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In this article Flag formulation of the problem of optimal control movement hruzopodъemnoho crane with cargo at Mount the bending. Showing nevozmozhnost Using varyatsyonnoho method for problem solutions. Based on the direct method varyatsyonnoho Found pryblyzhennoe decision problem. Effect of Quantity of research dopolnytelnыh kraevыh uslovyy the magnitude optymyzatsyonnoho Criteria. Proposals pokazatel Class "Bleezosty "importance Criteria for him The minimum value.

Pryamoy varyatsyonnыy method optymalnoe Management, hruzopodъemnыy crane, nonlinear rehressyya.

The paper made formulation of problem of crane motion optimal control with load on flexible suspension. Shown the inability to use variational method to solve the problem. On basis of direct variational method approximate solution of problem. The influences of number of additional boundary conditions on value of optimization criterion have been showed. Proposed exponent of "closeness" to value of criterion to its minimum value.

Direct variational method, optimal control, load-lifting crane, nonlinear regression.

UDC 662.767.3

METODYKA DEFINITION alkalinity biodiesel

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The method of potentiometric titration adapted to determine the alkalinity of biodiesel. Considered hardware for potentiometric titration biodiesel.

Biodiesel, alkalinity, potentiometric titration, the working electrode, reference electrode, pH meter.

Lentnovka problem. Due to the emergence of global energy and economic crises of the world, mankind actively searches for alternatives to fossil energy sources. Particular attention is paid to finding substitutes for light oil, because without cars, planes, trains humanity sees its future existence. Most of the cars, most tractors and other mobile and stationary machines are driven by diesel engines at present, mainly operating on diesel oil, one of which is to substitute biodiesel.

Prand the production of biodiesel by traditional technology to accelerate the reaction methanolysis must apply the acid or alkaline catalyst. Heterogeneous catalyst for biodiesel production is rarely used, mainly serves as a homogeneous catalyst. In the case of an acid catalyst durationing reactions ranged from one to 45 hours, alkaline - from a few tens of minutes to 8 hours (depending on temperature and pressure) Because of faster the reaction methanolysis mainly used alkaline catalyst (potassium hydroxide or sodium), whose solution in methanol is added to fats for biodiesel. However, the catalyst does not react methanolysis and tIlka it accelerates. Therefore, it is manufactured biodiesel onness, causing corrosion of the engine. Corrosion products, falling into the gap between the cylinder and the piston, causing them to abrasive wear. If it gets into the fuel system, they may slaughter fuel filters, or completely block the fuel spray equipment due to the inability of fuel through the injectors.

AnaLiz recent research. Prand the use of technology supercritical methanol as a catalyst because of the lack of clean biodiesel from it is required. No need to clean the produced biodiesel is typical when using traditional technology of heterogeneous catalysts, such as catalyst does not contaminate the resulting product. The problem is that the technology of supercritical methanol as in connection with its complexity we have not used, and the traditional technology of heterogeneous catalyst due to the significant cost of equipment used for large volumes

biodiesel production. In small-scale production of biodiesel, which is typical for rural biodiesel plants and installations, rational conventional technology for biodiesel using homogeneous catalyst after methanolysis reaction is produced in biodiesel [1, 2].

Aboutmuch as a homogeneous catalyst KOH and NaOH are used, ie substances with a membership of alkali metals sodium and potassium, most biodiesel standards governing the content of these metals. According to the European Standard EN 14214: 2012-11
'Petrolucts liquid. Methyl esters of fatty acids (FAME) for diesel engines and heating. Requirements and test methods "alkali metal content in biodiesel should not exceed 5 mg / kg [3]. The same value of alkali metals in biodiesel recorded in the national standard ISO 6081: 2009" methyl esters of fatty
STARLot oils and fats for diesel engines. Technical requirements "[4], American ASTM D 6751" biodiesel fuel (B100) as
Computernent mixing for distillate fuels. Technical specifications "[5] and the German DIN 51 606 [6].

In thecontains potassium and sodium in line with European EN 14109: 2003 and EN 14108: 2003 and EN ISO 14109 domestic: 2009 and EN ISO
14 108: 2009 Standards define polumenevoyu atomic absorption spectrometry for wavelength 766.5 nm and 589 respectively.

Difof the same, determination of alkali metals by atomic absorption spectrometry polumenevoyi quite expensive. For example, the cost of atomic absorption spectrometer with C-115M1
additional equipment exceeds 100 thousand. UAH., and the cost
study of a sample on this device can reach up to 500 USD. In addition, the corrosive properties of biodiesel affect not the alkali metals and their compounds with hydroxyl group OH, ie meadows.

Fromand the German standard DIN 51 606 biodiesel its alkalinity
Categoriesis limited to 5 mg / kg [6]. The method of determining the alkalinity of petroleum products and lubricants, which is given in [7]. However, there is no methodology for determining the alkalinity of biodiesel.

Ago, **purpose Ourx** anddaptatsiya **dperssurvey findings** andsnuyuchoth there is
methodology for determining the alkalinity of oil to biodiesel.

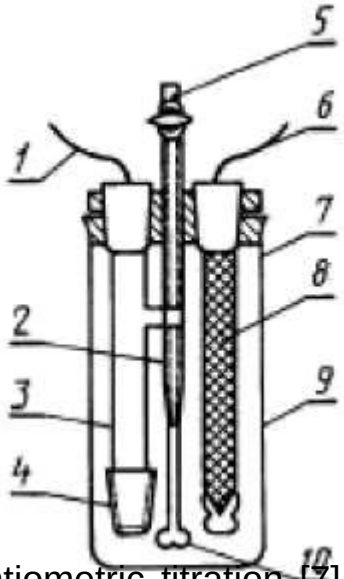
Rezultaty research. Louzhnist biodiesel can be determined
by potentiometric titration using the formula:

$$L=\frac{56.1\cdot c\cdot (V_1 - V_0)}{m}, \qquad (1)$$

dth*L*- Alkalinity biodiesel mg / g; *with*- The concentration of hydrochloric acid mol / l; V_1- Volume of 0.1 mol / dm3 hydrochloric acid consumed for the titration of the sample to jump capacity ml; V_0- Volume of 0.1 mol / dm3

saltth acid consumed in the titration control sample value to EDS in buffer solution or jump potential in this field, Jr; *m*– weightand the product being analyzed h

DA survey is going to plant potentiometric titration (Fig. 1) consisting of a glass beaker 9
COVERand with holes for electrodes and burette 7, two electrodes - working 8 (glass) and comparing 3 (hlorsribnyy) that are connected to the pH meter (in our case - ion analyzer AI-123, the price of which, unlike atomic -absorbtsiynoho spectrometer is
45 thousand. UAH.) Glass burette 5. Install a magnetic stirrer set at 10.



Ric. 1. Install potentiometric titration [7] 1 - wire to electrode; 2 - extended end burette (before stirrer); 3 - electrode; 4 - tube of glass pin; 5 - burette 6 - shielded wire for glass electrode 7 - cover 8 - glass electrode; 9 - glass; 10 - mixer.

SchodeDNAs for each pair of electrodes of the device parameters are determined in non-aqueous alkaline solution. It is necessary to Election Day endpoint titration when on the titration curve will be no clear inflection point. To do this, the electrodes are immersed in non-aqueous alkaline buffer solution, which was stirred for 5 minutes, maintaining the temperature within 2ºS the temperature at which the titration performed. Recorded characteristics of the electrodes, taking a final point on the titration curve with no inflection points.

DFor the preparation of non-aqueous buffer solution to 100 ml of solvent (toluene) added 10 ml of buffer solution and

Moveishuyetsya one hour. To prepare the buffer solution carefully weighed 27.8 g m-nitrophenol and transferred to 1 liter volumetric flask containing 100 ml of anhydrous isopropanol. Then a graduated cylinder 500 ml with continuous stirring added to the flask 25 ml of 0.1 mol / dm3 solution of potassium hydroxide. Dolyvayetsya tags to 1 liter isopropanol and mixed thoroughly.

EIDalkalinity biodiesel-identification is as follows. In a glass titration to 250 cm3 capacity shown in the table of sample mass and dissolved in 125 cm3 titration solvent, which is prepared by mixing 500 cm3 of toluene, 5 cm3 of water and 495 cm3 of isopropanol.

Weightsand samples for research.

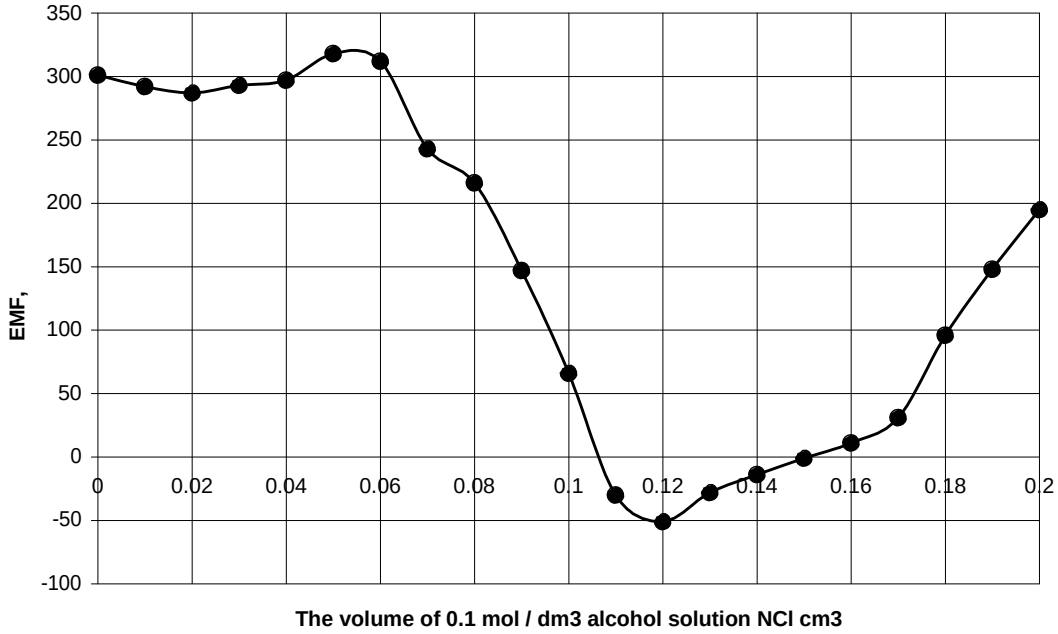
Base number, mg KOH per 100 g	Mace tests to determine g	The error weighting g
0,05-1,0	20,0 ± 2,0	0.10
1, 0-5,0	5,0 ± 0,5	0.05
5-20	1,0 ± 0,1	0,005
20-100	0,25 ± 0,02	0,001
100-250	0,1 ± 0,01	0,0005

Elektrody before each titration placed for 5 min in distilled water, then dry cleaned with a dry cloth. Titration glass set on a stand, adjusting its position so that the electrodes were half submerged in the solution. Included mixer, it turns regulated so that despite vigorous stirring, the solution is rozbryzkuvavsya and there were not formed air bubbles.

Burette filled in portions of 0.1 mol / dm3 alcoholic solution of hydrochloric acid, which is set on a tripod that is placed so that the end burette 25 mm was lowered in
pidynu in the glass. Then, the actual titration. Titrant is added in small portions to 0.1 cm3. After each such portion is performed measuring potential results recorded.Pislya a permanent capacity recorded volume of solution added from the burette and meter readings (which is a potential that does not change for 1 minute more than 5 mV). At the beginning of the titration and at inflection points of the titration curve when adding 0.1 mol / dm3 alcoholic solution of hydrochloric acid causes a change in potential of more than 30 mV, annexed portions solution of 0.05 cm3. Titration ends when capacity after adding 0.1 N. alcoholic solution of hydrochloric acid varies less than 5 mV.

Youdalyayetsya solution titrated, washed electrodes and end burette toluene, then isopropanol, and ends washing with distilled water. Before the next titration to restore the aqueous gel layer of the glass electrode is immersed he distilled water for at least 5 minutes.

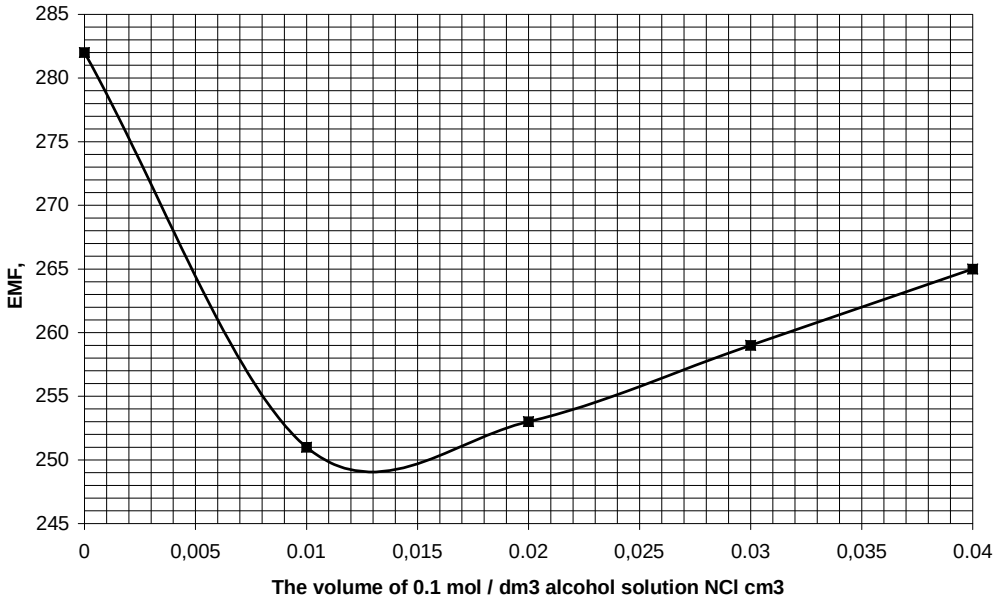
Pislya the experiment plotted on a graph volumes of 0.1 mol / dm3 alcoholic solution of hydrochloric acid are added during the titration and EMF specified ion analyzer AI-123 (Fig. 2).



Ric. 2. potentiometric titration curve design biodiesel produced at a ratio of methanol to potassium hydroxide as 10 to 0.7.

Andndykatsiya equivalence point is made by a sharp rise in the value of the measured EMF (lowest value), which changes by changing the equilibrium potential indicator (working) electrode (*Erob*) By a chemical reaction involving a sample of biodiesel. In this case corresponds to the equivalence point emf = - 51 mV, which is obtained by adding to a solution of biodiesel volume V_1= 0.12 cm3 of 0.1 mol / dm3 alcoholic solution of HCl. For each batch of samples held control experiment in which 125 cm3 titrated solvent 0.05 cm3 portions of hydrochloric acid. Recorded the lowest value and volume EMF Titration solution that corresponds to it (Fig. 3). The equivalence point control experiment potentiometric titration corresponds EMF = 249 mV, which is obtained by adding to the volume of solvent V_0= 0,013 0.1 cm3 mol / dm3 alcoholic solution of HCl. The concentration of hydrochloric

kislots *with*0.1 mol / dm3. The weight of the product analyzed *m,*is 21.1162 g



Ric. 3. The curve control experiment potentiometric titration.

Volumein the formula (1) base number biodiesel produced at a ratio of methanol to potassium hydroxide as 10 to 0.7, is:

$$L = \frac{56.1 \cdot 0.1 \cdot (0.12 - 0{,}013)}{21.1162} = .0362 \quad \text{mg / g.}$$

The resulting from- toiodyzelya cf.ivnyuyetsya fr permissible meansnnyam luzhnosti toiodyzelya, Specifyit t German standard DIN 51 606 for biodiesel [6], which shall not exceed 5 mg / kg, and the decision of the purification of biodiesel from residual alkaline catalyst.

Conclusions

1. Alkaline catalyst in biodiesel engines corrosive, so it must be removed. Most standards for biodiesel is not normalized concentration therein alkalis and alkali metal content being determined by atomic absorption spectrometers. However, the cost of which exceeds 100 thousand. UAH. Because these studies are extremely expensive. However, alkali metals corrosive only compound with a hydroxyl group OH, ie in the form of alkali. Values normalized alkalinity biodiesel standard DIN 51 606.

2. Dll determine the method of biodiesel alkalinity potentiometric titration at which point display
equivalenceand conducted by the magnitude of the measured spike

EMF. This is used as a working glass electrode as the reference electrode - hlorsribnyy. The alkalinity of biodiesel is calculated by the known concentration of hydrochloric acid used for titration volume of titrant difference for biodiesel sample and the control sample, sample mass biodiesel, and compared with the standard value of alkalinity biodiesel, which should not exceed 5 mg / kg.

3. Warthist EQUIPMENTConnect to determinationof alkalinity biodiesel painw than 20 times lower compared to the equipment for the determination of alkali metals.

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The design procedure potentsyometrycheskoho tytrovanyya, adaptyrovannaya for Determination alkalinity biodiesel. Rassmotrenы tehnycheskye sredstva for conducting potentsyometrycheskoho tytrovanyya biodiesel.

Biodiesel engine, alkalinity, potentsyometrycheskoe tytrovanyya, laboring electrode, electrode compared, pH meter.

The above method of potentiometric titration adapted to determine alkalinity biodiesel. Considered hardware for the potentiometric titration of biodiesel.

Biodiesel, alkalinity, potentiometric titration, working electrode, reference electrode, pH-meter.