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Fire chemistry — Generation and measurement of aerosols

Chimie de la combustion — Production et mesurage des aérosols

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Foreword

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The committee responsible for this document is ISO/TC 92, *Fire safety*, Subcommittee SC 3, *Fire threat to people and environment*.

Introduction

Aerosols generated in fires are complex, non-homogeneous mixtures of liquid droplets of tar or water, solid-phase carbonaceous agglomerated soot with adsorbed organic compounds, or mineral particles. After formation through complex chemical and physical processes, fire aerosols continuously undergo changes in physical size, structure, and chemical composition as the particles may coalesce, agglomerate, absorb gases, evaporate or deposit on surfaces. The aerosol concentration, particle size, temperature, and gas-phase composition also play a role in the rate of change.[1][2][3]

There are multiple mechanisms by which fire-generated aerosols affect the fire threat to people and the environment. First, small particles are respirable and can penetrate deep into the lung structure. Inhaled particles themselves can be irritating, reducing the ability of people to escape from a fire.[4][5] Next, these particles can adsorb and/or absorb toxic and irritant gases and vapours, providing a means for transport past the respiratory tract natural defences and deep into the lungs.[5][6] Third, even less or non-respirable particles may effectively reduce the concentration of toxic gases and vapours in the fire effluent and can deposit them on surfaces. Fourth, aerosols may obscure vision, potentially reducing the ability of people to move effectively toward safety (see ISO 13571). Finally, the aerosol fraction in fire effluents also has significant potential to adversely affect the environment, particularly where the fires are large and of long duration.[7][4]

Therefore, it is important, within the context of the mechanisms of generation and evolution of aerosols, to be able to measure aerosol concentrations and size distributions accurately; to appreciate the scope and limitations of the apparatus and methodologies available for these measurements; and to interpret such measurements effectively, consistent with the hazards and risks being evaluated. This International Standard provides details of a range of sampling and measurement methods and guidance on which ones to use for particular applications, together with an interpretation scheme based on current knowledge. This document also includes informative annexes that summarize the physical aspects of fire aerosol generation, aerosol movement and modification with and away from the fire plume, the aerosol contribution to fire growth through flame radiation, and the roles of particulates in threat to life and the environment.