

Application**LRA Negative Ion Early Discharge Lightning Rod**

There are two prerequisites for lightning formation: charged cloud and discharge channel. When a charged cloud passes by, an electric field will be generated between the cloud and the ground, and its intensity can reach 10KV/m or even greater. Under the action of a strong electric field, the surrounding charged particles (positive ions and negative ions) will move along the direction of the electric field to form a conductive channel, and the energy of the thundercloud will be discharged to the ground along this channel to complete the first lightning strike. Under normal circumstances, the atmosphere is in a neutral state. In severely polluted areas, there may be more positive ions, but due to environmental influences, the number of charged particles that survive naturally is often small, and the survival time is very short, so it is difficult to form a lightning channel.

In response to this situation, VSSIO has developed the Anion 3+ technology negative ion early discharge lightning rod, which has built-in conductive dispersing materials such as electrolytic negative ion dispersing powder and catalytic powder. Through the combination of this material and the lightning rod, it can discharge in advance and form a conductive channel. This material has thermoelectricity and pressure properties. Under temperature and pressure changes, it will form a potential difference between the component crystals, up to 1 million electron volts, ionizing the surrounding air. The ionized electrons attach to water and oxygen molecules and are converted into air negative ions. The concentration of negative ions released per second can reach 6000-12000pcs/cm³. Under the action of the thundercloud electric field, the negative ions move in the opposite direction of the electric field, discharge in advance, and form a good conductive channel. At the same time, in the surrounding environment of about 200 meters, a "negative ion air mass" is formed with the LRA lightning rod as the center and gradually weakens to the surrounding area. Compared with ordinary lightning rods, the protection range is larger.

**Technical advantages of LRA negative ion early discharge lightning rod**

1. Negative ion discharge in advance, using the original Anion 3+ technology, built-in electrolytic negative ion emission powder, catalytic powder and other conductive emission materials, continuously and slowly release active conductive negative ions to the upper space of the lightning rod, discharge in advance, and form a lightning rod + conductive negative ion lightning connection combination, thereby increasing the lightning connection height and expanding the protection range, and the performance is significantly better than that of ordinary lightning rods.

Calculation of protection radius of LRA negative ion early discharge lightning rod

According to NFC17-102, the protection radius of LRA negative ion lightning rod:

$$R_p = Vh(2D-h) + \Delta L(2D+AL)$$

R_p : protection radius of lightning rod on the ground (m)

h : horizontal height difference between the tip of lightning rod and the top of protected building (m)

D : rolling ball radius, which depends on the lightning protection level of protected building. According to NFC17-102, 1, 1, and 60m are taken for Class 1 buildings, respectively. GB50057-2010 stipulates that Class 1 is 30m

AL : uplink lead distance (m), $AL = V \cdot AT + L_n \cdot k$

V : leader propagation speed, experimental data shows: $V \sim 1\text{m/us}$

AT : Early discharge time (us)

L_n : Effective impact distance of negative ions in lightning rod (m)

k : Environmental impact coefficient

