PRODUCTION OF BIODIESEL FUEL FOR SELF-PROPELLED AGRICULTURAL MACHINERY

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Summary. The project of universal installation for production of biodiesel fuel (BDF) by the method of dispersion of different components at a molecular level is described. This installation is proposed for endorsement in agro-industrial manufacture.

Key words: biodiesel fuel, oils, rape oils, hydrodynamical.

INTRODUCTION

The developed European countries (Germany, Austria, France etc.) have successfully organized manufacture of biodiesel from hydrodynamically activated mixes of rape oil with diesel fuel of petroleum origin. The principle of manufacture (BDF) is the reaction of rape oils with methyl or ethyl spirit in the presence a catalyst. The resulting esterification provides an active mix containing biodiesel fuel, glycerin and other components. Abroad, for example, in the EU countries the combination of « manufacture of oil - reception of biodiesel fuel » in one production cycle has been achieved.

The basic manufacturers of BDF in the EU countries are:
- Diester Indastrie (France);
- INEOS Chlor (Great Britain);
- ADM, RVM (Germany);
- Novaol, DR Zubrificanti (Italy);
- Bionet Europa SC (Spain).

In Europe over 600 thousand tons of biodiesel fuel (BDF) with the use of rape oils are developed annually [1]. For the last 10 years demand for (BDF) has grown to 5 million tons. Abroad, till the end of 2010, manufacture of 12 million tons of biodiesel engine oil is predicted. General requirements amount to 25 million tons. In Ukraine there have been objective conditions for the development of BDF manufacture on the basis of rape oils, above all in mine factories and manufactures. Some manufacturers already exist, for example the Polish company MAN – ZOIL. The regulation of the problem of manufacture of a biodiesel engine is stipulated in Ukraine by the Decree of the President of Ukraine ¹ 1094. According to the decree, the Ministry of Agrarian
Policy of Ukraine formulates the concept of the state program on the development and introduction of technologies and equipment for manufacture of alternative fuels from biomass [2].

**RESEARCH METHOD**

Universal installation for manufacture of biodiesel fuel, by the method of dispersion of different components at a molecular level [3] has been developed. The installation is intended for the production of BDF in conditions of agro-industrial manufacture [4]. The basic circuit of universal installation for the BDF obtainment is presented in Figure 1. It includes the technological capacity 1 for raw material (rape oil) hydrostation which consists of electric motor 3, clutch 4, pump 5, bypass 6 and fan 7 for regulation of pressure of oil in the system. Bypass 6 forcing a highway 8 through the crane 9 is connected with amalgamator type injector 10 and hydrodynamical disperser 19 [5]. Feeder, amalgamator 10 and disperser 19 are fixed at the output. Feeder or amalgamator 10 has a cavity “É” between 11 and 12 placed in its case reciprocally [6]. Feeder cavity feeds pipeline 17 through crane 18, connected to collector 13. Collector 13 is connected to armature through cranes 14, 15 and 16 with internal cavities of tank 35 that has three sections 20, 21 and 22 for components. Section 20 is intended for diesel fuel of petroleum origin, section 21 - for methanol, 22 - the catalyst (hydro sodium) [7].

Fig. 1. Universal installation for manufacture of biodiesel fuel
Output feeder 10 is connected to output of hydrodynamical disperser 19. Simultaneously, an output from disperser of the pipeline is connected to technological container 24, for a hydrodynamically active mix of rape oils with components which act from section 20, 21 and 22 tanks 35 through collector 13 and feeder or the amalgamator 10. Capacity 24 through the crane 25 connected to a separator 26 for division of phases « biodiesel fuel » and « water - a glycerin mix », are accordingly acting in containers 27 and 28. Tank 28 for « water - glycerin mix » is connected to the filter 29 which is in turn connected to container 30 for glycerin and 31 for gathering moisture (water) [8]. Container 24 is equipped with the drainage pipeline 32 with the crane 33 for distribution of finished goods. The installation is equipped with measuring devices (a manometer 36, the gauge of temperature 37, a flowmeter 34) [9]. It is constructed as a universal block type. The universality of installation consists in its opportunity to work in three modes, namely:

1. Production of biodiesel fuel (BDF) on the basis of dispersion of coldly pressed cleared rape oils (PM), diesel fuel (DP) of petroleum origin and methanol (î), under an influence of the catalyst (è).

2. Production of biodiesel fuel (BDF) on the basis of pure methyl ester (ME), from dynamically made active mix (PM) and methanol (î) processed by the catalyst (è).

3. Production of (BDF) from mixing “DT” and “PM» dispersed components at a molecular level.

RESULTS OF RESEARCH

Universal installation works in modes 1, 2 and 3 thus:

In a mode 1 - cranes 14; 15; and 16 tanks 35 open for passage in the feeder - amalgamator of all 10 components [11]. At inclusion the electric motor 3 through clutch 4 starts to rotate hydro-pump 5 which soaks up “PM» from capacity 1 in bypass 6 and pressure head highway 8 of the installation. After that the crane 6 adjusts working pressure in highway 8 which is supervised by manometer 36. Rape oil under pressure passes on to pressure head highway 8 at the open crane 9 and gets in the feeder - amalgamator 10. Simultaneously, at open cranes 14, 15 and 16 of 20, 21 and 22 tanks 35 in a collector 13 get components (“DT”, “MT» and “è”), which performs preliminary mixing up, then soaking through open crane 18 and pipeline 17 in cavity “É” of feeder 10. In the feeder - amalgamator 10 rape oil is intensively dispersed into components (“DT”, “î” and “è”). Preliminary sated mix gets into hydrodynamical disperser 19. In disperser 19 there is carried out deep dispersion and mixing of components from “PM» at a molecular level [12]. The mix receiving properties (BDF) is activated a on the pipeline 23 in technological container then - in a separator 26 at the open crane 25. In separator 26 the mix is divided into phases « biodiesel fuel » and « water glicerin mix », then each phase acts in conformity of container 27 and 28. Further, the « water - glycerin mix » moves from capacity 27 in filter 29 where it is divided into glycerin and water [13]. Glycerin merges in container 30, and the moisture (water) in container 31. As a result, the produced biodiesel fuel (BDF) from container 27 following the pipeline 32 is ready at the open crane 33 and, through flow-meter 34 is released to the consumer. Glycerin can be used in the production of fodder additives for birds [14].

In mode 2 the installation works at the closed crane 14 and open cranes 15 and 16 for release of the appropriate components (methanol and the catalyst) through collector 13 in cavity “É” of the feeder - amalgamator 10. The technological process of reception (BDF) is similar to the work in mode 1 [15 ].

In mode 3 the installation works at the closed cranes 15 and 16 of tank 35 and the open crane 14 for release of “DT” of petroleum origin through the pipeline 13 of cavity “É” in the feeder - amalg-
gamator 10. Further, similar stages as in mode 1 and 2 are followed during technological process of BDF production by the method of dispersion of “DT” and “PM” [16]. The properties of this biodiesel engine fuel practically do not differ from those of the diesel fuel of petroleum origin (Table 1).

Table 1. Properties of biodiesel fuel and diesel fuel of petroleum origin.

<table>
<thead>
<tr>
<th>Kind of fuel</th>
<th>Parameters</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Cetane number</td>
</tr>
<tr>
<td>Biodiesel fuel from rape oils</td>
<td>40</td>
</tr>
<tr>
<td>Diesel fuel of petroleum origin</td>
<td>50</td>
</tr>
</tbody>
</table>

Universal installation for manufacture of biodiesel fuel is tested in (JUHTC UAAN) [17], received encouraging results, namely:
- physical properties of biodiesel fuel in operation practically do not differ from those of the diesel fuel of petroleum origin;
- emissions of the exhaustion gases considerably decrease;
- emissions of solid particles decrease up to 50 %;
- serviceability of diesel engines practically do not change without constructive modernization of the basic units;
- work of diesel engines on biodiesel fuel is ecologically safe, which has a great value for protection of environment;
- productivity of installation reaches 1100 l/hour of biodiesel fuel. The installation can be used for maintenance of biodiesel fuel production, considering the simplicity of its design, productivity and small overall dimensions, and also wide opportunities for rape cultivation in Ukraine.

CONCLUSIONS

Manufacture of biodiesel fuel can easily be organized, also in the conditions of a farm. Cost of biodiesel fuel now does not exceed cost of traditional petroleum diesel fuel and tends to decrease. Biodiesel fuel has received a wide circulation in many countries of the world including Germany, Australia, Austria, Czech, France, Italy, Sweden, USA, and also other countries. Experts in mobile engineering consider biodiesel fuel the best fuel for engines with self-ignition. Following the foreign experience, the installation developed by us will be useful in solving the problems of providing agro-manufactures with diesel fuel.

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UZYSKIWANIE OLEJU NAPĘDOWEGO BIODIESEL DLA SAMOJEZDNYCH MASZYN ROLNICZYCH

**Streszczenie.** Opisano projekt instalacji dla produkcji oleju napędowego biodiesel (BDF) w oparciu o dyspersję różnych komponentów na poziomie molekularnym. Instalacja ta jest proponowana dla uzyskiwania paliwa w agroprzemysłowych zakładach.

**Słowa kluczowe:** olej napędowy biodiesel, oleje, olej rzepakowy, hydrodynamiczny.