the quality of the road and decrease the shrinkage cracks.

### **Summary**

The results of the test above show that the best isothermal bag has the good heat preservation effect and this bag could improve the quality of the roads thus decrease the shrinkage cracks. The most important, the best isothermal bag can be implemented easier than traditional maintenance way and the curing effect is better.

### **Acknowledgements**

The financial support of National Science and Technology Support Programme Project (project number: 2014BAG05B00) and The Highway Construction Technology Promotes the Applied Research in Xinjiang Typical Alpine Permafrost Region (project number: 2011-318-365-100) to this investigation through research groups is kindly acknowledged.

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