Research on the Effect of the Dustfall on the Statue Surface on the Water Migration of the Earthen Layer

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Abstract. In order to study the influence of salt in the dustfall on the statue surface on the water migration in the earthen layer, this paper compared the relationship between the moisture content, electrical conductivity, and soluble salt content (Cl⁻, SO₄²⁻, K⁺ and Na⁺) with the sample height of the soil in the coarse-fine mud and  the soil before-after desalination, after the migration of the simulated earthen test block under different relative humidity stabilizes. The result shows: When the dustfall salt migrate to the earthen layer, its salinity will migrate downward at the upper end of the test block; When the interaction between the dustfall salt and the water of the earthen layer, the electric conductivity and soluble salt content in the test block are increase with the increase of sample height, and quickly increase above the test block 6.7cm;  The effect of coarse-fine mud layer on electrical conductivity and ion content is not significant, and the electric conductivity and soluble salt content in the test block containing salt were obviously higher than those in the desalted test block. Overall, the dustfall salt, as exotic salinity, plays a certain role in promoting the production of salt damage in the statue and promotes the ability of the water-salt transport in the earthen layer which will aggravate the corrosion of the statue surface.

Keywords: The dustfall; Salinity; Moisture migrate; Interaction; The statue surface.

1. Introduction

The statue, refers to the colorful clay statue of the temple which are used for worship by the believers, has a very important cultural appreciation value. The earthen layer as the direct carrier of the statue is generally composed of coarse mud layer, fine mud layer and pigment layer, which is the central content of the protection of the statue. Because of the earthen layer is a porous medium material, the salt migrates to the statue surface under the impetus of water migration, which makes the statue suffer from various diseases during the process of soil moisture evaporation and the capillary migration. And the changes in the micro-environments during the preservation of the statue have caused varying degrees of damage
to the fragile statues (Huyuan Zhang et al., 2012), such as: weathering, flaking, cracking and powdering, etc (Huyuan Zhang et al., 2016).

Nobuaki (Nobuaki et al., 2000) and Angeli (Angeli et al., 2007) found that the migration of salt in the pore medium is the salt migration driven by the water migration in the salt solution, and it is the root cause of the salt damage of soil cultural relics. Konrad (Konrad, 2007) studied the problem of the weathering in the mural of the Mustair Monastery in Switzerland, discovered that the clear correspondence between the destruction of weathering caused by the rise of ground moisture and the migration of water-salt. Zhang (Mingquan Zhang and Li, 1997) concluded that the main reason for the salt damage of the mural earthen layer is the characteristics of the material composition and microstructure of the earthen layer cause the migration and accumulation of salt in the process of water migration in the earthen layer, and the salts causing soil cultural relics diseases mainly are Na2SO4 and NaCl. Although the cultural relics protection department has taken effective measures to better protect cultural relics in recent years, but the statue diseases caused by salt migration and enrichment still cannot be ignored (Yan, 2009).

With the rapid development of industrialization and urbanization, many cities in China are suffering from serious environmental problems, for example dust pollution in the air, its carrier and primary source is atmospheric dustfall (Chen et al., 2014). Atmospheric dustfall as the main component of atmospheric particulate matter can reflect the natural sedimentation of atmospheric particulate matter, due to its particle size very small and it is easy to continually invade into the voids of the pigment layer of the statue and causing the surface of the statue to crack. Atmospheric dustfall will forms an energy in the pores of the pigment layer that squeezes the statue out of the soil and causes the pigment layer to fall off in a large area and seriously damage the visual art effect of the statue with the accumulation of atmospheric dustfall material (Guo and Huang, 2005). In addition, atmospheric particles absorb the salt and heavy metal pollutants in the atmosphere during the process of environmental alternation, and are enrichment on the surface of the statue in different forms (Yingquan Li et al., 2020). Therefore, it is worth investigating whether these salts will affect the law of water migration in the earthen layer.

This paper, through a comprehensive analysis of the electric conductivity and soluble salt content along with the sample height distribution, obtained the rule of the dustfall salt migration to the earthen layer, further got the influence of the dustfall salt on the water migration of the earthen layer, which provide some basic information for the prevention of statue diseases and the restoration of cultural relics.

2. Methods and materials

2.1. Collection and preparation of test materials

It was selected as the main material in the local residual slope soil of a certain temple, and the auxiliary materials are nearby river bed fine sand, wheat straw or fiber. The simulated statue earthen layer test block made refer to the manufacturing process and composition ratio of the existing mural earthen layer (Linyi Zhao et al., 2005; Wang et al., 2002). In order to explore the influence of the original salt in the soil sample, the soil sample are divided into desalted and soil containing salt, soil are desalinated to obtain desalted soil samples according to the geotechnical test standard (China, 2019). Previous studies found that most the ancient mural statue earthen layers have coarse mud layers and fine mud layers. In order to ensure that the test is more reasonable and complete, this experiment contains 4 kinds of simulated earthen test blocks: Desalted salt coarse mud (test block-DC), Desalted salt fine mud (test block-DF), Coarse mud containing salt (test block-SC) and Fine mud containing salt (test block-SF).
Table 1. The physical properties of test block

| Test block type | Optimal moisture content | Dry density | Liquid limit | Plastic limit | Mass composition ratio |
|-----------------|--------------------------|-------------|--------------|---------------|-----------------------|
| Coarse mud      | 15.23%                   | 1.94 g/cm³  | 35.15%       | 13.92%        | soil:sand:wheat straw=30:1:1 |
| Fine mud        | 14.90%                   | 1.97 g/cm³  | 35.15%       | 13.92%        | soil:sand:fiber=60:2:1   |

Table 2. The ion content of samples

| Samples          | F  | Cl⁻ | SO₄²⁻ | NO₃⁻ | Na⁺ | K⁺ | Mg²⁺ | Ca²⁺ |
|------------------|----|-----|-------|------|-----|----|------|------|
| Atmospheric dustfall | 186.8 | 419.3 | 1106.1 | not detected | 275.9 | 465.9 | 843.5 | 1039.9 |
| Soil containing salt | 1.95 | 4.5  | 161.4 | 9.62 | 59.1 | 13.2 | 15.9  | 118.9 |
| Desalted soil sample | 1.77 | 0.78 | 36.8  | 5.2  | 2.1 | 7.7  | 9.2   | 75.2  |

Fig.1 Particle size distribution of Desalted soil samples

The preparation method of the simulated earthen layer test block is as follows: Firstly, the soil sample and sand are sieved through a 0.5 mm soil sample sieve, and the wheat straw or fiber are shredded. Secondly, under the mass ratio of coarse mud layer (Table 1), the water is sprayed so that the soil sample with uniform stirring is in the state of optimal moisture content. The soil sample is placed in a sealed bag for braising and is prepared in about 24 hours. In order to ensure the test block is dense and the degree of compaction is uniform, the soil sample was divided into 5 layers and packed into a cylindrical sampler. Finally, the prepared coarse mud sample is placed in an oven and thoroughly dried, then placed in a dryer to cool to room temperature. In the same way, 12 samples of fine mud were prepared under the optimum moisture content, and a total of 24 test blocks were prepared. Dustfall on the statue surface in a temple was collected as an atmospheric dustfall sample, and was evenly applied 0.100g on each test block. Table 2 is the ion content the samples. Fig.1 shows the particle size distribution curves of dustfall sample and simulated earthen soil samples, as shown in the figure, the particle size of the soil samples...
is all less than 0.1 mm, the particle size is about 90% within 0.005 ~ 0.05 mm that the best particle size range for capillary water rise (Hu et al., 2019).

2.2. Research Methods
The test device of the dustfall salt migration to the earthen layer is shown in the Fig. 2, and saturated salt solution is loaded into a humidifier to control the environment with relative humidity of 58% (dry), 75% (humidity) and 97% (wet). The relative humidity refers to percentage of the actual water vapor density in the air and the saturated water vapor density at the same temperature and usually is expressed as RH. Its size can reflect the moisture status in the atmosphere environment, and it is an intuitive indicating the degree of dryness-wetness in the environment (Huyuan Zhang et al., 2011). Generally, the increased RH of the air makes the density of water vapor greater and the air more moist, and the process of the test block absorbing moisture in the air is more intense, which will eventually produce accumulated moisture. RH becomes smaller makes the air dry and the moisture in the test block evaporates into the air more easily. Therefore, the moisture absorption-dehumidification cycle can make the moisture content of the simulated ground test block and the local air environment reach a dynamic balance. Because saturated salt solutions have a stable vapor pressure, saturated sodium bromide (NaBr), sodium chloride (NaCl), and potassium sulfate (K$_2$SO$_4$) solutions are used to control the relative humidity environment in enclosed spaces (Keith, 2010). RH of saturated salt solution at different temperatures is shown in Table 3.

Fig 2. The test device of the dustfall salt migration to the earthen layer

At the beginning of the test, the quality of the test block is weighed once every 12 h, and it is weighed every 24h when the quality of the test block changes little. When the quality change rate of the test block is weighed twice in succession is less than 10$^{-4}$ g/h, it is considered that the test block in the humidifier and RH environment are in balance (Yan, 2009).

| Saturated salt solution | 5°C  | 10°C | 15°C | 20°C |
|------------------------|------|------|------|------|
| NaBr                   | 59 % | 58 % | 58 % | 57 % |
| NaCl                   | 76 % | 75 % | 75 % | 75 % |
| K$_2$SO$_4$            | 98 % | 97 % | 97 % | 97 % |
Fig 3 shows the migration test device when the interaction between the dustfall salt and the water of the earthen layer. The plastic box is filled with distilled water as the migration liquid, and the liquid surface of the migration liquid is kept flush with the top surface of the permeable stone (the bottom surface of the test block). Similarly, supersaturated salt solution is used to control RH in the humidifier.

2.3. Determination method of the soil leaching liquor

After the test, slice samples were taken as shown in Fig.4. First, the dustfall on the surface of the test block was scraped off by the scraper as the dustfall sample point, the rest of the test block is cut away from the bottom up every 16.67mm as a section, therefore each test block was divided into a dust sample and 6 soil samples. Secondly, each sample was measured for moisture content, electrical conductivity, and soluble salt ion content.

Using drying method determine the moisture content of the test block. The soil leaching liquor needs to be leached when the electric conductivity and soluble salt content of the test block are determined. And the electric conductivity (Ec) and ion content of the soil leaching liquor were measured with 51800-10 electric conductivity meter and ICS-2000 ion chromatograph produced by the American DIONEX Corporation.
3. Results

3.1 Simulation study on dustfall salt migration to the earthen layer

3.1.1 Distribution of moisture content-electric conductivity after the dustfall salt migration to the earthen layer. Fig. 5 shows the change of moisture content-electric conductivity with the sample height after the dustfall salt migration to the earthen layer. It can be seen from the figure that the moisture content in different sample heights does not change significantly after the moisture absorption balance of the test block ($P > 0.05$). When 97% RH, the moisture content distribution of the soil sample in the test block-DC is basically stable at about 5.1%, but the moisture content of the dustfall sample is only 3.9%, which is because the soil has stronger moisture absorption performance than the dustfall, so the moisture content of the dustfall sample is significantly lower than the soil sample (Yu et al., 2019). The moisture content of the soil sample in the test block-DC is basically stable at about 2.8% and 3.4% when 58%RH and 75%RH. This means that if the relative humidity becomes larger, the more water vapor content in the air at the same temperature, the more intensely the sample absorbs moisture form the air, resulting in a higher moisture content in the test block and a longer time required for the test block to absorb moisture equilibrium. This also confirms that the greater RH, the longer it takes for the test block to absorb moisture to reach equilibrium (Su and Cheng, 2005).

![Fig. 5 Distribution curve of moisture content-electric conductivity after the dustfall salt migration to the earthen layer](image)

When 97% RH, the electric conductivity of the dustfall sample at the top of the test block-DC is up to 5.7 µs/cm, which gradually decreased during the downward migration of the dustfall salt, and the electric conductivity decreased to 2.7 µs/cm when it moved downwards to 3.32 cm from the top of the test block. As the migration continues downward, the electric conductivity within the test block
gradually increases, and the conductivity at the bottom of the test block increased to 3.9 µs/cm. Due to the presence of original salt in the test block containing salt, its electric conductivity is significantly higher than that in the desalted test block. RH has a significant effect on the dustfall salt migration to the earthen layer, and RH becomes larger, and the electric conductivity of the dustfall sample becomes lower after the migration test, which indicates that the migration of dustfall salt in the test block is greater.

3.1.2. Distribution of anion content after the dustfall salt migration to the earthen layer

Fig. 6 shows the change of anion content with sample height after the dustfall salt migration to the earthen layer. It can be seen from the figure that when 58% RH, after the test block-DC is hygroscopic and stable, the content of Cl⁻ in the dustfall sample at the top of the test block is 30.7 mg/kg, and the original content of Cl⁻ in the dustfall sample is 419 mg/kg (about 389 mg/kg of Cl⁻ in the dustfall migrated downward into the test block). The evaporation of water will lead to the supersaturation of chloride salts in the test block to precipitate crystals, which will clog the capillary water migration channel and reduce the migration rate of Cl⁻, so that the distribution of Cl⁻ content of the soil samples is basically around 10 mg/kg (Lv et al., 2018). The original content of SO₄²⁻ in the dustfall sample is 1106 mg/kg, and the content of SO₄²⁻ in the dustfall sample after the test block is hygroscopic and stable is 538 mg/kg (about 568 mg/kg of SO₄²⁻ in the dustfall migrated downward into the test block). The content of SO₄²⁻ after the migration from the top of the test block to 3.32 cm from the top is basically stable at about 110 mg/kg. The distribution of anion content in the test block-SC is similar to the change trend in the test block-DC, but the content of SO₄²⁻ was significantly more than that of the test block desalted due to the large amount of SO₄²⁻ in the test block containing salt.
3.1.3. Distribution of cation content after the dustfall salt migration to the earthen layer. Fig. 7 is the change of cation content with sample height after the dustfall salt migration to the earthen layer. It can be seen from the figure that with the change of RH, the migration amount of Na\(^+\) and K\(^+\) in the dustfall are different. The original content of Na\(^+\) and K\(^+\) in dustfall sample is 276 mg/kg and 466 mg/kg, when 58% RH, after the test block-DC is hygroscopic and stable, the content in the dustfall sample is 12 mg/kg and 40 mg/kg respectively (about 264 mg/kg and 426 mg/kg of Na\(^+\) and K\(^+\) in the dustfall migrated downward into the test block). The content of Na\(^+\) and K\(^+\) gradually decreased during the downward migration, and the content at the bottom of the test block is reduced to 3.6 mg/kg and 22.8 mg/kg. The distribution trend of Na\(^-\) content in test block-SC is similar to that in the test block-DC, but the content of K\(^+\) in the dustfall sample of test block-SC is 52 mg/kg (about 414 mg/kg of K\(^+\) in the dustfall migrated downward into the test block about) and the content of K\(^+\) in the soil sample of each layer of the test block is basically about 14 mg/kg, which indicates that the original salt in the soil containing salt has an obstacle to the capillary migration of K\(^+\) in dustfall. The variation trend of anion and cation content in the test block with the sample height under different RH is consistent, but as RH becomes larger, the amount of salt migration in the dustfall within the test block becomes greater.

![Fig. 7. Distribution curve of cation content after the dustfall salt migration to the earthen layer](image)

3.2. Research on simulated migration when the interaction between the dustfall salt and the water of the earthen layer

3.2.1. The law of capillary rise and change when the interaction between the dustfall salt and the water of the earthen layer. Fig. 8 is the law of capillary rise height and time when the interaction between the dustfall salt and the water of the earthen layer. As shown in the figure, the process of capillary migration is basically divided into two stages. The first stage is the capillary ascent stage, due to the low internal
moisture content of the test block after drying and the large water potential energy in the unsaturated soil at the lower end of the test block, which promotes the capillary water in the test block is moved upward. Therefore, the amount and rate of water migration at this stage are relatively fast, and the capillary migration rate depends on the moisture content at the test block bottom and the physical characteristics of the soil sample. The second stage is a capillary migration stable stage, after the soil at the bottom of the test block reaches saturation when the test block passes through the capillary rise stage and the water potential energy in the soil gradually decreases, which hinders the rise of water at the lower end of test block. Because RH is lower than 100%, the moisture on the surface of the test block is more easy to be lost into the air, and the amount of moisture migration in the test block gradually stabilizes. In short, the capillary migration rate at this stage is mainly affected by RH (Duan, 2015).

Fig. 8. The law of capillary rise under the interaction between the dustfall salt and the water of the earthen layer

As RH changes the vapor pressure generated by the environment, the water potential difference of the soil sample also changes. When RH becomes smaller, the water potential difference increases, which will cause the moisture in the test block to move upward easily under the action of capillary migration. That is, when the soil body is in a water state, if the vapor pressure of RH becomes larger, the moisture in the test block will becomes easier to evaporate. The form of water-salt migration in the earthen layer gradually changes from capillary migration to evaporation.

In addition, comparing the rise height of the capillary migration water of the same migration solution in different soil samples, it was found that the capillary migration rate of the desalted test block was greater than the test block containing salt, which shows that the original salt in the soil sample has an inhibitory effect on the capillary rise of the migration solution, and this inhibitory effect is not significant (Lv et al., 2018). That the wheat straw of the coarse mud test block is much larger than the fiber of the fine mud test block result in the capillary migration rate of the coarse mud test block is greater than that of the fine mud test block.
3.2.2. Distribution of moisture content-electric conductivity when the interaction between the dustfall salt and the water of the earthen layer. The earthen layer belongs to unsaturated soil, the important factor that affects the characteristics of the soil are the surface tension between the three phases of water-gas-soil particles in the earthen layer and the suction caused by the interaction between water and soil. The change of moisture content in the earthen layer will cause changes in suction, which further determines the law of water migration in the earthen layer and also determines the movement and enrichment of salt in the earthen layer, which plays a vital role in soil relics disease (Huyuan Zhang et al., 2011; Tianyu Zhao et al., 2011). The electric conductivity in the soil is the ability of a soil solution to electric current and is used to characterize the conductivity of a soil solution. Usually the total amount of soluble salts increases, the conductivity of the soil solution becomes stronger, that is, the conductivity of the soil is greater (Suming Li et al., 2009). It can be determined by measuring the conductivity in the extract after the migration test that whether the total salt in the sample has migrated and the amount of migration.

![Fig. 9](image_url)

**Fig. 9** Distribution curve of moisture content-electric conductivity when the interaction between the dustfall salt and the water of the earthen layer

Fig. 9 is the distribution curve of moisture content-electric conductivity with sample height when the interaction between the dustfall salt and the water of the earthen layer. As shown in the figure: the supply of capillary migration solution at the test block bottom is slower than the evaporation of water into the air, which result in a decreasing trend of the moisture content in the test block with the increase of the sample height. Since the pores of wheat straw are larger than fibers, so there is more water storage space in the test block and the moisture content in the coarse mud test block is obviously greater than the fine mud test block (Shen et al., 2019; Wei et al., 2010). When the air-liquid interface in the humidifier is in equilibrium, the moisture content in the soil sample corresponds to a specific equilibrium vapor pressure, and the specific vapor pressure corresponds to a specific RH of the air. When the deviation
between the actual air humidity and the equilibrium vapor pressure humidity corresponding to the moisture content of the soil sample becomes larger, the vapor pressure potential energy increases. The moisture content of the test block rises along the capillary pores under the action of capillary migration and the soil sample in the test block gradually tends to capillary saturation within a certain sample height. When RH of the air becomes small, the test block dehumidifies, causing moisture to migrate into the air, the potential energy of moisture migration becomes greater, and the migration becomes stronger (Jiang et al., 2014).

When 97% RH, after the test block-DC was stabilized by capillary migration, the electric conductivity of the test block 0-6.7 cm slowly increases from 7.2 µs/cm to 7.6 µs/cm with the increase of the sample height, and the electrical conductivity of the test block above 6.7 cm increases rapidly to 10.3 µs/cm in the direction of capillary rise. This is partly due to that the existence of water potential difference causes water to condense and evaporates between the surface of the test block and the air during the process of continuous replenishment of water through capillary action, and the salt is enriched and crystallized in the evaporation zone, which eventually leads to an increase in the conductivity of the test block. Another part of the reason is that the dustfall salt migrates downwards under the action of capillary migration, which causes the conductivity of the upper end of the earthen test block to increase rapidly (Jiang et al., 2014).

Compared with the dustfall salt migration to the earthen layer, the electric conductivity of the dustfall sample at the top of the test block is lower when the interaction between the dustfall salt and the water of the earthen layer, which indicates that the dustfall salt will accelerate the migration of water ability in the earthen layer, thereby the disease of statue relics will be exacerbated. It is similar that the change trend of the electrical conductivity in the unsalted coarse mud test block with the sample height and the desalted coarse mud test block, but the electrical conductivity in the desalted test block is generally higher than that in the unsalted test block. And the high electrical conductivity appears at the top of the test block, which indicates that the salt-rich crystals will appear in the edge area of the solution capillary migration zone. From this perspective, these original salts play a positive effect in the control of the statue salt damage. The changes in moisture content and electrical conductivity of the fine mud layer have similar characteristics as the coarse mud layer.

### 3.2.3. Distribution of anion content when the interaction between the dustfall salt and the water of the earthen layer

Fig. 10 shows the distribution curve of anion content when the interaction between the dustfall salt and the water of the earthen layer. It can be seen from the figure that the content of SO$_4^{2-}$ is always higher than that of Cl$^-$. When 97% RH, after the capillary migration of the test block-DF is stable, the content of Cl$^-$ and SO$_4^{2-}$ in the dustfall sample are 96 mg/kg and 502 mg/kg respectively (about 323 mg/kg and 604 mg/kg of Cl$^-$ and SO$_4^{2-}$ in the dustfall migrated downward into the test block). The content of Cl$^-$ and SO$_4^{2-}$ showed an inflection point at the sample height of about 6.7 cm, slowly increasing below 6.7 cm, and rapidly increasing above 6.7 cm, and the increase rate of SO$_4^{2-}$ in the test block above 6.7 cm was significantly faster than Cl$^-$. It can be found that the growth rate of the anion content above 6.7 cm in the test block is accelerated by comparing with the change rule of the anion content when the dustfall salt migrates to the earthen layer, which indicates that the dustfall salt will downwards migrate at the upper end of the test block, resulting in a higher anion content at the top of the test block. The distribution trend of anion content in the test block-SF is similar to the change trend of the test block-DF, but due to the existence of the original salt in the test block, the anion content in the test block containing salt is always higher than that in the desalted test block.
3.2.4. *Distribution of cation content when the interaction between the dustfall salt and the water of the earthen layer.* Fig. 11 shows the distribution curve of the cation content with the sample height when the interaction between the dustfall salt and the water of the earthen layer. It can be seen from the figure that the content of Na$^+$ in the test block has always higher than the K$^+$ content, and the change of sample type will lead to different cation content in the test block. When 97% RH, after the capillary migration of the test block-DF is stable, the content of Na$^+$ and K$^+$ in the dustfall sample is 66 mg/kg and 30 mg/kg respectively (about 210 mg/kg and 436 mg/kg of Na$^+$ and K$^+$ in the dustfall migrated downward into the test block), the content of K$^+$ gradually increases with the increase of the sample height. But the content of K$^+$ in the desalted test block has always higher than the test block containing salt, indicating that the original salt content in the test block will have a certain inhibitory effect on the migration of K$^+$ in dustfall, which is consistent with the change of K$^+$ content of when the dustfall salt migration to the earthen layer. As the height of the sample increases, the content of Na$^+$ in the bottom of the test block to 6.7 cm decreases from 58.5 mg/kg to 42 mg/kg, and the content of Na$^+$ in the test block above 6.7 cm gradually increases to 60.5 mg/kg.
Comparing the experiment results of dustfall salt migration to the earthen layer, it is found that the increase of Na⁺ content in the test block above 6.68 cm is due to the downward migration of soluble salt in the dustfall. It is basically consistent that the change trend of cation content of the test block-SF and the test block-DF with the sample height. When 58% RH and 75% RH, the change trend of the content of anions and cations in the test blocks of the coarse mud layer and the fine mud layer is basically consistent with the change trend of the ion content in the sample with 97% RH.

4. Discussion
The test results show that during the capillary migration of the solution in the test block, distribution characteristics of salt in the test block with the sample height has a significant relationship with capillary migration of the solution. Different salt crystals precipitate at different sample heights according to the solubility from low to high. The distribution of sodium alkaloid in the earthen layer of the mural and statue is divided from bottom to top on the earthen layer into crystalline region of insoluble salts (such as carbonate) and medium soluble salt (such as sulfate) and chloride and other soluble salts (Konrad, 2007).

The sodium sulfate in the unsaturated medium is most cause that give rise to the most damage to the statue earthen layer. When the temperature is lower than 32.4 °C, the solubility of Na₂SO₄ will variation with the change of the ambient temperature, and the solid phase formed in by Na₂SO₄ in this temperature range is Na₂SO₄·10H₂O (Thenardite). Thenardite crystals will carry out water when they are precipitate out, which plays the role of "evaporating" the solvent, and this double role constitutes a serious damage to the stability of statue earthen layer (Jin et al., 2015). The migration rate of chloride salts is greater...
than sulfate salts in porous media materials. Due to the supersaturation of chloride salts is very low under room temperature conditions, so the crystallization pressure generated by this crystallization is much lower than that caused by the conversion between sodium sulfate and thenardite (Michael and Sonke, 2008; W., 2004). All in all, under natural conditions, the damage of sodium chloride to porous media materials is much smaller than sodium sulfate (Jiang, 2014).

5. Conclusions
This paper, through examined the soluble salt content and electric conductivity in the test block, analyzed the impact of the dustfall salt on the water migration of the earthen layer. When the dustfall migrate in the earthen layer, its salt will migrate downward at the upper end of the test block under the action of relative humidity. The electric conductivity and soluble salt ions in the test block increase with the increase of sample height, and quickly increase above the test block 6.7cm when the interaction between the dustfall salt and the water of the earthen layer. The effect of coarse and fine mud layer on electrical conductivity and ion content is not significant, and the electric conductivity and ion content in the test block containing salt were obviously higher than those in the desalted test block. When 58% RH and 75% RH, the change trend of the content of anions and cations in the test blocks of the coarse-fine mud layer is basically consistent with the change trend of the ion content in the sample with 97% RH, but the migration of the dustfall salt in the test block increased with the increase of RH. Overall, the dustfall salt, as exotic salt, plays a certain role in promoting the production of salt damage in the statue, and promotes the ability of the water-salt transport in the earthen layer. Therefore, the dustfall salt will aggravate the corrosion of the statue surface, which provides a theoretical basis for the further protection of ancient clay statue.

Salt enrichment due to water-salt migration in the earthen layer is the main reason for the statue disease, but the influence of the external environment on water-salt migration of the statue earthen layer can not be ignored (atmospheric dustfall, RH, temperature, etc).

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7. Declaration of interest statement
None

8. Data accessibility statement
Data can be accessed

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