

Journal of ASTM International
Selected Technical Papers



STP 1477

Biofuels

JAI Guest Editors

Lou Honary

Charles Conconi



Journal of ASTM International
Selected Technical Papers STP1477
Biofuels

JAI Guest Editors:

Lou Honary
Charles Conconi



ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

ASTM Stock #: STP1477

Library of Congress Cataloging-in-Publication Data

ISBN: 978-0-8031-3411-9

Copyright © 2011 ASTM INTERNATIONAL, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Journal of ASTM International (JAI) Scope

The JAI is a multi-disciplinary forum to serve the international scientific and engineering community through the timely publication of the results of original research and critical review articles in the physical and life sciences and engineering technologies. These peer-reviewed papers cover diverse topics relevant to the science and research that establish the foundation for standards development within ASTM International.

Photocopy Rights

Authorization to photocopy items for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by ASTM International provided that the appropriate fee is paid to ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9634; online: <http://www.astm.org/copyright>.

The Society is not responsible, as a body, for the statements and opinions expressed in this publication. ASTM International does not endorse any products represented in this publication.

Peer Review Policy

Each paper published in this volume was evaluated by two peer reviewers and at least one editor. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM International Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of the peer reviewers. In keeping with long-standing publication practices, ASTM International maintains the anonymity of the peer reviewers. The ASTM International Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM International.

Citation of Papers

When citing papers from this publication, the appropriate citation includes the paper authors, "paper title", J. ASTM Intl., volume and number, Paper doi, ASTM International, West Conshohocken, PA, Paper, year listed in the footnote of the paper. A citation is provided as a footnote on page one of each paper.

Foreword

THIS COMPILATION OF THE *JOURNAL OF ASTM INTERNATIONAL (JAI)*, STP1477, on *BIOFUELS* contains papers published in JAI highlighting the many aspects of biofuels as a reference source for those involved in research, development, and/or the use of biobased fuels. Topics are widely varied and present unique and comprehensive areas of biofuels, the use of industrial crops and algae, enhancing existing esterification processes and new advancements.

This STP is sponsored by ASTM Committee D02 on Petroleum Products and Lubricants. The JAI Guest Editors are Prof. Lou Honary, University of Northern Iowa's National Ag-Based Lubricants Center, Waterloo, IA and Msc Eng. Charles Conconi, Mercedes-Benz do Brasil, São Bernardo Do Campo, Brazil, Ph.D. student of EESC.

The editors are pleased with the quality of the research papers submitted for review and publication and are certain the compilation of these papers will be helpful in advancing the development of biobased fuels.

Contents

Overview	ix
Analytical and Evaluation of Properties	
Analytical Characterization of Sediment Formed in Soy Oil-Based B20 Biodiesel T. P. McGinnis and K. B. Peyton,	3
Oxidation Stability of Soy and Palm Based Biodiesels Evaluated by Pressure Differential Scanning Calorimetry R. Artiaga, J. López-Beceiro, J. Tarrío-Saavedra, J. L. Mier, S. Naya, and C. Gracia,	29
Water Content Determination in Biodiesel: Optimization of Methodology in Coulometric Karl Fischer Titration M. P. Vicentim, M. V. B. Sousa, V. Fernandes da Silva, V. L. Mateus, J. M. Rodrigues, and V. S. da Cunha,	42
Standard Reference Data for the Thermophysical Properties of Biofuels M. O. McLinden, T. J. Bruno, M. Frenkel, and M. L. Huber,	51
Challenge of Analytical Characterization of Biofuels R. A. Kishore Nadkarni,	78
Monitoring and Blending Biofuels Using a Microfluidic Sensor D. Sparks, R. Smith, D. Riley, N. Tran, J. Patel, A. Chimbayo, and N. Najafi,	111
Compositional Analysis of Microwave Chemically Treated Biomass Samples L. N. Tenlep, D. E. Raynie, and N. J. Thiex,	123
Calibration Standards for Biodiesel Fuels B. H. Clampitt and J. B. Sardisco,	138
A Simple Green Method for Biodiesel Iodine Number Determination J. A. Aricetti, A. J. da Silva Maciel, O. C. Lopes, and M. Tubino,	146
Potentiometric Titration as an Alternative Technique for the Determination of the Iodine Value in Biodiesel Matrix from Palm Oil R. V. P. Leal, P. P. Borges, and P. R. Seidl,	157
Acid Number Determination of Biodiesel by Potentiometric Titration Using Different Methods M. A. Gonçalves, K. C. Cunha, S. P. Sobral, F. B. Gonzaga, I. C. S. Fraga, and P. P. Borges,	171
Determination of Ester Content in Different Kinds of Biodiesel F. D. Faria, K. O. Cerqueira, G. P. Leal, R. C. L. Pereira, and M. J. R. G. Neto,	181
Synthetic Jet Fuel Blend Analysis Using Mid-Infrared Spectroscopy D. Wilks,	193
Determining the Oxidation Stability of Biodiesel and Blends Using a New Rapid Small Scale Oxidation Test (RSSOT)—The PetroOXY V. Wierzbicki,	200
The Impact of Fischer–Tropsch Diesel on the Oxidation Stability of Biodiesel (FAME) Blends A. Blignaut, L. Collier, and M. Pretorius,	214
Application of Thermogravimetric Analysis for the Proximate Analysis of Livestock Wastes K. B. Cantrell, J. H. Martin, II, and K. S. Ro,	225

pH Measurement in Bioethanol by Using Different Electrodes and according to International Standards	
P. P. Borges, I. C. S. Fraga, B. S. R. Marques, J. C. Dias, and V. S. Cunha,	248
Cold Flow Properties of Biodiesel by Automatic and Manual Analysis Methods	
R. O. Dunn,	256
The Influence of the Addition of Oils in the Diesel Fuel Density	
D. M. do Espirito Santo Filho, F. L. B. De Abreu, R. G. Pereira, J. J. P. dos Santos Júnior, J. R. R. Siqueira, P. L. S. Ferreira, T. de Paula Barbosa, L. S. Lima, and F. de Oliveira Baldner,	277

Biodiesel Fuels and Base Oils

Synthesis of Biodiesel from Tobacco and Waste Frying Oil Using Heterogeneous $\text{KHCO}_3/\text{Al}_2\text{O}_3$ Catalyst	
G. Anastopoulos, A. Deligiannis, S. Kalligeros, D. Karonis, F. Zannikos, and E. Lois,	293
Performance Characteristics of a Dual Fuel Engine Operated with Mahua Biodiesel and Liquefied Petroleum Gas	
N. Kapilan, T. P. Ashok Babu, and R. P. Reddy,	312
Biodiesel Synthesis via Recyclable Heterogeneous Catalyst: Titanium Niobate Nanosheet	
E. J. Mercer and F. T. Halaweish,	328
Experimental Investigations of Preheated Jatropha Oil Fuelled Direct Injection Compression Ignition Engine—Part 1: Performance, Emission, and Combustion Characteristics	
A. K. Agarwal and A. Dhar,	337
Experimental Investigation of Preheated Jatropha Oil Fuelled Direct Injection Compression Ignition Engine—Part 2: Engine Durability and Effect on Lubricating Oil	
A. K. Agarwal and A. Dhar,	355
Characterization of Density of Biodiesel from Soybean, Sunflower, Canola, and Beef Tallow in Relation to Temperature, Using a Digital Density Meter with a Metrological Point of View	
D. M. E. Santo Filho, F. L. B. de Abreu, R. G. Pereira, J. R. R. Siqueira, J. J. P. dos Santos Júnior, and R. J. Daroda,	376
Lipase-Catalyzed Production of Biodiesel from Tallow	
J. Han, P. Silcock, M. Bell, and J. Birch,	384
CO_2-Neutral Fuels and Lubricants Based on Second Generation Oils such as Jatropha	
D. Spaltmann, A. von Gablenz, and M. Woydt,	398
The Potential of Biodiesel Production from Fatty Acid Methyl Esters of Some European/Mediterranean and Cosmopolitan Halophyte Seed Oils	
V. T. Sotiroudis, T. G. Sotiroudis, and F. N. Kolisis,	421
Characterization of Corn Grains for Dry-Grind Ethanol Production	
S. Srichuwong, J. Gutesa, M. Blanco, S. A. Duvick, C. Gardner, and J.-L. Jane,	434
Glycerol Tri-Ester Derivatives as Diluent to Improve Low Temperature Properties of Vegetable Oils	
S. N. Shah, B. R. Moser, and B. K. Sharma,	450

Related Topics

ASTM Proficiency Testing Programs for Biofuels	
R. A. K. Nadkarni and A. McKlindon,	467
Addressing the Issue of Fuel Filter Fouling with Recent Changes in Fuel Quality	
P. Richards, J. Barker, and S. Cook,	496

Pretreatment of Douglas Fir Wood Biomass for Improving Saccharification Efficiencies R. R. Singhanian, S. Chiesa, R. K. Sukumaran, J. D. Villegas, A. K. Patel, E. Gnansounou, and A. Pandey,	518
Bioproducts Process Pathways for Kraft Paper Mills C. M. Dickerson and J. Rubin,	530
Immobilization of Cellulase and Hemicellulases on Porous Glass Beads P. Mandali and B. K. Dalaly,	549
Review of Key Research Efforts to Make Algae Fuels Sustainable K. Parkavi and B. Mathumitha,	566
Vehicle Emissions and Fuel Economy Effects of 16 % Butanol and Various Ethanol Blended Fuels (E10, E20, and E85) M. Schulz and S. Clark,	577
Author Index	619
Subject Index	621

Overview

Crop oils and fuels derived from them present properties that are suitable for industrial and automotive lubricants and fuel applications. They also present an alternative to petroleum when the demand for this finite resource is ever increasing. In the United States, National policy has created a new impetus for promoting and using biofuels. Moreover, worldwide demand for petroleum, combined with geopolitical issues related to petroleum producing regions, has created a more accepting market and more vigorous search for alternative fuels.

The United States is the largest worldwide supplier of agricultural products and oilseeds. Advanced mechanized farming, combined with superior seed and related technologies, has made the countrys farmers highly efficient producers of commodity crops. Similarly, Canadian and European countries have invested significant amounts of resources in advancing production technologies for canola and rapeseed, respectively. Other countries, such as Brazil, have also increased production of oilseed crops, such as soybeans, to the point of being competitive in the world market.

This book provides a large array of topics related to biofuels. The editors selected the articles for their usefulness and variety. The topics range from detailed technical to economic and efficiency related subjects. We are certain the collection of these papers will be a useful reference for those interested in the research, development, and use of biofuels.

Lou Honary
University of Northern Iowa
National Ag-Based Lubricants Center
Waterloo, IA

Charles Conconi
Mercedes-Benz do Brasil
São Bernardo Do Campo, SP
USP — Universidade de São Paulo
São Carlos, SP
Brazil

**ANALYTICAL AND
EVALUATION OF PROPERTIES**



www.astm.org

ISBN: 978-0-8031-3411-9

Stock #: STP1477