Thermography of glazings in fire tests

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Abstract

The classification of fire resistance occurs with the aid of the results of fire tests. The criteria for the classification are determined in international standards. The use of infrared thermography not only for qualitative observation but also for quantitative measurement during fire tests of glazing and glazed elements makes it possible to check the demands of national or international standards as ISO 3009 and forthcoming EN 1364 more exactly.

Keywords : fire test, thermography, glazing, glass, glazed elements, fire, fire resistance, fire protection

1. Introduction

Fire especially in buildings is a severe threat of human beings. The frequency of fire can be very high in industrial countries. In the USA for example almost 8 fires per 1000 inhabitants per year break out1. The situation in Germany is something better with only 2.1 fires per 1000 inhabitants per year1. That means for Germany more than 500 people are killed every year by fire. In addition the damages caused by fire costs the national economy about five billion Deutsche Mark per year. Therefore it is necessary to make every effort to reduce this threat of human life and the loss of property.
The capabilities and possibilities for fire fighting have to be improved as well as the fire protection in buildings as a preventive measure. The use of infrared radiation is a very valuable tool to pursue these goals.

2. Use of thermography for fire detection and fire fighting

In Germany already before and during World War II infrared detecting systems have been developed. They were mainly used for military purposes. But there was also the System „KIEL“ which was used for early detecting of area fires. With this system a range of about 100 km could be reached.
This technology was later on perfected. In 1994 infrared cameras installed on towers were used for example in France to set up an early warning system for forest fire in the area of Bordeaux.
In the Eighties hand held infrared cameras were introduced to fire departements to enable the firemen to act in areas filled with smoke. Localization and rescue of wounded or unconscious people was drastically improved by this technique.
In modern stationary fire fighting systems for example in industrial plants carbon dioxide is used as an extinguishing medium. Carbon dioxide is stored in metal bottles which are linked together with a piping system. In a regular manner these bottles have to be checked if they are still correctly filled. If the bottles are heated slightly with a hot air pistol, a thermal contrast is created between the liquid level and the gas in the bottle.That level can be seen with a infrared camera and the correct height of liquid in the bottle can be detected.

3. Fire protection

When buildings are designed and constructed sufficient fire protection has to be taken into consideration to provide optimal safety for people and property. One aspect is the design and realization of fire compartments with doors or glazed elements in a building complex to limit the spreading of fire.
The next aspect takes into consideration the building materials. The classic building structures in Central Europe consisting of bricks or concrete are normally not critical in their resistance to fire. But in modern buildings more and more translucent components are installed. Modern fire resisting glazings typically consist of two or more glass panes which are combined by a special gel to a laminated glass.
In the case of fire the gel is heated up and changes its structure by forming a kind of foam. This foam between the panes
- increases the thermal insulation
- reduces radiation and
- reinforces mechanical stability even if panes are cracked.

These components must show appropriate fire protective properties due to national or international standards. New developed components must be therefore checked for their fire behaviour in fire tests.

4. Fire tests

4.1. Principles of fire tests

To test building components in fire tests they are installed in front of a special oven made of refractory bricks. This oven is normally heated by one or two oil burners. The glowing soot produced by the burning oil acts as a source of radiation and intensifies the testing conditions. In the furnace the pressure and temperatures must be measured for controlling and regulating the testing conditions. Also the temperature at the unexposed surface has to be measured to get some informations for classification. The dimensions of the elements and the fixing in the fire test shall be the same as intended in practice. During the fire test the element shall be exposed to a predefined fire action.

4.2. Fire tests of glazed elements

In the international standards ISO 834 and ISO 3009 or national standards as DIN 4102 the fire testing methods for glazed elements are described. The standards set demands to the dimensions, the method of fixing, the fire action and the measurement. Due to the standards the complete assembly of the glazed element must be tested. A typical experimental setup for a fire test of glazed elements is shown in Fig.1

Fig.1. Glazed element mounted in front of an oven for fire tests

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