

It is worth stressing that for both of the varieties examined, very high efficiency (over 50%) of Cellulose I → Cellulose II transition was found in the case of a wide range of the concentrations applied, from 12.5 to 20%, and for a duration of the process of at least 5 minutes. This finding may be of considerable significance in the case of industrial utilisation of rapeseed straw for composite production, for example, with a polypropylene matrix. Moreover on the basis of the degree of crystallinity of cellulose in rapeseed straw after alkali treatment, it was found that no degradation of lignocellulosic material occurred during the mercerisation process.

On the basis of the results presented in this study, it is possible to draw the following conclusions.

- There were significant differences in the influence of NaOH solution in phase transformations cellulose I → cellulose II on rapeseed straw compared with other lignocellulosic materials, like natural fibres and wood.
- From the point of view of industrial utilisation of the mercerisation process, it can be said that optimal conditions for the process occur at base solution concentrations ranging from 12.5 to 20%, with process continuing for at least 5 minutes.
- There were no structural differences found between various rapeseed straw varieties during the mercerisation process.
- On the basis of the degree of crystallinity of cellulose in rapeseed straw after alkali treatment, it was found that no degradation of lignocellulosic material in the above-mentioned conditions occurred.

Acknowledgements

- The author wishes to thank Ms. Bogumila Broda for her assistance in the course of the realisation of this project.
- The work presented was supported by the Grant no. 32-6190/2011-13 of the Polish National Science Centre.

References

1. Polish Patent, patent application P. 358038, 2002.
2. Paukszta D. Investigations of Lignocellulosic Materials from Rape for the Purpose of Producing Composites with Thermoplastic Polymers. *Fibres & Textiles in Eastern Europe* 2005; 13, 5: 90-92.

3. Paukszta D. *Oilseed Crops* 2005; XXVI: 499.
4. Borysiak S, Paukszta D. *Mol. Cyst. Liq. Cyst.* 2008; 484: 379.
5. Paukszta D, Zielińska-Mačkowiak J.
6. Paukszta D, Drzewiecka R. *Przemysł Chemiczny* 2012; 10: 91.
7. Kijeńska M, Kowalska E, Pałys B, Ryczkowski J. *Polym. Deg. & Stab.* 2010; 95: 536.
8. Borysiak S, Garbarczyk J. Applying the WAXS method to estimate the supermolecular structure of cellulose fibres after mercerization. *Fibres & Textiles in Eastern Europe* 2003; 11, 5: 104-106.
9. Meshitsuka G, Isogai A. *Chemical Modification of Lignocellulosic Materials*. Ed. David N.-S. Hon, Copyright 1996 by M. Dekker, Inc, USA.
10. Gangoly P. J. *Text. Inst.* 1993; 84: 349.
11. Ouajaji S, Shanks RA. *Polym. Degrad. & Stability* 2005; 89: 327.
12. Mwaikambo LY, Ansell M., J. *Appl. Polym. Sci.* 2002; 84: 2222.
13. Błędzki AK, Gassan J. *Progr. Polym. Sci.* 1999; 24: 221.
14. Wang HM. *Textile Res. J.* 2003; 73: 664.
15. Pan MZ, Zhou DG, Deng J, Hang SY. *J. Appl. Polym. Sci.* 2009; 114: 3049.
16. Gassan J, Błędzki AK. *Composites Science & Technology* 1999; 59: 1303.
17. Gassan J, Błędzki AK. *Apel. Composite Mat.* 2000; 7: 373.
18. Van de Weyenberg I, Chi Truong T, Vangrimde B, Verpoest I. *Composites Part A* 2006; 37: 1368.
19. Mwaikambo LY, Martuscelli E, Apella M. *Polimer Testing* 2000; 19: 905.
20. Borysiak S, Doczekalska B. *Fibres & Textiles in Eastern Europe* 2005; 13, 5(53): 87-89.
21. Borysiak S, Doczekalska B. *Fibres & Textiles in Eastern Europe* 2008; 16, 6(71): 101-103.
22. Suardana NPG, Yingjun Piao, Jae Kyoo Lim. *Materials Physics and Mechanics* 2011; 1: 11.
23. Borysiak S, Doczekalska B, *Holz Roh-Werkstoff* 2006; 64: 451.
24. Borysiak S, J. *Therm. Anal. Calorim.* 2012; DOI 10.1007/s10973-012-2221x.
25. Paukszta D, Borysiak S. *e-Polymers* 2006; 1618-7229, 1.
26. Hindeleh AM, Johnson DJ. *Polymer* 1974; 15: 697.
27. Rabej S. *Eur. Polym.* 1991; 27: 947.
28. Paukszta D. *SPIE* 2000; 38: 4240.
29. Mansikkamaki P, Lahtinen M, Rissanen K. *Cellulose* 2005; 12: 233.
30. Dinand E, Vignon M, Chanzy H, Heux L. *Cellulose* 2002; 7, 9: 7.
31. Paukszta D. *Oilseed Crops* 2006; XXVII: 143.
32. Paukszta D. *Conference XIPS 2007*, Cracow, 66.

Received 26.11.2012 Reviewed 22.02.2013

UNIVERSITY OF BIELSKO-BIAŁA

Faculty of Textile Engineering and Environmental Protection

The Faculty was founded in 1969 as the Faculty of Textile Engineering of the Technical University of Łódź, Branch in Bielsko-Biała. It offers several courses for a Bachelor of Science degree and a Master of Science degree in the field of Textile Engineering and Environmental Engineering and Protection.

The Faculty considers modern trends in science and technology as well as the current needs of regional and national industries. At present, the Faculty consists of:

- The Institute of Textile Engineering and Polymer Materials, divided into the following Departments:
 - Polymer Materials
 - Physics and Structural Research
 - Textile Engineering and Commodity
 - Applied Informatics
- The Institute of Engineering and Environmental Protection, divided into the following Departments:
 - Biology and Environmental Chemistry
 - Hydrology and Water Engineering
 - Ecology and Applied Microbiology
 - Sustainable Development
 - Processes and Environmental Technology
 - Air Pollution Control



University of Bielsko-Biała
Faculty of Textile Engineering
and Environmental Protection

ul. Willowa 2, 43-309 Bielsko-Biała
tel. +48 33 8279 114, fax. +48 33 8279 100
E-mail: itimp@ath.bielsko.pl