

Electronic Supplementary Information (ESI) for RSC

Advances

Thermal intumescent behavior of a gel containing silica

1 Experimental Section

1.1 Chemicals and Substrates: Float glass (5 mm) was supplied from Chengdu Qidian glass Co., Ltd. Sodium silicate (the molar ration of $\text{Na}_2\text{O}/\text{SiO}_2$ in sodium silicate = 1.032 ± 0.03) and glycerol were purchased from Changzheng Chemical Reagent Company. Ammonia (28%) and deionized water were obtained from Kelong Chemical Reagent Company. All the chemicals used were of reagent grade. Silicone sealant was purchased from Weifang Sanze Silicone Co., Ltd.

1.2 Sample Preparation: Fire resistant glazing was prepared by pouring the fire resistant gel into a glass cavity. The glass cavity was made of two pieces of 100*100 mm float glass, three pieces of 10*90 mm float glass, one piece of 10*80 mm glass and silicone sealant. Sodium silicate was dissolved in water at 70°C to prepare the sodium silicate solution (33.3 wt%). Ammonia was added to the sodium silicate solution mixed with colloidal silica and glycerol. And the mixed solution was poured into the cavity from an opening, then cured in oven at 80°C for 1hr. Thereafter, the silicone sealant was used to seal the opening. Finally, fire resistant gel containing silica can be formed between two sheets of glass.

1.3 Characterization: Thermal insulation of the fire resistant glazing was evaluated in a fire test, according to GB 15763.1-2009. Thermogravimetric analysis (TGA) was performed using HENVEN HCT-1 TG-DSC analyzer with a temperature range of 50-1000°C in static air atmosphere at a heating rate of 10°C/min. Sample weight was in the range of 3-5 mg. Scanning electron microscopy (SEM) was conducted on a HITACHI S4700 instrument at room temperature in order to investigate the morphology of the residual layer after burning. All the samples were sputtered with platinum before SEM analysis. The chemical structure of the residue of the gel after the fire test was characterized by Fourier transform infrared (FTIR) spectrometer (ThermoNicolet Nexus 670).

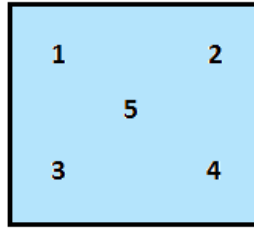
2 Calculation of temperature rise and average temperature rise:

Temperature rise (T_R) and average temperature rising (T_{AR}) on the surface of the glazing not exposed to flame were calculated according to the following equation:

$$T_R = T_S - T_0$$

$$T_{AR} = (T_{R1} + T_{R2} + T_{R3} + T_{R4} + T_{R5}) / 5$$

Where T_S is the temperature of the glazing surface not exposed to fire during the fire test, T_0 is the room temperature, T_{R1} , T_{R2} , T_{R3} , T_{R4} and T_{R5} are the temperature rising of five points (1, 2, 3, 4 and 5), which are on the glazing surface not exposed to fire. These points on the surface of the glazing are placed as shown:



3. Figures

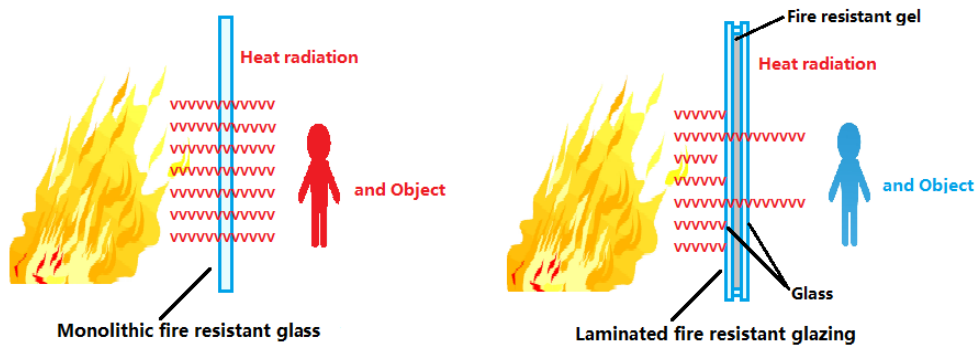


Figure S1 Difference between monolithic fire resistant glass and laminated fire resistant glazing

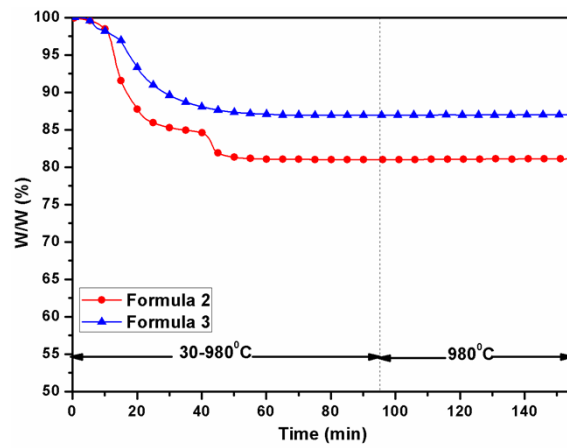


Figure S2 TG curves of the fire resistant gel samples at 980°C for 60min



Figure S3 Fire resistant glazing during the fire test (Formula 3)