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Application of inverse gas chromatography in physicochemical characterization of phenolic resin adhesives

Beata Strzemiecka, Adam Voelkel *, Mateusz Hinz, Mateusz Rogozik

Poznań University of Technology, Institute of Chemical Technology and Engineering, pl. M. Skłodowskiej-Curie 2, 60-965 Poznań, Poland

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ABSTRACT

One of the most important stages during production of abrasive tools is their hardening. The degree of hardening is very important and influence toughness of the final product. During hardening process the cross-linking of the phenolic resins, used as a binder, occurs. Nowadays, there is no standard accurate and simple method for the estimation of the hardening degree of abrasive tools. The procedure of the determination of hardening degree of the binder (phenolic resin) by means of inverse gas chromatography (IGC) was presented in this paper. Results obtained by use of IGC derived method was verified by Soxhlet extraction and by FTIR method. Good agreement was found for results from IGC and Soxhlet extraction whereas those from FTIR were much lower. FTIR method supplies data concerning bulk properties not the surface as in case of IGC and Soxhlet methods. These results indicate that resins are more cross-linked on the surface than inside the material.

1. Introduction

The production of the abrasive materials includes the following stages: covering of abrasive materials by wetting agent, addition of the filler with the binding material, mixing of the components, stabilization of the composition and the hardening. The most important processes influencing the properties of the final product are the coverage of the abrasive materials, mixing and proper hardening [1,2]. The homogeneity of the mixture of semi-product increases the quality of the final product. The effectiveness of the hardening process depends also on the applied temperature programme. Although the determination of wettability of abrasive materials is relatively simple, the controlling of the hardening process is much more complicated. There is no easy standard industry method for controlling the hardening degree of such complex composites [3]. Brinell test is the most commonly used test for assessment of hardness of abrasive tools. This method suffers from several disadvantages. The main disadvantage of this standard method is its very low repeatability and accuracy in case of such composites as abrasive tools. The results depend strongly on the glaze of ball pressing. Moreover, only final hardness of abrasive tool can be assessed. It is not possible to monitor the hardening process on-line. Viscoelastic parameters can be also applied for estimation of the degree of hardening. This method needs to use expensive equipment for dynamic rheological measurements. Moreover, it can be applied only for resins without additives or with nano/microfillers. The presence of filler nano/microparticles in resin can influence the rheological parameters significantly.

Inverse gas chromatography is an extension of classic gas chromatography [4–8]. The word "inverse" means that the examined material is placed in the chromatographic column and its properties are determined based on the retention behaviour of carefully selected test compounds. Inverse gas chromatography method is widely used for characterization of polymers and polymer blends [9], surfactants [10,11], biopolymers, solid food and petroleum pitches [11]. Inverse gas chromatography can be divided into inverse gas-liquid and inverse gas-solid chromatography. The obvious criterion of such discrimination is the state of the examined material placed in the column. The dominating retention mechanism is related to the temperature of IGC experiment. Polymeric materials might be characterized by using both surface parameters (surface free energy, surface acid/base properties and bulk parameters). The pertinence of IGC measurements to surface or bulk properties clearly depends on whether or not the probe molecules can diffuse into the bulk during the experiment. Retention volume measured at the temperature of IGC experiment higher than T_g of the examined polymer (or blend) results from the sum of surface and bulk sorption. Below T_g mainly from the adsorption of probe molecules

* Corresponding author.
E-mail address: Adam.Voelkel@put.poznan.pl, adamvoelkel@wp.pl
(A. Voelkel).

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Physicochemical Applications Of Gas Chromatography

Paul R. Loconto

Physicochemical Applications Of Gas Chromatography:

Physicochemical Applications of Gas Chromatography R. J. Laub,R. L. Pecsok,1978-08-17 An up to date critical review of recent advances covering all aspects in a simplified user oriented and understandable fashion Gives a brief historical review and compares the technique with classical static methods for obtaining thermodynamic data emphasizing gas chromatography s accuracy and reproducibility Covers virial coefficients use of chemically active mobile phases solution properties complexation interaction and adsorption phenomena also contains a critique of recently proposed models of solutions Examines the potention for investigating kinetic phenomena and the properties of pure substances Contains a comprehensive bibliography **Physicochemical Measurement by Gas Chromatography** John R. Conder,Colin Leslie Young,Colin L. Young,1979 *Physical Methods in Modern Chemical Analysis V3* Theodore Kuwana,2012-12-02 Physical Methods in Modern Chemical Analysis Volume 3 presents the fundamental principles the instrumentation or necessary equipment and applications of selected physical methodologies in chemical analysis This volume contains chapters that discuss various topics on chemical analysis methods such as transform methods in chemistry X ray spectrometry the principles of electrochemical measurements and global optimization strategy for gas chromatographic separations The book will prove to be an excellent reference material for chemists researchers and students of chemistry *Handbook for the Analysis and Identification of Alternative Refrigerants* Thomas J. Bruno,2019-07-23 Many laboratories are engaged in research on the development of new fluids for use as refrigerants to replace the fully halogenated materials that are believed to contribute to atmospheric ozone depletion An integral part of this effort is the chemical analysis of new fluids that are synthesized prepared and tested This comprehensive book which is divided into two parts fills an important need in this vital chemical analysis protocol The first part reviews the major chemical analysis methods that have been developed and used at NIST and in other laboratories This review covers spectroscopic chromatographic and wet analytical methods with treatment divided by qualitative identification qualitative determinations and chemical reaction screening The second part contains a compilation of analytical information of the new fluids and their products Physical properties mass spectra infrared spectra ultraviolet spectra nuclear magnetic resonance spectra and gas chromatographic retention data are provided for each fluid or product **Tenth International Symposium on Chemical Reaction Engineering** J. R. Bourne,W. Regenass,W. Richarz,2017-05-04 ISCRE 10 Tenth International Symposium on Chemical Reaction Engineering documents the proceedings of the symposium which brought together experts from all over the world to discuss developments in CRE Efforts were made to cover high added value substances and to encourage papers from industry Some success was achieved but there remain significant gaps between Chemists and Chemical Engineers when considering high added value products as well as between researchers and practitioners of CRE The volume begins with plenary papers covering topics such as challenges in reactor modeling bioreactor engineering the design of reaction systems for specialty organic chemicals This is followed by papers

presented during the eight technical sessions Technical session A focused on the modeling and control of chemical reactions Technical session B was devoted to studies on biotechnology Technical session C covered mixing while Technical session D dealt with special reactor systems and chemicals The papers in Technical session E examined reactions for emission control and recycling Technical session F covered the safety aspects of CRE Technical session G focused on the experiments with multiphase reactions while Technical session H dealt with catalytic reactors Gas Chromatography of Polymers ,2011-09-22 Gas Chromatography of Polymers **Chromatographic Theory and Basic Principles** J. A. Jonsson,1987-07-28 *Trace Environmental Quantitative Analysis* Paul R. Loconto,2005-08-29 Trace Environmental Quantitative Analysis Principles Techniques and Applications Second Edition offers clear and relevant explanations of the principles and practice of selected analytical instrumentation involved in trace environmental quantitative analysis TEQA The author updates each chapter to reflect the latest improvements in TEQA that *Physical Methods in Modern Chemical Analysis V1* Theodore Kuwana,2012-12-02 Physical Methods in Modern Chemical Analysis Volume 1 presents the fundamental principles the instrumentation or necessary equipment and applications of selected physical methodologies in chemical analysis This volume contains chapters on gas chromatography principles and instrumentation of mass spectrometry fluorescence and atomic absorption spectroscopy applications scope and structural problems of mass spectrometry and flame and plasma emission methods of analysis Chemists researchers and students of chemistry will find the book an excellent reference material **Advances in Chromatography** J. Calvin Giddings,2021-06-23 This book provides the most up to date information on a wide range of developments in chromatographic methods and applications It presents timely cutting edge reviews in the fields of bio analytical organic polymer and pharmaceutical chemistry

Physicochemical Applications Of Gas Chromatography Book Review: Unveiling the Power of Words

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