

## Lethal combustion product evaluation of polymeric materials used in Power cables

Burjupati NAGESHWAR RAO (1), R ARUNJOTHI (1)

1 Central Power Research Institute, Bangalore, India,  
[nagesh@cpri.in](mailto:nagesh@cpri.in), [arunjothi@cpri.in](mailto:arunjothi@cpri.in)

The generation of lethal combustion products is of primary importance in the assessment of "fire hazard" resulting from cable materials during fire accidents. The fire safety requirements in the international standards are based on exigencies of the fire behaviour of individual materials that are used in the cable system. PVC compounds have been used for decades as insulation / sheathing material in cable manufacturing due to its excellent mechanical and chemical properties. However, halogen acids, which are generally produced during combustion, are highly suffocating and can cause problems of corrosion to electrical apparatus and metallic structures even months after the fire.

Statistics indicate most of the fire victims die or affected by smoke rather than the Asphyxia which is the principal mechanism of intoxication, mediated by oxygen depletion, carbon monoxide inhalation and sometimes even by hydrocyanic acid inhalation. In recent times due to increase in fire accidents and with loss of lives and property, regulatory authority have enforced strict laws and regulations to minimize the risk of fire by assessing 'Fire hazard' of materials used in any industry. Therefore interest has centered on in the development of polymers which evolve reduction in smoke levels and toxic gases. PVC materials are replaced with low smoke zero halogen (LSOH) materials which are free of Chlorine, Fluorine, Bromine and Iodine.

The fire safety is addressed through small scale flammability, smoke /toxicity of fire gases, determination of halogen acid generated and performance criteria is based on guidelines laid in the international standards. A study was undertaken in the laboratory of Central Power Research Institute, Bangalore, India to assess the toxicity products of cable materials. This paper presents and discusses the toxicity of the products of combustion in terms of small molecular species arising when a small sample of a material is completely burnt in excess air under specified conditions. The evaluation of the toxicity of fire gases is made through the determination of the following gases: Carbon oxides(CO, CO<sub>2</sub>), halogen acids (HCl, HBr, HF), Prussic acid (HCN), nitric oxides (NO<sub>x</sub>), acrylonitrile (CH<sub>2</sub>CHCN), Phenol, H<sub>2</sub>S as per NES 713/NCD 1409 standards. Halogen acid determination have been carried out in accordance with IEC 754 part 1 & 2 standard methods. Further Char analysis has been done using Fourier Transform Infrared spectrometer and Scanning Electron microscopic techniques. Cable insulation, filler and sheathing materials have been evaluated and the results are presented and discussed.

Key words

Toxicity, Char analysis, Corrosion, halogen acid generation,