

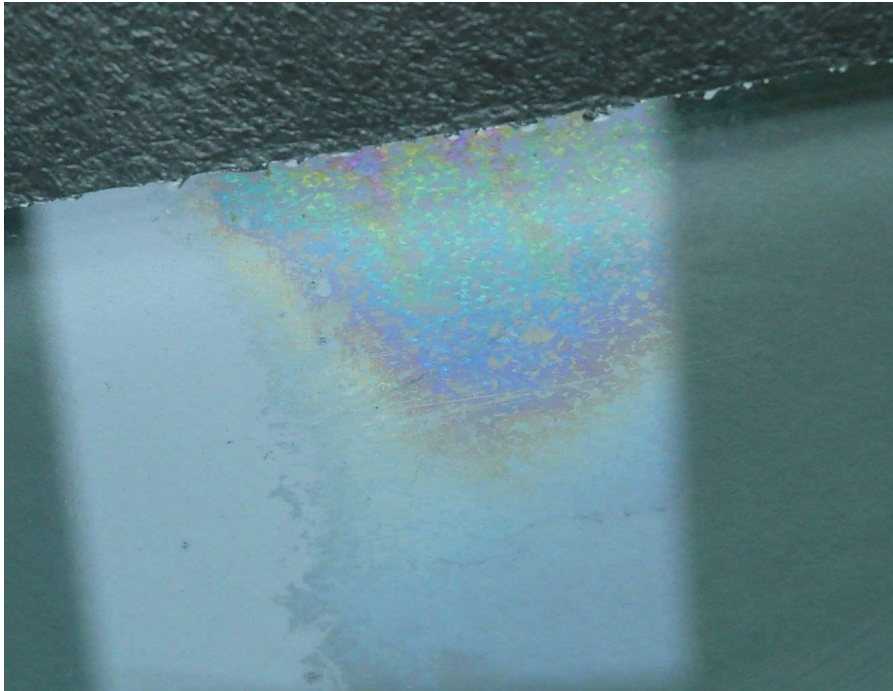
## Glass mildew: reasons, appearance and identification

Glass mildew is an industrial problem in the glass industry. Every spring and summer, due to the high temperature and high humidity, glass mildew is easy happen. Therefore, how to prevent glass mildew has become the top priority of many glass processors.



### Reasons for glass mold:

Glass is mostly made of quartz sand ( $\text{SiO}_2$ ), soda ash ( $\text{Na}_2\text{CO}_3$ ), limestone ( $\text{CaCO}_3$ ) and feldspar, in which  $\text{SiO}_2$  (about 72%),  $\text{Na}_2\text{O}$  (about 15%) and  $\text{CaO}$  (about 9%), so called soda-lime glass, is widely used because of its low cost.



According to research, during the annealing process of soda lime glass, alkali ions move to the surface of the glass, making ion exchange easy on the surface of the glass; for example, the glassy  $\text{SiO}_2$  on the surface can be hydrolyzed.

Therefore, when the soda-lime glass is stored in a humid environment, water or moisture will diffuse from the glass surface and gradually diffuse into the glass. When the soluble sodium silicate ( $\text{Na}_2\text{SiO}_3$ ) in the surface layer is hydrolyzed, it is contacted by water. ( $\text{H}_2\text{O}$ ) Carbonic acid ( $\text{H}_2\text{CO}_3$ ) formed with carbon dioxide ( $\text{CO}_2$ ) produces ortho silicic acid ( $\text{H}_4\text{SiO}_4$ ) which is weaker than carbonic acid. If the saturated orthosilicate ( $\text{H}_4\text{SiO}_4$ ) solution is left for a long time, it will be amorphous. Silica ( $\text{SiO}_2$ ) precipitates in a milky white color and appears as colloidal particles, precipitates or gels.



**Glass mildew is generally divided into five stages:**

1. Initially, water or moisture is adsorbed on the glass surface.
2. Subsequently, water or moisture diffuses into the glass.
3. The soluble silicate in the surface is hydrolyzed and destroyed. First, sodium silicate and potassium silicate are hydrolyzed and destroyed. Caustic soda ( $\text{NaOH}$ ) is formed and  $\text{SiO}_2$  is separated.
4. The separated  $\text{SiO}_2$  forms a silicone gel which forms a protective film on the surface of the glass which prevents further erosion.
5. The caustic soda formed by hydrolysis reacts with carbon dioxide in the air to form sodium carbonate, which accumulates on the surface of the glass to form a soluble salt in the surface film. Due to its strong hygroscopicity, it absorbs moisture and deliquesces, eventually forming lye droplets. As the surrounding temperature and humidity change, the concentration of these droplets also changes. If the concentrated lye droplets are in contact with the glass for a long period of time, the gel-like silicone film can be partially dissolved therein, causing severe local erosion of the glass surface to form spots. This is a group of white alkali-rich ions that are formed by the migration of sodium ions from the glass body and reacting with air. A white particle swarm can be observed by scanning electron microscopy.

**Appearance phenomenon of mildewed glass:**

1. White fog, white spots: The slightest mildew on the glass surface due to storage time, air humidity or glass quality problems.
2. Rainbow: When the white mist and white spots appear for a long time and are not treated in time, a rainbow will form. At this time, the moldy condition only stays on the glass surface and does not corrode into the glass.



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3, sulfur change: glass mildew appearance and mild mildew, but the alkaline moldy components of the glass surface have been corroded into the glass, is a serious mold.

4, paper printing: the same as sulfur, moldy outside the glass and inside, is a serious mildewed.



### Mildew identification and inspection methods:

Visual inspection of the appearance is the most succinct and feasible method. The sample was placed in reflected light and transmitted light to observe the presence or absence of spots and mist on the surface of the glass under concentrated intense light. These spots and mists cannot be wiped off with cloth or water. The glass in which the above phenomenon occurs indicates that the sample has been mildewed. If concentrated glare is observed, a small number of spots and mists are slightly mildewed by the naked eye. If concentrated glare is observed, many spots and light mists are observed by the naked eye. If there is no concentrated beam of light, some spots and fog are observed by the naked eye to be severely moldy.

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From aesthetics, to strict environmental and energy specifications, to critical budget and delivery requirements, our input can make a difference.

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