

## Risk of Nickel Sulfide presence in glass

### Origin

Glass can contain inclusions of various natures, coming from the raw materials, cullet or from the production facilities themselves. Among these, we find the Nickel Sulfide (NiS). These inclusions have a size of about 60  $\mu\text{m}$  to 500  $\mu\text{m}$ . They have the distinction of having a different crystalline structure at low and high temperature so that their volume is greater at low temperature. The presence of such inclusion does not render the glass defective, and normally does not impair the appearance or technical performance of the glass.

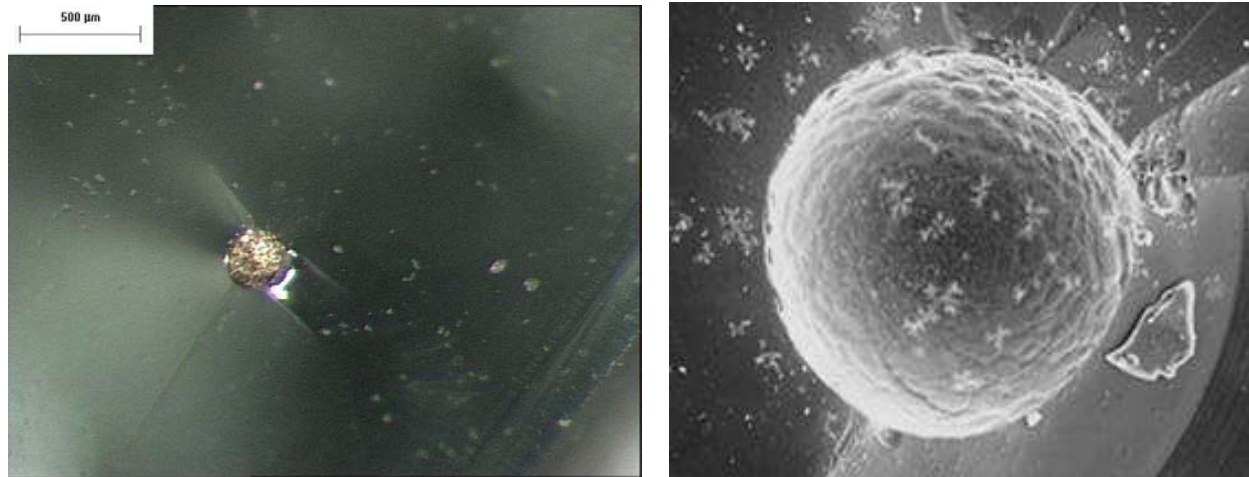
### Phenomenon

During annealing process, all particles of NiS have the time to reach their structure at low temperature (as annealed glass). The change in volume of inclusions can be absorbed by the still "soft" glass and they do not present a danger to the glass. But, in the case of thermally toughened glasses, NiS reaches its stable structure at high temperature at the beginning of the operation of tempering when temperature of the glass is about 650°C. The quenching process (rapid cooling) which follows does not leave time for NiS to reach its stable structure since the glass temperature rapidly reduce to room temperature (glass have solidified). Its transformation will therefore continue at the temperature of service of the glass and the related increase in volume can cause spontaneous breakage of the glass sheet.

In this case, we find a characteristic breakage in the shape of butterfly. Many articles and publications exist on the subject. The phenomenon is inherent to thermally toughened glass, and can therefore not be considered a hidden defect of the product.



*Typical breakage starting from a NiS inclusion*



*Zoom on a NiS inclusion*

These ruptures remain not very frequent, but can affect a certain number of thermally toughened glazings of a building.

### **Prevention**

In order to reduce the risks of spontaneous breakage, two solutions exist.

- 1) If the thermally toughened glass is necessary for your application, we can opt to choose heat strengthened glass instead of tempered glass which can reduce the risk of spontaneous breakage. However, please mind that heat strengthened glass has also possibility of spontaneous breakage.
- 2) If the tempered glass is necessary, a process called "heat soak" treatment should be strongly recommended. This one consists in placing glass in a furnace at a stage of temperature, during a determined time, in order to enable and accelerate the transformation of NiS. The breakage due to the possible presence of critical particles of NiS will partially occur during this treatment. Please mind that "heat soak" treatment cannot fully eliminate the risk of spontaneous breakage. The "heat soak" treatment methods are described in several standards such as EN 14179 and ASTM.

### **Conclusion**

When using thermally toughened glass, a risk of spontaneous breakage due to the presence of nickel sulfide particles is possible. And it is not possible to eliminate nickel sulfide in glass composition, in terms of characteristics of raw material of glass and current technology. But this problem can be minimized using heat strengthened glass or tempered glass with "heat soak" treatment

**Disclaimer**

Under this condition, AGC does not guarantee spontaneous breakage and strongly recommend applying "heat soak" treatment for tempered glass.

Therefore, by using AGC's float glass, our customers agree to take responsibility for any costs, damages, or injuries, including incidental or consequential damages, personal injury, labour cost, due to whole or in part, directly or indirectly which related to the presence of nickel sulfide and/or spontaneous breakage.

Note: Some national regulations define applications for which the use of "heat soak" treatment for tempered glass is mandatory.