

ALTERNATIVE FUELS FOR THE INTERNAL COMBUSTION ENGINES IN THE 21st CENTURY

Edited by: Prof. Dr. Dragoslava Stojiljković

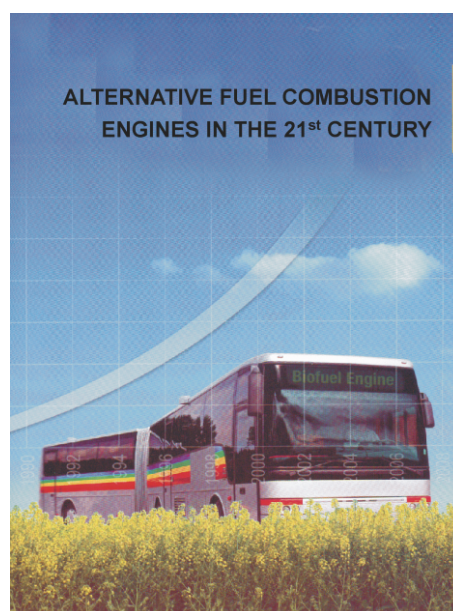
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The investigations to which this 275 pages monograph refers started more than three decades ago, and were related to the possibilities for utilization of alcohol in mixtures with gasoline or diesel fuel. The researchers from the Faculty of Mechanical Engineering in Belgrade and Faculty of Mechanical Engineering in Kragujevac, as well as from the “Crvena Zastava” Industry in Kragujevac, the DMB Engine Industry in Rakovica, and the Oil Refinery in Pančevo have taken part in these investigations. Research of alternative fuels has continued to the present days and has been the subject of a large number of master and Ph. D. thesis, studies and projects, financed both by the industry and relevant ministries.

The monograph “Alternative fuels for IC engines in 21st century” is based on a study with the same title financed under the National Energy Efficiency Programme by the Ministry of Science and Technological Development of the Republic of Serbia. It deals with the review of the available raw materials and their quantities needed for production of alternative fuels, as well as with the existing technologies and expected directions for development of new technologies for short and long term use to produce alternative fuels for IC engines. In addition to the contents of the study, this monograph is amended with two more chapters related to the direct engine tests and comprehensive investigations performed so far.

The alternative fuels for engines with internal combustion (IC) dealt with in the Monograph include both the liquid biofuels (biomethanol, bioethanol, glycerine tertial butile-ether) and the gaseous fuels (liquefied petroleum gas, liquefied natural gas, gas in liquid, compressed natural gas, and hydrogen). These fuels were analysed from the point of view of securing raw materials and available know-how on production technologies, as well as of their use in IC engines to reduce consumption of oil derivates and thus reduce emissions that pollute environment and induce global warming, with particular attention paid to CO₂ emissions.

Monograph “Alternative fuels for the IC engines in the 21st century” was carefully edited by Prof. Dr. Dragoslava Stojiljković. She also coordinated the work of other eleven authors, who have taken part on these subjects that have been their fields of research for many years and where they have made significant scientific contributions. The list of authors includes Dr. Dušan Nestorović from Automobile Institute, Kragujevac, Prof. Dr. Milan Radovanović, Prof. Dr.



Stojan Petrović and Prof. Dr. Miroljub Tomić from the Faculty of Mechanical Engineering in Belgrade, Dr. Ozren Očić from Pančevo Oil Refinery, Prof. Dr. Stevan Veinović and Prof. Dr. Radivoje Pešić from the Faculty of Mechanical Engineering in Kragujevac, Prof. Dr. Slavica Šiler Marinković and Prof. Dr. Ljiljana Mojović from the Faculty of Tehnology and Metallurgy in Belgrade and Prof. Dr. Dušanka Pejin from the Faculty of Tehnology in Novi Sad. The monograph originates from their contributions in the above mentioned study.

Monograph is composed of Foreword and 12 chapters, including Conclusion (Chapter 14) in the form of a sinthesis of particular conclusions presented at the end of each of the chapters. In Chapter 1 (Introduction) authors describe the role of conventional fuels (gasoline and diesel fuels) and alternative fuels for the IC engines (biofuels and gaseous fuels) within strategic goals of the European Union to promote their use. Particular emphasis is placed on the EU Directive 2003/30/EC, which requires member countries to reach a common goal of 5.75 % share of biofuels in total fuels by the year 2010, and Directive 2003/96/EC on the promotion of biofuels. Since transportation consumes about 30% of total energy in the EU and is responsible for about 28% of CO₂ emissions in the EU, alternative fuels are expected to contribute considerably to reduce these emissions by 8% in 2012, compared the average emissions in 1990. Chapter 2. (Methanol) presents production of methanol from coal, natural gas and biomass, with an emphasis placed on Serbia, and concludes that methanol from biomass will be a priority (with a possibility to be used in the future by fuel cells). Chapter 3 (Ethanol) describes raw materials and tehnologies used for production of bioethanol, with particular attention paid to local possibilities and conditions in Serbia. Chapter 4 (Glycerine tertial butile-ether, GTBE) deals both with raw materials and tehnologies for GTBE production, with particular emphasis on glycerine production in Serbia. Chapter 5 (Liquid petroleum gas, LPG) describes production of LPG, again with an attention paid to Serbia. Chapters 6 (Liquefied natural gas and gas in liquid, LNG/GTL), Chapter 7 (Compressed natural gas, CNG) and Chapter 8 (Hydrogen) particular emphasis on technologies and possibilities to be used in Serbia. Chapter 9 (Local research on alcohol as a fuel) deals with mixtures of gasoline and diesel with alcohol and the local results obtained in full scale experiments conducted so far. Chapter 10 (Technologies for use of alternative fuels in IC engines) includes technologies for use of methanol, bioethanol, LPG, LNG, GTL, hydrogen, and other fuels (dimethyl ether, DME, dimet-oxi methane, DMM, and biogas), with detailed descriptions and comparisons of their operational and environmental performances. Chapter 11 (Technologies for use of alternative fiels in IC engines in the world and in Serbia) describes in detail different modes of operation and adaptation of standard engines when alternative fuels are used.

Separate chapters 12 and 13 (Technologies for use of alternative fuels in domestic engines and Technologies for use of alternative fuels in IC engines in Serbia) give a vast amount of experimental results obtained when using CNG, methanol, and LPG, that were available on the local market. Of all available alternative fuels, CNG was mostly dealt with in private cars as well as in public transport busses, but its use did not overcome experimental phase. Extensive results with the use of methanol, which was considered to be very prospective fuel during 1980s for its simplicity of use in standard gasoline engines and potential surplus in local production, are presented in detail when used in the local serial engines (DMB 100D). Experiments with use of the LNG in the engines DMB 116C, as well as in the diesel engine FAMOS 2FU are presented as well. Experimental results with two fuels used by the engine OM 45 in Zastava 640 D proved to be beneficial both from the economic and from the environmental aspects.

Chapter 14 (Conclusion) is formed as a sinthesis of concluding remarks given in the preceeding chapters. It clearly shows that the use of alternative fuels in IC engines is inevitable, with priority given to ethanol from biomass. As far as ethanol is concerned, particular emphasis

is placed on production of sufficient quantity of bioethanol of adequate quality (anhydrous ethanol) because of its smaller emissions of CO₂ than from conventional fuels. With regard to the use of these and other alternative fuels, it was concluded that a series of activities need to be performed with an objective to initiate their production and use in Serbia. It was particularly pointed out that Serbia is obliged by ratifying the Energy Community Treaty of the South-Eastern Europe to deliver Plan of implementation of EU Directive 2003/30/EC on promotion of biodiesel and/or other fuels for transportation, produced from the renewable energy sources. Bearing in mind a tremendous share of emissions from transportation in the overall emissions that cause environmental pollution and global warming, strategy on promotion of renewable energies in Serbia should have to include alternative fuels for IC engines that reduce such emissions.

Although written by a large number of authors, the monograph "Alternative fuels for the IC engines in the 21st century" represents a systematic and well composed review of the possibilities of production and use of different alternative fuels, edited with an intention to make it homogenous in style, well balanced in the scope and equable in terminology. Inevitable overlapping and/or rare repetition of certain items do not derange the overall integrity of the monograph, but, on the contrary, make it possible to independently use single chapters of particular interest, each being completed by the conclusions and references.

The concluding remarks in the monograph indicate paths and possibilities for using alternative fuels in Serbia in accordance with the European standards and local obligations resulting from the international agreements. The authors have expressed their hope that alternative fuels will be used in IC engines more and more, followed by an increased energy efficiency and reduced environmental pollution. In agreement with such an opinion, this monograph is recommended to professionals involved in research and/or production of alternative fuels and IC engines, as well as to the general public as their future users, to make them aware of the necessity to support a gradual implementation of alternative fuels in a worldwide longterm endeavour to replace conventional fuels in transportation, once they became exhausted.

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