Performance of Ceramic-Block Fire Stops for Power Cable Installations

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Abstract
Fire losses due to cable fire in thermal power plants and industrial units are mounting. Fire in cable galleries is caused either by an external source or internal heating due to overloading or poor cable insulation. Most of the power cables are laid in groups that run on trays. In the event of fire, cable insulation melts and cable conductors come into contact and generate sparks. The resulting flame spreads through cables and engulf other groups of cables. This leads to damage in control rooms and distribution units that causes power generation disruption and plant shutdown.

To minimize the damage and system disturbance due to fire, a new system for cable installation has been developed. The system involves construction of fire stop walls using fire-resistant cavity blocks, heat-resistant wool, and fire-resistant sealant.

Introduction
Fire occurs very often in thermal power plants and industrial units through cable installations. Cable fire causes heavy loss to a nation in the form of interruption to power generation and plant shutdown. Malfunctioning cables and electrical wires are well-recognized fire threats. The problem becomes acute when cables are used in groups. There exists a critical value of cable mass per unit length above which grouped cables propagate fire, though they may not propagate it individually. The cable ducts route fire from one compartment to another. This may cause a large amount of secondary or consequential damage in the electric utility industries that severely affects production. The economic loss is immense.

In fire, the polymers used in manufacturing electric power cables that contain halogens give off highly corrosive acid gases, vapors, and smoke. These by-products are highly toxic and, when combined with the large quantities of smoke given off, quickly result in a lethal atmosphere. Acid gases formed during pyrolysis react with atmospheric humidity to form aggressive halogen acid and, depending on which halogen the polymer contains, attacks and corrodes almost anything metal, including components, and even a building’s structure. Halogen acids are not only corrosive chemicals, but their vapors can cause severe irritation or cauterization of the respiratory tract, whereby a chemical reaction with

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proteins of the tissue cells cause cramp-like states and lung edema. Smoke always presents a great danger for people, since it disorients, and toxic gases, such as carbon monoxide, produce dizziness, then headache, a state of daze, and, finally, unconsciousness and death.

Electric power cables penetrating a wall lessen its fire resistance. During exposure to fire, cracks develop on the wall around the cable, even if the cable penetration is made airtight using the fire stops best suited to it. Cable insulation melts, and the metal conductors in the exposed cables transfer heat through the wall to the unexposed side. Hot gases can flow through cracks and raise the heat load on the wall interior. Flammable gases from an oxygen-starved fire may be hot enough to ignite when they emerge on the unexposed side.

Cables can be protected against the effects of fire by compartmentalizing cable tunnels. This is done by laying fire stop barriers, so that fire spreading from its point of origin to other adjacent areas can be prevented. A fire protection system for cable installation using fire-resistant cavity blocks has been developed at Central Building Research Institute, Roorkee, India. Since the cables are separated from each other in this system, the heat dissipation does not affect the other cables. This minimizes fire occurrence.

This research paper describes the design and construction of fire stop walls using cavity blocks, heat-resistant wool, and fire-resistant sealant.

Design of Fire-Resistant Block
It has been established that all cables will be affected by fire to some degree, depending on the duration and temperature of the fire and the composition of the cable insulation. Fire originates either from inside the cables, due to overheating, or by an external heat source. Such fires result in the generation of heavy spark. Cables get damaged and entire cable galleries get gutted. To reduce fire occurrence, a new method of construction of fire stop wall with fire-resistant cavity blocks has been developed in which cables are separated from each other to avoid the heat transfer from cable to cable.

A fire-resistant cavity block 460 mm long x 230 mm wide x 150 mm high is prepared for the construction of fire stop walls, as shown in Figure 1. Three semicircular grooves 50 mm in diameter and 230 mm long are provided on top and bottom surfaces of the block. These grooves are 65 mm apart from each other and from the edges of the block. At all the four corners of the block, half of the semicircular grooves of the same dimensions are provided, so that when two blocks are joined at the same level, they form another semicircular groove.

Design of Mold for Casting Fire-Resistant Cavity Block
A split-type mold was designed and developed for casting fire-resistant cavity blocks as shown in Figure 2. It consists of two smooth, leveled wooden plates 560 mm long x 230 mm high x 20 mm thick. On each of the wooden plates, three