Table 1. Density, dynamic and kinematic viscosity of obtained biofuel samples

Biodiesel	Density at 15 °C, gm/cm^3	Viscosity at 20 °C	
		Kinematic, mm^2/s	Dynamic, mPa/s
From pure oil	0.8881	15.195	13.495
From waste oil	0.8908	14.345	12.779

from pure oil was 371.60 gram, and from waste oil was 237.80 gm.

The results of determining the density, dynamic and kinematic viscosity of the obtained biodiesels are presented in table 1.

Also, for the obtained biofuels using a low-temperature cryostat, the cloud point and pour point were determined. The results are presented in a table 2.

Table 2. Low-temperature properties of obtained biofuel samples

Biodiesel	Cloud point, °C	Pour point, °C
From pure oil	–3	–8
From waste oil	–3	–4

From the results presented in tables 1 and 2, it can be seen that biofuels synthesized from waste oil have a higher density value and, accordingly, a worse pour point, but lower viscosity compared to biodiesel obtained from pure oil.

Based on the obtained results, it can be concluded that the second-generation biodiesel is comparable in characteristics to the first-generation biodiesel, which makes used vegetable oils a promising feedstock for producing renewable and environmentally friendly fuel.

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OPTIMIZATION OF COLUMN FOR ORGANIC CONTAMINANTS ELIMINATION FROM BRINE WASTEWATER

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Many chemical productions that utilize acids as catalysts or raw materials such as production of acrylates, plasticizers, isocyanates and other have a neutralization and washing stage to remove product salts and unreacted base substances. It is well known that solubility of organic substance decries significantly in brine streams because of salting out effect but wastewater still contain organic contaminants.

Thus methylene diphenyl diisocyanate (MDI) based synthesis of polyisocyanates includes polyamine production stage at which contaminated with organic substances wastewater stream is formed. Main stream impurity is aniline that is used in excess quantity in reaction:

$$(n + 1)C_6H_5NH_2 + nCH_2O \xrightarrow{HCl} [NH_2HCl –$$

$$– C_6H_4 – CH_2]n – C_6H_4 – NH_2HCl + nH_2O$$

In addition, aniline is used for methylene diphenyl diamine (MDA) extraction from wastewater.

Standard solution for brine stream utilization is discharge to sea or use as raw material for chlor-alkali process [1]. Regardless utilization way it is necessary to recover aniline from wastewater because in first case it is high toxic material and in second one total organic carbon (TOC) is strictly controlled as electrolysis requirement. It should also be noted that aniline is a value component and it losses is impractical for economical reason.

At the moment there are several methods for aniline treatment and some are under development but basic technique is rectification [2].

The purpose of the current work is to develop wastewater rectification block. It was done by the methods of modelling in Aspen Plus software with activity coefficient model elecNRTL.

Txxy equilibria calculated by elecNRTL was analyzed and compared with NIST database experimental data. Aniline concentration in raw material was compared with data of Dallos group [3] to con-

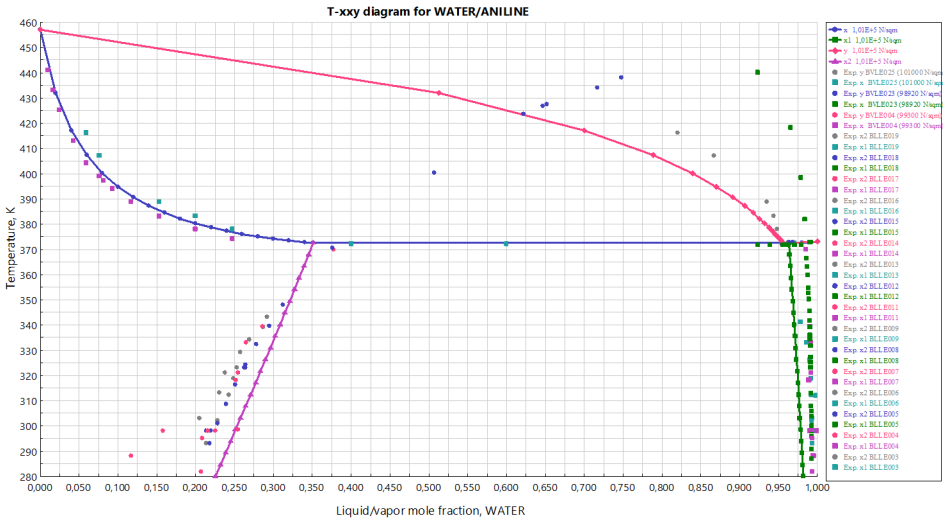

Fig. 1. *Vapor-liquid-liquid equilibria for aniline-water system*

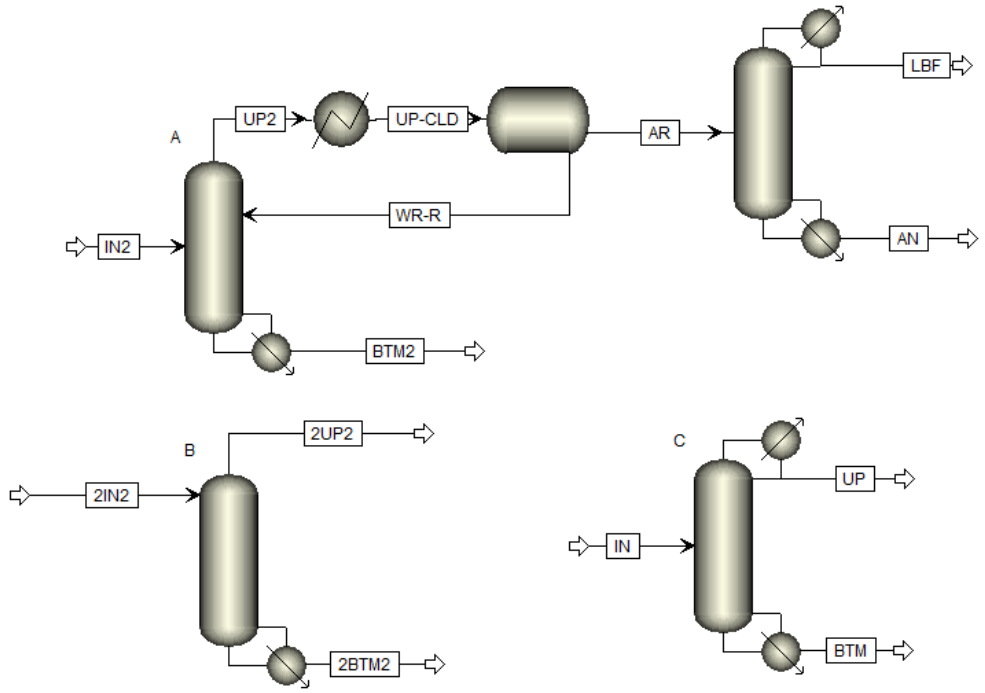

Fig. 2. *Wastewater treatment block. A – pure aniline separation, B – simple distillation, C – rectification*

sider salting out effect. In addition, different cases of rectification block organization was compared – from simple distillation to pure aniline separation and intermediate rectification that gives a possibility to determine specification of upper product stream. These variants are shown in fig. 2.

Rectification (C in fig. 2) is optimal for polyamine synthesis because it allows overhead product recycling and its utilization for washing stage. Thus, overall freshwater consumption by the technology could be minimized. For this case, optimal column number of stages and feed stage that allows minimizing reboiler heat duty was determined. Also column dimensions and hydraulics calculation was done for internals that are available in Aspen Plus database.

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STUDY OF CARBON NANOPOWDER FLUORINATION

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Fluorine and carbon compounds are widely used in industry, such as fluorolefins and freons. Fluorolefins are used as monomers for the synthesis of thermo- and chemically resistant polymers and copolymers, such as fluoroplasts and fluorocarbons, which have been widely used in engineering because of their properties. Freons, in turn, are used as refrigerants, feedstocks for industrial production of fluorolefins, for aerosols, etc. In addition, fluorocarbon compounds (perfluorocarbons) can potentially be used for terraforming, I don't know what makes them strategic substances.

These facts about fluorocarbon compounds make them quite important in technology and industry, so we decided to investigate the synthesis of new such substances, namely the possibility of creating a substance with the general formula CxFy, and $x \geq y$.

During the experiment, the carbon nanoparticle was fluorinated with elemental fluorine at a mass delivery rate of 1.4 g/h. The results are shown in Figure 1.

After interpolating the chart, the function is:

$$y = -0.151 \cdot \exp(-0.00276 \cdot x) + 0.2.$$

The order-one reaction graph and type-one adsorption isotherm can be described in terms of the time increase of the sample.

The general equation of reaction can be written as:

$$x\,C + y/2\,F_2 = CxFy.$$

The increase in mass of the sample is then equal to the mass of fluorine reacted at time t.

Then, by comparing the resulting equation with the general linear record of the first-order reaction equation, the reaction rate constant is 0.00214 s^{-1}.

The kinetic equation of adsorption curves is described by the equation:

$$a_1 = a_\infty (1 - \exp(-K \cdot t))$$

a_1, a_∞ – current and equilibrium absolute values of adsorption, respectively; K – adsorption coefficient [1].

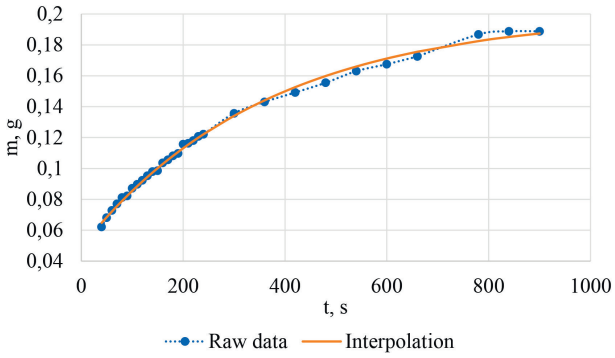

Fig. 1. *Graph of the relationship of the carbon mass increase with the reaction time*