

National Technical University of Athens (NTUA)

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Bioresource Technology Unit

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Organisation

The Bioresource Technology Unit (BTU) of the National Technical University of Athens is a R&D unit within the Process & Product Development Division, Department of Chemical Engineering at NTUA, Athens, Greece, devoted to the study of the engineering of the lignocellulosic, the pulp and paper and the chemical/biochemical industries. Established in 1985 by E.G.Koukios, BTU has had significant research experience in the above fields through projects financially supported by national and international agencies, including the Commission of the EC. A major feature of the BTU approach is its extensive network of research contacts and collaborations with academic, research, industrial and other organisation in Greece, other EC countries, East Europe and other European countries, North America and the developing world. Recent or ongoing relevant projects are:

-Innovative Concepts in Agricultural Residues Utilisation for Sustainable Development (ICARUS project) (1994-1997)

-Developing Analytical Methods From Fluorescence Spectra and Video Images with Relevance to Food and Non-Food Agro-Industrial Engineering Using New Computer – Based Evaluation Techniques (AFFLUENCE project) (1994-1998).

NTUA/BTU has been particularly active in the development of innovative methods for lignin characterisation and for the study of paper structure. The experience of the team is proved by the followings references: Billa E., Koukios E. and Monties B. "Investigation of lignins structure in cereal crops by chemical degradation methods" *Polymer Degradation and Stability*, in press. Billa E. and Koukios E.G. "A new, Fluorescence based, multivariate chemometrics approach for the characterization of lignocellulosics" *Proceedings 9th International Symposium on Wood and Pulping chemistry*, pp. T1-(1-4) June 9-12, 1997, Montreal, Canada. Billa E., Argyropoulos D. and E.G. Koukios. "Correlating residual kraft lignins ³¹P NMR and fluorescence spectroscopy data by multivariate chemometric analysis" *Proc. Workshop in Advances of Microscopy and NMR Spectroscopy of Lignocellulosic Materials*, p. 3 June 5-6, 1997, Quebec, Canada.

Background and qualifications

The Bioresource Technology Unit (BTU) is a R&D group operating within the Process & Product Development Division, Department of Chemical Engineering, at NTUA. Establishing BTU in the mid-80s has come as a response to the gradual emergence of new technologies for large-scale conversion of renewable raw materials of biological origin to various non-food (industrial and energy) market outlets. The BTU approach in handling research questions in this field is essentially a systems' one, combining relevant engineering, chemical, biological and socio-economic sciences and disciplines. To meet the demands for such a multi-disciplinary work, BTU has put together several European and world-wide research collaboration networks.

The BTU relevant RTD areas are as follows:

- **EVALUATING THE RESOURCE BASIS:** Studies of biomass potential; physico-chemical characteristics of agro-industrial residues and energy crops.
- **NEW RESOURCE/END-USE INTERFACES: BIOMASS REFINING:** Physico-bio-chemical fractionation and pretreatment of biological materials.
- **INTEGRATING LOCAL/REGIONAL APPLICATIONS:** Local/regional-level biomass studies; technology diffusion; policy & decision-making support tools and models.

The expertise includes the following:

* Characterisation: BTU can contribute to the characterisation of various bioresources through "novel" spectroscopic methods. BTU applies non-destructive fluorescence techniques for the correlation of feedstock structure with product properties. Fluorescence microscopy is also used in the analysis of tissue composition, whereas spectrofluorimetry is applied for the characterisation of extractives and phenolics in plant-derived materials. Multivariate analysis is used for the interpretation of fluorescence spectra.

Recent relevant projects include

- BIO-PATH: Network on bio-products from agricultural raw materials, EC, Co-operation Programme with Central and Eastern European Countries, 1993-1996 (Network Co-ordinator).
- ICARUS: Innovative concepts for agricultural residues utilisation for sustainable development, EC STD (Science and Technology for Development) Programme, 1994-1997 (Project co-ordinator).
- AFFLUENCE: Developing analytical methods from fluorescence spectra and video images with relevance to food and non-food agro-industrial engineering using new computer-based evaluation techniques, EC AIR Programme, 1994-1998.
- XYLOPHONE: Development of xylo-oligosaccharides and xylitol for use in pharmaceutical and food industries, EC FAIR Programme (FAIR2-CT97-3811), 1998-2001.

Most recent publications

- Billa, E., and Koukios, E.G., "Fluorescence analysis of paper pulps," *Bioresource Technology*, **67**, 25-33 (1999).
- Billa, E., Argyropoulos, D.S., and Koukios, E.G., "Recent advances in residual kraft lignin characterisation combining ³¹P NMR and fluorescence spectroscopy with chemometrics," in: *Advances in Lignocellulosics Characterisation*, pp. 131-143, Tappi Press, Atlanta (1999).
- Koullas, D.P., Umealu, O.S., and Koukios, E.G., "Solvent selection for the extraction of ethanol from aqueous systems," *Separation Science and Technology*, **34**, 2153-2163 (1999).
- Arvelakis, S., Sotiriou, C., Moutsatsou, A., and Koukios, E.G., Prediction of the behaviour of biomass ash in fluidised biomass combustors and gasifiers," *Journal of Thermal Analysis and Calorimetry*, **56**, 1271-1278 (1999).
- Diamantidis, N.D., and Koukios, E.G., "Agricultural crops and residues as feedstocks for nonfood products in Western Europe," *Industrial Crops and Products*, **11**, 97-106 (2000).
- Avgerinos, E. and Koukios, E.G. et al., "Modelling the kinetics of the autocatalysed hydrolysis of lignocellulosic materials," Proc. 3rd National Chemical Eng. Conference, Athens, May 2001.
- Kabel, M.A., Carvalheiro, F., Garrote, G., Avgerinos, E., Koukios, E., Parajó, J.C., Gírio, F.M., Schols, H.A. & Voragen, A.G.J., "Characterisation of four xylan rich by-products and of their corresponding hydrolysates obtained by a mild hydrothermal treatment," *Carbohydrate Polymers*, Submitted (2001).