

4. Klarin M, Spasojevic Brkic V, Stanisavljev S, Sajfert Z, Radojicic M, Nikolic M, Jovanovski B. A Stochastic Model to Determine the Elements of Production Cycle Time in Enterprise. In Klarin M. (Ed.) *2nd International Symposium Engineering Management and Competitiveness 2012 (EMC 2012)*. Zrenjanin, Republic of Serbia: University of Novi Sad, Technical faculty "Mihajlo Pupin", Zrenjanin. June 22-23, 2012; Zrenjanin, Republic of Serbia. Proceedings 978-86-7672-165-8. 2012, pp.425-432.
5. Klarin MM, Cvijanović MJ, Spasojević-Brkić KV. The shift level of the utilization of capacity as the stochastic variable in work sampling. *International Journal of Production Research* 2000; 38 (12): 2643-2651.
6. Klarin MM, Milanović DD, Misita M, Spasojević-Brkić KV, Jovanović A. A method to assess capacity utilization in short cycle functional layouts. *Institution of Mechanical Engineers Part E - Journal of Process Mechanical Engineering* 2010; 224(E1): 49-58.
7. Maynard HB. *Industrial Engineering Handbook*. Ed. PA: McGraw-Hill, Pittsburgh, 1971.
8. Moder JJ. Selection of work sampling observation times – Part I: Stratified sampling. *AIE Transactions* 1980; 12(1): 23-31.
9. Niebel WB. *Time Study, Handbook of Industrial Engineering*. Salvendi G. (Eds). New York: Wiley, 1980.
10. Richardson WJ, Eleanor SP. *Work Sampling, Handbook of Industrial Engineering*. Salvendi G. (Eds.), New York: Wiley, 1982.
11. Tippett LHC. Statistical Methods in Textile Research: The Analysis of Complex Variations. *Shirley Institute Memoirs* 1929; 8: 175-190.
12. Tippett LHC. Some Applications of Statistical Methods to the Study of Variation of Quality in the Production of Cotton Yam. *Supplement to the Journal of the Royal Statistical Society* 1935; II: 27-62.
13. Tippett LHC. *Applications of Statistical Methods to the Control of Quality in Industrial Production*. Transactions of the Manchester Statistical Society 1936: 1-32.

Received 26.09.2014 Reviewed 12.02.2015



INSTITUTE OF BIOPOLYMERS AND CHEMICAL FIBRES

LABORATORY OF BIODEGRADATION

The Laboratory of Biodegradation operates within the structure of the Institute of Biopolymers and Chemical Fibres. It is a modern laboratory with a certificate of accreditation according to Standard PN-EN/ISO/IEC-17025: 2005 (a quality system) bestowed by the Polish Accreditation Centre (PCA). The laboratory works at a global level and can cooperate with many institutions that produce, process and investigate polymeric materials. Thanks to its modern equipment, the Laboratory of Biodegradation can maintain cooperation with Polish and foreign research centers as well as manufacturers and be helpful in assessing the biodegradability of polymeric materials and textiles.

The Laboratory of Biodegradation assesses the susceptibility of polymeric and textile materials to biological degradation caused by microorganisms occurring in the natural environment (soil, compost and water medium). The testing of biodegradation is carried out in oxygen using innovative methods like respirometric testing with the continuous reading of the CO₂ delivered. The laboratory's modern MICRO-OXYMAX RESPIROMETER is used for carrying out tests in accordance with International Standards.



The methodology of biodegradability testing has been prepared on the basis of the following standards:

- **testing in aqueous medium:** 'Determination of the ultimate aerobic biodegradability of plastic materials and textiles in an aqueous medium. A method of analysing the carbon dioxide evolved' (PN-EN ISO 14 852: 2007, and PN-EN ISO 8192: 2007)
- **testing in compost medium:** 'Determination of the degree of disintegration of plastic materials and textiles under simulated composting conditions in a laboratory-scale test. A method of determining the weight loss' (PN-EN ISO 20 200: 2007, PN-EN ISO 14 045: 2005, and PN-EN ISO 14 806: 2010)
- **testing in soil medium:** 'Determination of the degree of disintegration of plastic materials and textiles under simulated soil conditions in a laboratory-scale test. A method of determining the weight loss' (PN-EN ISO 11 266: 1997, PN-EN ISO 11 721-1: 2002, and PN-EN ISO 11 721-2: 2002).



AB 388



The following methods are applied in the assessment of biodegradation: gel chromatography (GPC), infrared spectroscopy (IR), thermogravimetric analysis (TGA) and scanning electron microscopy (SEM).

Contact:

INSTITUTE OF BIOPOLYMERS AND CHEMICAL FIBRES
ul. M. Skłodowskiej-Curie 19/27, 90-570 Łódź, Poland
Agnieszka Gutowska Ph. D.,
tel. (+48 42) 638 03 31, e-mail: lab@ibwch.lodz.pl