STEEL, ALLOYS, CORROSION PROTECTION AND MATERIALS TECHNOLOGIES

EDITED BY
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Preface

This special edition presents a concise yet comprehensive exploration of some key advancements and solutions in contemporary materials science and engineering.

Chapter 1, “Alloys and Steel,” introduces readers to the critical properties, classification, and production and processing techniques of alloys and steel, shedding light on their pivotal role in modern industry and technology.

Chapter 2, “Corrosion Protection,” addresses solutions for protecting materials from corrosive degradation, offering bio-based inhibitors and innovative protective epoxy coating that extend the lifespan and reliability of engineered structures.

Chapter 3, “Functional and Special Materials and Technologies,” presents readers with the rapidly evolving field of advanced functional materials and related technologies, ranging from high-performance composites to emerging specialised technologies, that are shaping the future of manufacturing, construction, and beyond.

This special collection aims to provide essential scientific and engineering information, fostering a deeper understanding of the complex interplay between materials, technologies, and features of their applications.

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Experimental-Statistical Models for Obtaining a Database on the Ignition Temperatures of Metal Fuel Particles in Gaseous Products of Thermal Decomposition of Fluoroplasts-Based Pyrotechnic Mixtures

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Abstract. New patterns of the complex influence of various parameters on the ignition temperature of magnesium, aluminum and zirconium particles in the products of thermal decomposition of pyrotechnic mixtures based on fluoroplastics have been established. Experimental and statistical models have been developed for the first time to predict the influence of controlled technological parameters on the ignition temperature of metal particles to form a database on the fire-hazardous properties of pyrotechnic products under external thermal effects.

Introduction

For practical use of previously obtained results on the ignition of metal combustible particles (magnesium, aluminum, zirconium, etc.) in various oxidizing media, including gaseous products of thermal decomposition of pyrotechnic mixtures for various purposes based on fluoroplastics [1, 2, 5, 6 – 9], it is necessary to create a database convenient for assessing the fire hazard properties of pyrotechnic products under conditions of external thermal effects, one of the main parameters of which is the ignition temperature of metal particles. Currently, this database is not available, which makes it difficult to predict the fire hazard properties of these mixtures under various external thermal conditions (for example, during the ignition of warehouses where pyrotechnic products equipped with charges from the mixtures under consideration are stored, during transportation under intense convective heating of their surfaces, or during aerodynamic heating of metal shells of products during firing and flight), an important characteristic of which is the heat flow that heats the bodies of pyrotechnic products to critical temperatures that may exceed the ignition temperature of metal fuels in gaseous products of thermal decomposition of mixtures. This leads to premature activation of the products, which leads to their destruction with the formation of high-temperature combustion products that fly at high speeds in different directions and are fire hazardous to surrounding objects.

Problem Formulation

Currently, there is no database on the ignition temperature of metal fuel particles in various oxidizing media, including gaseous products of thermal decomposition of pyrotechnic mixtures. This significantly complicates the prediction of the fire hazard properties of these mixtures under external thermal influences, such as the ignition of warehouses, intense convective or aerodynamic heating. In this regard, difficulties arise in determining the critical temperatures at which spontaneous ignition of metal particles in the decomposition products of mixtures is possible. The absence of such a database also hinders the development of effective measures to reduce fire hazard and prevent premature operation of pyrotechnic products, which leads to their destruction and the formation of high-temperature combustion products that pose a serious threat to surrounding objects.

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