Renewable and Sustainable Energy Reviews 66 (2016) 228–232

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Prospects of bioethanol fuels E30 and E85 application in Russia and technical requirements for their quality

M.A. Ershov [a], E.V. Grigoreva [a,*], I.F. Habibullin [a], V.E. Emelyanov [a], D.M. Strekalina [b]

[a] VNII NP JSC, Aviamotornaja 6, 111116 Moscow, Russia
[b] NUST "MISIS", Leninsky prospekt 4, 119049 Moscow, Russia

ARTICLE INFO

Article history:
Received 7 October 2015
Received in revised form
31 March 2016
Accepted 10 July 2016

Keywords:
Bioethanol
E85 fuel
E30 fuel
Midlevel ethanol blends
Gasoline

ABSTRACT

In world practice bioethanol is widely used as a component for standard motor gasolines, with concentration 5–15% by volume (E5, E10, E15 fuels) or as bioethanol fuels with ethanol content from 20% till 85% by volume (E20-E85 fuels).

Currently in Russia the motor biofuel and its components are not used. At the same time, the development of biotechnologies and bioenergy is the priority task of the scientific and technical policy of the State. The complex program sets the goal to increase the consumption volume of motor biofuel up to 10% till 2020. It should be achieved primarily by bioethanol production, which will be used as a component of automotive gasolines or for production of bioethanol fuels.

Bioethanol in Russia can be used in essentially different ways: 1) as a high-octane component in concentration not higher than by 5% by volume for the production of motor gasoline 2) as a high-octane component in concentration not higher than 10% by volume for benzanol (gasohol) production 3) for ethyl tertiary butyl ether (ETBE) production 4) as a component of bioethanol fuels in concentration up to 85% by volume.

The final aspect is especially topical for production of high quality high-octane fuel from low-octane hydrocarbon fractions, as well as maximum utilization of bioethanol octane-increasing potential.

Currently VNII NP JSC is conducting research work aimed to develop production technology of E30 and E85 bioethanol fuels. This technology will enable the essential expansion of the potential of bioethanol application and the efficient resolution of usage of low-octane fractions due to production of high-octane fuel with improved ecological characteristics with a minimum possible cost.

This article presents the developed technical requirements for bioethanol fuels E30, E85.

Contents

* Corresponding author. Fax: +74953610816.
E-mail address: trifonovaev@vniinp.ru (E.V. Grigoreva).

http://dx.doi.org/10.1016/j.rser.2016.07.054
1364-0321/

1. Introduction

Practically all over the world the oxygenates – octane-increasing oxygen-containing components – are used for production of high-octane gasolines. In Russia methyl tertiary butyl ether (MTBE) has obtained widespread use, and its domestic consumption in 2014 reached the amount of approximately 1.2 million tons. Meanwhile, worldwide, starting from 2006, the leading oxygenate is bioethanol [1].

Application of bioethanol, especially during the initial period, was supported in many countries on legislative level, with the result that its production has occupied a special place – more than 6% of world motor gasoline production.

One of the main economic benefits, which ensures the support of bioethanol development programs, is the creation of new jobs, essential support of agriculture and territorial development. As an example, the production of 42.7 million tons of bioethanol [2] at 210 plants in USA has resulted in creation of about 300,000 direct and associated jobs and, respectively, 70,000 jobs at 70 plants in EU countries [3].

2. Bioethanol and bioethanol fuels in the world practice

2.1. USA and EU experience

In world practice bioethanol is widely used as a component for standard motor gasolines with concentration 5–15 vol% (E5, E10, E15 fuels) or as bioethanol fuels with ethanol content from 20% till 85 vol% (E20-E85 fuels). Motor gasolines with relatively low content of ethanol (E5, E10 and E15) can be used in many cars which are currently on-the-road without any engine modifications or in fuel system, meanwhile E85 bioethanol fuel is applied for FFV – flexible-fuel vehicles. Such vehicles can operate on E85 fuel, as well as on standard gasolines or any of their mixture.

There is no evidence of decreasing demand for FFV's, for example, in USA in 2014 50% of newly produced by General Motors, Ford and Chrysler motor cars were FFV [3], which were 25% of all sold new cars.

In USA among existing 142,000 gas stations 2600 have pumps (dispensers) for E85 fuel [4]. The allocation of gas stations distributing E85 fuel is characterized as non-uniform and regional, (Fig. 1): and it is maximum where the major bioethanol production units are located or in the regions with complicated ecological situation, which have more strict standards for fuel ecological characteristics (California).

The total level of E85 fuel consumption in Europe is more modest in comparison with USA, but has a regional trend as well – only few countries possess technical specifications for this kind of bioethanol fuel, and, accordingly, gas stations which distribute E85 fuel are not widespread available (Fig. 2).

2.2. Situation in Russia

In Russia, currently the motor biofuel and its components are not used. At the same time, the development of biotechnologies and bioenergy is the priority task of the scientific and technical policy of the State. It can be proved by the acceptance of two framework documents: "The Complex Program of development of biotechnologies in Russian Federation for the period until 2020" and the Road map "Development of biotechnologies and genetic engineering". The complex program sets the goal to increase the consumption volume of motor biofuel up to 10% till 2020. It should be achieved primarily by bioethanol production, which will be used as a component of automotive gasolines or for production of bioethanol fuels. So, from 71 action items, featured in the Road map and related to development of different branches of biotechnologies and genetic engineering, 7 are directly aimed at consistent development of conditions for mass commercial production and implementation of fuel bioethanol, including excise exemption (Table 1).

Meanwhile, the action items of the Road map do not define the specific ways of using bioethanol, which in Russia can be used in essentially different ways:

- As a high-octane component in concentration not higher than 5 vol% for the production of motor gasoline, conforming to the requirements of applicable Regulations of the Customs Union (TR TS 013/2011) [9];
- As a high-octane component in concentration not higher than 10 vol% for benzanol (gasohol) production according to GOST R 52201. Despite the fact that this kind of fuel has not been formally considered yet as an automotive gasoline, it can be used for the majority of vehicles which are on-the-road in Russia, with no need of any modernization or adjustment. Besides, the limit concentration of bioethanol in benzanols (gasohols) can be extended up to 15 vol%. Such fuel in USA is recommended as standard fuel for all vehicles, produced after 2001, which makes approximately 85% of the national car fleet. [2].
- For production of Ethyl tertiary butyl ether (ETBE), which can be used as a high-octane component in concentration not higher than 15 vol% for the gasoline production, conforming to the

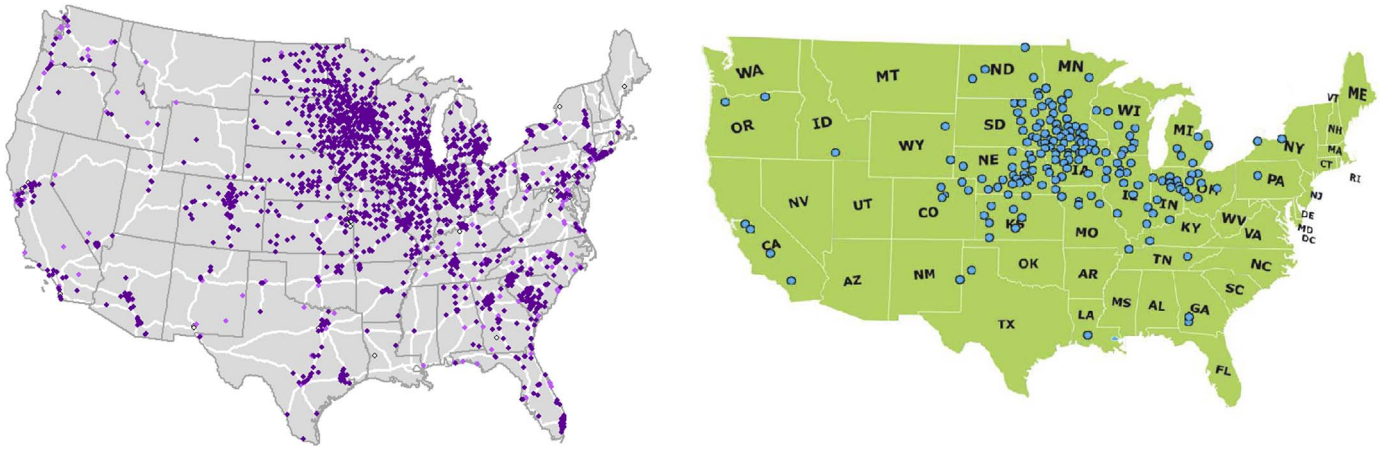

Fig. 1. Maps of allocation of gas stations, distributing E85 fuel (left) and bioethanol production plants (right) in USA.
Source: left – U.S. Energy Information Administration, based on U.S. Department of Energy (DOE), Alternative Fuels & Advanced Vehicles Data Center right – Renewable Fuel Association. Falling Walls and Rising Tides. 2014 Ethanol Industry Outlook [5,6].