# 8JORNINC-3JORPROCIV

8as Jornadas de Segurança aos Incêndios Urbanos
e as 3as Jornadas de Proteção Civil
Porto, 1 e 2 de junho 2023

# LIVRO DE RESUMOS

isep Instituto Superior de Engenharia do Porto

P.PORTO

*8as Jornadas de Segurança aos Incêndios Urbanos e as 3as Jornadas de Proteção Civil*
*Instituto Superior de Engenharia - Portugal - 1-2 de junho de 2023*

TÍTULO:
Resumos das 8as Jornadas de Segurança aos Incêndios Urbanos e as 3as Jornadas de Proteção Civil (8JORNINC-3JORPROCIV)

EDITOR:
Instituto Superior de Engenharia do Porto, ISEP

COORDENADORES DA EDIÇÃO:
Elza M. M. Fonseca; Hernâni R. Lopes; Armando V. Campos;
Ana R. João; António G. Magalhães; João F. Silva

ISBN:
978-989-35087-2-5

TIRAGEM:
60

1ª edição, junho de 2023

# FIRE BEHAVIOUR OF MORTARS WITH PORTLAND CEMENT AND RESIDUAL DIATOMACEOUS EARTH

Leandro Magalhães
Researcher
IPB - Bragança

Renan Zolin
Master Student
UTFPR - Paraná

Matheus Alves
PhD Student
IPB - Bragança

Luísa Barreira
Professor
IPB - Bragança

Débora Ferreira *
Professor
IPB - Bragança

Eduarda Luso
Professor
IPB - Bragança

Luís Mesquita
Professor
IPB - Bragança

Óscar Lima
Project Owner
Caves Campelo

**ABSTRACT**
The high pollution levels produced by the manufacturing of conventional Portland cement have motivated several studies in an attempt to modernize this process with alternative binders and the conscious use of natural resources. The correct treatment of residues has become a matter of great concern. The project "BacchusTech" aims to reuse diatomaceous earth from wine filtrations, introducing them into the composition of cement mortars through the reduction of cement and sand, seeking to valorise this winemaking residue and contributing to a sustainable construction. Three compositions of Portland cement-based mortars introducing residual diatomaceous earth are studied and fire behaviour tests are performed to the obtained specimens of mortars. The characterisation of these elements regarding their reaction to fire is performed using the cone calorimeter equipment.

**KEYWORDS:** Portland cement mortars; Residual diatomaceous earth; Sustainable construction; Fire reaction.

## 1. EXPERIMENTAL PROGRAM

The construction industry is one of those that has mostly contributed to the negative impact that our planet has suffered over the years. Portland Cement based materials is the largest manufactured product in the world and it is the second most used substance after water [1]. It is inevitable to find an eco-friendly alternative material to the existing Portland Cement. As a consequence, investigations related to the resources and energy consumed during the construction phase and the production of cement or other materials essential for construction, have been performed in the last years [2,3]. Considering the promising results obtained until now,

* Débora Macanjo Ferreira – Instituto Politécnico de Bragança, Escola Superior de Tecnologia e Gestão, Campus de Santa Apolónia - 5300-253 BRAGANÇA, Portugal, email: debora@ipb.pt http://www.ipb.pt

this research aims to reuse diatomaceous earth from wine filtrations, introducing them into the composition of cement mortars through the reduction of cement and sand. In this work, three compositions of Portland cement-based mortars introducing residual diatomaceous earth are studied. A reference composition with cement, water and sand (REF), a composition with 15% cement reduction and introduction of 15% residual diatomaceous earth ($C_{15}R$), and another composition with 5% sand reduction and introduction of 5% residual diatomaceous earth ($S_5R$). An experimental program was carried out in order to evaluate the behaviour of these mortars when exposed to a constant heat flux, with the purpose of studying the fire reaction of the mortars with the introduction of residual diatomaceous earth. The characterisation of these elements regarding their reaction to fire is performed using the cone calorimeter equipment and the test method was established according to ISO 13927 standard [4]. The mortars were tested under a heat flux of 75 kW/m² which simulates a fully developed fire [4]. The temperatures in the specimens throughout the test were recorded using thermocouples.

## 2. CONCLUSIONS

The achieved results confirm the possibility of an effective use of residual diatomaceous earth in cement mortars. The cone calorimeter tests reveal that the mortars with diatomaceous earth present peak values of Heat Release Rate 20% lower than the reference mortar. The temperatures recorded in the mortars over time also reveals that the mortars with diatomaceous earth show lower temperatures when compared to the reference mortar, which confirms the possibility of using residual diatomaceous earth to improve the fire reaction behaviour of cement mortars.

## ACKNOWLEDGEMENTS

This article is a result of the project “BacchusTech - Integrated Approach for the Valorisation of Winemaking Residues” (POCI-01-0247-FEDER-069583), supported by the Competitiveness and Internationalization Operational Programme (COMPETE2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF).

## REFERENCES

[1] Scrivener K, John V, Gartner E. *Potential economically viable solutions for a low-$CO_2$ cement-based materials industry*. Eco-efficient cements. 2018, 9p.

[2] Yılmaz B, Ediz C. *The use of raw and calcined diatomite in cement production.* Cement and Concrete Composites 30. 2008, 202-211p.

[3] Degirmenci N, Yilmaz A. *Use of diatomite as partial replacement for Portland cement in cement mortars.* Construction and Building Materials 23. 2009, 284-288p.

[4] International Organization of Standardization. *Simple Heat Release Test Using a Conical Radiant Heater and a Thermopile Detector*, in ISO 13927:2015.