

## A study on the cleanser for terrestrial heating pipe

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**Keywords:** chemical cleanser, terrestrial heating pipe.

**Abstract:** In this paper, the cleanser for was prepared using sulfouren, citric acid and sulfamic acid. The performance of the chemical cleanser on corrosion and corrosion inhibition was studied. The results showed that, the rust deposit ratio of the cleanser at the regulated cleaning condition exceeds 95%, and the cleaner showed a good corrosion inhibition performance. The biodegradation rate exceeded 95%.

### 1. Introduction

Terrestrial heating pipe is widely used in the northern of China. After a long time of usage, the inner part of the pipe would yield a large amount of slime, bacteria and scale. Pipe lining, forming pipe blockage, resulting in poor circulation, insufficient heat dissipation would affect heating temperature and heating effect. The data show that the earth warms after a year of usage, every increase 1 mm of dirt, the wall causes a 6 °C decline in heating indoor temperature. This not only affects the normal use of the heating pipe, but also causes the waste of energy. Such a long time without effective cleaning treatment will cause the geothermal heating system to fail, thus cannot be used in the pipe, or even destroy the ground, dismantle or replace the geothermal energy. Piping system, to the floor heating users caused property loss and life inconvenience. There are three kinds of methods on terrestrial heating pipe cleaning, include ejection cleaning, pulse cleaning, and chemical cleaning. When the high-pressured gas is driven by the high speed in the terrestrial heating pipe, the front of the projectile move in a pipe with a hard solid can cause a lot of dirt. Solids do damage to geothermal pipes. At present, pulse cleaning is widely used for the application. The working principle is to wash the dirt with the pulse shock of air and remove the dirt from water and clean it. Chemical cleaning is the most thorough cleaning of all cleaning methods, because chemical agents dissolve the scale and rust of the water. In this study, the chemical cleaning method was used mainly include the amino sulfonic acid, citric acid. Dimethylphenylthiourea and sodium nitrite, the acid that is used will not corrode the geothermal pipeline and the metal part. In addition, the addition of additives also includes scale and rust prevention. It is of great significance for the protection of terrestrial heating pipe.

### 2. Experimental Preparation

The amino sulfonic acid, citric acid, o-xylene thiourea and sodium nitrite are put into the cone mixing machine with a certain proportion, and the finished product is mixed evenly. Corrosion rate of the determination is made by a certain concentration of detergent solution placed in the conical flask, the specimens of different material separately hanging in the conical flask of aqueous solution containing detergent, static test of 12 h. The biodegradation performance was determined by the method of biological shaking bed.

### 3. Experimental results and discussion.

#### 3.1 Effect of the concentration of cleanser on the rust deposit rate

The experiment studied the influence of different concentration on the rust deposit rate at temperature of 30 °C for the time 30 min.

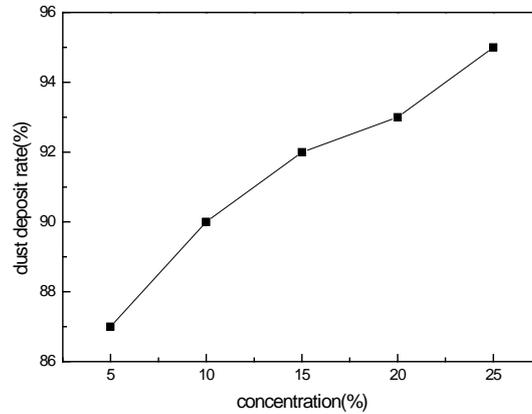


Figure 1 Influence of different concentration on the rust deposit rate

From the figure 1, it is can be seen that the rust deposit rate increased with the concentration of cleanser. When the concentration of cleanser was higher than 10%, the removal rate was higher than 90%. In the cleanser agent, amino sulfonic acid hydrolysis produce ammonium sulfate acid, can react with metal oxides in the heating pipe, generate amino sulfonic acid salt and other dissolved substances, and lower corrosive to metal. Therefore, as the main raw material of floor warm cleanser agent is appropriate. Considered the cleaning effect and the cost of agent, 15% of this cleanser agent is suitable to be used.

#### 3.2 Effect of the temperature of cleanser on the rust deposit rate

The experiment studied the influence of different temperature of cleanser on the rust deposit rate at temperature of 20 ~ 50 °C for concentration of 15%, the cleaning time for 30 min.

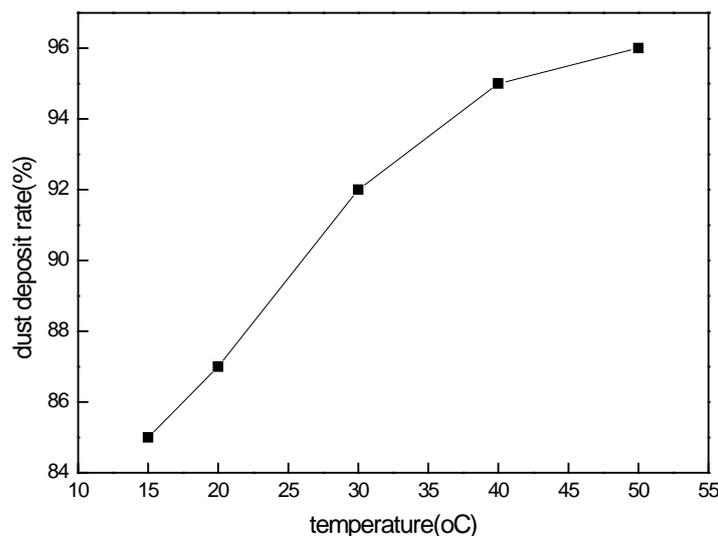


Figure 2 Influence of different temperature of cleanser on the rust deposit rate

From the figure 2, it is can be seen that the rust deposit rate increased with the temperature increases. The cleanser adding citric acid, citric acid small advantage is corrosion, non-toxic, high

security. It can generate and iron ion complexing iron complex ions but need to adjust the solution pH value to 3.5 to 4. Because the reaction rate of citric acid and iron ion is slow, the calcium and magnesium scale dissolving ability is slightly worse, it needs a certain high temperature when it be used. The increase of temperature can improve the rust deposit rate effectively. However, in the process of using citric acid, appropriate corrosion inhibited, and corrosion inhibitor should be added to reduce the corrosion of the acid to the metal. In addition, the high temperature can accelerate the corrosion of acid to metal. Thus, temperature of 30 °C is used in this research.

### 3.3. Effect of cleaning time on the rust deposit rate

The experiment studied the influence of cleaning time on the rust deposit rate at the temperature of 30 °C and the cleanser concentration is 15%.

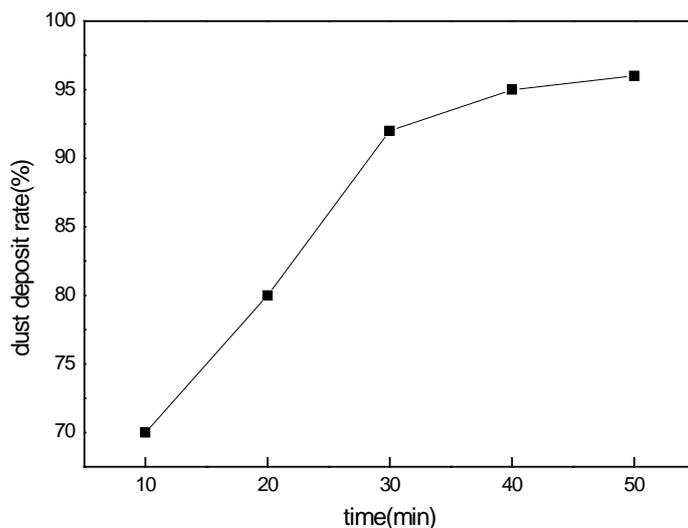


Figure 3 Influence of cleaning time on the rust deposit rate

From the figure 3, it is can be seen that the rust deposit rate is over 90% after 30min, and the rust deposit rate can reach 98% when the cleaning time is 50min. However, excessive time will affect working efficiency. The cleaning time used in this study is 30min.

### 3.4. Biodegradability of cleanser

The experiment studied the biodegradability of the cleanser. When determining the biodegradability of the cleaning agent, the concentration of the detergent was 50mg/L.

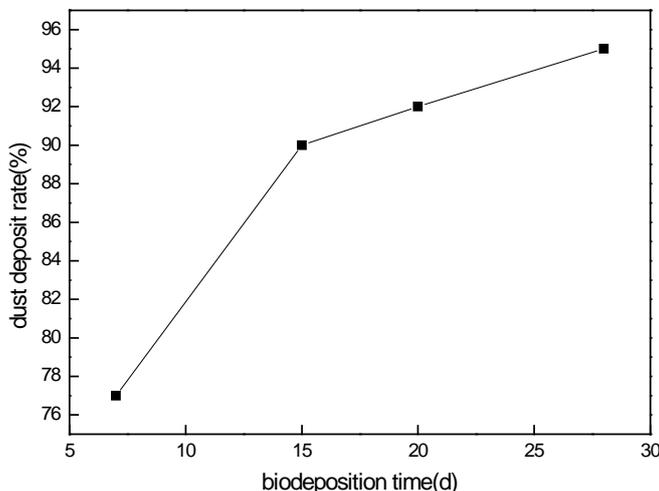


Figure 4 Biodegradability of the cleanser

As seen from the figure 4, the biodegradation rate of cleaner is increasing with the increase of time. At the seventh day, the degradation rate has reached 78%, the degradation rate of more than 90% after 14 days, as it reached to 95% to 28 days. It is shown that the cleanser is an easy degradation, safety and environmental friendly products.

#### 4. Conclusion

(1) The cleanser prepared with amino sulfonic acid, citric acid, o-xylene thiourea has a good rust deposit performance at the condition of 30 °C, the time 30 min, and the concentration 15%. The rust deposit rate can reach 95%.

(2) The cleanser has low toxicity, friendly environment and good biodegradability.

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