

ARB Literature Review

This document is a comprehensive list of the available literature that ARB is staff is aware of regarding the effect of biodiesel blends from commonly available feedstocks on NOx emissions in compression ignition engines. Staff has reviewed all of the studies and reports listed here and is analyzing the data for inclusion in the upcoming biodiesel and renewable diesel rulemaking process.

Lit Search			
Author	Title	Journal	Year
Adi, G.	Soy-Biodiesel Impact on NOx Emissions and Fuel Economy for Diffusion-Dominated Combustion in a Turbo-Diesel Engine Incorporating Exhaust Gas Recirculation and Common Rail Fuel Injection	Energy & Fuels Vol. 23 pp 5821-5829	2009
Alam, M.	Combustion and Emissions Performance of Low Sulfur, Ultra Low Sulfur and Biodiesel Blends in a DI Diesel Engine	SAE 2004-01-3024	2004
Arai, M.	Effect of biodiesel fuel on direct injection diesel Engine performance	Journal of Propulsion and Power, Vol. 24, No. 3, 2008, pp. 603-608.	2008
Banapurmath, N.R.	Experimental investigations of a four-stroke single cylinder direct injection diesel Engine operated on dual fuel mode with producer gas as inducted fuel and Honge oil and its methyl ester (HOME) as injected fuels	Renewable Energy Vol. 33 pp 2007-2018.	2008
Bennett, M.	Biodiesel effects on particulate radiocarbon (C-14) emissions from a diesel Engine	Journal of Aerosol Science Vol. 39 667-678.	2008
Bhardwaj, O.	A Comparative Study of Performance and Emission Characteristics of a CRDe SUV Fueled With Biodiesel Blends and Diesel Fuel	SAE 2008-28-0075	2008
Bielaczyc, P.	A Study of RME-Based Biodiesel Blend Influence on Performance, Reliability and Emissions from Modern Light-Duty Diesel Engines	SAE 2008-01-1398	2008
Bunce, M.	Stock and Optimized Performance and Emissions with 5 and 20% Soy Biodiesel Blends in a Modern Common Rail Turbo-Diesel Engine	Energy & Fuels Vol. 24 pp 928-939	2010
Cheng, A.S.	Investigation of the impact of biodiesel fuelling on Nox emissions using an optical direct injection diesel engine	Energy & Fuels, Vol. 21, No. 4, 2007, pp. 1989-2002.	2006
Cheng, C. H.	Comparison of emissions of a direct injection diesel Engine operating on biodiesel with emulsified and fumigated methanol	Fuel Vol. 87 pp 1870-1879.	2008
Cho, H. M.	Waste Cooking Oil as Fuel in Diesel Engines	SAE 2008-28-0013	2008
Clark, N.	Class 8 Truck Emission Testing: Effects of Test Cycles and Data on Biodiesel Operation AND DATA ON BIODIESEL OPERATION	ASAE, 1999, 42(5), 1211-1219	1999
Clark, N.	Transient Emissions Comparisons of	SAE 1999-01-1117	1999

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Author	Title	Journal	Year
	Alternative Compression Ignition Fuel		
Contadini, J.	Life-Cycle Emissions of Alternative Fuels for Transportation: Dealing with Uncertainties	SAE 2000-01-0597	2000
DraftLube	Advance Petroleum -Based Fuels - Diesel Emissions Control (APBF-DEC) Lubricants Project Phase 2: Effects of Oil Properties on the Performance of Nox Adsorber Catalysts (NAC) for Heavy Duty Diesel Engines	Report	2005
Durbin, T.D.	Effects of Biodiesel Blends and Arco EC-Diesel on Emissions from Light Heavy-Duty Diesel Vehicles	Environmental Science & Technology Vol. 36 No. 8 pp 1686-1691	2002
Durbin, T.D.	Feasibility Study for the Use of Biodiesel in the Caltrans Fleet	Report	2007
Durbin, T.D.	CE-CERT Engine Testing Portion for the CARB Assessment of the Emissions from the Use of Biodiesel as a Motor Vehicle Fuel in California "Biodiesel Characterization Study, Nox Impact Study"	Draft Memorandum	2009
Durbin, T.D.	The Effects of Biodiesel Blends and ARCO EC-Diesel on emissions from light heavy duty diesel vehicles	Report (Published as Durbin 2002)	2001
Durbin, T.D.	Regulated emissions from biodiesel fuels from on/off-road applications	Atmospheric Environment Vol. 42 pp 5647-5658	2007
Durbin, T.D.	Evaluation of the Effects of Alternative Diesel Fuel Formulations on Exhaust Emission Rates and Reactivity	Report (Published as Durbin 2000)	1999
Durbin, T.D.	Effects of Biodiesel, Biodiesel Blends, and a Synthetic Diesel on Emissions from Light Heavy-Duty Diesel Vehicles	Environmental Science & Technology Vol. 34 No. 3 pp 349-355	2000
Eckerle, W.A.	Effects of Methyl Ester Biodiesel Blends on NOx Emissions	SAE 2008-01-0078	2008
Frank, B.P.	A Study of the Effects of Fuel Type and Emission Control Systems on Regulated Gaseous Emissions from Heavy-Duty Diesel Engines	SAE paper no. 2004-01-1085	2004
Frey, H.C.	Characterization of Real-World Activity, Fuel Use, and Emission for Selected Motor Graders Fueled with Petroleum Diesel and B20 Biodiesel	Journal of Air & Waste Manag Assoc. 2008 Oct;58(10):1274-87.	2008
Goetz, W.	Evaluation of a Tallow/Diesel in a DDC 6V-92TA Engine	Ortech International report no. 93-E14-37 International report no. 93-E14-37	1993
Graboski, M.S.	The Effect of Biodiesel Composition on Engine Emissions from a DDC Series 60 Diesel Engine, Final Report: Report 2 in a series of 6	NREL SR-510-31461	2003
Graboski, M.S.	Transient Emissions From No. 2, Diesel and Biodiesel Blends in a DDC Series 60 Engines	SAE paper no. 961166	1996
Hansen, K.F.	Chemical and Biological Characteristics of	SAE paper no. 971689	1997

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Author	Title	Journal	Year
	Exhaust Emissions from a DI Diesel Engine Fuelled with Rapeseed Oil Methyl Ester (RME)		
Hasegawa, M.	Effects of Fuel Properties (Content of FAME or GTL) on Diesel Emissions under Various Driving Modes	SAE 2007-01-4041	2007
Hess, M.	Effect of Antioxidant on NOx Emissions of Biodiesel	Energy & Fuels Vol. 19 pp 1749-1754	2005
Hess, M.A.	Effect of Antioxidant Addition on Nox, Emissions from Biodiesel	USDA Report	2005
Holden	Effect of Biodiesel on Diesel Engine Nitrogen Oxide and Other Regulated Emissions Effect of Biodiesel on Diesel Engine Nitrogen Oxide and Other Regulated Emissions	technical report A709384	2006
Howell, S	Biodiesel and 2010 Engine After-treatment Technology	presentation, Alternative Fuels & Vehicles National Conference	2009
Hribernik, A.	Influence of biodiesel fuel on the combustion and emission formation in a direct injection (DI) diesel Engine	Energy & Fuels Vol. 21pp 1760-1767	2007
IEA	Emissions from heavy-duty engine with and without after treatment using selected biofuels	IEA-AMF Annex 13	2006
Kass, M.D.	Utilizing Water-Emulsification to Reduce NOx and Particulate Emissions Associated with Biodiesel	Transactions of the ASABE, 2009, vol. 52, no 1, pp. 5-13	2007
Kaufman, J.	Renewable Diesel*	Renewable Diesel. 5-15-2007. SAE Government/Industry Meeting.	2007
Kawano, D.	Optimization of Engine System for Application of Biodiesel Fuel	SAE 2007-01-2028	2007
Kegl, B.	Effects of biodiesel on emissions of a bus diesel Engine	Bioresource Technology Vol. 99 pp 863-873	2007
Kegl, B.	Experimental investigation of optimal timing of the diesel Engine injection pump using biodiesel fuel	Energy & Fuels Vol. 20 pp 2239-2248	2007
Kegl, B.	NOx and particulate matter (PM) emissions reduction potential by biodiesel usage	Energy & Fuels Vol. 21 pp 3310-3316	2007
Kim, M.Y.	Characteristics of Particulate Emissions of Compression Ignition Engine Fueled With Biodiesel Derived From Soybean	ASME Internal Combustion Engine Division 2007 Fall Tech. Conf. 2007, ICEF2007-1715, 1-7.	2007
Kinoshita, E.	Combustion Characteristics of Diesel Engine with Coconut Oil Ethyl Ester	SAE 2007-01-2021. International 2004, 2004-01-1860.	2007
Korres, D.M.	Aviation fuel JP-5 and biodiesel on a diesel Engine	Fuel Vol. 87 pp 70-78	2008
Krahl, J	Exhaust Gas Emissions and Mutagenic Effects of Diesel Fuel, Biodiesel, and Biodiesel Blend	SAE 2007-01-4042 4042.	2008
Krahl, J.	Comparison of Emissions and Mutagenicity from Biodiesel, Vegetable Oil, GTL and Diesel	SAE 2007 Transactions Journal of Fuels and Lubricants, Vol.	2007

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Author	Title	Journal	Year
	Fuel	V116-4, No. 2007-01-4042, 2007. 4042.	
Kumar, M.S.	Ethanol Animal Fat Emulsions as a Diesel Engine Fuel - Part 2: Engine Test Analysis. Emulsions as a Diesel Engine Fuel	Fuel Vol. 85 pp 2646-2652. 2006-01-0238.	2005
Kuronen, M.	Hydrotreated Vegetable Oil as Fuel for Heavy Duty Diesel Engines	SAE 2007-01-4031	2007
Lapuerta, M.	Effect of the alcohol type used in the production of waste cooking oil biodiesel on diesel performance and emissions	Fuel Vol. 87 pp 3161-3169	2008
Lea-Langton, A.	Comparison of Particulate PAH Emissions for Diesel, Biodiesel and Cooking Oil using a Heavy Duty DI Diesel Engine	SAE 2008-01-1811	2008
Lebedevas, S.	Use of waste fats of animal and vegetable origin for the production of biodiesel fuel: Quality, motor properties, and emissions of harmful components	Energy & Fuels Vol. 20 pp 2274-2280	2006
Li, H.	Study of Emission and Combustion Characteristics of RME B100 Biodiesel from a Heavy Duty DI Diesel Engine	SAE 2007-01-0074	2007
Lin, Y.C.	Characterization of particle size distribution from diesel Engines fueled with palm-biodiesel blends and paraffinic fuel blends LIN2008	Atmospheric Environment Vol. 42 pp 1133-1143	2008
Lu, X.C.	Experimental study on the combustion characteristics and emissions of biodiesel fueled compression ignition Engines with premixed dimethoxymethane	Energy & Fuels Vol. 21 pp 3144-3150 2007, pp. 3144-3150	2007
Lu, X.C.	Simultaneous reduction of NOx emission and smoke opacity of biodiesel-fueled Engines by port injection of ethanol	Fuel Vol. 87 pp 1289-1296 2008, 87 (7), 1289-1296.	2007
Malhotra, R.K.	Effect of Bio-diesel Blends on Performance and Exhaust Emissions in Passenger Car	SAE 2005-26-032	2005
Marques, A.	NOx Emissions Reductions in a Biodiesel Engine by Means of EGR Technology	SAE 2007-01-0078	2007
Masjuki, H.	Emissions and Lube Oil Monitoring of a Diesel Engine Fueled with Palm Oil Methyl Esters and its Emulsions	SAE 961083	1996
Mayer, A.	Impact of RME/Diesel Blends on Particle Formation, Particle Filtration and PAH Emissions	SAE 2005-01-1728	2005
Mazzoleni, C.	A case study of real-world tailpipe emissions for school buses using a 20% biodiesel blend	Science of the Total Environment Vol. 385 pp 146-159	2007
McCormick, R.L.	Effects of Biodiesel Blends on Vehicle Emissions	NREL/MP-540-40554	2006
McCormick, R.L.	Impact of Biodiesel Fuel on Pollutant Emissions from Diesel Engines	The Biodiesel Handbook, chapter	2005
McCormick, R.L.	The Impact of Biodiesel on Pollutant Emissions	Inhalation Toxicology Vol. 19	2006

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Author	Title	Journal	Year
	and Public Health	pp.1033-1039	
McCormick, R.L.	Fuel Additive and Blending Approaches to Reducing NOx Emissions from Biodiesel	SAE 2002-01-1658	2002
McCormick, R.L.	Regulated Emissions from Biodiesel Tested in Heavy-Duty Engines Meeting 2004 Emissions Standards	SAE 2005-01-2200	2005
McCormick, R.L.	Impact of Biodiesel Source Material and Chemical Structure on Emissions of Criteria Pollutants from a Heavy Duty Engine	Environ. Sci. Technol., 2001, 35 (9), pp 1742–1747	2001
McGill, R.	Emissions Performance of Selected Biodiesel Fuels	SAE 2003-01-1866	2003
Mueller, C.	An Experimental Investigation of the Origin of Increased NOx Emissions when Fueling a Heavy-Duty Compression-Ignition Engine with Soy Biodiesel	SAE 2009-01-1792	2009
Munack, I.	Comparison of Shell Middle Distillate, Premium Diesel Fuel and Fossil Diesel Fuel with Rapeseed Oil Methyl Ester	FAL report	2006
Muncrief, R.L.	Combining biodiesel and exhaust gas recirculation for reduction in NOx and particulate emissions	Energy & Fuels Vol. 22 pp 1285-1296	2008
Murillo, S.	Performance and exhaust emissions in the use of biodiesel in outboard diesel Engines	Fuel Vol. 86 pp 1765-1771	2007
Myo, T.	Combustion Characteristics of a DI Diesel Engine with Palm Kernel Oil Biodiesel and Its Blend (B20)	SAE J20076568	2007
Nagaraju, V.	Effect of Biodiesel (B-20) on Performance and Emissions in a Single Cylinder HSDI Diesel Engine	SAE 2008-01-1401	2008
Nikanjam, Manuch	Performance and Emissions fo Diesel and Alternative Diesel Fuels in a Modern Heavy-Duty Vehicle	SAE 2009-01-2649	2009
NREL	Empirical Study of the Stability of Biodiesel and Biodiesel Blends	NREL/TP-540-41619	2007
NREL	Biodiesel - Handling and Use Guidelines	NREL/TP-540-43572	2001
Nuszkowski, J	Evaluation of the Nox emissions from heavy duty diesel engines with the addition on cetane improvers	IMechE Vol. 223 Part D: JAUTO1114	2009
Okamoto, T.	Fuel Properties and Engine Performance of Dimethyl Ether-Blended Biodiesel Fuels	SAE 2007-01-2016	2007
Ozkan, M.	Comparative study of the effect of biodiesel and diesel fuel on a compression ignition Engine's performance, emissions, and its cycle by cycle variations	Energy & Fuels Vol. 21 pp 3627-3636	2007
Patterson, J.	Experimental Study of DI Diesel Engine Performance Using Three Different Biodiesel Fuels	SAE 2006-01-0234	2006
Proc, K.	100,000-Mile Evaluation of Transit Buses	NREL/CP-540-40128	2006

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Author	Title	Journal	Year
	Operated on Biodiesel Blends (B20)		
Rantanen, L.	NExBTL - Biodiesel Fuel of the Second Generation	SAE 2005-01-3771	2005
Rantanen, L.B.	Effect of Fuel on the Regulated, Unregulated and Mutagenic Emissions of DI Diesel Engines	SAE paper no. 932686	1993
Reksowardojo, I.	The Combustion and Exhaust Gas Emission of a Direct Injection Compression Ignition Engine Using Physic Nut Oil (Jatropha Curcas L.oil)	SAE 2007-01-3622	2007
Reksowardojo, I.	Performance and Exhaust Gas Emissions of Using Biodiesel Fuel from Physic Nut (Jatropha Curcas L.) Oil on a Direct Injection Diesel Engine (DI)	SAE 2007-01-2025	2007
Saanum, I.	Study of Particulate Matter-,NOx-and Hydrocarbon Emissions from a Diesel Engine Fueled with Diesel Oil and Biodiesel with Fumigation of Hydrogen, Methane and Propane	SAE 2008-01-1809	2008
Savvidis, D.	A New Volvo V70 2.5 and an Old Ford Escort 1.6 Were Tested and Compared on a Chassis Dynamometer, Using the Same Blends of Frying Biodiesel and Neat Diesel	SAE 2008-01-1576	2008
Schramm, J.	Emissions from a Diesel Vehicle Operated on Alternative Fuels in Copenhagen	SAE 1999-01-3603	1999
Sheehan, J.	An Overview of Biodiesel and Petroleum Diesel Life Cycles	NREL TP-580-24772	1998
Sirman, M.B.	Emissions Comparison of Alternative Fuels in an Advanced Automotive Diesel Engine	Southwest Research Institute, AD A353968/PAA, November 1998	2008
Sivaprakasam, S.	Optimization of the transesterification process for biodiesel production and use of biodiesel in a compression ignition Engine	Energy & Fuels Vol. 21 pp 2998-3003	2007
Souigny, M.	Heavy Duty Diesel Engine Performance and Comparative Emission Measurement for Different Biodiesel Blends used in the Montreal BIOBUS Project	SAE 2004-01-1861	2004
Southwest Research Institute	Soluble Organic Fraction Emissions from Biodiesel-Fueled Engines	Report	2003
Spataru, A.	Emissions and Engine Performance from Blends of soya and canola methyl esters with ARB #2 Diesel in a DCC 6v92TA MUI Engine	SAE 1995-01-2388	1995
Suh, H.K.	Spray and combustion characteristics of biodiesel/diesel blended fuel in a direct injection common-rail diesel Engine	Journal of Engineering for Gas Turbines and Power Vol. 130 pp 032807	2008
Sundarapandian	Theoretical and Experimental Investigation of the Performance of Vegetable Oil Operated CI Engine	SAE 2007-32-0067	2007
Sze, C	Impact of Test Cycle and Biodiesel Concentration on Emissions	SAE 2007-01-4040	2007

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Author	Title	Journal	Year
Szybist, J.P.	NOx emissions of alternative diesel fuels: A comparative analysis of biodiesel and FT diesel	Energy & Fuels Vol. 19 pp 1484-1492	2005
Terry, B.	Impact of Biodiesel on Fuel System Component Durability	NREL/TP-540-39130	2005
Thompson, G.J.	Neat fuel influence on biodiesel blend emissions	IMEchE 2010 JER04909	2009
Tsolakis, A.	Effects on particle size distribution from the diesel Engine operating on RME-biodiesel with EGR	Energy & Fuels Vol. 20 pp 1418-1424	2006
U.S. EPA	A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions	Report	2002
Van Gerpen, Jon	Comparison of the Engine Performance and Emission Characteristics of Vegetable Oil-based and Animal Fat-Based Biodiesel	Report	1996
Verhaeven, E.	Results of demonstration and evaluation projects of biodiesel from rapeseed and used frying oil on light and heavy duty vehicles	SAE 2005-01-2201	2005
Wang, J	Application and Development of Biomass Fuels for Transportation in China	Tsinghua Science & Technology, 12, 2, April 2007, 223-230	2007
Wang, W.G.	Emissions from nine heavy trucks fueled by diesel and biodiesel blend without Engine modification	Environmental Science and Technology Vol. 34 pp 933-939	2000
West Coast Biofuels Inc	Evaluation of the effects of Alternative diesel fuel formulations on exhaust emissions	Report	2003
Williams, A.	Effect of Biodiesel Blends on Diesel Particulate Filter Performance	NREL/TP-540-39606	2006
Wu, Y.P.	Combustion characteristics of fatty acid methyl esters derived from recycled cooking oil	Fuel Vol. 86 pp 2810-2816	2007
Zervas, E.	Regulated and non-regulated pollutants emitted from two aliphatic and a commercial diesel fuel	Fuel Vol. 87 pp 1141-1147	2008
Zhang, X.	Characteristics of Particulates and Exhaust Gases Emissions of DI Diesel Engine Employing Common Rail Fuel System Fueled with Bio-diesel Blends	SAE 2008-01-1834	2008
Zhang, Y.	Impact of biodiesel on NOx emissions in a common rail direct injection diesel Engine	Energy and Fuels Vol. 21 pp 2003-2012	2007
Zheng, M.	Biodiesel Engine performance and emissions in low temperature combustion	Fuel Vol. 87 pp 714-722	2008