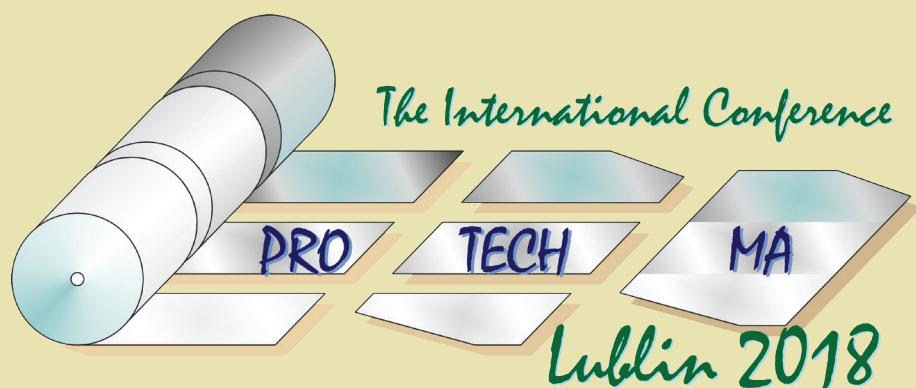


PRO-TECH-MA 2018

The Progressive Technologies and Materials

*edited by
Grzegorz Samołyk*



Lublin 2018

KONFERENCJE

PRO-TECH-MA 2018

The Progressive Technologies and Materials

Konferencje – Politechnika Lubelska



Politechnika Lubelska
Wydział Mechaniczny
ul. Nadbystrzycka 36
20-618 LUBLIN

PRO-TECH-MA 2018

The Progressive Technologies and Materials

edited by
Grzegorz Samołyk



Politechnika Lubelska
Lublin 2018

Adviser by Scientific Committee:

Prof. Zbigniew Pater, Ph.D.,D.Sc.,(Eng.), Lublin University of Technology

Prof. Feliks Stachowicz, Ph.D.,D.Sc.,(Eng.), Rzeszow University of Technology

Prof. Ing. Emil Spišák, C.Sc., Technical University of Košice

Prof. Stanisław Adamczak, Ph.D.,D.Sc.,(Eng.), Kielce University of Technology

Prof. Marek Blazinski, Ing., M.Sc.A., Ph.D., Polytechnique Montréal

Prof. Ing. Janette Brezinová, C.Sc., Technical University of Košice

Prof. Leszek F. Demkowicz, Ph.D.,D.Sc.,(Eng.), University of Texas at Austin

Prof. Andrzej Gontarz, Ph.D.,D.Sc.,(Eng.), Lublin University of Technology

Prof. Ing. Ernest Gondár, PhD., Slovak University of Technology in Bratislava

Prof. Ing. František Greškovič, Ph.D., Technical University of Košice

Prof. Eugeuniusz Hadasik, Ph.D.,D.Sc.,(Eng.), Silesian University of Technology

Prof. Waldemar Karwowski, Ph.D.,D.Sc.,(Eng.), University of Central Florida

Doc. Ing. Viliam Hrnčiar, CSc., Slovak University of Technology in Bratislava

Publikacja wydana za zgodą Rektora Politechniki Lubelskiej

© Copyright by Politechnika Lubelska 2018

ISBN: 978-83-7947-313-7

Wydawca: Politechnika Lubelska

ul. Nadbystrzycka 38D, 20-618 Lublin

Realizacja: Biblioteka Politechniki Lubelskiej

Ośrodek ds. Wydawnictw i Biblioteki Cyfrowej

ul. Nadbystrzycka 36A, 20-618 Lublin

tel. (81) 538-46-59, email: wydawca@pollub.pl

www.biblioteka.pollub.pl

Druk: TOP Agencja Reklamowa Agnieszka Łuczak

www.agencjatom.pl

Elektroniczna wersja książki dostępna w Bibliotece Cyfrowej PL www.bc.pollub.pl

Nakład: 50 egz.

Contents

Preface	9
1. Unconventional material from sewage sludge with a potential application in a road construction	11
M. Wójcik, Ł. Bąk, F. Stachowicz	
2. The analysis of forming loads of friction stir welding joint	14
P. Myśliwiec, T. Balawender, R. E. Śliwa	
3. The influence of joining parameters on mechanical properties of friction stir welding joint	17
T. Balawender, P. Myśliwiec, Ł. Micał	
4. Manufacturing technology of the thin-walled integral aircraft constructions	20
P. Bałon, E. Rejman, R. Smusz, B. Kielbasa, J. Szostak	
5. Comparative analysis of the impact of die design on its load and distribution of stress during extrusion	22
I. Nowotyńska, S. Kut	
6. Effect of thickness and sheet material properties on loading the bending tool	25
S. Kut	
7. Investigation of die oscilation effect in KOBÓ extrusion process	28
M. Zwolak, T. Balawender, R. E. Śliwa	
8. Mechanical properties of chips from magnesium alloy after consolidation using the KOBÓ method	31
B. Pawłowska	
9. Analysis of friction condictions in in hot ring rolling process	34
P. Surdacki, A. Gontarz	
10. Analysis of friction conditions for commerical plasticine – copolymer ABS friction pair	36
Ł. Wójcik, Z. Pater	

11. The effect of thermal treatment and hot forming on the structure and properties of magnesium alloy AZ91	38
A. Dziubińska, K. Majerski, G. Winiarski, M. Szucki, K. Drozdowski	
12. Investigation of the deformability of aluminium – copper casting alloys	40
G. Winiarski, A. Dziubińska, K. Majerski, M. Szucki, K. Drozdowski	
13. Creating the structure and properties of 7075 alloy casts by thermal and forming processes	43
K. Majerski, A. Dziubińska, G. Winiarski, M. Szucki, K. Drozdowski	
14. Analysis of the possibility of using cast 2xxx and 7xxx series Al alloys in the forging process	45
M. Szucki, A. Dziubińska, G. Winiarski, K. Majerski, K. Drozdowski, M. Górny, J. Buraś	
15. Investigation of the effect of the forming angle on force parameters in a skew rolling process for a stepped shaft	48
K. Lis, Z. Pater	
16. Evaluation of fibers orientation effect in the polymer matrix on strength properties of wood-polymer composites (WPC)	51
W. Frącz, G. Janowski	
17. Analysis of the change in thickness of the thin double reduced steel sheets by drawing of cups	54
J. Majerníková, E. Spišák, Ľ. Kaščák, J. Slota	
18. Forming analysis of continuously annealed, double reduced steel sheets	57
E. Spišák, J. Majerníková, P. Mulidrán, Ľ. Kaščák, J. Slota	
19. The influence of nanofillers on LDPE mechanical properties	60
Ľ. Dulebová, J.W. Sikora, F. Greškovič, B. Kiszka	
20. Radiation crosslinking of plastics in the automotive industry	63
F. Greškovič, E. Spišák, Ľ. Dulebová	
21. Weldability analysis of combination of dual-phase steels DP600 and DP780	66
Ľ. Kaščák, E. Spišák, J. Slota, J. Majerníková	
22. Options of use recycled materials in constructions of anti-sound clone (walls)	69
M. Badida, L. Sobotová, T. Dzuro, A. Badidová, A. Mikulová	
23. Creation of al joins by thermal drilling little-waste technology	72
L. Sobotova, M. Badida, A. Badidova, A. Mašlejová	

24.	Possibilities of renovation functional surfaces of equipments in the steel industry	75
	J. Brezinová, J. Viňáš, D. Draganovská, A. Guzanová, J. Brezina	
25.	Application possibilities of ceramic coatings for the restoration of functional surfaces	78
	J. Viňáš, J. Brezinová	
26.	Investigations of hydromechanical forming technology for sheet blanks and tubes made of nickel superalloys inconel type	81
	M. Hycza-Michalska	
27.	Homogenization of honeycombs structures by microplar elasticity approach	83
	A. Skrzat, F. Stachowicz, V. Eremeyev	
28.	Numerical and experimental analysis of the strength of tanks dedicated to hot utility water	85
	P. Bałon, E. Rejman, R. Smusz, B. Kielbasa, J. Szostak	
29.	Effect of parameters of reduction and mixing on brake properties	86
	R. Moszumański, A. Waško	
30.	Research of the influence of the initial deflection on the product radius in the equal angle bar bending process on three-roller bending machine	87
	I. Usydus, A. Tofil, A. Gontarz	
	Authors Index	89

Radiation crosslinking of plastics in the automotive industry

Keywords: radiation crosslinking, automotive, polymer composite.

Abstract

The cross-linking is the most important reaction of polymers that significantly changes product properties. In the cross-linking, the molecules are joined to create a functional net. The radiation in cross-linking causes change of the thermoplastic into the thermoset. Increasing density of cross-linking increases rigidity and hardness, electric resistance and resistance to solvents; and decreases the degree of bulking. The cross-linking is carried out by peroxides, silanes, ionizing radiation (for example the radiation dose in PE is within the range 1 – 30 Mrad) and by vulcanization of sulphur (in caoutchouc).

Higher temperatures are usually used (polymer is melted) in cross-linking by peroxides (dibenzoylperoxide, butylperoxide). In the first step, peroxide (ROOR) is decomposed by heat into free radicals RO which further react with polymer string. In the recombination of polymer radicals, there occurs joining of string through the C-C bond.

The disadvantages of cross-linking is its low efficiency (side reactions of peroxides and free radicals) and necessity of using the big amount of relatively expensive peroxides as well as mixing the compound of polymers with peroxides and stabilizers in a special equipment (in PE - Engel process).

Peroxide is used to create a primary radical. Molecules of silane are then inoculated with primary radicals. Then Si-O-Si bridges are created. For the optimal speed of reaction, elevated temperature is used (in PE from 80°C to 90 °C) with the presence of catalyst. The advantage of cross-linking by silanes is in using conventional machines, and in addition, wider temperature range

¹ Technical University of Košice, Faculty of Mechanical Engineering, Slovakia

* Corresponding author: frantisek.greskovic@tuke.sk

is available in comparison to the cross-linking by peroxides. The problem is the by-products occurrence (methanol and water) during reaction.

The cross-linking includes the basic assumption, that the materials during ionising radiation are mainly cross-linked and do not degrade. It is a physical method and chemical ingredients are not needed (for example in PP a cross-linking reagent TAIC is used). The main condition is the presence of three or more functional monomers. The interaction of radiation and polymers causes the creation of polymer radicals (decomposition of bonds C-H), which create nets by recombination in strings. A net is created by bonding of two free radicals between adjacent strings with creation of a C-C bond. The cross-linking is performed mostly by beta or gamma radiation. Because of radiation, thermoplastics are transformed into the materials with the properties of elastomers in certain temperatures. The elastomers or partially non cross-linked systems have a sufficient number of cross-linked areas due to radiation. It is not necessary to use the elevated temperature during the radiation cross-linking process. The cross-linking is always used after processing. Electrons can be accelerated artificially in so-called electron accelerators, for example transformation type Betatron or electrostatic cathodic.

The properties of a composite filled with an element filler depend on the physical properties of components (matrix, filler). The coherence of the matrix with the filler has a significant influence on the transmission of stresses on reinforcement as well as on the mechanical properties. The radiation technology of beta or gamma rays is utilized to achieve joining of the matrix structure with the reinforcement to increase the material strength, as presented in the figure 1 and figure 2.

The evaluation of composite structure is usually based on the fracture area after tensile test. It is realized by REM RE-Detector with given magnification. The material filled with glass short fibres PA6 GF30 is shown in figure above. Its structure is irradiated by dose of 100 kGy.

Using of regrinds from irradiated material in a repeated process of injection prevents the irradiated material from melting, which can affect the properties, as well as the appearance of the component. The method of the injection cycle reduction or cooling time can be reduced in some cases by about 40%.

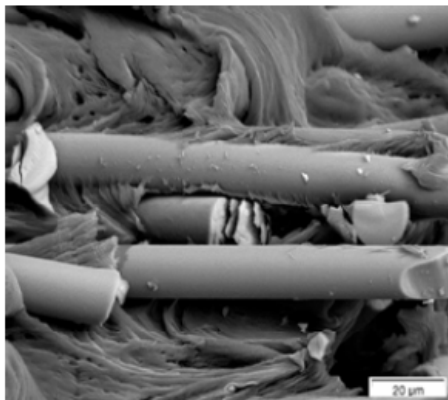


Fig. 1. Structure of unirradiated material

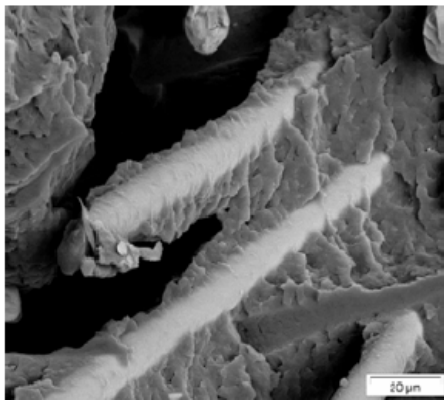


Fig. 2. Structure of irradiated material

Acknowledgment

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 734205 – H2020-MSCA-RISE-2017.



References

- [1] ref
- [1] Manas D., Manas M., Stanek M., Danek M. Materials Science and Engineering, 32 (2), 2008, 69-76
- [2] Kunststoff Magazin: Hart im Nehmen Strahlenvernetzung für hohe Temperaturen, 2009, 46-47