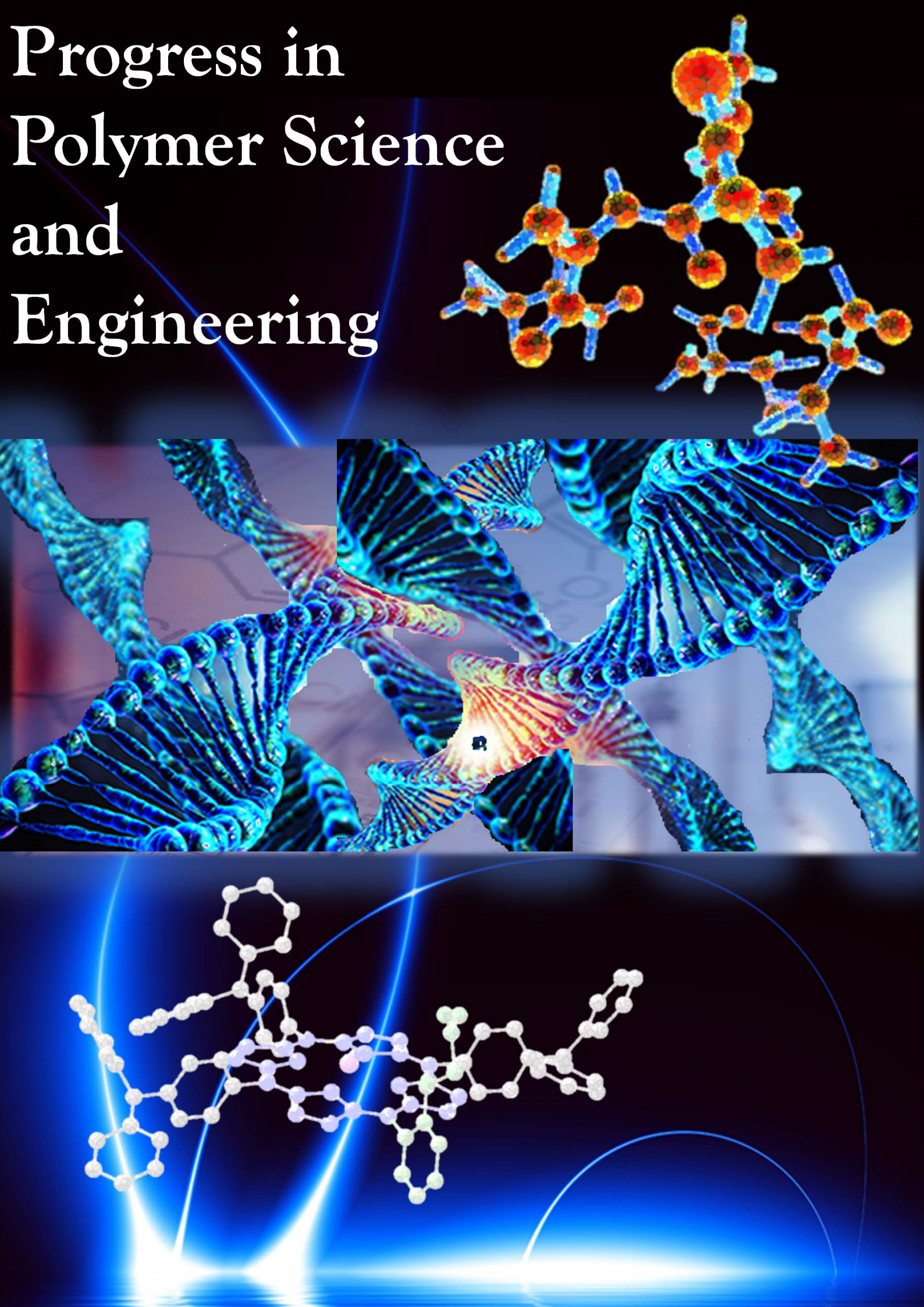
Progress in Polymer Science and Engineering



Progress in Polymer Science and Engineering

Progress in Polymer Science and Engineering

Edited by

Concepción Valencia Barragán

F. Javier Navarro Domínguez

José M. Franco Gómez

Centro de Investigación en Tecnología de Productos y Procesos Químicos (Pro2TecS).
Departamento de Ingeniería Química, Universidad de Huelva.

GRUPO ESPECIALIZADO DE POLÍMEROS (RSEQ Y RSEF)
Huelva, 2018

I.S.B.N. 978-84-16621-78-1

Sponsors


GEP


RSEQ
Real Sociedad Española de Química


iesmat

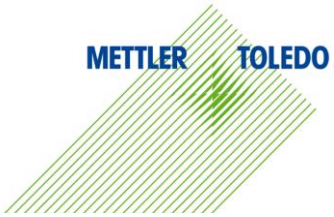

IFI


Pro2Tecs
Centro de Investigación en Tecnología de Productos y Procesos Químicos


Universidad de Huelva


masso analítica, s.a.
www.masso.com


ETSI
ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA
uhu.es


METTLER TOLEDO


Cátedra
Fundación Cepsa


PerkinElmer
For the Better


cátedra aiqbe
Universidad de Huelva


TA
Instruments
Análisis Térmico, Reología y Microcalorimetría


USISA


Thermo
SCIENTIFIC


PQN
PROQUINORTE
www.proquinorte.com


dicsa
Distribuciones Industriales y Científicas S.L.
ciencia e innovación

Preface

Following the tradition of the previous and successful Meetings, GEP 2018 is organized with the auspice of the Specialized Group of Polymers (GEP) of the Royal Spanish Society of Physics (RSEF) and the Royal Spanish Society of Chemistry (RSEQ), and will be held in Punta Umbría (Huelva) on September, 24th-27th. This XV edition of the GEP Meeting is intended to be, as those that preceded it, an opportunity for an intense exchange of information on recent advances in Polymer Science and Engineering.

About 130 communications will be presented, from which, 74 have been selected as oral communications by the Scientific Committee. The scientific program also includes five invited lectures. This book contains manuscripts from most of the submitted and invited contributions that will be presented at GEP 2018. To all authors, our acknowledgment for the effort in the preparation of the manuscripts in time.

The editors also acknowledge the Scientific Committee for their kind collaboration. Finally, we would like to express our gratitude to the whole Organizing Committee of GEP 2018 for their commitment and hard work.

The Editors

Contents

Biodegradable polymers, biopolymers and biomaterials

Polymers and nano-technology for advanced applications

Processing, industrial processes and recycling of polymers

Rheological and mechanical properties of polymers and composite materials

Aging of elastomeric components of a solar thermal collector under solar radiation

M.C. Ferreira[1], G. Ritto[2], M.T. Cidade[2], M.J. Carvalho[1], T.C. Diamantino[1]

[1] National Laboratory of Energy and Geology, Lisbon (Portugal).
[2] Department of Materials Science, Nova University of Lisbon (Portugal)

Introduction

Elastomeric components play important functions in solar thermal collectors (STC's) as sealings, fittings or absorbers, being important that they maintain their performance along STC lifetime. However, stress factors such as high temperatures and high levels of solar radiation, as exist in southern Europe countries, can affect the properties of those components.

A testing programme for the assessment of elastomeric materials of such components is detailed in international standards (ISO 9808 and ISO 9553), which already considers the effect of heating.

To our knowledge, there is lack of information regarding the evaluation of the effect of solar radiation as well as of the combined effect of heat and radiation on those elastomeric materials.

The work presented is part of a study [1] aiming at gathering data concerning the effect of solar radiation on elastomeric components of STC's and evaluating the necessity of introducing this factor in a more complete testing programme which is of the utmost importance for a producer of such equipments. The work was performed on two components of a commercial STC, a fitting with the function of isolating inlet and outlet connections, and a glazing sealant, both carbon black filled ethylene propylene diene terpolymer (EPDM) compounds.

In order to understand and compare the effects of solar radiation, conjugate effect of heat and solar radiation and of the laboratory light sources, the components and the solar thermal collectors including them were exposed in two outdoor exposure testing (OET) sites in Portugal (Sines and Lumiar-Lisboa) [2]. In addition, laboratory accelerated tests, including exposure to UV fluorescent radiation and to xenon arc radiation, were performed. This paper focuses mainly on the analyses of the changes of hardness and crosslinking density upon exposure.

Experimental

The components itself were tested after 1, 2 and 3 years exposure on the two OET sites and those included in the collectors were tested after two years of exposure of the collector in stagnation conditions.

Exposure to xenon-arc radiation was done according to ISO 4892-2:2013, cycle nº 4, in an Atlas Weatherometer Ci35A with daylight (borosilicate) filters. Periods of exposure varied between 72 h and 3240 h.

Exposure to UV fluorescent radiation was done according to ISO 4892-3:2013, cycle nº 2, in a chamber Q-Lab QUV spray with a UVA-340 lamp type. Periods of exposure varied between 84 h and 4320 h.

Crosslinking density was determined by the equation of Flory-Rehner, using toluene as swelling agent [3]. The samples were immersed for 48 h, changing the solvent after 24 h.

Results presented are the average of five determinations.

Hardness (International Rubber Hardness Degrees-IHRD) was determined using a durometer Adamel Lhomargy DU.05.

Results and Discussion

It was found that in general crosslinking density increased upon exposure of the components in OET sites and to laboratory light sources, in accordance with the occurrence of photodegradation reactions.

Highest levels of crosslinking density were obtained for the samples exposed to laboratory UV radiation for longer periods.

Fitting samples in the collector showed differences according to their position, crosslinking density of those in higher position being higher than those in lower position.

Crosslinking density of the samples exposed in OET sites for two or three years approached the values determined for the same components in the collector after two years exposure in stagnation conditions.

Similar values of crosslinking density of the components after exposure in the collector were obtained after laboratory exposure. However, the source of radiation and time of test depended on the component. For example, the value of crosslinking density of the sealing from the collector exposed in Sines was reached more quickly on the exposure to Xenon-arc radiation than on the exposure to UV radiation, while for the fitting the opposite was observed.

It is expected that an increase of crosslinking density will lead to increase of hardness. However, a straightforwardly relation between these two characteristics was not always observed. This was observed in the fitting that showed higher values of hardness after Xenon-arc exposure than after UV-exposure, although values of crosslinking density in the latter case were higher. This behaviour is probably explained by the higher temperature reached in the Xenon-arc test in which black panel temperature is 63±3 ºC, while in the UV test is 50±3 ºC. Higher testing temperature can lead to loss of lower boiling point formulation components.

Aknowledgements

This work is a result of the project FCOMP-01-0124-FEDER-027507 (Refª FCT RECI/EMS-ENE/0170/2012) and the project POCI-01-0145-FEDER-016709 (Refª FCT PTDC/EMS-ENE/0578/2014) supported by COMPETE 2020 and LISBOA 2020 under the PORTUGAL 2020 Partnership Agreement through the European Regional Development Fund (ERDF) and supported by FCT through National Funds.

References

1. Ferreira, M.C., Rosado, A.R, Carvalho, M.J. and Diamantino, T.C. (2016). Assessment of Elastomeric Components of a Solar Thermal Collector. In: EuroSun 2016, ISES Conference Proceedings.
2. Diamantino, T.C., Gonçalves, R., Nunes, A., Páscoa, S., Carvalho M. J. (2017). Sol. Energy Mat. Sol. Cells 166, 27-38.
3. Kwak, S. B., Choi, N. S. (2011). Int. J. Auto. Tech-Kor. 12, 401-408.