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## КЛИНИЧЕСКИЕ АСПЕКТЫ БРОНХОЛЕГОЧНОГО АСПЕРГИЛЛЕЗА

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## CLINICAL ASPECTS OF BRONCHOLOGICAL ASPERGILLOSIS

***Аннотация:***
*В нашей работе были использованы данные литературного анализа по аспектам аспергиллеза легких, которые имеют важное значение особенно у инфекционистов.*
***Abstract:***
*In our work, we used the data of literary analysis on aspects of pulmonary aspergillosis, which are of great importance especially among infectious disease specialists.*

***Ключевые слова****: грибы, популяции, ребенок, легкие, аспергиллез, случаи.*
***Key words****: fungi, populations, child, lungs, aspergillosis, cases.*

В настоящее время в природе описано около 100 тыс. видов грибов. Около 400 из них могут быть причинами заболеваний органов дыхания – острых и хронических пневмомикозов. Как отмечено в литературе , что поражения дыхательной системы, вызываемые патогенными грибами, впервые описаны более 150 лет назад. Выполненные в последние годы исследования свидетельствуют о повсеместном и неуклонном росте количества грибковых заболеваний, в частности грибковых поражений дыхательной системы. Наиболее часто вызывается грибами Aspergillus fumigatus. В последние годы наблюдается рост частоты выделения других представителей — A. flavus, A. niger, A. ferrens и др. Споры этих грибов распространены повсеместно, их количество существенно возрастает в жаркую и влажную погоду.

В литературе отмечено, что большинстве случаев заражение происходит через верхние дыхательные пути, инфекция может проникать также через поврежденную кожу и кишечник. Аспергиллы вызывают поражения, традиционно подразделяемые на инвазивные, сапрофитические и аллергические. Аспергиллы продуцируют ферменты (протеолитический, сахаролитический, липолитический и др.) и эндотоксины. Выделение различных типов токсинов (альфа-токсина, глиотоксина и др.) в окружающую среду и в организм человека при прогрессировании заболевания также является характерной чертой Aspergillus fumigatus. Соединения, синтезируемые аспергиллом (в том числе серинновые и аспарагиновые протеазы, металлопротеиназы, дипептидилпептидазы и фосфолипазы и др.), являются сильными аллергенами. В результате аллергической реакции на них или при развитии инфекционного процесса могут поражаться и другие органы – придаточные пазухи носа, гортань, трахея и бронхи – с возможным распространением инфекции в кожу, в желудочно-кишечный тракт, головной мозг, сердце. Дальнейший анализ показал, что аспергиллы являются причиной аллергического бронхолегочного аспергиллеза, хронического некротического легочного аспергиллеза, могут вызывать бронхиальную астму, экзогенный аллергический альвеолит. Заразиться можно, употребив пищу, пораженную аспергиллами, при вдыхании грибковых спор, а также при их попадании на поверхность раны. Способствуют заражению болезни, ослабляющие иммунитет, а также определенная сфера деятельности человека, например работа с голубями, которые являются переносчиком заболевания. Специалистами был отмечен тот факт, что к инвазивным формам относят поражение нижних дыхательных путей, синуситы, а также инфекции кожи и мягких тканей, которые могут представлять собой входные ворота для этиотропного агента. Может наблюдаться поражение ЦНС, сердечнососудистой системы, других органов и тканей вследствие гематогенной диссеминации или непосредственного распространения из близко расположенных очагов. К сапрофитическим поражениям относят отомикоз и легочную аспергиллему. Аллергические формы представлены аллергическим

аспергиллезным синуситом и аллергическим бронхолегочным аспергиллезом. Зарубежными и отечественными авторами было отмечено ,что поражение легких наблюдается при аспергиллезе примерно в 90% случаев. В дебюте болезни у 1/3 больных инвазивный аспергиллез легких (ИАЛ) может быть асимптомным, и первые признаки появляются лишь при прогрессировании микоза. Наиболее ранние симптомы — кашель (вначале — сухой) и лихорадка, устойчивая к антибиотикам широкого спектра действия. В дальнейшем присоединяется одышка, появляются «плевральные» боли в грудной клетке (вследствие грибковой инвазии в сосуды, приводящей к множественным инфарктам легкого) и кровохарканье, обычно умеренное, хотя в отдельных случаях возможно и массивное. Следует иметь в виду, что на фоне терапии температура тела может быть субфебрильной или нормальной, а болевой синдром минимально выраженным. Возможно развитие спонтанных легочных кровотечений, обусловленных формированием полостей распада в легких . Разрозненность исследований, посвященных проблемам микозов легких, отсутствие четких критериев диагностики, схем лечения создают трудности в оказании эффективной помощи больным с этими заболеваниями. В отличие от бактерий грибы редко ведут себя как инвазивные патогены у здоровых людей, но могут индуцировать астматические реакции у страдающих аллергией. В такой ситуации развитие заболевания возможно не только по аллергическому, но и по инфекционно-аллергическому варианту . Аллергический процесс – результат первичного иммунного ответа организма в виде бронхиальной астмы с сенсибилизацией к плесневым грибам. В этом случае инвазии гриба не отмечается, грибы представлены в дыхательных путях транзиторно и обычно эффективно элиминируются фагоцитами. Чаще других астматические реакции вызывают грибы, относящиеся к классам Zygomycetes, Ascomycetes, Deiteromycetes, Basidomycetes. В воздухе находится множество спор этих грибов; они могут вызывать ранние и поздние астматические реакции. А также авторами было утверждено ,что инфекционно-аллергический процесс характеризуется персистенцией грибов в дыхательных путях, их вегетацией в просвете бронхов, вызывающей нарастающую сенсибилизацию и аллергическую реакцию организма. В этом случае можно говорить об аллергическом бронхолегочном микозе, к наиболее частым возбудителям которого относят грибы рода Aspergillus . Клинически аллергический бронхолегочный аспергиллез протекает стадийно, как прогрессирующая бронхиальная астма с вовлечением интерстициальной ткани легких, сопровождается развитием эндо- и перибронхиального воспаления. При хроническом его течении продуктивная реакция соединительной ткани приводит к развитию легочного фиброза.

В свою очередь литературный анализ показал ,что хронический легочный аспергиллез (ХЛА) впервые описан как фатальное заболевание в 1842 г. в Эдинбурге (Великобритания) , а первый опыт терапии амфотерицином опубликован в 1957 г. у больного ХЛА на фоне туберкулеза . Рентгенологическая картина аспергиллемы впервые описана в 1938 г. во Франции как «большая мицетома внутри бронхоэктазов» . К середине XX в. получено множество клинических описаний аспергиллемы. В 1959 г. предложена классификация аспергиллеза, в которой использован термин «мицетома», тогда как сегодня этот термин обозначает только подкожную грибковую инфекцию .

Зарубежными авторами был отмечен интересный факт, что в 1960х годах в Великобритании открыты антитела к Aspergillus , которые использовались как способ подтверждения грибковой природы округлых грибковых конгломератов («грибковых шаров»), выявляемых при проведении рентгенографии (РГ) или компьютерной томографии (КТ). Термины полуинвазивного и хронического некротизирующего легочного аспергиллеза (ХНЛА) введены в начале 1980х годов. К тому времени с помощью достижений торакальной хирургии от аспергиллемы излечены несколько пациентов с одиночными очагами поражения; известно, что при множественных полостях (сложная аспергиллема) исход заболевания неблагоприятный . В и первые открытые исследования итраконазола, хотя и без стандартизованных критериев эффективности, все же показали частичное клиническое улучшение без изменений клинически. В 2003 г. предложены критерии диагностики и стратификации больных , которые затем были обновлены . Выполнено несколько проспективных исследований по лечению аспергиллеза. Подсчитан ущерб от ХЛА в мировом масштабе, включая ХЛА на фоне туберкулеза легких (n = 1,74 млн), аллергического бронхолегочного аспергиллеза (АБЛА) (n = 411 000) и саркоидоза (n = 72 000) , при этом показано всемирное значение данной проблемы. Среди факторов риска, усугубляющих течение легочных микозов, наибольшее значение имеют функциональные, иммунные, эндокринные и врожденные анатомические нарушения. Особая роль принадлежит ятрогенным факторам риска развития пневмомикозов; к ним относят частое, продолжительное и порой неоправданное применение антибиотиков широкого спектра действия, глюкокортикостероидов, цитостатиков, иммунодепрессантов, угнетающих защитные системы организма.

Таким образом подводя итог нашего литературного обзора можем прийти к единому выводу , что появление новых противогрибковых препаратов с большей активностью и лучшей переносимостью позволило значительно улучшить исходы лечения больных с риском возникновения тяжелой аспергиллезной инфекции. Однако существует еще много вопросов, требующих решения, в частности разработка способов раннего выявления инфекционного процесса, оценка исходов заболевания, лечение прогрессирующей или рефрактерной аспергиллезной инфекции, а также выделение групп пациентов, у которых профилактика аспергиллеза была бы наиболее эффективной.

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# PHYSICS AND MATHEMATICS

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## ТЕХНОЛОГИЯ КРИТИЧЕСКОГО МЫШЛЕНИЯ ПРИ ИЗУЧЕНИИ МАТЕМАТИКИ.

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## TEKHNOLOGIYA KRITICHESKOGO MYSHLENIYA PRI IZUCHENII MATEMATIKI.

***Аннотация***

*В данной статье мы рассматриваем, как с помощью элементов образовательных педагогических технологий можно помочь студентам в соответствие со способностями и интересами каждого адаптироваться в учебном процессе, преодолевать трудности и обучаться успешно, реализовывать свои способности для выполнения поставленной задачи или осуществления определенной деятельности.*

***Abstract***

*In this article, we consider how, with the help of elements of educational pedagogical technologies, it is possible to help students, in accordance with the abilities and interests of everyone, to adapt in the educational process, overcome difficulties and learn successfully, realize their abilities to complete a task or carry out a certain activity.*

***Ключевые слова:*** *математика, технологии, информационные технологии, объяснительно-иллюстративная модель, интерактивная доска, критическое мышление.*

***Keywords:*** *mathematics, technology, information technology, explanatory and illustrative model, interactive whiteboard, critical thinking.*

Критическое мышление – это способность анализировать информацию с помощью логики и личностно-психологического подхода, с тем, чтобы применять полученные результаты как к стандартным, так и нестандартным ситуациям, вопросам и проблемам.

Данная технология позволяет решать такие задачи, как: образовательной мотивации, информационной грамотности, социальной компетентности. Способствует не только усвоению конкретных знаний, а социализации ребенка, воспитанию доброжелательного отношения к людям.

Методические приемы для развития критического мышления, включающие в себя групповую работу, ролевые игры, дискуссии, индивидуальные и групповые проекты, способствуют приобретению знаний, обеспечивают более глубокое усвоение содержания, повышают интерес студентов к дисциплине, развивают социальные и индивидуальные навыки.

Технология критического мышления включает в себя три стадии: вызова, осмысления и размышления.

1. Стадия вызова актуализирует имеющиеся знания обучающихся, пробуждает интерес к теме. Именно здесь определяются цели изучения материала.

2. Стадия осмысления нового материала (новой информации, идеи, понятия). Здесь происходит основная содержательная работа студента с текстом.

3. Стадия размышления или рефлексии. Здесь студент осмысляет изученный материал и формирует свое личное мнение, отношение к нему.

Все три стадии соблюдаются преподавателями кафедры, так как это отражает сложный мыслительный процесс.

Например, прием «Знаю – Хочу узнать - Узнал » используется при изучении неопределенных интегралов:

– Как вычислить табличный неопределенный интеграл $\int \frac{dx}{x}$

– Как вычислить не табличный неопределенный интеграл $\int (2x+1)^{20} dx$

– Решение методом непосредственного интегрирования

$$\int \frac{dx}{x^2-6x+25} = \int \frac{dx}{(x-3)^2+16} = \frac{1}{16}\int \frac{dx}{\left(\frac{x-3}{4}\right)^2+1} = \frac{1}{16} arctg\left(\frac{x-3}{4}\right) + C.$$

– Решение методом подстановки $\int \sqrt{\sin x}\cos x dx$. Сделаем замену *t = sinx, dt = cosxdt.*

$$\int \sqrt{t} dt = \int t^{1/2} dt = \frac{2}{3} t^{3/2} + C = \frac{2}{3}\sin^{3/2} x + C.$$

– Решение с помощью формул интегрирования по частям

$$\int \frac{\ln x}{x^3} dx = \left\{ \begin{array}{ll} u = \ln x; & dv = \frac{1}{x^3} dx; \\ du = \frac{1}{x} dx; & v = -\frac{1}{2x^2}; \end{array} \right\} = -\frac{\ln x}{2x^2} - \int -\frac{1}{2x^2} \cdot \frac{1}{x} dx = -\frac{\ln x}{2x^2} + \frac{1}{2}\int \frac{dx}{x^3} = -\frac{\ln x}{2x^2} +$$

$$+ \frac{1}{2}\left[ -\frac{1}{2} x^{-2} \right] + C = -\frac{\ln x}{2x^2} - \frac{1}{4x^2} + C.$$

В первый столбец «Знаем» записываем идеи студентов, которые они предлагают.

Во второй столбец «Хотим узнать» предлагаем им внести свои опорные мысли и идеи, которые у них возникли в процессе обсуждения темы. Затем при чтении текста учебников, они пытаются найти ответы на поставленные вопросы.

И в третий столбец «Узнал» предлагаем внести изучения темы, соотнося с полученной информацией, которая была у них в начале занятий.

Данный прием предусматривает комплексный подход к изучению материала. Обучение начинается с активизации уже имеющихся знаний обучающихся.

Прием «Синквейн»

Это пятистрочная стихотворная форма, которая помогает описывать суть изучаемых понятий в лаконичной форме, а также осуществлять рефлексию на основе полученных знаний.

При составлении примеров, у студентов развивается не только критическое мышление, но и образное.

Данная форма работы направлена на развитие творческих способностей.

Примеры:

1.Контрольная работа по теме «Линейная алгебра».

2.Интересная лекция по теории вероятностей

3. Вычисляем производные.

4. Я умею решать дифференциальные уравнения

**Список литературы**

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# ECONOMIC SCIENCES

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## FACTORS OF ECONOMIC GROWTH OF THE REPUBLIC OF UZBEKISTAN AT THE PRESENT STAGE

***Abstract.***
*This article is devoted to the analysis of the main factors ensuring the growth of the Gross Domestic Product of the Republic of Uzbekistan. It examines the quantitative characteristics of macroeconomic indicators in recent years.*

***Key words****: Gross Domestic Product,investments, final consumption*

The beginning of 2020 is marked by a significant event in the history of our country. On January 24, the President of the Republic of Uzbekistan Shavkat Mirziyoyev addressed the newly elected parliament of the country with a Message, which identified strategic tasks for the further development of the economy and society. "... our main task is to ensure macroeconomic stability and contain inflation in the process of economic reforms." [1] The result of solving this problem is to ensure high rates of economic growth.

Economic growth is understood as the dynamics of an increase in the production of goods and services in the country, accompanied by an increase in income and an increase in the welfare of the population. Economic growth reflects quantitative changes in the economy of the state and is part of economic development. Economic development means an increase in production volumes, scientific and technological progress and an increase in the level and quality of life of the population.

Further development of the economy is one of the important directions identified in the Action Strategy for the Further Development of the Republic of Uzbekistan for 2017-2021. It provides for the achievement of macroeconomic stability and sustainable growth rates of the economy and its sectors, deepening structural and institutional transformations, increasing the competitiveness of manufactured products through in-depth processing of mineral resources, developing the potential of regions, districts and cities, and intensive development of agriculture. [2]

An important indicator of economic growth is the indicator of the value of the gross domestic product (GDP). At the same time, per capita GDP is a more accurate indicator of the level of well-being and quality of life. For an evaluative and comparative analysis, we present the data of the State Committee on Statistics of the Republic of Uzbekistan of indicators of real GDP and GDP per capita from 2012 to 2019 (table 1).

Table.1.

**Dynamics of changes in the gross domestic product (GDP) indicator of the Republic of Uzbekistan.**

| Years | State GDP (billion soums) | GDP per capita (thousand soums) | Annual GDP growth rate,% GDP per capita growth rate,% | Growth rate of GDP per capita,% |
|---|---|---|---|---|
| 2019 | 511838.1 | 15242.0 | 105.6 | 103.6 |
| 2018 | 407514,5 | 12339,1 | 105,4 | 103.6 |
| 2017 | 302536,8 | 9340,8 | 106,0 | 102.7 |
| 2016 | 242495,5 | 7614,2 | 113,3 | 104.3 |
| 2015 | 210183,1 | 6715,4 | 111,1 | 105.6 |
| 2014 | 177153,9 | 5759,7 | 109,5 | 105.4 |
| 2013 | 144548,3 | 4779,5 | 108,3 | 105.9 |
| 2012 | 120242,0 | 4038,4 | 112,7 | 105.8 |

The data in the table show that the GDP of Uzbekistan in 2018 amounted to 407.5 trillion soums and increased by 5.4% compared to 2017, GDP per capita amounted to 12.3 million soums and increased by 3.3%. The largest contribution to GDP growth was made by industry, which grew by 10.6% compared to 2017. The positive dynamics in this industry was ensured by the growth of the added value of the mining industry and quarrying - by 28.2%, the manufacturing industry - by 6.4%, and other industries - by 4.7%.

According to preliminary data for January - December 2019, the republic's GDP amounted to 511.8 trillion soums, the largest contribution to GDP growth was made by industry and construction, and the volume of construction work, compared to the same period last year, increased by 35.2%. According to experts, the

rates of economic growth are due to positive dynamics in the main sectors of the economy.

The current stage of development of the economy of Uzbekistan began in 2016, when a political course was announced for the accelerated development of the economy and the democratization of all aspects of public life. Then, speaking at a joint meeting of the Oliy Majlis on December 14, 2016, the President of the Republic of Uzbekistan Sh.M. Mirziyoyev noted the following: "Modernization of industries and regions, increasing their competitiveness, developing export potential will always be in the center of our attention. To do this, it is necessary to even more actively attract foreign investments, advanced technologies, including information and communication technologies, in all areas. It is on this basis that we will be able to achieve an increase in the volume of gross domestic product by more than 2 times by 2030. To achieve such a GDP growth, it is enough to provide an average annual growth rate of 4.8% ". [3]

Theoretical studies of the effectiveness of economic growth factors, taking into account quantitative and qualitative indicators, revealed that an increase in their efficiency is associated with the level of employment, an increase in the volume of fixed capital, an increase in the share of savings, and an efficient allocation of resources. They, in turn, increase the qualitative characteristics of the integral indicator, which expresses the effectiveness of economic growth factors in the country, such as labor efficiency, capital efficiency, capital intensity, material consumption and energy intensity of the real sector of the economy, export volume, and the level of production competitiveness. In addition, an increase in the factors of economic growth is also associated with the stable development of political, social and ecological systems.

At the current stage of development of Uzbekistan, an increase in the efficiency of economic growth can be achieved, firstly, by increasing the amount of capital in accordance with the change in the number of labor resources, and secondly, by increasing the possibilities of effective use of human resources.

In the first case, it is advisable to increase the volume of investments in the economy and the efficiency of their use, identify new sources of investment and invest them in the real sector. The analysis shows that in 2012–2019. The volume of investments in fixed assets grew steadily and by 2019 amounted to 37.1% of the total size of the country's GDP. It can be seen that the share of investment in GDP in 2019 increased by more than 7% compared to 2018 (Table 2).

Table.2.

**Dynamics of changes in the volume of investments in the economy of the Republic of Uzbekistan in 2012-2019**

| Years | The invstments to the main capital( Bln.soum) | GDP of country (bln.soum) | Share of investment in GDP (percent) |
|---|---|---|---|
| 2019 | 189924,3 | 511838.1 | 37,11 |
| 2018 | 124231,3 | 407514,5 | 30,48 |
| 2017 | 72155,2 | 302536,8 | 23,85 |
| 2016 | 51232,0 | 242495,5 | 21,12 |
| 2015 | 44810,4 | 210183,1 | 21,31 |
| 2014 | 37646,2 | 177153,9 | 21,25 |
| 2013 | 30490,1 | 144548,3 | 21,09 |
| 2012 | 24455,3 | 120242,0 | 20,33 |

It should be noted that the volume of investments in fixed assets is directly affected by the level of national savings, which, according to the Central Bank of the Republic of Uzbekistan for January-June 2019, amounted to $ 10.2 billion, the average amount of savings per capita is estimated at $ 1134. In turn, the level of savings is greatly influenced by inflationary expectations of the population. The central bank's shift to inflation targeting was the impetus for a real decline in inflation and an increase in savings.

To increase the return on human capital, it is necessary to pay special attention to ensuring continuous professional development of labor resources, the development of innovative activities, and the modernization of the national economy through the use of new modern technologies. As noted in the President's Address "... first of all, we need to educate personnel of a new formation, initiating reforms, possessing a strategic vision, deep knowledge and high qualifications". [1] This requires directing investments in science and innovation and ensuring efficiency.

One of the most important elements of gross domestic product is the final consumption expenditure of households. It is they who occupy the largest share in the country's GDP (55% in 2018) and provide its growth among other constituent elements, thereby affecting economic growth (Table 3). Household final consumption expenditure consists of final consumption expenditure, government final consumption expenditure, and final consumption expenditure of non-profit institutions serving households.

Table.3

**Dynamics of changes in household final consumption expenditures in 2012-2018**

| Years | Household final consumption expenditure (billion soums) | Growth rate (%) |
|---|---|---|
| 2018 | 223635,1 | 125,2 |
| 2017 | 178585,6 | 118,5 |
| 2016 | 150644,0 | 118,3 |
| 2015 | 127249,2 | 121,2 |
| 2014 | 104930,1 | 122,7 |
| 2013 | 85485,3 | 125,1 |
| 2012 | 68298,8 | 127,5 |

As the data in Table 3 show, the growth rates of household final consumption expenditures have a positive trend over the entire analyzed period. We especially note the growth of final consumption in 2018. The same growth rate of the indicator can be predicted based on the results of 2019.

Thus, it can be concluded that the ongoing reforms in the economic sphere ensure sustainable growth rates of the country's GDP for the medium term. At the same time, further economic growth requires an active investment policy, the development of human potential, as well as the improvement of state regulation in the field of improving the quality of life of the population.

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## MODEL OF PREPARATION OF FUTURE PHYSICAL EDUCATION TEACHERS FOR SPORT MARKETING ACTIVITIES

***Abstract:***
*This article provides information on the model of training future physical teachers for sport marketing activities.*

***Key words:*** *Model system, monologue method, exhibition of method, algorithmic method of teaching, compulsory competence.*

At the heart of the model lies a theory of similarity which requires adherence to conditions such as not distorting the properties of the object and abstracting the insignificant aspects of a given aspect in the construction of the model. The model solves the problem clearly enough - explains how some aspects of the object under study affect other aspects and the whole process. The model reveals the important qualities and elements of the system, the structure and content of the object in the general sense, the existing relationships, predicts its development, describes the object under study as an ideal descriptor of real processes.

In our view, the preparation of future physical teachers for sports marketing activities is based on the following main conditions: the current situation in the Uzbek market; mandatory competence in knowledge of financial and economic issues; acquisition of necessary social skills; readiness to read and study independently throughout life; have self-expression skills that are taken into account during model construction.

For the effective formation of professional activity in the developmental stages of education can be used methods of teaching students grouped by the following types of activities: methods of teacher narration - monologue, visual, communicative;

the method of organizing students' independent learning - heuristic, research, programming, algorithmic.

1.Monological method is a method of explaining the subject to students in the form of a story or lecture using audiovisual means and directing the system of rules of preparation and narration of educational material to the principles of education in order to form knowledge and skills of their reception. The monologue method of teaching allows the teacher to describe the teaching material, explain the events, students observe, hear, remember, work on the sample, work with tables,

instruments, solve problems, etc. characterized by the activation of such activities. When using the monologue method, the main focus is on the opportunities for preparing students for the profession, focusing on the learning process, defining the purpose of the activity.

2. Demonstrative method is to direct the system of rules of preparation and explanation of educational material to the principles of the education system by posing a problem and showing ways to solve it, or by rationally expressing scientific research to students.

Demonstrative method features: 1) the logical solution of a scientific problem is solved by scientists or the writers of the solution of ethical problems; 2) ways to prove, discuss, search for a solution; 3) practical problem solving methods are shown.

Functions of the visual method: students form an understanding of logic and methods of solving scientific or practical problems, form an idea of the methods of creative activity.

The rules for using the visual method are: 1) to create a problem situation by showing the solution of the problem and to explain the content of the basic concepts; 2) preparation of students for future work; 3) to draw attention to the learning situation.

Methods of application: storytelling (demonstration) by showing the logic of lighting; solve a scientific or practical problem; demonstrate the process of activity through demonstrations of experiments, video films. This method is used in two variants. In the first option, the teacher takes the event from the history of science and demonstrates the logic of solving a scientific problem by scientists. In his story, he cites historical events, reveals their opposite sides, creates a problematic situation, shapes the problem, and shows how it is solved by scientists.

In the second option, the teacher uses an exhibition method that demonstrates a research pattern in finding a solution to a practical problem, an equation, a proof, a law. In this case, the teacher's activity is similar to the teacher's activity in the first option. Student activities are of a reproductive nature, but have a greater impact on learning activities than the monologue method. His work is intensified by the following activities: asking problematic questions that evoke wonder, complexity, emotional relationships; demonstrations that confirm or refute assumptions that focus students 'attention on the concepts being studied; communication with the pedagogical process; the teacher's resultant attention; building students 'confidence in their abilities.

3. The method of communication is the explanation of the teaching material by the teacher, its mastery by students; ensuring the participation of students in setting problems and finding solutions; to direct the system of rules of preparation of educational material and communication to the principles of the education system in order to activate their educational activity.

The main features of the method of communication: the learning material is given to the student in the form of an informative conversation, which uses mainly reproductive questions on a particular material. The teacher can again create a problematic situation, ask problematic questions, but in this case he himself explains the content of the new concepts and methods.

The main functions of the communication method are: to reveal new concepts and methods of learning activities using reproductive questions and pre-created problem situations; activation of cognitive communication and awakening of students' mental or practical activity, formation of their oral communication and independent activity; teaching them with team thinking activities.

The rules of using the method of communication are: 1) to create a problematic situation (if possible) during the informative conversation; 2) to involve students in solving problems that show a hypothesis, substantiate a hypothesis and its proof; 3) monitor and evaluate the level of activity of students during informative conversations and in solving learning problems.

Learning new material in the classroom using the communication method, generalization and systematization of knowledge is carried out. During the interview, the teacher asks questions based on the knowledge and skills that students need to acquire. Their independence in learning activities is determined by the number of questions of a reproductive nature. When asking questions that require new information, new knowledge, answers to a new approach, the teacher either answers the questions himself, or gives the students a textbook, video, and so on. The organized study of this method is dynamic, it can be changed to both heuristic and monologic methods, applied at any stage of the training.

4. Algorithmic method of teaching is to direct the process of acquisition of new knowledge and movement by the teacher to the principles of the regulatory system of organization by demonstrating the algorithm for performing tasks (learning algorithms).

the main of symptoms: verbal instruction to students; show an example of the action and execution of the algorithm (set of rules); work on samples and algorithms; the existence of situations in which the students themselves create the algorithm.

Main functions: to form students' ability to work on defining rules and guidelines; organization of practical and laboratory work according to the instructions; developing skills to independently create new algorithms.

The main of rules: 1) instructing students on how to complete the task; 2) demonstrate to students the practical implementation of the task; 3) use of algorithms (or created by the teacher) given by students in the performance of tasks; 4) monitoring and evaluation of performance.

Using the algorithmic method of teaching, the teacher gives students the opportunity to show ready-made patterns of movement, instruct, teach them the algorithm of actions, to form their knowledge and skills of independent, practical work (independent planning, adjustment, control, creation of algorithms). Based on this method, an individual approach to the acquisition of new knowledge and acquisition of skills is formed.

The given method is implemented in the form of algorithms or tasks performed in search of a new algorithm. The basis of the algorithmic method is to give an algorithm of actions in the form of instructions on the goals, objectives, methods of performing future tasks. Depending on the level of development of the students, the instructions can be short, generalized or complete, detailed, in the form of questions and answers or in writing, on the basis of cards. For example, when performing laboratory work, the following work plan can be given: 1. What is the purpose of the next work? What to do, what knowledge to acquire, in what way to master? 2. What should be done for this? What to determine at work? Which law should apply? and so on.

5. The program method is a guide to the principles of a system of rules governing the independent work of students and the organization of teaching materials, which are studied using pedagogical software. Its main functions are: management of educational activities using PPS and TSO; computer-assisted learning; creating tutorials and other software for the computer; developing individual interests.In this method, the training material is sorted using PPS; it engages students in activities and encourages them to complete programmed tasks in a new form; programmed tasks are evaluated based on the results of the performance.The programming method used in personal computers is more widely used than other teaching methods. Due to the high technical and didactic capabilities of computers, this method is widely used in teaching many subjects.

6. The heuristic method is to focus on the principles of the regulatory system of heuristic conversation with the preparation of educational material and the solution of cognitive tasks.The main features of the heuristic method: the organization of the study of educational material in a heuristic form; asking problematic questions; solving cognitive problems; learning problems are posed and solved by students with the help of a teacher.The main functions of the heuristic method are: independent mastering of knowledge and methods of action; development of creative thinking (transfer of knowledge and skills to a new situation; introduction of a new problem to the traditional situation; introduction of new features of the object of study; change of known methods of activity and creation of new ones independently); development of mind, thinking skills, formation of cognitive abilities; teaching students to engage in active cognitive communication; developing adaptability to learning, adaptability to achievement.

Rules of application of the heuristic method: 1) the formation of new knowledge is based on heuristic conversation and is applied in conjunction with the independent work of students (participation in heuristic conversation - asking encountered, problematic questions, answering problematic questions, solving cognitive problems); 2) the teacher creates the problem situation himself, students have to analyze them and put problems, put forward and prove the hypothesis, draw conclusions; 3) students are assessed mainly on the ability to use the acquired knowledge, to put forward and substantiate hypotheses, to prove them, to master the methods of work.

The heuristic method is used in the study of new material of a reverse nature or in consolidating previous impressions, interest in understanding multifaceted phenomena, consolidation of knowledge acquired by students in order to independently search for new ways of working. The application of this method depends on the level of learning and development of students, especially the formation of their cognitive knowledge. The heuristic method is used in the form of heuristic conversations during seminars, discussions, training conferences. the teacher partially explains the new problem task. Students work independently, analyze problem events, pose a problem, find a solution to it, and seek new knowledge and ways of working.

7. The research method is to teach students to solve problems such as new concepts, methods of work, based on teaching materials prepared by the teacher and organized independent work, and to guide the system of regulatory rules to the principles of the education system to develop their intellectual abilities.

The main features of the research method: the teacher gives students a task of a problematic nature as an independent work and together with them develops the purpose of the work. Problem situations, as a rule, arise during the performance of tasks by students, which are not only theoretical (instrumental), but also practical (search for additional information, sorting and analyzing information, etc.).

The main functions of the research method are: the formation of creative thinking, the independent acquisition of new knowledge and methods of work by students; forming areas of flexibility, emotion, willpower.

Rules of use of the research method: 1) based on the possibility and purpose of problem-based learning, the teacher gives the student independent work to solve the learning problem; 2) the teacher develops students' ability to search for information by leaving a problem situation and problem; 3) find ways to solve tasks, set learning problems and know how to solve them, draw conclusions and prove the conclusion.

The research method (as a complex method) is less commonly used than the heuristic method. This method is used in group practice, solving interdisciplinary learning problems in several sessions, solving problems with a creative group of students, organizing educational games.

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# REGIONAL PRODUCTION OF GRAIN AND LEGUMINOUS CROPS IN UKRAINE AND ITS INFLUENS ON EXPORT OF THE COUNTRY

***Abstract***

*The article assesses the state of production of grain and legumes in Ukraine in terms of its regions. The areas under cereals and grain yields were studied. The influence of the volume of grain and legumes production on the export potential of the region is modeled*

***Key word:*** *grain, legumes, trends, production, gross harvest, export, modeling*

In the agricultural market, grain and leguminous crops retain leading positions in exports, processing and domestic consumption, which proves their strategically important role in ensuring the food and economic security of Ukraine. Therefore, research of the problem of the effectiveness of grain and leguminous crops production at agricultural enterprises and methods of their increase is an urgent issue in Ukraine.

More than half of Ukrainian lands are planted with grain crops and therefore they provide most of the income for agricultural enterprises. According to the State Statistics Service of Ukraine, the size of acreage under grain crops in 2019, Ukraine can be divided into zones (Table 1).

Table 1

**Distribution series of harvested area in Ukrane, 2019, thsd. ha**

| Harvested area, thsd.ha | Frequency | The middle of interval | Regions of Ukraine |
|---|---|---|---|
| 80,9-308,8 | 6 | 194,85 | Volyn, Transcarpathia, Ivano-Frankivsk, Lviv, Rivne, Chernivtsy |
| 308,8-536,7 | 5 | 422,75 | Zhytomyr, Luhansk, Sumy, Ternopil, Khmelnytskiy |
| 536,7-764,6 | 4 | 650,65 | Donetsk, Kyiv, Cherkasy, Chernihiv |
| 764,6-992,5 | 5 | 878,55 | Vinnitsya, Kirovohrad, Kherson, Mikolayiv, Poltava |
| 992,5-1197,2 | 4 | 1094,85 | Dnipropetrovsk, Zaporizhzhya, Odessa, Kharkiv |
| **Total:** | **24** | **X** | **X** |

According to Table 1, the largest area under crops is observed in Dnipropetrovsk, Zaporizhya, Odessa, Kharkiv. However, only by the area of crops we cannot say that these regions occupy the largest share in the structure of grain production of the country. It is also necessary to consider the yield of grain in the regions of Ukraine. According to Figure 1, the highest yield of grain crops was achieved in the Vinnytsia region, respectively, and the volume of grain production in this region (Fig. 2) is also the largest at the level of 54447 thousand centner.

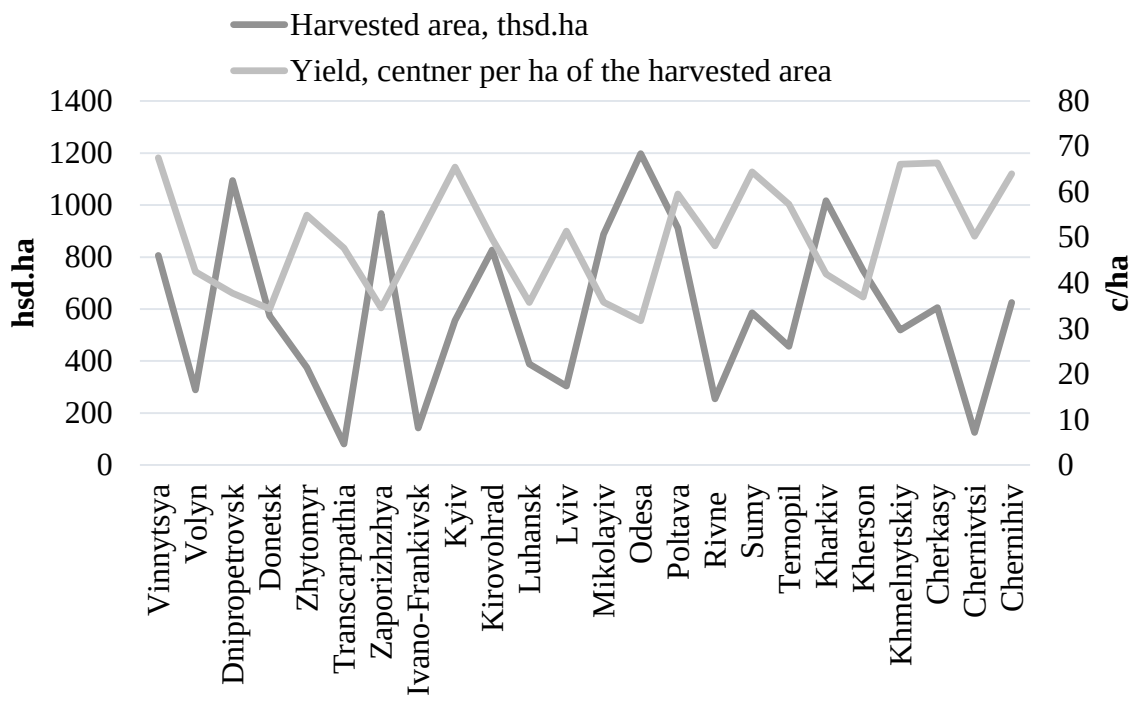


*Fig. 1. Harvesting of cereal and leguminous crops in regions of Ukraine, 2019 y.*

Zakarpattia, Chernivtsi and Ivano-Frankivsk oblasts have the lowest production volumes. This level of yield is mainly caused by the influence of soil and climatic conditions of grain growing. The climate of these regions and soils do not allow farmers to achieve high grain yields.

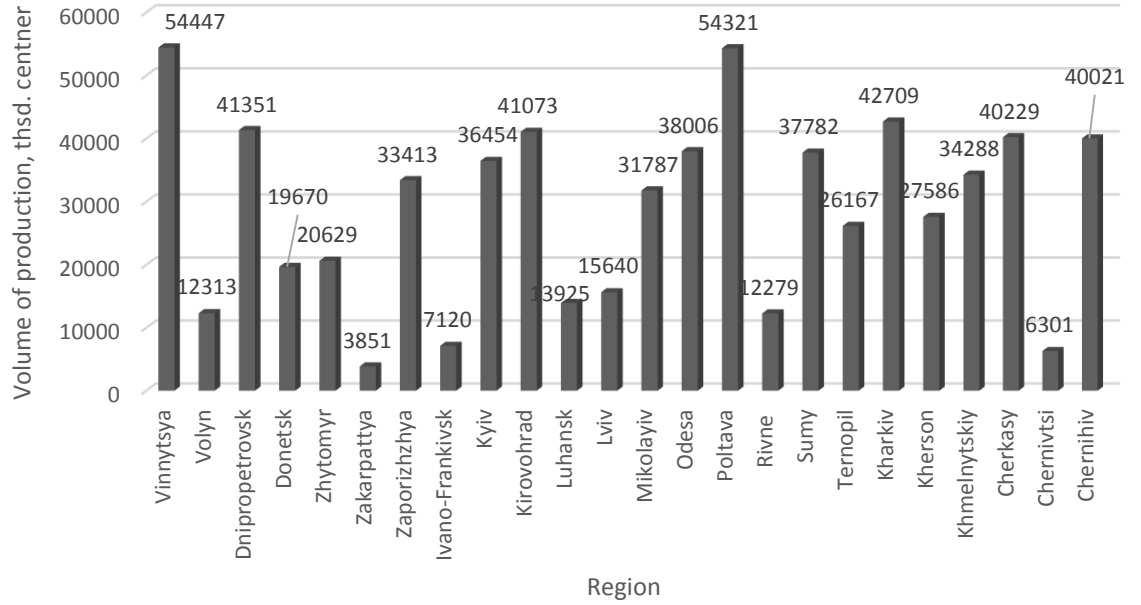


*Fig. 2. Volume of production of cereal and leguminous crops in regions of Ukraine, 2019 y., thsd. centner*

Analyzing the dynamics of increasing grain production, we have the opportunity to establish that the production of grain and legumes is growing rapidly in Ukraine. This made it possible in 2019 to collect a record gross collection. The main factors in increasing the volume of grain crops are the profitability of this crop and its export-oriented nature. According to the State Statistics Service of Ukraine, grain exports occupy a leading position in the structure of the country's exports – 18.6 %.

In order to study the impact of grain production on the export potential of the country, we selected information in terms of 24 regions of Ukraine: the volume of grain production - factor, independent variable and quantity of export - result, dependent variable. The results of the econometric modeling are contained in the Table 2.

Table 2

**Conclusions**

| | |
|---|---|
| Multiple R | 0,634601 |
| R-square | 0,402718 |
| Normalized R-square | 0,312085 |
| Standard error | 1686 |
| Observations | 24 |
| F- criterion | 1,281352 |
| F - Significance | 0,269836 |
| Y-intersection | 788569,7 |
| Variable X 1 | 26,87561 |

The results of the econometric modeling indicate a moderate impact of grain production on exports by region (correlation coefficient is 0.6), so the volume of exports caused by 40% due to the impact of grain production in a particular region of the country and 60% of export variations caused by unaccounted factors during modeling. The obtained model is adequate because the actual value of Fisher's F-test is greater than the critical point. The independent variable $x_1$ indicates that with an increase in grain production by 1 thsd. centner - the volume of exports will increase by 26.88 thsd. $ USA.

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## К ВОПРОСУ ОБ ОПРЕДЕЛЕНИИ ПОХОДОВ К СУЩНОСТИ ЭКОНОМИЧЕСКОЙ КАТЕГОРИИ «ЦЕНА»

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## ON THE QUESTION OF DETERMINING APPROACHES TO THE ESSENCE OF THE ECONOMIC CATEGORY "PRICE"

***Аннотация***

*Существование и тиражирование различных подходов к трактовке одних и тех же экономических терминов и категорий ведет к развитию терминологической путаницы. Целью исследования явилось оценка научных подходов к определению сущности категории «цена» и практике их применения. Опираясь на систему общенаучных и специальных методов исследования, автором предлагается при раскрытии сущности категории «цена» исходить и обозначать статус и цель использования данной категории при новом ее толковании.*

***Abstract***

*The existence and replication of different approaches to the interpretation of the same economic terms and categories leads to the development of terminological confusion. The aim of the study was to evaluate scientific approaches to determining the essence of the category "price" and the practice of their application. Based on the system of general scientific and special research methods, the author proposes, when disclosing the essence of the "price" category, to proceed and indicate the status and purpose of using this category in its new interpretation.*

***Ключевые слова:*** *цена, стоимость, экономический термин, экономическая категория, терминологическая путаница*

***Key words:*** *price, value, economic term, economic category, terminological confusion*

Зрелость научного познания в той или иной области определяет устойчивость используемого категориального аппарата. Экономика как наука, несмотря на свой многовековой опыт, зачастую этим грешит. Наиболее часто разночтения в трактовке одних и тех же экономических категорий встречаются в работах молодых ученых-перфекционистов. Результаты их исследований в этой части могут носить как созидательный, так и деструктивный характер.

Созидательный характер свойственен определениям, явившимся следствием проведения глубоких фундаментальных и прикладных исследований и основанных на знаниях и опыте исследователя. Деструктивный характер наиболее часто встречается в определениях, выработанных на основе поверхностных исследований и недостаточном опыте исследователя, либо при отсутствии у него достаточных базовых знаний в исследуемой области, что ведет к развитию терминологической путаницы.

Кроме этого, в экономике используются синонимы и омонимы. В первом случае это слова одной части речи, близкие по значению, но разные по звучанию, а во втором – слова одной части речи, одинаковые по звучанию и написанию, но разные по лексическому значению. В качестве примера можно привести такие экономические категории, используемые в научной лексике как актив, дисконт, партия, акцепт, касса, пассив, принципал, рынок и другие.

Экономической категории «цена» также дано множество определений и трактовок. В словаре В.И. Даля, категория «цена» трактуется как достоинство, стоимость, плата или мера на деньги, что, собственно, отражает актуальные взгляды того времени [1, с. 595]. В современной русскоязычной научной литературе можно выделить экономический и правовой подход к определению сущности категории «цена». В ряде экономической литературы под категорией «цена» понимается соглашение между продавцом и покупателем об обмене некоего количества товара или услуги на эквивалентную по ценности сумму денег. Однако, такой подход вызывает некоторый скептицизм относительно его соответствия концепции рыночных отношений, где спрос на товар и услугу определяется потребностью в них и способностью их обеспечить получение контрагентами выгод, то есть полезностью.

Правовой статус категории «цена» закрепляется в нормативных и правовых актах. Но и здесь также могут быть разночтения. Так, например, в Законе Республики Беларусь «О ценообразовании», цена определяется как «денежное выражение стоимости единицы товара», однако указанный закон не дает нам самой трактовки термина «стоимость». Если обратиться к словарю П.А. Кошеля, то в нем термин «стоимость» представлен как омоним, то есть с одной стороны это ценность чего либо, а с другой – величина затрат [2, с. 150].

В современных реалиях цена товара или услуги должна рассматриваться с позиции их полезности для потребителя. Но рациональный потребитель, как и продавец стремиться максимизировать свой доход. Принимая решение о покупке, потребитель купит тот товар, полезность которого для него будет выше, чем оценка, данная полезности реализуемого товара продавцом. При этом, у каждого из участников сделки будет свое видение сущности категории «цена». Так, потребитель будет рассматривать цену как затраты, которые он понес в связи с приобретение того или иного блага или услуги, тогда как продавец «цену» будет ассоциировать с получаемой выручкой и прибылью. В тоже время, нужно отметить, что потребитель может приобретать товар или услугу как для собственного потребления, так и в пользу третьего лица, что в свою очередь найдет отражение в определении сущности категории «цена».

Аналогичную ситуацию с трактовкой категории «цена» можем наблюдать относительно позиции экономиста и бухгалтера. Это связано с имеющимися различиями в подходах относительно состава и структуры экономических и бухгалтерских издержек.

При использовании экономической категории «цена» в юриспруденции разработчики имеют целью формирование краткой однозначной и универсальной трактовки, использование которой будет иметь место в законодательных и нормативных правовых актах. При этом трактовка для законодательных актов (законов, указов и др.) будет иметь более жесткую формулировку нежели для нормативных правовых актов. В нормативных правовых актах допускается более широкое раскрытие сущности категории для целей деятельности органов, утверждающих ее. Например, налоговыми органами может быть использовано более широкое, специальное определение категории «цена».

Таким образом, если подходить к трактовке категории «цена» с экономической точки зрения, в общем плане она может быть определена как полезность товара, работы или услуги выраженная в денежном эквиваленте. Однако, для более узкой трактовки, например, при проведении исследований и разработке рекомендаций, определяющим фактором является единообразное понимание ее трактовки как контрагентом, так и всеми участниками процесса. В этой связи, для определения и трактовки категории «цена» нами предлагается исходить из статуса и целей или среды использования:

- юридический статус (законодательные, правовые и нормативные акты);
- общественный статус (универсальное – для образовательных целей, отраслевое – по сферам деятельности);
- коммерческий статус (в соответствии с выполняемой основной функцией);
- потребительский статус (с позиции промежуточного или конечного покупателя (потребителя)).

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# FEATURES OF THE DEVELOPMENT OF THE MACHINE-BUILDING COMPLEX OF UKRAINE

***Abstract.***
*In the presented article, the problems of the development of the machine-building complex of Ukraine are studied, as well as the prospects for the development of the machine-building complex in a market economy. The positive and negative aspects of the development of mechanical engineering are revealed. It has been substantiated that an important condition for the development of mechanical engineering is the expansion of the export potential, which, in turn, is associated with foreign exchange earnings necessary for the structural restructuring of the economy, modernization of production, and the purchase of fuel and raw materials.*

***Keywords:*** mechanical engineering, market economy, mechanical engineering problems, mechanical engineering development prospects, economic crisis, market environment, economic development

Mechanical engineering is one of the central sectors of the economy of any state. The level of GDP, its material consumption and energy intensity depend on the level of development of mechanical engineering. In addition, the development of mechanical engineering affects the increase in labor productivity and the efficiency of almost the entire economy. Therefore, it is quite clear that the state of the machine-building complex should be a constant subject of consideration by the country's leadership. The prospects for the country's economic and social development impose new requirements on the level of mechanical engineering, its scientific, technical and production base. This article is devoted to the study of the features, problems and opportunities for the development of the machine-building complex of Ukraine.

Mechanical engineering is recognized all over the world as the leading industry. The level of development of the machine-building complex determines the state of the production potential of the state, ensures the stable functioning of the leading sectors of the economy (fuel and energy complex, transport and communications, agro-industrial complex, defense industries, construction), as well as filling the consumer market. The most important specific indicators of the country's gross domestic product (material consumption, energy intensity, etc.), labor productivity in the sectors of the national economy, the level of environmental safety of industrial production and, of course, the state's defense capability depend on the development indicators of mechanical engineering. The machine-building complex ensures scientific and technological progress and the restructuring of the economy of the entire country, therefore, its industries in modern conditions are developing at an accelerated pace, and their number is constantly growing.

However, when analyzing economic activity in the country, there is a need to create conditions for combining the factors of the scientific and technical program, resource potential and staffing, which requires mobilization of efforts from all subjects of the economic system. In turn, these fundamental mechanisms are implemented within the framework of the Ukrainian machine-building complex, which suffered more than other economic sectors during the last economic crisis. Currently, the economic situation in the machine-building complex is rather difficult.

The research results show that by 2012 the profitability of machine-building enterprises tended to grow. But with the beginning of the political crisis in the country in 2012, since 2013 the profitability of machine-building enterprises tended to decrease and positive values, which indicates the presence of losses in the activities of enterprises. First of all, it is connected with the loss of sales markets in the countries of the Commonwealth of Independent States, the share of which reached 80% of all machine-building production.

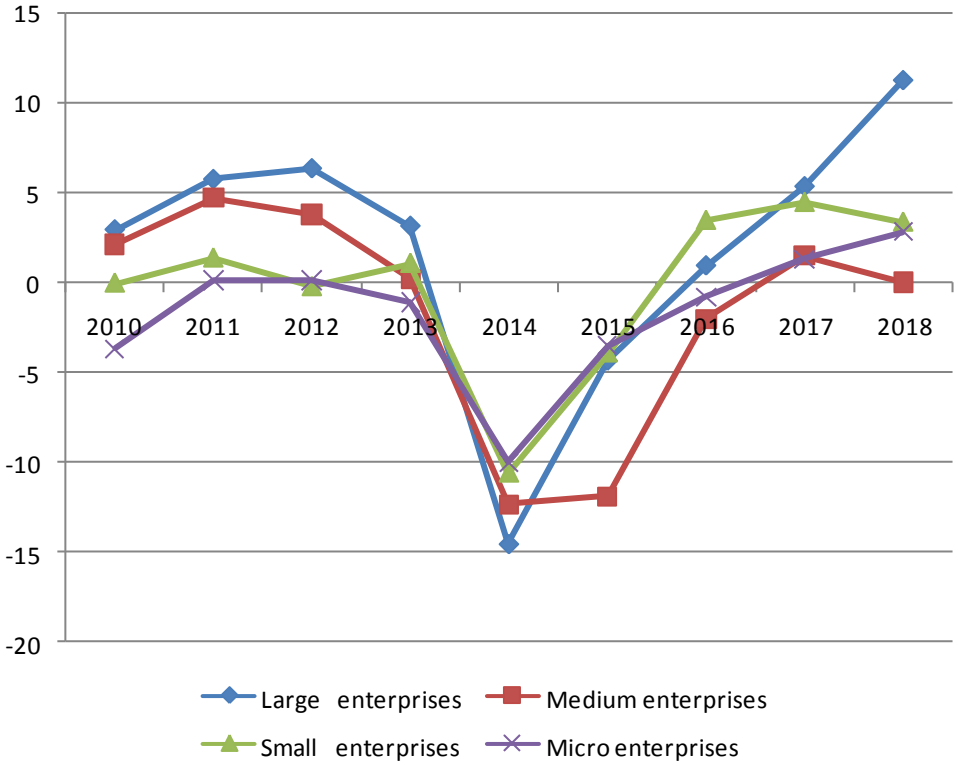


*Figure 1 - Profitability of production facilities for large, medium, small and micro enterprises [1]*

The export of engineering products from Ukraine in 2018 increased by 9% from 5,05 to 5,51 billion dollars. With the exception of the countries of the Eurasian Economic Union (EAEC) (Russia, Belarus and Kazakhstan), the growth is higher – 14,8%. But such growth is not sufficient to achieve the pre-crisis level. In 2012, machine building exports amounted to $13,3 billion. In 2012, the machine-building export amounted to $13.3 billion, and outside the EAEC countries it is also more - $4,7 billion. The growth is due to the electrical products of international campaigns located on the western border of the country. All other industries, old enterprises in general, reduce exports. Table 4 shows the export volumes of the main groups of engineering products - equipment and machinery, railway transport and electrotechnical industries. Railway transport is mainly wagons. In 2012 they accounted for 20% of all engineering export from Ukraine. In 2015 the export of wagons, as well as of other railway transport, fell to the minimum values. Exports of equipment and machinery decreased during the crisis in 2015 and almost did not recover. At the same time, exports of electrical products are catching up with pre-crisis indicators.

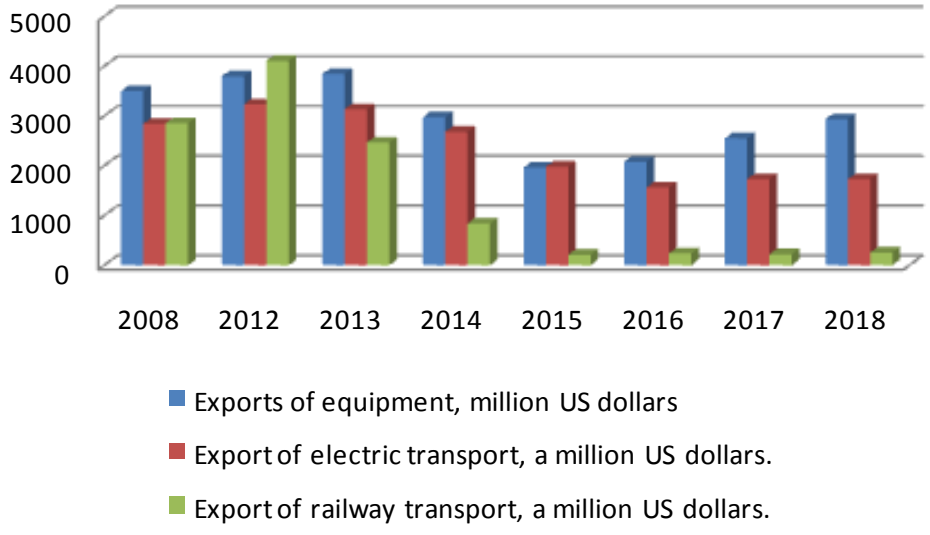


*Figure 2 - Exports of major groups of engineering goods, million dollars [1]*

Figure 3 shows the dynamics of exports by main machine building commodity groups. If in 2012 the main commodity group were railway wagons, in 2018 their contribution is not visible. Wagons were exported to Russia and other post-Soviet countries. The crisis of 2014-2015 reduced the opportunities for fuel and raw materials countries to buy railcars, besides, they built their factories in Russia. The demand for railcars in the post-Soviet countries fell naturally, no other people appeared.

The second place was occupied by engines, mainly turbojet engines. They were sold mainly in Russia and countries bought Russian vehicles. Political reasons led to a sharp decrease in supplies to the Russian Federation, to other countries - old contracts were fulfilled, there were fewer and fewer new ones, because the engines came with Russian supplies. Therefore, the sales of engines did not drop to 0 at once, but is significantly reduced every year.

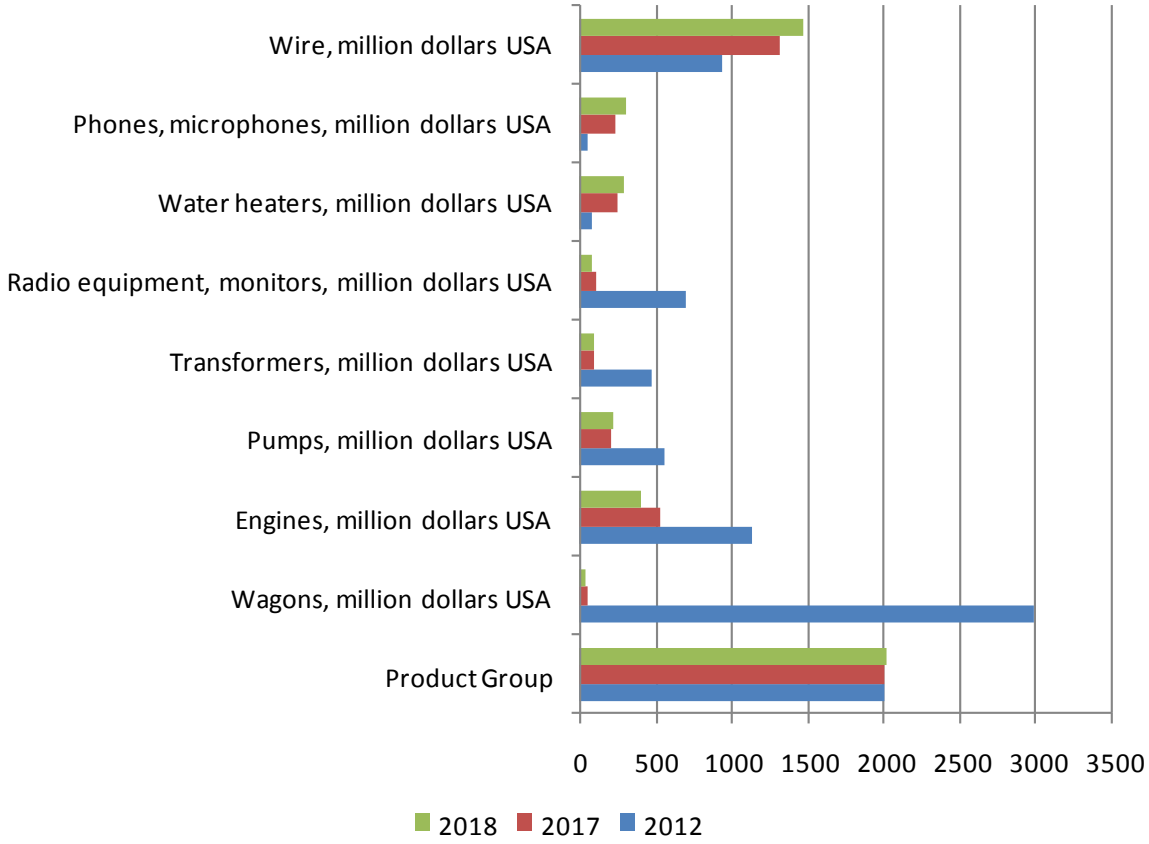


*Figure 3 - Dynamics of export of main groups of machine-building production of Ukraine*

The main problems of Ukrainian mechanical engineering can be described as follows:

1. Domestic mechanical engineering lags far behind many developed and some developing countries.

2. Severe depreciation of fixed assets. The need for the development of domestic mechanical engineering is especially emphasized by the situation in the structure of fixed assets: the coefficient of renewal of fixed assets is quite low, and the rate of renewal of mechanical engineering is 2 times lower than in the industry as a whole.

3. Duration (often uncertainty) of the payback period of investment resources. Since the production assets of machine-building enterprises require significant renovation, an important indicator is the volume of investments in the machine-building sector. The growth rate of investment in mechanical engineering lags behind the growth rate in the economy as a whole. Taking into account the fact that the industry was chronically underfunded during the crisis years, such dynamics does not contribute to the qualitative growth of both machine building and the entire Ukrainian economy. The plans for modernization and the transition to an innovative path of development cannot be implemented at such rates and volumes of financing for the machine-building industry.

4. Deepest specialization of production. Each machine-building enterprise still has its own fairly strictly defined range of products. In market conditions, too deep specialization is a serious obstacle to development.

5. Steadily aging and deterioration of the qualitative composition of engineering and production personnel, their insufficient qualifications.

Depending on the nature of the difficulties that hinder the development of the machine-building complex of Ukraine, the following groups of problems can be distinguished:

- investment (critical moral and physical deterioration of equipment and technologies; obsolete infrastructure of production facilities; low investment attractiveness of mechanical engineering);

- innovative (lack of financial resources due to low profitability of production; low quality of products, high production costs; low innovation susceptibility of industry enterprises; insufficient funding of research and development);

- competitive (underdeveloped quality management system; lack of experience and resources for the formation of an effective marketing policy; insufficiently developed system of service and technical support of manufactured products throughout the entire life cycle of the product; unequal conditions of competition in the market with foreign manufacturers of similar products of engineering enterprises, etc.);

- managerial (slowness in the preparation and implementation of managerial decisions; lack of departments ensuring the integration of production into a single economic space);

- personnel (an acute shortage of qualified personnel due to relatively low wages, a decline in the prestige of engineering and technical and working specialties; ineffective personnel policy, which does not contribute to attracting qualified specialists to the sphere of industrial production, scientific, technical and technological activities);

- organizational and legal (underdeveloped system of industrial cooperation; imperfection of the legislative framework in state industrial policy, technical regulation, pricing for engineering products; ineffective interaction of financial and credit organizations and the real sector of the economy, etc.).

The machine-building complex of Ukraine must be brought to a fundamentally new level of development. The main thing in this should be the development of modern technologies, the production of high-tech and science-intensive products that can not only cover the needs of the domestic market, but also allow them to successfully compete in foreign markets. Therefore, great importance is attached to attracting investments in fixed assets of machine-building enterprises.

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## METHODOLOGY OF CALCULATING THE COST OF PRODUCTION OF BIOFUELS FROM AGRICULTURAL WASTE, SHARE OF REPLACEMENT OF TRADITIONAL FUELS BY THEM AND ECONOMIC BENEFITS FROM SUCH SUBSTITUTION

***Abstract.***

*A characteristic feature of the current stage of human development is the search for alternative energy sources and the development of bioenergy production. The article considers topical issues of biofuels production from organic waste produced by agricultural enterprises. The life cycle of agricultural biomass (waste) generation, its processing into biofuels and use for energy purposes is analyzed. An algorithm for calculating the cost of biofuels from agricultural production waste is presented. It is substantiated that the main research methods used in studying the raw material potential of waste are desk research and the method of business contacts. It is proved that raw materials make up a significant part of the cost of biofuels from agricultural waste, and since the cost of waste is a fairly conventional value, further research is needed in the formation of methods for their evaluation. A method for calculating the share of traditional fuels, which can be replaced by biofuels from crop waste, is proposed. The peculiarity of the proposed method is the calculation of the share of waste (by-products), which should be used for the production of solid biofuels, as part of the waste must remain in the fields to preserve soil fertility. A method for calculating the share of natural gas, heat and electricity, which can be replaced by similar products obtained from livestock waste by bioconversion. The peculiarity of the proposed method is that it takes into account that biogas is inferior to natural gas in terms of energy output and there is a need to enrich it to the level of biomethane, if a direct target replacement is envisaged. A method of calculating the economic benefit from the replacement of traditional fuels with biofuels from the company's own waste is proposed, which provides for the comparison of the cost of biofuels with the price of traditional energy sources*

***Key words:*** *biofuels, waste, organic waste, cost, methodology.*

**Introduction.** The governments of many countries are taking radical measures to conserve traditional forms of energy and develop bioenergy production. So-called “green quota” has been introduced in European countries, which provides the mandatory use of energy produced by alternative methods: 20% of the total energy consumed must be provided by renewable energy sources and in the amount of 10% – for biofuels. There

is also growing interest in the use of unconventional energy sources from government, business and scientific circles, and from agricultural producers in Ukraine. The Law of Ukraine "About Alternative Fuels" defines the legal, social, economic, environmental and organizational foundations for the production of alternative energy sources and sets the goal of increasing their share of use to 20% of the total fuel consumption in the country until 2020 [1]. Thus, the study of the cost of biofuels production and replacing traditional energy sources by them is extremely relevant.

The word "biofuel" consists of two parts "bio" and "fuel". "Bio" is the first part of complex words, which indicates their connection with life and life processes, such as biology, biography, biosphere [6]. "Fuel" – combustible substances that emit a significant amount of heat during combustion, which is used in technological processes or converted into other types of energy [16]. Thus, biofuel is a fuel that has a biological origin.

According to Kaletnik G.M. biofuels are solar energy accumulated through photosynthesis. Their advantages are environmental friendliness and the ability to produce energy resources from renewable raw materials. Biofuels in the form of bioethanol, biodiesel, biogas are the most cost-effective, and therefore promising [9].

According to the Law of Ukraine "About Alternative Fuels" biological fuels (biofuels) - solid, liquid and gaseous fuels made from biodegradable raw materials (biomass), which can be used as fuel or a component of other fuels [1].

Today, the role of biofuels from waste of organic origin is growing in the world (biomass). It is customary to define biomass as all organic substances of both plant and animal origin, the source of which is the current biosphere of our planet [15].

The most familiar source of renewable energy is wood, namely wood waste: sawdust, wood chips, sawdust, plywood waste, pruning, rails, bark, branches and pruning of trees and shrubs, etc. For many wood processing enterprises, these are constant unproductive expense, as it is necessary to spend money on removing waste from the territory. Open burning of wood waste on the territory of the enterprise is inadmissible - it falls under the sanctions of regulatory authorities.

Modern technologies make it possible to turn wood waste into a source of income. To do this, they need to be pressed. Pressing solves two problems: it reduces transport costs by almost 5 times by reducing the volume of waste and removes water from the waste. The perfect fuel for boilers is obtained. When receiving 1 ton of pellets or briquettes, a place of 7-8 cubic meters of sawdust is cleared.

Until recently, everyone attributed straw to waste, but now there is another approach to it - a source of energy. When growing one ton of grain, from 1.5 tons (barley) to 2.4 tons (corn) of straw are obtained. Part of the straw is stored in the fields, part is plowed. But there are many cases of burning in the fields, that is completely unacceptable. , The straw is pressed into rolls or bales for transportation, storage and subsequent use.

Straw has many ways to be used, the most profitable is being used as fuel. Straw usually has a relatively low relative humidity (no more than 25%) and a fairly high heat of combustion: wheat straw has 17-18 MJ / kg, rape straw has 16-17 MJ / kg, and corn straw has about 18 MJ / kg.

Straw pellets are an efficient and, most importantly, cheap fuel that can be used for grain drying and space heating. When burning one ton of straw, about 3 MW of thermal energy is released, which means replacing 333 cubic meters of gas. Straw is well granulated and briquetted. It can be fed into boilers with automatic feeding in pressed form.

When obtaining sunflower seeds, rice or buckwheat, they get the husk, which has become a raw material for solid biofuels – pellets and briquettes. In Ukraine, such opportunities are available at oil plants, which have several dozen large capacities and more than 500 small productions. In the southern regions of Ukraine, it is advisable to produce pellets and briquettes from the husk, which can be transported over long distances for sale to power plants.

**Literature review.** Kaletnik G., Prutska O., Pryshliak N. studied resource potential of bioethanol and biodiesel production in Ukraine [10]

Kolyadenko S.V. noted that the production of biofuels has become widespread ,in the world in recent decades. The reasons for such rapid growth were, first of all, the reduction of fossil resources, the complexity of their extraction, environmental pollution, economic and political unrest. She substantiated theoretical aspects of ecological and economic efficiency of biofuel production, and also investigated the synergetic effect of their combination in the information economy [11].

Recent developments and key barriers to advanced biofuels were studied by Oh, Y. et al. [13]

Berezyuk, S. studied resource potential of waste usage as a component of environmental and energy safety of the sate [5]. In his work [4] he tried to solve the problems of recycling in Ukraine, as the accumulation of waste every year becomes more and more threatening. According to his research waste, accumulated in landfills, occupies 7 percent of the territory of Ukraine (more than 43 thousand $km^2$), which simultaneously leads to pollution of water, soil, air and the deterioration of the ecological and economic situation in general.

Geletukha, G.G., Oliynyk, E.M., Antonenko, V.O., Zubenko, V.I., Radchenko, S.V. studied organizational and technical solutions for using agricultural residues for energy [8].

Vis, M., van den Berg, D. et al in the frames of Biomass Energy Europe (BEE) project tried improve the accuracy and comparability of future biomass resource assessments for energy by reducing heterogeneity of terms and definitions, increasing harmonization of data and calculations and exchanging knowledge on methods and approaches [19].

**Aim of the research.** Investigate and improve methodological approaches to the analysis of the cost of biofuels production from agricultural waste of organic origin, the methodology of calculating the share of replacement of traditional energy sources by biofuels derived from waste and the economic benefits of such substitution for agricultural enterprises.

**Materials and methods of the research.** In the course of the research the methods of statistical and economic analysis were used: the abstract-logical method that provided theoretical generalizations, formation of conclusions; statistical and economic methods, comparison and juxtaposition of quantitative and qualitative indicators; tabular and graphical methods – to display analytical information; monographic method.

**Results of the research and discussion.** Today, waste is not just a concept from the natural, technical or geological sciences, but an economic category. And this category follows not only from accounting terminology. Waste is an economic object and the development of economic systems of individual enterprise and the country as a whole, in some cases – individual regions depends on its the management. After all, waste is an integral part of production and interaction of the enterprise with the environment.

Waste is a powerful internal reserve for increasing the efficiency and competitiveness of agricultural enterprises in the domestic and international markets. Analysis of international practice proves that the development of an integrated system for handling waste from agricultural industries allows not only to increase the efficiency of using reserves of material resources and the effectiveness of the company as a whole, but also to reduce the anthropogenic load on the environment by returning waste to production cycles as a secondary raw material.

A general definition of "waste" is contained in the Waste Framework Directive 75/442 / EU: "…Waste means any substance or object which the holder disposes of or is required to dispose ... " [14]. Since this definition is too general, an annex to the Directive contains a list of specific substances and items that may be considered waste. This list is constantly being supplemented and changed: today it contains more than 600 types of waste.

Definition of the term "waste" in different documents is shown in Table 1.

Having ratified the Association Agreement between Ukraine on the one hand, and the European Union, the European Atomic Energy Community and their member states, on the other hand, Ukraine has undertaken the obligation to gradually adapt the Ukrainian legislation to European compliance with the directions defined in the agreement.

Table 1

**Definition of the term "waste"**

| Document | Definition |
|---|---|
| Law of Ukraine "About waste" [2] | Any substances, materials and objects that are formed in the process of activity and do not have further use at the place of formation or detection and which their owner must get rid of by disposal or removal |
| Ukrainian State Waste classifier ST 005-96 [18] | 1) Waste – any substances and objects formed in the process of production and human activity, as a result of man-made or natural disasters, which have no further purpose at the place of formation and are subject to disposal or recycling to protect the environment and human health. or for the purpose of their repeated involvement in economic activity as material and raw material and energy resources, and also the services connected with waste;<br>2) Waste – any substances, materials and objects that are formed in the process of human activity and have no further use at the place of formation or detection and which their owner gets rid of, intends or must get rid of by disposal |
| Basel Convention [3] | Substances or objects to be removed, are intended for disposal or are subject to disposal in accordance with the provisions of national law |
| Directive "On waste and repealing certain Directives" [14] | Any substance or object which the holder disposes of or is required to dispose |

Cooperation in the field of the environment, aimed at developing a green economy is among them. Accordingly, changes were made in the Ukrainian legislation to the existing ones and new regulatory documents were adopted. In particular, on November 8, 2017, the Cabinet of Ministers of Ukraine adopted the National Waste Management Strategy in Ukraine until 2030, which focuses on identifying problematic areas of waste management policy in Ukraine and defining the main European norms that are advisable to implement into Ukrainian legislation based on the experience of countries - EU members.

To choose a rational type of agricultural waste for energy use, it is necessary to take into account the specifics of the project site [17], the provisions of the Energy Strategy of Ukraine for the period up to 2035 "Security, Energy Efficiency, Competitiveness" [7].

The main advantages of organic waste as a raw material for biofuels production:

- is a local fuel. In the process of energy production from biomass, the available local resources of the region are used, including labor. Thus, the use of biomass leads to: the development of the local economy; recoverability, neutrality in relation to greenhouse gas emissions; relative ease of extraction and use;

-is a renewable fuel, and therefore, when used rationally, is essentially an inexhaustible source of energy, the use of which contributes to the sustainable development of the region, and does not create the risks of gradual consumption typical of traditional energy sources (corresponding price increases) due to depletion of natural deposits;

-is an environmentally friendly fuel compared to

other solid fuels such as coal. As a rule, biomass contains little sulfur, and its combustion at relatively low temperatures does not lead to the formation of nitrogen oxides. In addition, due to the inclusion of biomass in the natural cycle of absorption, storage and release of $CO_2$, the burning of biomass does not lead to an increase in the greenhouse effect and reduces the negative anthropogenic impact on the environment;

- as a rule, it is a cheaper fuel per unit of energy than other types of traditional energy resources; at the same time, the trends of the last twenty years show a faster growth rate of prices for traditional energy resources than for renewable ones, and this difference is increasing every year;

- energy use of organic waste reduces its amount in cities, and in the case of using biogas, it leads to the disposal of hazardous waste from solid waste landfills, contributes to the cleansing of contaminated areas, the return of biodiversity, and a general improvement in the environment;

- the introduction of biomass generation facilities contributes to the attraction of modern, advanced technical solutions in the field of heat supply, the renewal of technological parks of existing equipment, the development of the production of new equipment, activities for its installation and maintenance.

Table 2 shows the classification of organic waste by origin in accordance with the recommendations of the Best Practices and Methods Handbook of the BEE - Biomass Energy Europe project, which aims to harmonize estimates of biomass resources in Europe and other countries.

Table 2

Classification of organic waste by origin [19]

| Main type | Sub-type | Examples |
|---|---|---|
| I. Forest biomass | Stemwood | Biomass from pre-commercial and commercial thinnings and final fellings, available for energy production, including whole trees and delimbed stemwood from pre-commercial thinnings |
| | Primary forestry residues | logging residues, stumps. |
| | Secondary forestry residues | Residues resulting from any processing step: sawdust, bark, black liquor, etc. |
| | Woody biomass from short rotation plantations on forest lands | |
| | Trees outside of forests | Trees in settlement areas, along roads and on other infrastructural areas |
| II. Agricultural residues - he by-products of agricultural practice | Primary or harvesting residues, by-product of cultivation and harvesting activities | Wheat straw, etc. |
| | Secondary processing residues of agricultural products, e.g. for food or feed production | Rice husks, peanut shells, oil cakes, etc |
| | Manure | Pig manure, chicken manure, cow manure, etc. |
| III. Organic waste | Tertiary residues, released after the use | Biodegradable municipal waste, landfill gas, demolition wood, sewage gas and sewage sludge |

Organic waste can be used for energy purposes by direct incineration, as well as in recycled liquid (rapeseed oil esters, alcohols, liquid pyrolysis products) or gaseous biofuels (biogas from agricultural and crop waste, sewage sludge, solid waste, gasification products solid fuels).

Conversion of organic waste into other types of energy or final energy (thermal or electrical) can occur by physical, chemical and biochemical methods.

According to the production process and options for possible further use, biomass is divided into the following groups:

1) organic and organ-containing waste from processing industries and utilities, the disposal of which is a problem for the producer;

2) secondary raw materials of agricultural production, which are used or in the future should be used for the production of organic fertilizers and restoration of soil fertility (animal waste, non-commodity part of the crop, etc.);

3) biomass, which is specially grown for energy needs (energy crops, rapeseed for biofuels production, algae cultivation, phytomass cultivation, etc.) [11].

It is worth noting that the biomass of the 1st group (according to the classification above), which the manufacturer at the first stage agrees to provide free of charge or pay for its disposal in order to avoid environmental problems, after the introduction of an effective method of using it as an energy source, will give rise to the status of secondary raw materials. This, in turn, naturally prompts the former waste producer to demand payment for new raw materials.

For the production of solid biofuels, biomass of group I, woody and herbaceous crops of group II, primary and secondary residues of group III are most often used. In Ukraine, wood biofuel (firewood, wood chips,

pellets and briquettes from wood) is mainly used in heat power engineering and in recent years - sunflower husks, grain straw, rapeseed, soybeans in the form of bales, granules and briquettes. The areas of energy plantations of willow, poplar and miscanthus are growing rapidly. The stalks and other wastes of corn and sunflower seeds are not yet actively used (except for husks), but they are a promising source of biomass for energy use in Ukraine.

Several industries are involved in the biomass-biofuels-energy chain. So, in systems on agricultural biomass (Fig. 1), resources are involved: agriculture for the production and harvesting of biomass, transport for its transportation of biomass and distribution of biofuels, processing of biomass into biofuels and heat power engineering, where raw materials are burned and electricity and / or heat are generated.

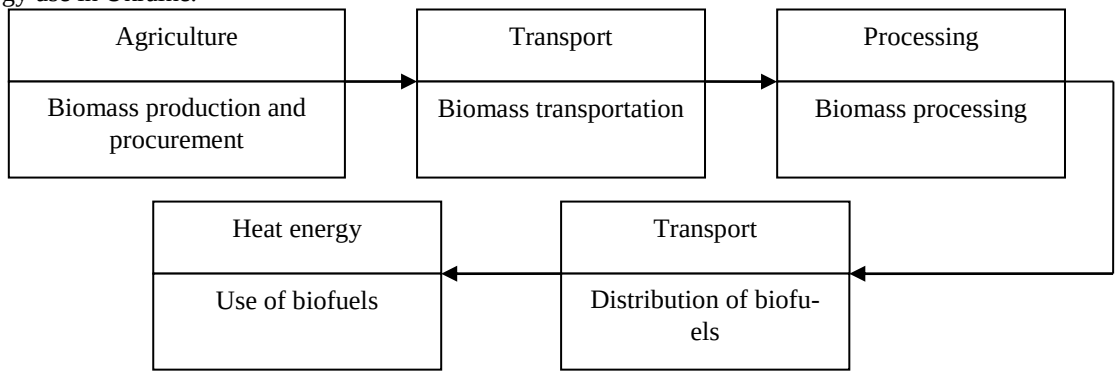


*Fig 1. Life cycle of agricultural biomass generation (waste), its processing into biofuels and use for energy purposes*

The input cost of various types of biofuels depends on the interaction of participants in the procurement, processing and logistics process. Therefore, it is important to determine the scheme of its delivery to the bioenergy facility, ensuring diversification, if possible.

The mechanism for calculating the cost of various types of biofuels includes an estimate of their cost. It is convenient to track costs according to the stages of the production process. The initial data for this is the volume of biofuel and the scheme of stages of its production. The amount of biofuel is estimated in mass tons or volumetric units: $m^3$. Although for consumers, given the different moisture and ash content and the varied chemical composition of biofuels, the key characteristic is the lower calorific value. However, its constant control leads to additional financial costs. Therefore, in practice, the price of biofuel is adjusted depending on its moisture content.

Production costs for biofuels are divided into three groups:

- capital investments;
- direct production costs per unit of output {including raw materials, basic materials, basic salary and accrual of electricity, fuels and lubricants, thermal energy, other costs);
- fixed production costs: expenses for the maintenance and operation of equipment (salaries of maintenance personnel and payroll, spare parts and auxiliary materials, repair services of third-party organizations, equipment rental) and general production costs (salaries of production management personnel and charges for it, inventory, repairs and maintenance of buildings and structures, depreciation, other business expenses).

The algorithm for determining the cost of biofuels from waste is shown in Fig. 2.

At the initial stages of determining the feasibility of a bioenergy project, it is difficult to fully estimate the cost of biofuels due to the lack of information.

Specialized literature and the Internet allow to establish the technological scheme and stages of the production process. In the brochures of technological equipment, it is possible to find only general and data and some characteristics.

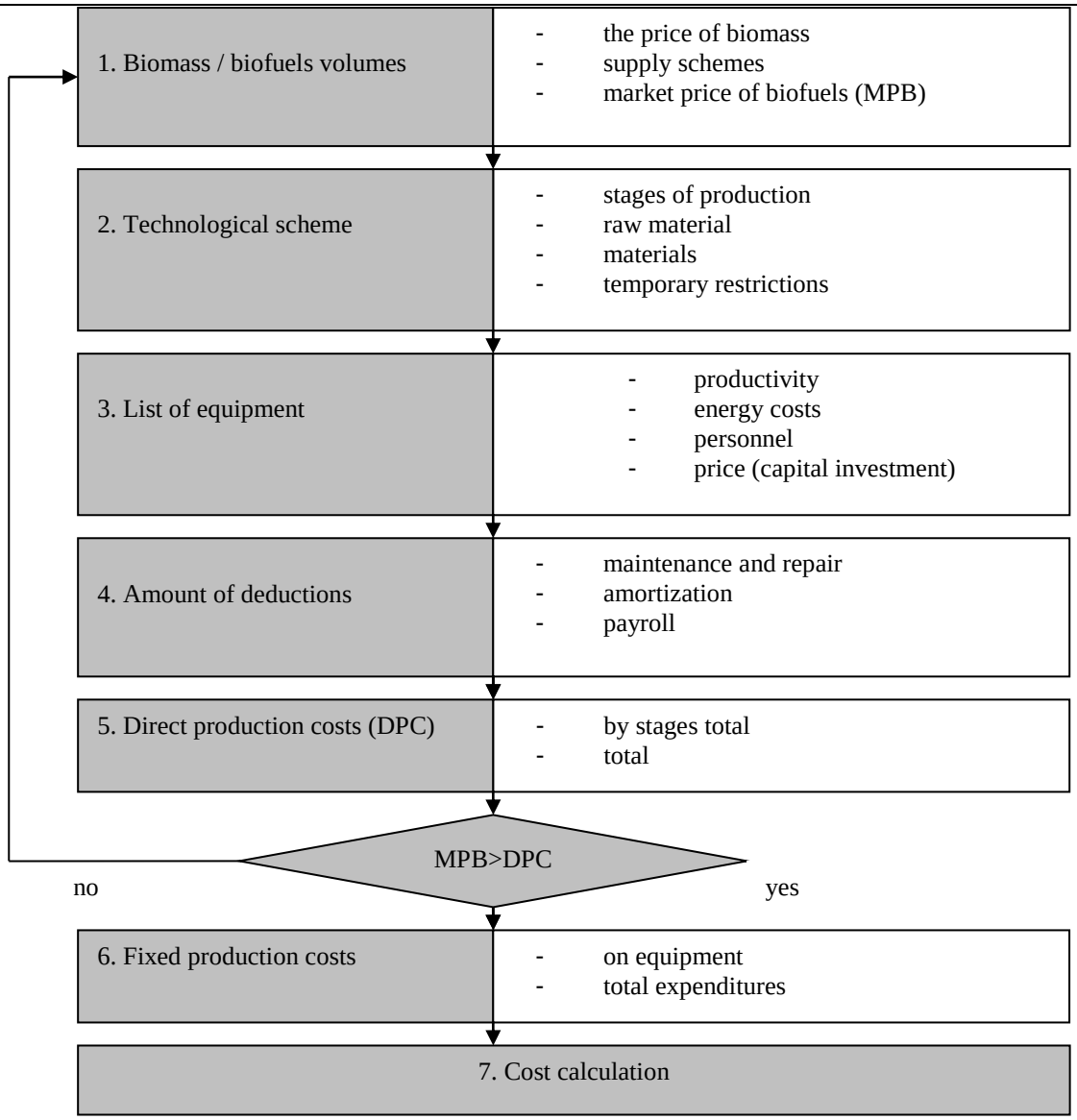


*Fig. 2. Algorithm for calculating the cost of biofuels from agricultural waste*

Manufacturing plants and dealers provide a commercial offer with a price upon request. But this information is enough to determine the volume of investments and estimate direct production costs, the analysis of which allows to formulate a specific project proposal in more detail.

The calculations of the cost of biofuels are being clarified and a feasibility study is being prepared for the project on the energy use of agricultural waste in the future.

So, the algorithm includes determination of volumes, approximate prices and all stages from harvesting biomass to supplying it in the form of biofuels to a bioenergy facility, a basic list of equipment, number of personnel, transportation distances. Further, the calculations of cost items are performed at each stage. The total costs determine the cost of t or $m^3$ of biofuels, their analysis by stages and items allows you to optimize the production process.

Marketing research plays a significant role in organizing the use of waste for energy purposes, in particular, in determining the energy potential, on which the efficiency of this activity and the production cost directly depend.

The main research methods that are used in studying the raw material potential of waste are desk research and the method of business contacts.

Desk research involves the collection and analysis of secondary information, the main sources of which are publications, Internet sources, information databases of enterprises, and statistical data.

The method of business contacts involves obtaining primary information directly from agricultural producers.

Thus, experience has shown that it is advisable to assess waste raw materials for energy needs at two levels:

1. district level (desk research);

2. the level of the agricultural enterprise (method of business contacts).

At the district level, it is advisable to establish cooperation with regional, district and city (settlement) authorities, in particular to gain access to statistical in-

formation and establish contacts with large local agricultural producers.

Desk research allows you to:

- to determine the general characteristics and production potential of crop production in a particular area: data on the total arable land; the structure of sown areas; yield and gross yield of individual crops;
- get a list and contact details of agricultural producers.

The advantages of desk research include its efficiency and low cost. But the generalization and analysis of information requires special professional training of experts. In addition, there is a risk of obtaining outdated, incomplete or inaccurate information in such studies. Correct organization of desk research and systematic analysis of the data obtained can significantly reduce the number of responses, save time and money for the next stages of research, involving direct communication with potential waste suppliers.

For the purpose of preliminary acquaintance, it is advisable to conduct a survey of agricultural producers. The essential questions of the questionnaire are: the area of agricultural land in the context of individual crops, yields, gross harvest by crops, the total potential for the production of agricultural waste, in particular, grain straw, the volume of straw use for own economic needs, the potential for the supply of straw, features of agricultural technology and the level of technical equipment enterprises, the possibility of organizing temporary storage of straw, the distance to the bio-boiler house, etc.

When processing questionnaires, it is necessary to pay attention to agricultural technologies that are used by agricultural producers, since modern technologies used by large enterprises, in particular, provide for the use of stabilizers for the growth of straw stalks, can significantly affect its yield.

The next step in research is the organization of working meetings. The issues covered in the questionnaire are discussed in detail, the level of interest in cooperation, the essential conditions for cooperation are determined, and the idea of forming a price for waste is discussed. As a result of negotiations, Memorandums of Cooperation or Agreement of Intent may be signed.

This stage of research is the longest, as it involves several meetings with each potential supplier of straw. The following problems are possible at this stage: receiving incomplete information from the agricultural producer, unwillingness to communicate, the problem of pricing. The last problem is that the market for straw as biofuels in Ukraine does not actually exist. Some farms sell straw in small household bales weighing about 10 kg for private farms, or supply it (usually in small or rolled bales) for mushroom pickers, but this does not correspond to industrial volumes.

To estimate the cost of straw it is necessary to determine the cost components: straw in rolls, baling, cargo operations, transportation, storage.

The approximate cost structure of harvesting and logistics of baled straw is shown in Fig. 3.

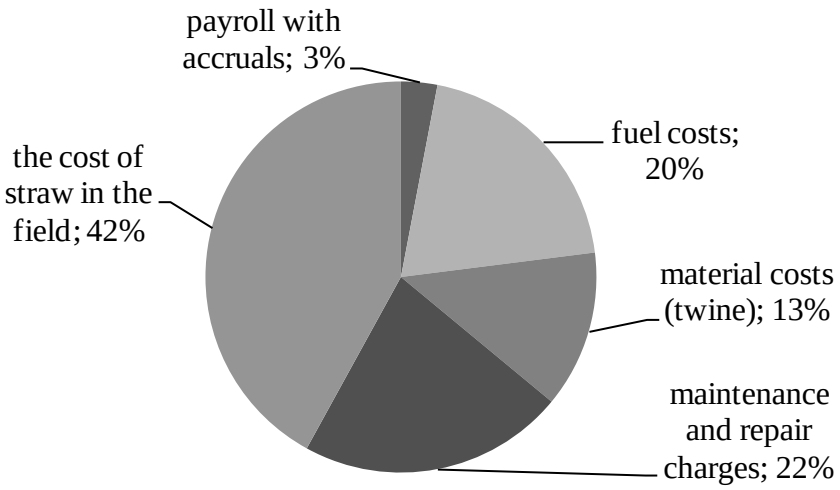


*Fig. 3. Cost structure of harvesting and logistics of baled straw,%*

Considering that the straw rolls are formed by the farmer's combines, the following stages of work can be distinguished:

1) straw baling
2) collection and loading of bales;
3) transportation of bales;
4) unloading and storing for storage [12].

Cost components: wages, fuel, maintenance and repairs, and for baling straw it is still necessary to use a consumable material – twine. For more accurate calculations, it is necessary to take into account taxation, overhead costs, depreciation of equipment, other specific costs for specific conditions, including food and transportation of workers, non-working movement of machines, etc. It is convenient to determine all costs per ton of baled straw.

The cost structure of harvesting and logistics of baled straw by stages is shown in Fig. 4.

It should be noted that the burning of plant residues is strictly prohibited in Ukraine. Burning stubble, meadows, pastures, areas with steppe, wetland and other natural vegetation or its remnants in the right-of-way of roads and railways without the permission of state control authorities in the field of environmental protection or violation of such a permit entails administrative responsibility and provides for fines sanctions.

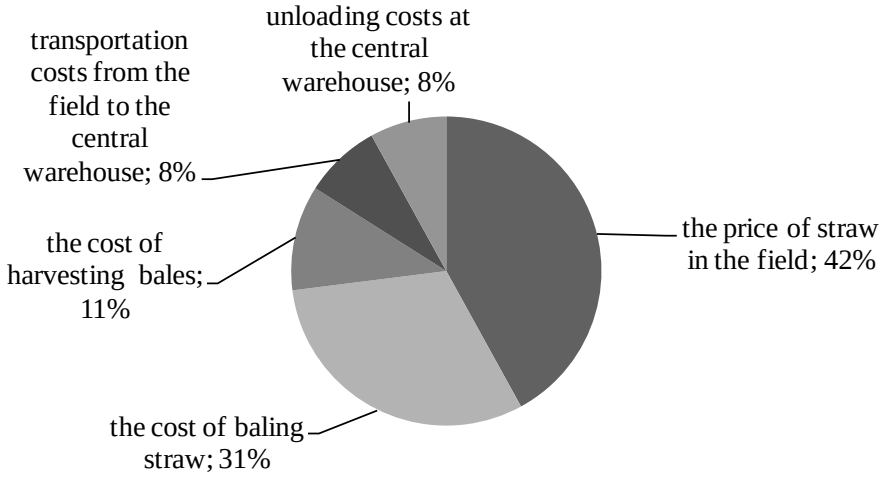


*Fig. 4. Cost structure of harvesting and logistics of baled straw by stages,%*

In addition, according to Article 245 of the Criminal Code of Ukraine, the destruction or damage of forests, green spaces around settlements, along the railways, as well as stubble, dry wild herbs, vegetation or its remains on agricultural land by fire or in another generally dangerous way – are punishable by a fine from three hundred to five hundred tax-free minimum incomes of citizens or by restriction of liberty for a period of two to five years. In the case that people died as a result of this crime, or there was a mass death of animals or other grave consequences, it is punishable by imprisonment for a term of 5 to 6 years.

But some farmers in Ukraine, despite the prohibitions, annually with enviable consistency burn stubble or straw in the fields after harvest, which reduces the cost of technological operations associated with the incorporation of plant residues into the soil and in order to destroy pests and pathogens of agricultural crops.

In agricultural enterprises, in the presence of livestock farms, straw is used as bedding and roughage. In crop enterprises, by-products of grain growing are used as organic fertilizers. Therefore, the collection and removal of straw from fields, in particular for energy use, is possible only if it is replaced by other fertilizers to ensure soil fertility.

The straw market in Ukraine today is not formed, in particular, straw in rolls in the field. Therefore, the cost of biomass is set individually by agreement between the seller and the buyer. The estimated price can be determined by the cost of mineral fertilizers that need to be applied to the soil to compensate for the removal of nutrients contained in the straw. It is necessary also to take into account the reduction in costs for farmers to perform technological operations for spreading straw over the field and tillage. In addition, the ash formed after burning straw is a valuable fertilizer, but it has a number of peculiarities in use due to its chemical composition. Therefore, for its application, it is necessary to obtain an opinion from the agronomic service on the efficiency of waste use in agriculture, then conduct a hygienic assessment of fertilizers and obtain a conclusion from the state sanitary and hygienic inspection.

An important task for agricultural enterprises is to develop a methodology for calculating the share of replacing traditional fuels consumed in the process of production and economic activities with biofuels based on their own waste. The calculation algorithm for crop waste is shown in Fig. 5.

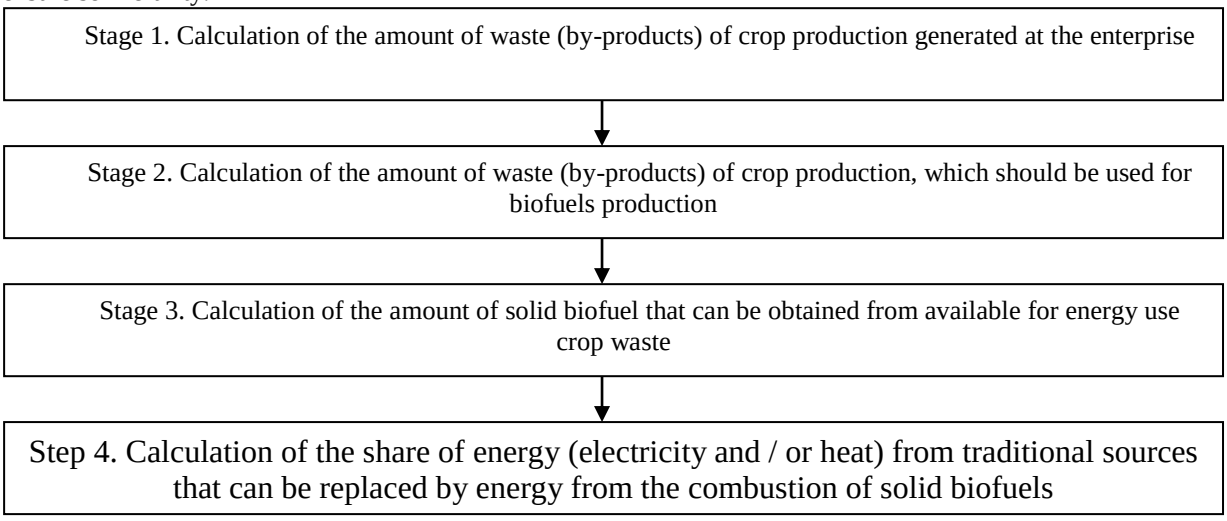


*Fig. 5. Algorithm for calculating the share of replacement of traditional energy sources with biofuels obtained from waste (by-products) of crop production*

At the first stage, the yield of crop by-products (waste) is calculated, using reference information on the ratio of the main and by-products when growing individual crops.

At the second stage, it is necessary to calculate what amount of crop waste should be used for energy purposes, and what – to leave in the field to preserve soil fertility or use as litter for animals. Taking into account the recommendations of the Bioenergy Association of Ukraine, the coefficient of energy use is 0.25-0.40, depending on the culture.

At the third stage, the volume of solid biofuel (pellets or briquettes), which can be obtained from crop waste available for energy use, is calculated.

At the fourth stage, the share of energy from traditional sources is calculated, which can be replaced by energy, acquired from burning solid biofuel.

To determine the economic efficiency of replacing traditional energy carriers with biofuels obtained from crop waste, using reference books, the cost of a mass or volume unit of the produced biofuel is converted into the cost of a unit of thermal energy. Further, a comparison with the price of a unit of thermal energy obtained from traditional sources is carried out, allowing to analyze the efficiency of its production from different energy carriers.

The algorithm for calculating the share of replacing traditional energy carriers with biofuels obtained from animal waste (by-products) is shown in Fig. 6.

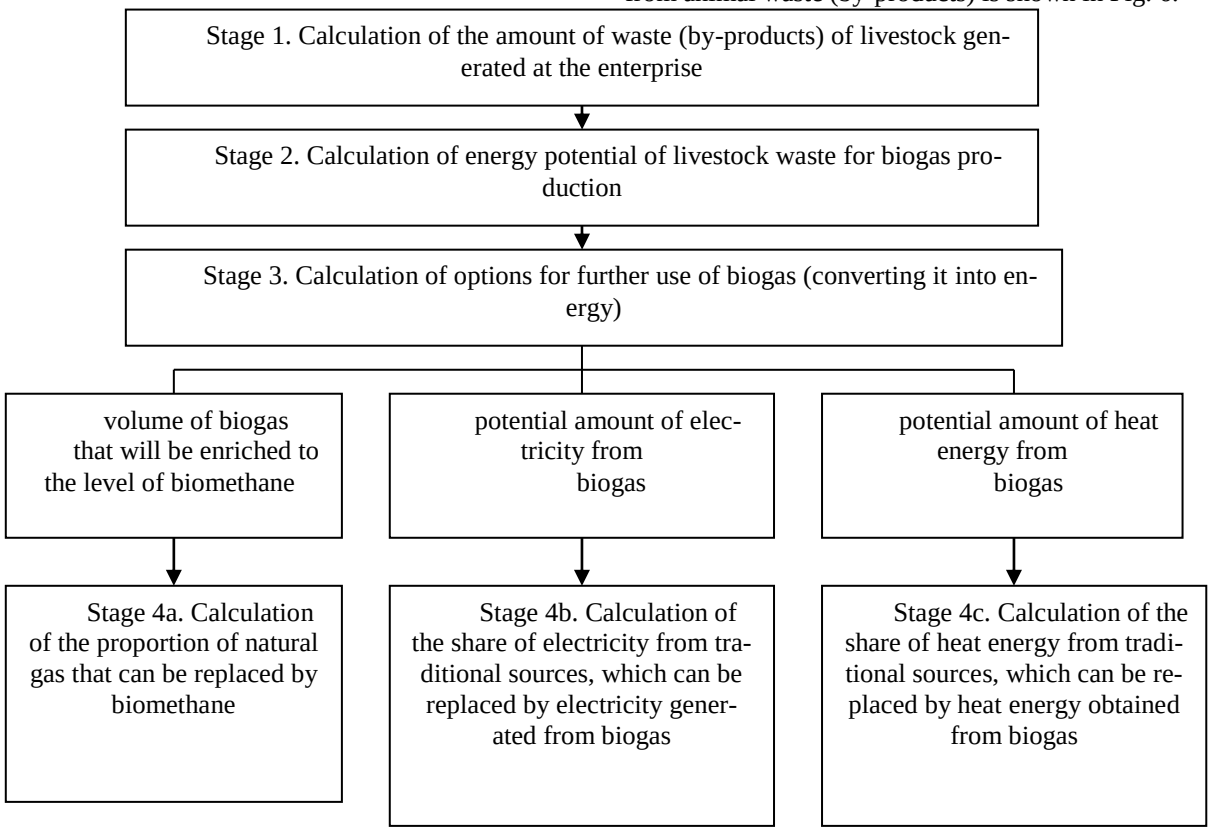


*Fig. 6. Algorithm for calculating the share of replacement of traditional energy sources with biofuels obtained from animal waste (by-products)*

At the first stage, the volume of waste (by-products) of animal husbandry generated at the enterprise is calculated. Manure from livestock, pigs, poultry droppings, etc. are taken into account.

At the second stage, the energy potential of animal waste is calculated, that is, the potential amount of biogas production. In contrast to the algorithm for calculating the share of replacing traditional energy carriers with biofuel obtained from crop waste, it is advisable to subject all animal waste to bioconversion. This is due to the fact that in addition to energy carriers, a biogas plant provides organic fertilizers, which are then used to increase soil fertility.

At the third stage, options for the further use of biogas (converting it to energy carriers) are calculated, which includes:

- enrichment of biogas to the level of biomethane for targeted replacement of the latter, since biogas is inferior to natural gas in terms of energy output;
- production of electrical energy from biogas;
- production of heat energy from biogas.

At the fourth stage, the share of traditional energy carriers is calculated, which can be replaced with energy products based on biogas.

To determine the economic efficiency of replacing traditional energy carriers with biofuels obtained from animal waste, compare:

- the cost of biomethane obtained and the cost of natural gas;
- the cost of electrical and thermal energy obtained from biomass and from traditional sources.

**Conclusions.** The main components of the potential of organic waste are primary agricultural waste (straw, waste from the production of corn for grain and sunflower), which remain in the fields as by-products

after the harvest of primary crops. The most important type of primary agricultural waste available for energy use is straw. Secondary agricultural waste is produced and accumulated when crops are processed for food and feed production. These include: sunflower husks, rice hulls, nutshells, bean waste and other types of biomass of a similar type suitable for biofuels production. Animal manure and poultry droppings are classified as organic animal waste.

The algorithm of calculating the cost of biofuels from waste is developed that provides calculating the volume of biomass, technological scheme, forming a list of equipment, calculating the amount of deductions, direct and fixed production costs. It is determined that raw materials play an important role in the cost of biofuels from agricultural waste. Since the market value of waste is mostly not established, the is a need to calculate it for a specific use case, incl. for energy purposes. The methodology for calculating the economic efficiency of using biofuels instead of traditional energy carriers has been substantiated.

The algorithm of calculating the share of replacing traditional energy carriers with solid biofuels obtained from crop waste is presented. It is envisaged to take into account the share of waste that is advisable to use for energy purposes, and the share of waste that should be used for plowing in order to increase soil fertility. The methodology for calculating the share of replacing traditional energy carriers with biofuels obtained from animal waste (by-products) by bioconversion is proposed.

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# БИЗНЕС-ПРОЦЕССЫ ФИНАНСОВЫХ ПОТОКОВ ПРЕДПРИЯТИЙ СФЕРЫ УСЛУГ: ОСОБЕННОСТИ ПОСТРОЕНИЯ, ОТЛАДКИ И УПРАВЛЕНИЯ

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# BUSINESS PROCESSES OF FINANCIAL FLOWS OF ENTERPRISES IN THE SERVICE SPHERE: FEATURES OF CONSTRUCTION, DEBUGGING AND MANAGEMENT

***Аннотация***

*В статье рассмотрены бизнес-процессы, связанные с повышением эффективности предприятий действующих в сфере услуг, которые по своему влиянию на деловую активность предприятий. Особенности построения отладки и управления финансовыми потоками, оптимизировать производство, логистику, а также рационально использовать оборотные и основные средства компании, генерируя максимальную прибыль, а качественное управление бизнес процессами помогает предприятию сервиса выйти в лидеры продаж на своем рынке.*

***Abstract***

*The article discusses the business processes associated with increasing the efficiency of enterprises operating in the service sector, which in their influence on the business activity of enterprises. Features of building debugging and managing financial flows, optimizing production, logistics, as well as rationally using the company's working and fixed assets, generating maximum profit, and high-quality management of business processes helps the service enterprise to become the sales leader in its market.*

***Ключевые слова:*** *бизнес-процесс, управление, услуга, сервис, финансовый поток, отладка, сервисная деятельность*

***Keywords:*** *business process, management, service, service, financial flow, debugging, service activities*

За последние годы мы не вольно становимся свидетелями многочисленных изменений в процессе управления компаниями. Усложняются процессы, принимаемые решения, формируются связи. Простые процессы переходят в сложные. Управление процессами на предприятии сегодня становится более стратегическим, охватывает динамику развития, тем самым формирует траекторию будущих изменений. Используя процессный подход руководство организации реализует сразу несколько целей, а именно, разрабатывает регламенты деятельности организации (как на внутреннем, так и на внешнем рынке), совершенствует показатели оценки работы предприятия (процессов, подразделений, отдельных продуктов, сотрудников), развивает процессы информатизации, как внутри организации, так и с внешними контрагентами, запускает процессы реинжиниринга, направленные на повышение эффективности бизнес-процессов. Описание бизнес-процессов – это очень трудоемкий, объемный процесс, нуждается в постоянном развитии, конкретизации, уточнении и развитии методической основы.

Управляя бизнес-процессами, совершенствуя их, необходимо четко понимать, что такое бизнес-процесс. «Бизнес процесс – это четкий, зафиксированный письменно алгоритм выполнения некой деятельности», отмечает в своей книге Михаил Рыбаков [1].

Сегодня руководители всех уровней четко должны понимать, что описав подробно бизнес-процессы, добившись четкого их исполнения, при этом постоянно совершенствуя процессы, могут получить огромное количество выгод: повысить управляемость бизнеса (с точки зрения прозрачности, качества, скорости выполнения процессов и т.п.), снизить уровень рисков, снизить уровень зависимости от персонала организации (учитывается при увольнении сотрудников), найти резервы на развитие бизнеса (речь идет как о внутренних, так и о внешних резервах), повысить репутацию организации, увеличить прибыль и рыночную стоимость организации.

Учитывая специфику деятельности предприятий сферы услуг, Парамонова Л.А. рекомендует следующие циклы основных бизнес-процессов, рисунок [2]:

Фактически циклы бизнес-процессов не имеют ни начала, ни конца, если не считать моментов возникновения и ликвидации (реорганизации) предприятия. Хозяйственная система начинает функционировать, формируя капитал (обычно в денежной форме). Денежные средства направляются на оплату задолженности поставщикам и подрядчикам (цикл оплаты), возникшей в связи с приобретением элементов производства (цикл снабжения).

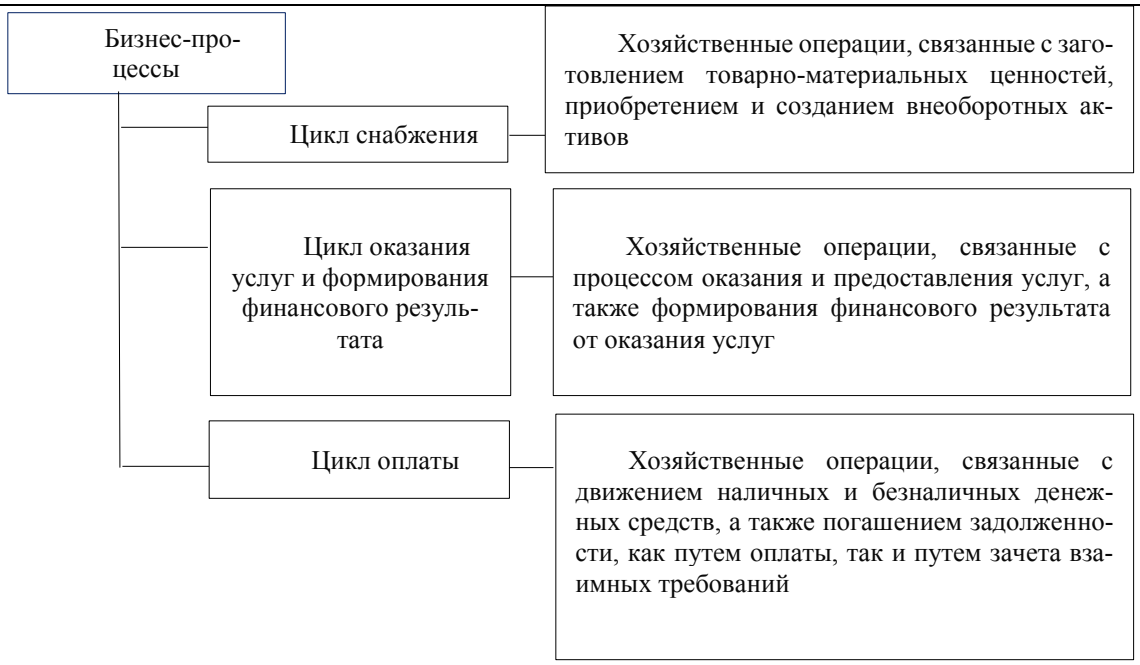


*Рисунок 1 - Содержание основных бизнес-процессов организации сферы услуг*

Затем начинается процесс оказания услуг. Приобретенные внеоборотные активы передаются в эксплуатацию, а товарно-материальные ценности – в производство, например, в мастерские, ателье и т.д. Начисляется заработная плата работникам (подцикл оказания услуг). Образуется дебиторская задолженность за реализованную продукцию, оказанные услуги. Выявляется финансовый результат от оказания услуг (цикл оказания услуг и формирование финансового результата).

В процессе каждый цикл основных бизнес-процессов необходимо исследовать в отдельности, что позволит провести более эффективные проверки. При этом проверка должна быть организована таким образом, чтобы своевременно выявлять связи между циклами.

Описание бизнес-процессов является сложным и трудоемким процессов и нуждается в создании определенной платформы. Сегодня существует огромное количество программ (нотаций по описанию бизнес-процессов), которые применяются на практике. Так же хотелось отметить и тот факт, что, описав четко все бизнес-процессы организации возможно добиться их четкого исполнения, совершенствуя описанные бизнес-процессы, мы можем получить огромное количество эффектов, как текущей перспективе, так и в будущем.

Описание и декомпозиция бизнес-процессов позволит руководителю найти узкие места, определить источник экономии затрат.

Функциональная модель предназначена для описания существующих бизнес-процессов на предприятии (так называемая модель AS-IS «как есть») и идеального положения вещей – того, к чему нужно стремиться (модель TO-BE «как должно быть»). Методология IDEF0 предписывает построение иерархической системы диаграмм – единичных описаний фрагментов системы [3].

Контекстная диаграмма IDEF0, например, деятельность предприятия оптовой торговли представлена на рисунке 2.

Взаимодействие системы с окружающей средой описывается в терминах:

– входа (на рис. это «Поставщики», «Покупатели» и «Товары»);

– выхода (основной результат процесса - «Оплата за товар», «Прибыль» и «Продажа»);

– управления («Законодательство РФ», «Иные внешние нормативные документы»);

– механизмов («Материальная база», «Персонал» — это ресурсы, необходимые для процесса функционирования предприятия).

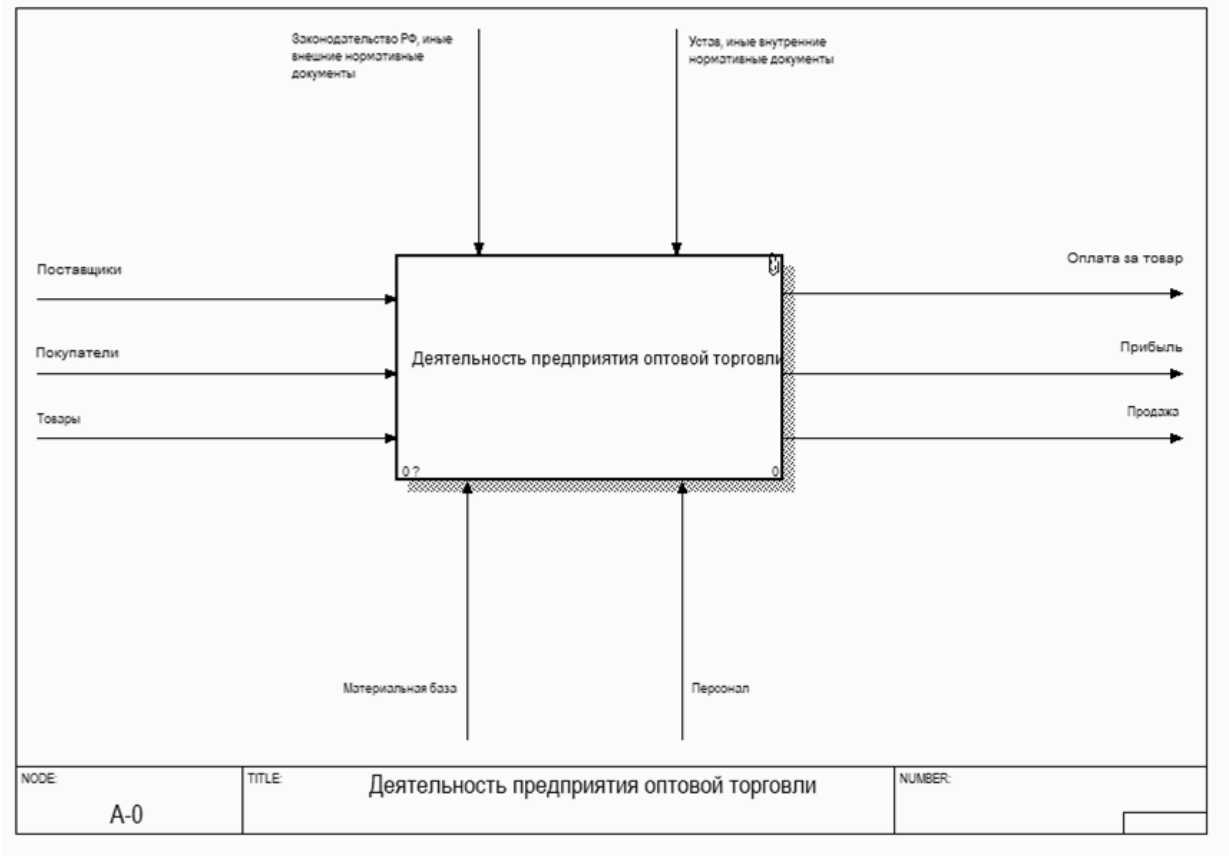


*Рисунок 2 - Контекстная диаграмма IDEF0*

«Поставщики» - представляют собой поставщиков товаров, заключенные договоры и контракты, первичную, товаросопроводительную документацию; «Покупатели» - те, для кого функционирует торговое предприятие, с документацией, включающей договоры, контракты, первичную документацию. «Товары» - представляют собой непосредственно товары и техническую документацию на товары, реализуемые через торговую компанию.

Получение прибыли - цель коммерческой деятельности предприятия, чтобы добиться этой цели, необходимо продать как можно больше товаров. «Оплата за товар» - представляет собой совокупную сумму денежных средств, уплаченную поставщикам товаров. «Продажа» - то есть реализуемые товары и техническая документация.

«Законодательство РФ», «Иные внешние нормативные документы» - это вся совокупность нормативно-правовых актов регулирующих деятельность предприятий оптовой торговли.

В деятельности предприятия принимает участие «Персонал». «Материальная база» представлена помещениями (офисным, складским), техникой для транспортировки товара, вычислительной и иной офисной техникой, вспомогательными механизмами на складе и т.д.

После описания контекстной диаграммы проводится функциональная декомпозиция, рис. 3 - система разбивается на подсистемы, и каждая подсистема описывается отдельно (диаграммы декомпозиции). Затем каждая подсистема разбивается на более мелкие и так далее до достижения нужной степени подробности. В результате такого разбиения, каждый фрагмент системы изображается на отдельной диаграмме декомпозиции.

Функциональная декомпозиция IDEF0 родительской диаграммы деятельности предприятия оптовой торговли представлена тремя основными блоками – по наиболее значимым функциональным свойствам.

Это блоки: «Деятельность коммерческого отдела», «Деятельность склада», «Деятельность бухгалтерии»

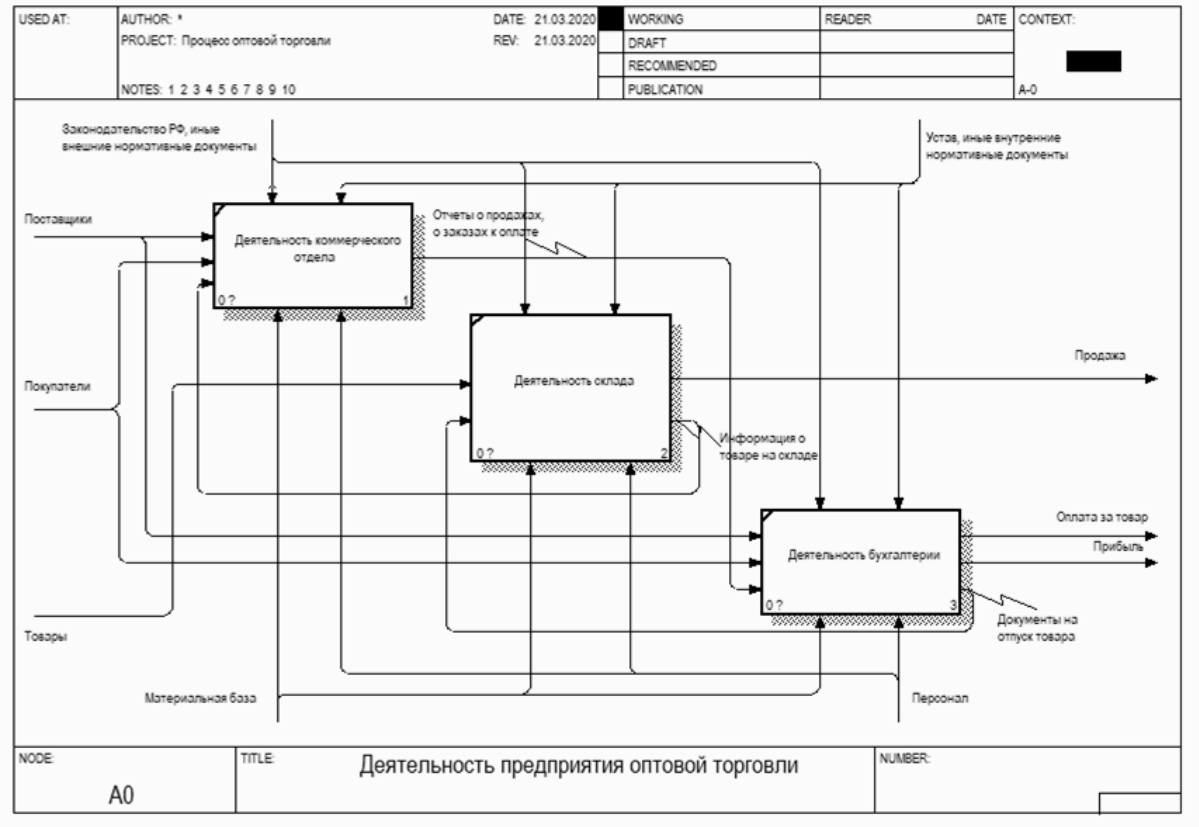


*Рисунок 3 - Функциональная декомпозиция IDEF0*

Наибольшую функциональную загруженность имеют процессы «Деятельность коммерческого отдела» и «Деятельность бухгалтерии».

Наименее – «Деятельность склада».

Оптимизируем структуру и исключим склад из процессов, рис. 3.

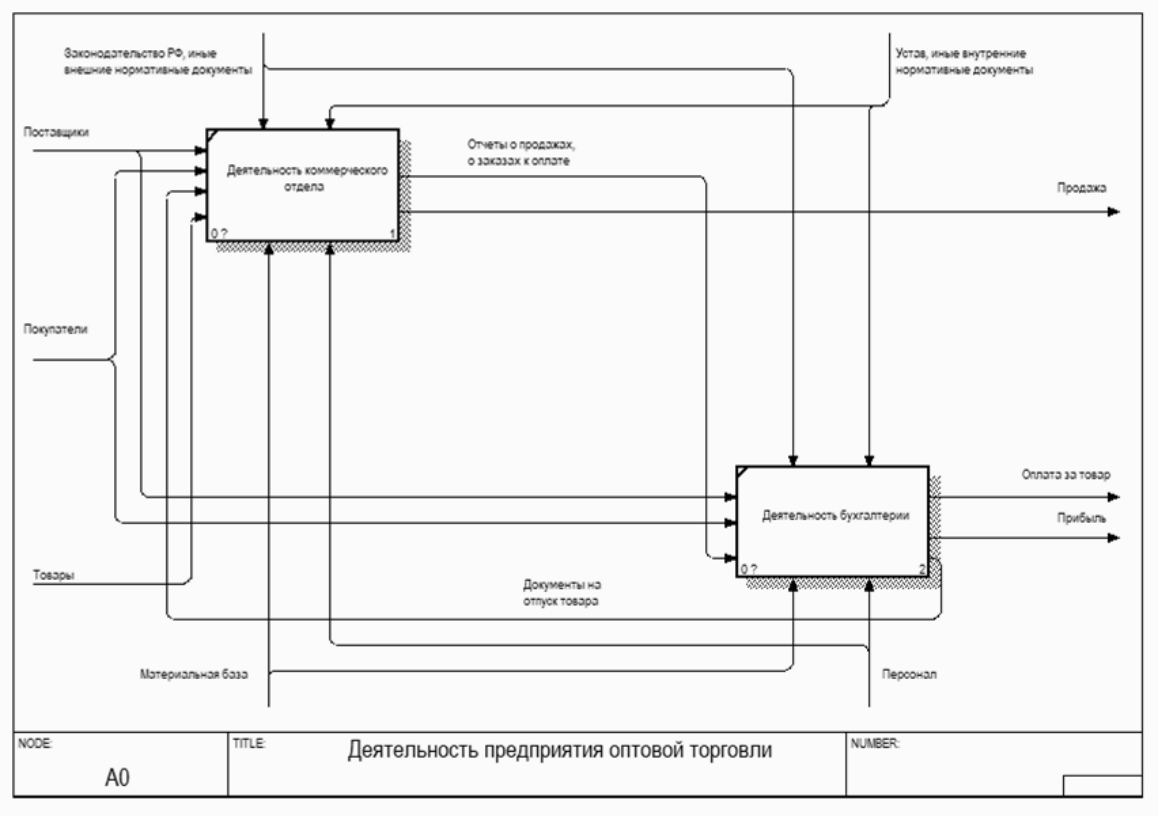


*Рисунок 3 - Оптимальная декомпозиция IDEF0*

С внедрением цифровых технологий, совершенствуются бизнес-процессы, которые позволяют рассматривать предприятия сервиса от систем управления документами до систем организации стратегия интеграции производства и регулирования финансовых потоков. Отлаженный бизнес-процесс и организация управления могут расширить возможности сервиса в получении конкурентных преимуществ.

Оптимизированные бизнес-процессы управления финансовыми потоками закрепляются в регламентных документах, например в «Алгоритм прохождения платежей в компании».

Для поддержки оперативного управления финансовыми потоками необходима автоматизация соответствующих бизнес-процессов, а выбранное программное обеспечение позволяет:

– создавать электронные учетные документы;

– формировать электронную отчетность;

– реализовать поддержку процедур контроля и согласования и т.д.

Таким образом, когда бизнес-процессы финансового управления определены и оптимизированы, а соответствующие регламенты разработаны и утверждены, начинается этап их внедрение с сервисную деятельность. Любая разрабатываемая программа или услуга проходит через этапы: тестирование, устранение неполадок, обслуживание в другой среде. Чтобы клиент был доволен, программное обеспечение должно работать без ошибок, которые устраняются с помощью процесса отладки.

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# TECHNICAL SCIENCE

УДК 648.23

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## ВЛИЯНИЕ КОНСТРУКТИВНЫХ ПАРАМЕТРОВ СТИРАЛЬНОГО БАРАБАНА НА ЭКСЦЕНТРИСИТЕТ УРАВНОВЕШИВАЮЩЕЙ ЖИДКОСТИ АВТОБАЛАНСИРУЮЩЕГО УСТРОЙСТВА

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## INFLUENCE OF CONSTRUCTIVE PARAMETERS OF THE WASHING DRUM ON THE ECCENTRITY OF THE BALANCING LIQUID OF THE AUTO-BALANCING DEVICE

***Аннотация.***
*В данной статье рассматриваются вопросы качественного исследования эксцентриситета уравновешивающей жидкости автобалансирующего устройства (АБУ) в зависимости от конструктивных параметров стирального барабана. В работе получены зависимости, определяющие качественную взаимосвязь между конструктивными параметрами АБУ и эксцентриситетом уравновешивающей жидкости, сделаны выводы и предложения. Результаты работы могут быть использованы при дальнейших комплексных исследованиях эффективности АБУ, что позволит снизить динамические нагрузки и виброактивность стиральных машин при отжиме.*

***Abstract.***
*This article discusses the issues of a qualitative study of the eccentricity of the balancing fluid of an auto-balancing device (ABU), depending on the design parameters of the washing drum. In the work, dependences are obtained that determine the qualitative relationship between the design parameters of the ABU and the eccentricity of the balancing fluid, conclusions and proposals are made. The results of the work can be used for further comprehensive studies of the efficiency of the ABU, which will reduce the dynamic loads and vibration activity of washing machines during spinning.*

***Ключевые слова****: стиральная машина, барабан, центробежный отжим, динамические нагрузки, виброактивность, автобалансирующее устройство, уравновешивающая жидкость, эксцентриситет, неуравновешенные силы*

***Key words:*** *washing machine, drum, centrifugal spin, dynamic loads, vibration activity, self-balancing device, balancing liquid, eccentricity, unbalanced forces.*

В настоящее время в связи с увеличением скоростей перемещения рабочих органов стиральных машин барабанного типа, а также ростом требований в отношении их надёжности, в том числе вибронадёжности, актуальным является поиск новых научных подходов и технических решений, направленных на снижение виброактивности стиральных машин в период центробежного отжима текстильных изделий. Одной из наиболее важных задач по снижению вибрации стиральных машин является снижение значительных динамических нагрузок, возникающих в стиральном барабане в результате неравномерной раскладки белья по обечайке барабана при центробежном отжиме.

Наиболее эффективным способом снижения динамических нагрузок в машинах подобного типа, относящихся к роторным машинам, является использование автоматической балансировки неуравновешенных масс [1].

В последнее время для снижения виброактивности роторных машин все большее применение находят жидкостные автобалансирующие устройства (АБУ) активного или пассивного типа.

Одним из наиболее перспективных жидкостных АБУ является устройство пассивного типа, описанное в ряде изобретений, на которые получены патенты, в частности [2], [3], [4], [5].

В отдельных работах Алехина С.Н. были рассмотрены некоторые вопросы, связанные с исследованием как самого процесса перемещения внутренней ёмкости стирального барабана, так и процесса поведения эксцентриситета уравновешивающей жидкости при воздействии внешней нагрузки. Вместе с тем обращает на себя внимание недостаточность качественных исследований процессов, протекающих в АБУ данного типа.

В работе [6] было показано, что эксцентриситет $e$ уравновешивающей жидкости может быть определён по формуле:

$$e = \frac{d^2 \Delta l}{\left(D^2 - d^2\right)}, \qquad (1)$$

где $D$ и $d$ – диаметры цилиндрических ёмкостей стирального барабана, соответственно, наружной и внутренней;

$\Delta l$ – перемещение внутренней ёмкости под действием силы $F$ от неуравновешенных масс белья.

Здесь величина перемещения $\Delta l$ определяется по известной из теории колебаний формуле:

$$\Delta l = \frac{F}{c},$$

где $c$ – суммарная жёсткость упругих элементов АБУ в направлении действия силы $F$.

Введём коэффициент $k_д$, показывающий соотношение между диаметрами внутренней и наружной ёмкостями:

$$k_д = \frac{d}{D}.$$

С учётом этого формула (1) может быть представлена в следующем виде:

$$e = \frac{\left(k_д D\right)^2 \frac{F}{c}}{\left(D^2 - k_д^2 D^2\right)}, \qquad (2)$$

После преобразования, получим:

$$e = \frac{F}{c} \frac{k_д^2}{\left(1 - k_д^2\right)}, \qquad (3)$$

В некоторых случаях более удобно представлять коэффициент $k_д$ через величину $\delta$, показывающую разницу между радиусами наружной $R$ и внутренней $r$ ёмкостями в местенном пространстве (так называемое, межстенное расстояние):

$$\delta = (R - r) \text{ или } 2\delta = (D - d),$$

откуда

$$k_д = 1 - \frac{2\delta}{D}. \qquad (4)$$

Проанализируем формулу (3). В ней можно выделить две составляющие $A$ и $B$:

1) $A = \frac{F}{c}$ – данная составляющая формулы отражает силовую характеристику процесса формирования эксцентриситета $e$ и является случайным параметром;

2) $B = \frac{k_д^2}{\left(1 - k_д^2\right)}$ – данная составляющая формулы отражает геометрическую (безразмерную) характеристику процесса формирования эксцентриситета $e$ и является постоянной величиной.

Силовая характеристика $A$ представляет собой случайную величину, вероятностный характер которой определяется случайными значениями силового воздействия $F$, изменяющегося случайно не только в каждом цикле обработки белья при различной загрузочной массе и виде текстильных изделий, но и в период выполнения процесса отжима. В свою очередь, величина жёсткости $c$ является постоянной для данной конструкции АБУ. Значения составляющей $A$ лишь частично зависят от заданных конструктивных параметров, а именно от заданной жёсткости $c$. Составляющая $A$ определяет линейный характер поведения функции $e=f(A,B)$.

Геометрическая составляющая $B$ зависит от соотношения диаметров внутренней и наружной ёмкостей барабана и определяет нелинейный характер поведения функции $e=f(A,B)$.

Определим диапазон возможных значений коэффициента $k_д$. Внутренняя ёмкость барабана по своей сути представляет рабочий орган машины, в котором происходит непосредственно процесс обработки изделий, поэтому размеры данной ёмкости, в том числе её диаметр $d$, должны обеспечивать выполнение заданных функций машины и требуемые показатели качества выполнения реализуемых процессов. Исходя из этого, рассчитываются геометрические параметры внутренней ёмкости.

В свою очередь, размеры наружной ёмкости, в том числе её диаметр $D$ или размер местенного пространства барабана $\delta$, должны удовлетворять следующим требованиям:

1) обеспечение необходимого объёма уравновешивающей жидкости в межстенном пространстве барабана;

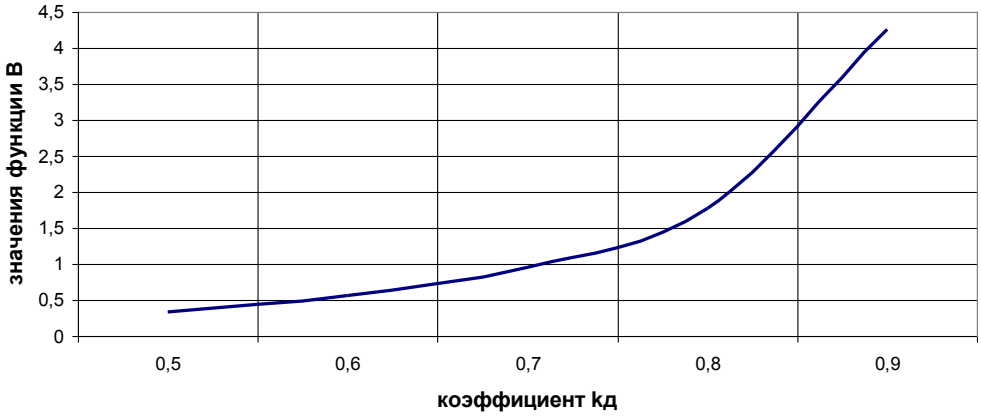
2) возможность установки упругих элементов в межстенном пространстве барабана;

3) обеспечение свободного перемещения внутренней ёмкости для формирования необходимого эксцентриситета уравновешивающей жидкости;

4) минимальные возможные габариты машины.

В соответствии с этим можно с уверенностью утверждать, что значения коэффициента $k_\partial$ будут находиться в диапазоне следующих возможных крайних величин: $k_\partial$=0,5…0,9.

Исследуем параметр $B$ как функцию $B=f(k_\partial)$ в диапазоне $k_\partial$=0,5…0,9. На рис.1 представлен график функции $B=f(k_\partial)$.




Анализ поведения функции $B=f(k_\partial)$ показывает, что при увеличении значений коэффициента $k_\partial$ в принятом диапазоне от 0,5 до 0,9 происходит рост значений функции $B$, а следовательно, при наличии линейной характеристики составляющей $A$, происходит аналогично рост значений эксцентриситета $e$. Причем наиболее интенсивный рост наблюдается в диапазоне $k_\partial$=0,8…0,9. Следовательно, при уменьшении значений межстенного расстояния δ происходит рост значений эксцентриситета $e$.

Так как уравновешивающая сила АБУ зависит как от эксцентриситета, так и от массы уравновешивающей жидкости, то делать однозначные выводы об эффективности АБУ на основании полученных в данной работе результатов возможно при наличии дополнительных исследований, связанных с учётом влияния на уравновешивающие силы массы уравновешивающей жидкости. Таким образом, полученные в работе результаты будут полезными при дальнейшем комплексном исследовании эффективности АБУ.

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# АНАЛИЗ ЗАВИСИМОСТИ НАПРЯЖЕННО-ДЕФОРМИРОВАННОГО СОСТОЯНИЯ ОСНОВАНИЯ ПОД ФУНДАМЕНТОМ МНОГОЭТАЖНОГО ЖИЛОГО ДОМА В ЗАВИСИМОСТИ ОТ ШИРИНЫ ПОДОШВЫ ФУНДАМЕНТА ПРИ СТРОИТЕЛЬСТВЕ В РАЙОНАХ С ОПАСНОСТЬЮ ОБРАЗОВАНИЯ КАРСТОВЫХ ПРОВАЛОВ В СРЕДЕ AUTODESK ROBOT STRUCTURAL ANALYSIS 2019

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# ANALYSIS OF THE DEPENDENCE OF THE STRAIN-DEFORMED STATE OF THE SUBSTRATE UNDER THE FOUNDATION OF A MULTI-STOREY RESIDENTIAL BUILDING DEPENDING ON THE WIDTH OF THE SOLE OF THE FOUNDATION DURING CONSTRUCTION IN THE AREAS WITH A DANGER OF FORMATION ANALYSIS ROBIS 2019

***Аннотация***

*Покрытие больших площадей Российской Федерации и стран СНГ участками различной степени опасности образования карстовых провалов ставит вопрос проектирования и строительства гражданских и промышленных зданий с учетом данного фактора весьма актуальным. В статье рассматривается анализ зависимости напряженно-деформированного состояния основания под фундаментом многоэтажного жилого дома в зависимости от ширины подошвы фундамента при*

*строительстве в районах с опасностью образования карстовых провалов в среде Autodesk Robot Structural Analysis 2019.*

***Abstract***

*The coverage of large areas of the Russian Federation and the CIS countries with areas of varying degrees of danger of the formation of karst sinkholes raises the issue of design and construction of civil and industrial buildings, taking into account this factor, is very relevant. The article examines the analysis of the dependence of the stress-strain state of the base under the foundation of a multi-storey residential building, depending on the width of the base of the foundation during construction in areas with the risk of karst sinkholes in the Autodesk Robot Structural Analysis 2019 environment.*

***Ключевые слова:*** *монолитный ленточный фундамент, напряженно-деформированное состояние, карстовый провал, AUTODESK ROBOT STRUCTURAL ANALYSIS 2019, максимальное напряжение по Мизесу.*

***Key words:*** *monolithic strip foundation, stress-strain state, karst failure, AUTODESK ROBOT STRUCTURAL ANALYSIS 2019, maximum von Mises stress.*

Объектом исследования является монолитный ленточный фундамент многоэтажного жилого дома. Предметом исследования является влияние ширины подошвы монолитного ленточного фундамента на напряженно-деформированное состояние основания.

В работе проведено исследование и сравнение напряженно-деформируемых состояний четырех вариантов ленточных монолитных фундаментов. Варианты отличаются шириной подошвы фундамента. Ширина подошвы фундамента составляет 0,6 (а); 1,2; 2,4 и 3,6 м соответственно для первого, второго, третьего и четвертого варианта.

Моделирование карстового провала реализовывалось путем удаления части конечных элементов из модели основания в виде окружности диаметром 3 м на глубине 3 м от подошвы фундамента, что соответствует аналогичному карстовому провалу [1, 2], Характеристики грунтов основания, получены в процессе предварительных геологических изысканий. Основанием фундамента является суглинок. Наличие мест возможного образования провалов также основывалось на изысканиях. На рисунке 1 представлены результаты исследования деформаций основания в зависимости от ширины подошвы до образования карстовой пустоты под подошвой фундамента и после ее образования.

На рисунке 2 представлены результаты исследования эквивалентных напряженийя в основании под подошвой фундамента по Мизесу в зависимости от ширины подошвы до образования карстовой пустоты под подошвой фундамента и после ее образования. Трехмерные напряжения образуются в нескольких направлениях. Обычно эти напряжения суммируются для получения эквивалентного напряжения, называемое напряжением по Мизесу.

Для главных напряжений $\sigma_1$, $\sigma_2$, $\sigma_3$ напряжение по Мизесу выражается как:

$$\sigma_{vonMises} = \sqrt{\frac{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_1 - \sigma_3)^2}{2}},$$

где $\sigma_1$, $\sigma_2$, $\sigma_3$ соответственно первое, второе и третье главные нормальные напряжения.

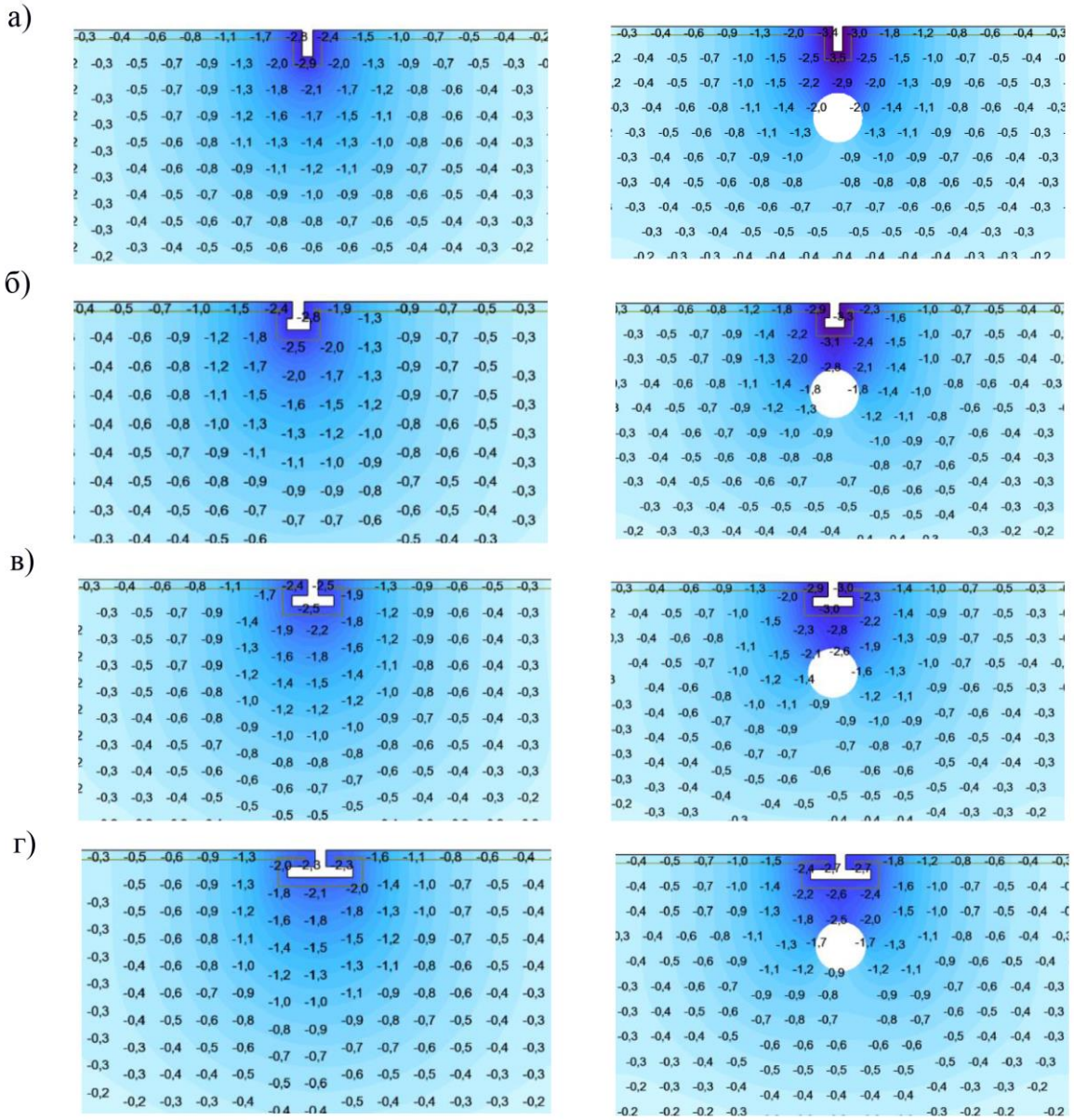


*Рисунок 1 – Деформации основания в см по 1 (а); 2 (б); 3 (в) и 4 (г) вариантам (до образования карстовой пустоты – слева; после образования карстовой пустоты – справа)*

Как видно из рисунка 1, деформации основания уменьшаются с увеличением размера подошвы фундамента. Данный момент связан с давлением по подошве фундамента, которое с увеличением размера подошвы также уменьшается [3, 4]. Эффект проявляется как до образования карстовой пустоты – слева на рисунке, так и после ее образования. В целом, наличие карстовой пустоты под подошвой фундамента сказывается на увеличение максимальной осадки основания под фундаментом на 20-25% по сравнению с аналогичным параметром при отсутствии карстовой пустоты.

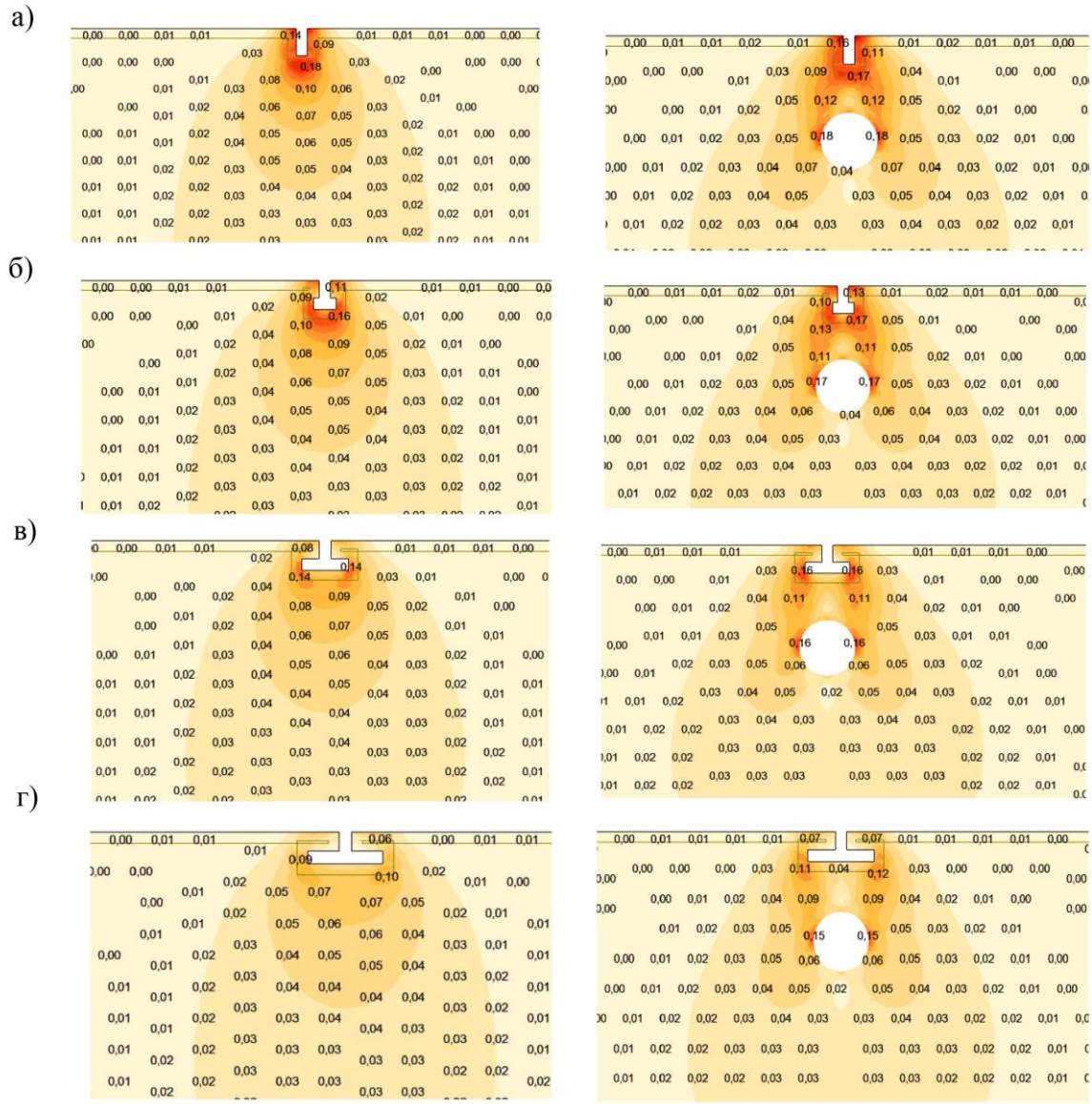


*Рисунок 2 – Эквивалентные напряжения основания под фундаментом многоэтажного жилого здания по Мизесу 1 (а); 2 (б); 3 (в) и 4 (г) вариантам (до образования карстовой пустоты – слева; после образования карстовой пустоты – справа)*

Как видно из рисунка 2, напряжения в основании как на кромке карстовой пустоты, так и под подошвой фундамента уменьшаются с увеличением размера подошвы фундамента. Так при увеличении ширины подошвы фундамента с 0,6 до 3,6 м приводит к уменьшению максимальных напряжений в основании на 20 % по сравнению с аналогичным параметром при отсутствии карстовой пустоты.

На рисунках 3 и 4 представлены зависимости осадки основания и максимальных напряжений на кромке карстовой пустоты от ширины подошвы фундамента соответственно.

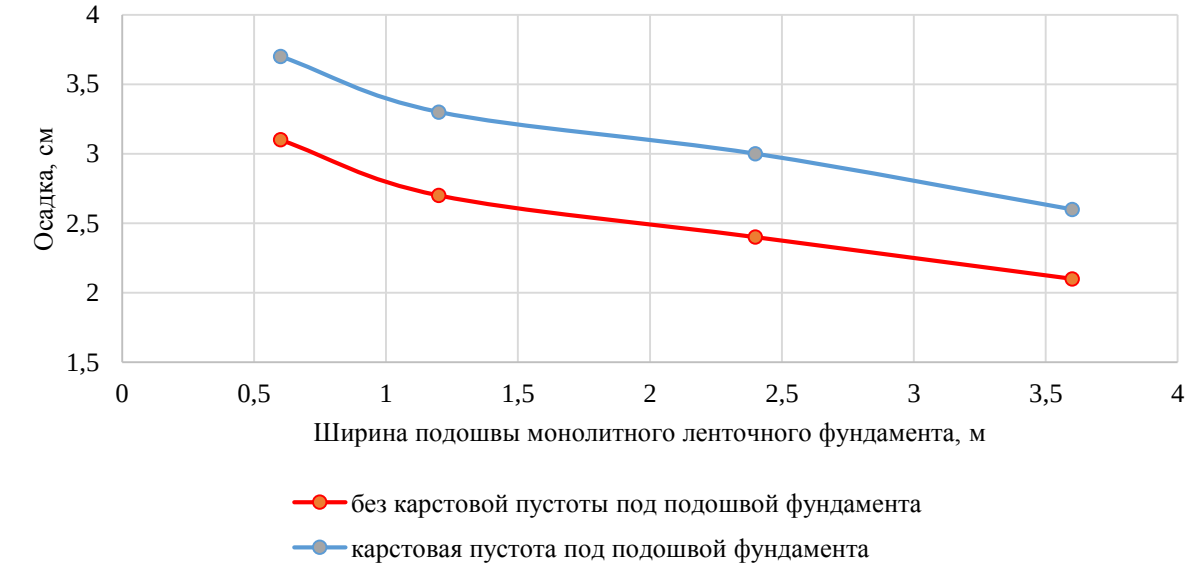


*Рисунок 3 – Зависимость осадки основания от ширины подошвы фундамента соответственно*

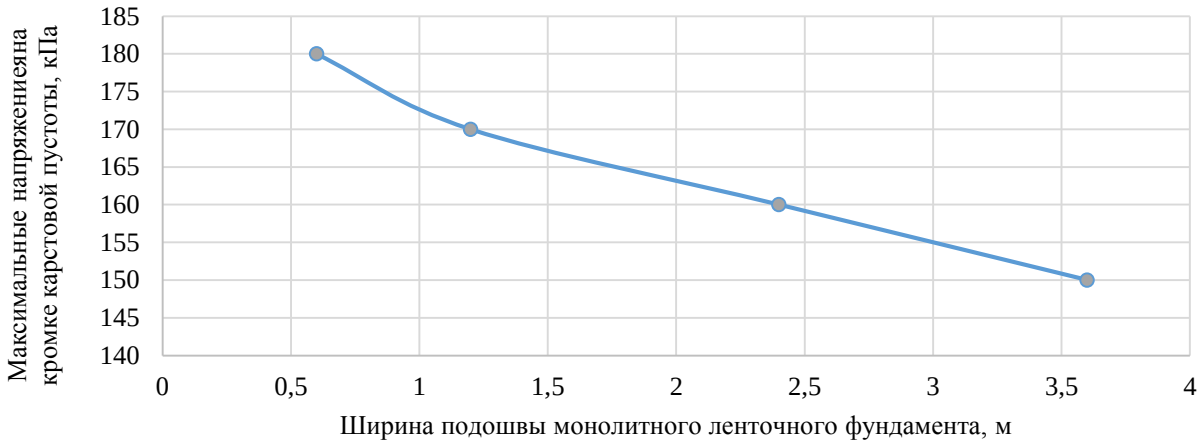


*Рисунок 4 – Зависимости максимальных напряжений на кромке карстовой пустоты от ширины подошвы фундамента*

Как видно из рисунка 3 в случае образования карстового провала увеличение размера подошвы в упругой стадии работы основания дает эффект уменьшения деформации аналогичный эффекту в случае отсутствии карстовой пустоты при всех остальных эквивалентных параметрах. В целом, увеличение максимальной осадки основания под фундаментом больше на 20-25% по сравнению с аналогичным параметром при отсутствии карстовой пустоты.

Как видно из рисунка 4, увеличении ширины подошвы фундамента с 0,6 до 3,6 м приводит к уменьшению максимальных напряжений в основании на 20 % при наличии под подошвой фундамента карстовой пустоты. Данный момент при определенных факторах в реальных условиях способно предотвратить аварийную ситуацию или замедлить время до ее наступления.

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# СРАВНЕНИЕ СПОСОБОВ ОПРЕДЕЛЕНИЯ СКОРОСТЕЙ ТОЧЕК КРИВОШИПНО-ПОЛЗУННЫХ МЕХАНИЗМОВ ДВС АВТОКАРОВ

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# COMPARISON OF METHODS FOR DETERMINING THE SPEEDS OF CRANK-SLIDER MECHANISMS OF INTERNAL COMBUSTION ENGINES OF CARGO CARTS

***Аннотация***

*В статье представлен анализ использования различных способ определения скорости ползуна кривошипно-ползунного механизма, с использованием относительной погрешности и приближения расчетов математическими соотношениями.*

***Abstract***

*The article presents an analysis of the use of various methods for determining the speed of the slider of the crank-slider mechanism, using the relative error and the approximation of calculations by mathematical relations.*

***Ключевые слова:*** *план скоростей, мгновенный центр скоростей, теорема Грасгофа.*
***Key words:*** *plan of velocities, instant center of velocities, Grashof's theorem.*

В настоящее время все отрасли встречаются с большим грузооборотом, и при отправке или доставке грузов необходимо грузы загрузить или выгрузить, соответственною. Есть случаи, при которых вручную груз не поднять, а использовать автокран, башенный кран и т.п. экономически или по размещению не рационально. В таких случаях большое распространение получили автокары. Автокары – это самоходные тележки с электроприводом. Их грузоподъёмность в пределах от 0,5 т до 10 т. В зависимости от видов сменного рабочего оборудования автокары бывают простые и универсальные. Последние, кроме основного рабочего оборудования (вилочных подхватов), имеют ковши, стрелы и другие захватные приспособления. Поэтому автокары имеют широкое применение для перемещения грузов не только на складах, но и на строительных предприятиях, в агропромышленной отрасли и т.д.

Одним из механизмов, обеспечивающим работу автокаров, является кривошипно-шатунный механизм. При кинематическом анализе (в частности, при определении скоростей) аналогичных механизмов, в основном применяют план скоростей (графический способ) и мгновенный центр скоростей (аналитический способ). Однако, кроме применяемых двух способов, есть ещё два аналитических способа. Проанализируем результаты определения скоростей точек кривошипно-ползунного механизма различными способами с применением: плана скоростей, мгновенного центра скоростей звеньев, теоремы Грасгофа, теоремы о сложении скоростей.

При расчетах рассмотрены девять вариантов типоразмеров звеньев *OA* (0,04 м; 0,043 м; 0,047 м; 0,05 м; 0,053 м; 0,057 м; 0,06 м; 0,063 м; 0,067 м), *AB* (0,12 м; 0,13 м; 0,14 м; 0,15 м; 0,16 м; 0,17; 0,18; 0,19 м; 0,2 м) кривошипно-ползунного механизма, при 19 положениях, через каждые 10° угла поворота $\varphi_1$ (рисунок 1). Так как угловая скорость кривошипа *OA* постоянна при любом положении механизма, значит скорость точки *A* будет постоянной и одинаковой при любом способе расчета. Поэтому, сравним значения скоростей ползуна *B* при различных положениях механизма, определённые четырьмя способами.


*Рисунок – 1*

За наиболее верный способ расчёта принято определение скоростей с использованием мгновенного центра скоростей. Для каждого варианта типоразмера посчитана относительная погрешность определения скорости ползуна *B* при всех рассматриваемых положениях. И выведены средние значения относительных погрешностей, для различных положений механизмов, при определении скорости ползуна. Результаты вычислений представлены в таблице 1.

Таблица – 1

| Положение механизма, определяемое угловой координатой | Погрешность значений скорости ползуна B, вычисленное | | | |
|---|---|---|---|---|
| | с использованием мгновенного центра скоростей, % | по теореме Грасгофа, % | с использование теоремы о сложении скоростей, % | с использованием плана скоростей, % |
| $\varphi_1 = 0°$ | 0 | 0 | 0 | 0 |
| $\varphi_1 = 10°$ | 0 | - 0,062 | - 0,070 | - 2,180 |
| $\varphi_1 = 20°$ | 0 | - 0,084 | 0,016 | 1,989 |
| $\varphi_1 = 30°$ | 0 | - 0,034 | - 0,032 | - 1,534 |
| $\varphi_1 = 40°$ | 0 | 0,047 | 0,095 | 2,362 |
| $\varphi_1 = 50°$ | 0 | - 0,021 | - 0,037 | 2,755 |
| $\varphi_1 = 60°$ | 0 | 0,062 | 0,020 | - 2,307 |
| $\varphi_1 = 70°$ | 0 | 0,071 | - 0,069 | - 2,730 |
| $\varphi_1 = 80°$ | 0 | - 0,053 | 0,082 | - 2,151 |
| $\varphi_1 = 90°$ | 0 | 0 | 0 | 0 |
| $\varphi_1 = 100°$ | 0 | 0,074 | - 0,030 | 1,978 |
| $\varphi_1 = 110°$ | 0 | 0,047 | 0,095 | 2,362 |
| $\varphi_1 = 120°$ | 0 | - 0,080 | 0,064 | - 2,360 |
| $\varphi_1 = 130°$ | 0 | 0,011 | - 0,038 | - 2,716 |
| $\varphi_1 = 140°$ | 0 | 0,083 | 0,021 | - 1,825 |
| $\varphi_1 = 150°$ | 0 | - 0,013 | 0,013 | - 2,587 |
| $\varphi_1 = 160°$ | 0 | 0,078 | 0,045 | 2,631 |
| $\varphi_1 = 170°$ | 0 | 0,089 | - 0,051 | 2,710 |
| $\varphi_1 = 180°$ | 0 | 0 | 0 | 0 |

Для наглядности представим разброс полученных результатов на графике (рисунок 2).

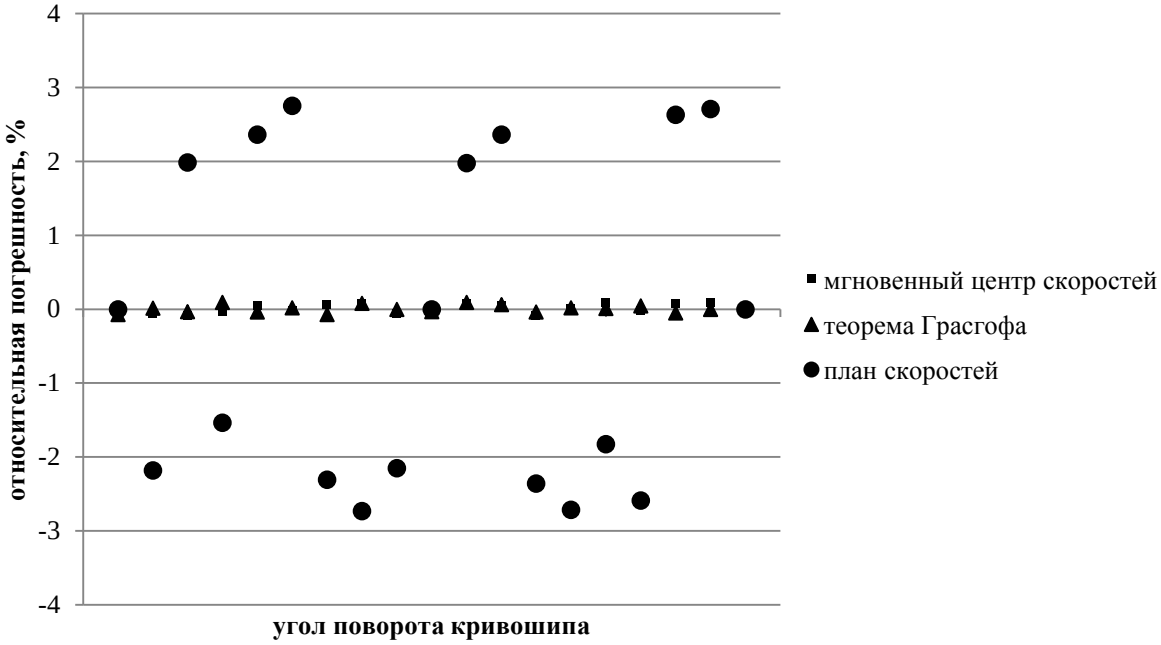


*Рисунок – 2*

Из таблицы 1 и рисунка 2 видно, что погрешность аналитических расчётов в пределах $\pm 1\%$, для графического способа (план скоростей) относительная погрешность в пределах $\pm 3\%$. Конечно, наиболее точными являются аналитические способы определения скоростей точек. Уменьшить погрешность определения скоростей точек с использованием плана скоростей можно если использовать графические редакторы для черчения на ПК.

При аппроксимации полученных результатов по определению скоростей точек $B$ (рисунок 3) видно, что величины, полученные с применением теоремы Грасгофа и теоремы о сложении скоростей приближают к значениям, полученным с использованием мгновенного центра скоростей, линейная и степенная функции $f(x) = x$ (рисунок 3 а, б, в, г). Величины скоростей ползуна B, полученные по плану скоростей, аппроксимируют следующие функции: линейная $f(x) = -0{,}15 + 1{,}03 \cdot x$ (рисунок 3 д), степенная $f(x) = 0{,}98 \cdot x^{1{,}01}$ (рисунок 3 е). Полученные результаты так же говорят о том, что наиболее точными значения скоростей ползуна являются при применении аналитического способа.

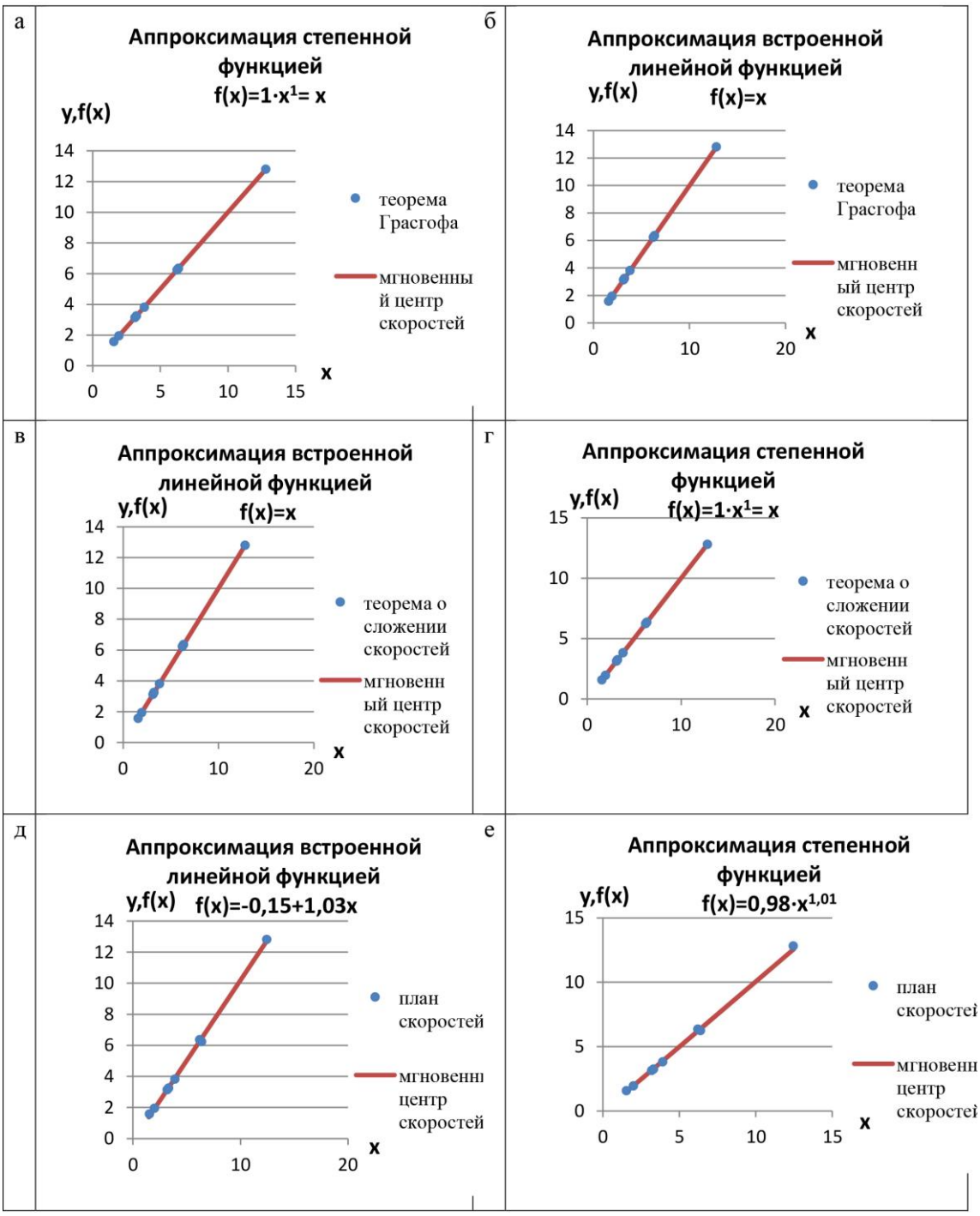


*Рисунок – 3*

Отметим, что погрешности расчётов во всех случаях находятся в пределах инженерной точности – 5%. Значит, определение скоростей ползуна кривошипно-ползунного механизма двигателя внутреннего сгорания допустимо любым из четырёх способов: с использованием мгновенного центра скоростей, по закону Грасгофа, с использование теоремы о сложении скоростей, с использованием плана скоростей, но наиболее точными являются аналитические способы расчётов. Эти выводы справедливы для расчета скоростей точек любого плоского механизма.

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# AGRICULTURAL SCIENCES

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## CHANGES IN CHEMICAL, AMINO ACID AND LIPID COMPOSITION OF RAINBOW TROUT (ONCORHYNCHUS MYKISS) BY DIFFERENT FEEDING METHODS

***Abstract.***

*The selection of appropriate feed to rationally meet the needs of fish with all the necessary nutrients is of particular importance in the planned production of salmon fish products, the demand for which in human nutrition is constantly growing. Therefore, the nutrients contained in the feed should not only support the vital functions of the body, but also promote its growth and ensure the normal functioning of the whole organism.*

*Scientific research was to determine the effect of different types of feed and their combinations on the morphometric parameters of trout age groups, changes in chemical, amino acid and lipid composition of tissues, which allowed us to draw conclusions about the effectiveness of feeding fish with the studied feed.*

*The research is based on a comparative assessment of the impact of the above granular feeds on the overall functional state of fish growth.*

*Granulated compound feeds from the manufacturer «Aller Aqua» and «Biomar» were used in feeding, formulations and diameter of granules according to the age and weight of the fish. The composition of the feed and nutrition corresponded to the period of fish farming. The daily feed rate was calculated in accordance with generally accepted methods in fish farming, taking into account water temperature and fish weight. Only healthy fish without visible damage were used for the studies, which were caught immediately before the studies and were not fed for 24 hours.*

*These studies allowed to determine the main biochemical parameters using methods generally accepted in fish farming and to study the effect of the studied feeds on the functional state of growth, biochemical parameters.*

*The conducted researches allow us to draw conclusions about direct connection between marketable qualities of rainbow trout and the consumed forages, their qualitative structure and nutritional value. In addition, we do not rule out the influence of abiotic factors, they were the same for all studied groups of trout, which is equally important, and along with rational feeding plays a key role in production.*

***Keywords:*** *feeds of Aller Aqua firms, Biomar, balanced nutrition, biochemical parameters, morphometric evaluation, feed composition and nutrition.*

### Introduction

Salmon occupy a special place among the objects of industrial fish farming, which is due to the biological laws of the life cycle in a closed aquatic environment. Among this species of fish, rainbow trout deserves special attention, the potential for functional growth of which is well manifested in the first 2-3 years of life, then this process slows down and is unimportant for the production of marketable products (Rasmussen, Ostenfeld, 2000; Bobel, Pivtorak, 2019 ).

Not only Ukraine, but also modern highly developed countries such as Germany, Dinia and Turkey face the issue of high feed production costs with relatively low productivity and ambiguous production efficiency (Lasner et al., 2017). In addition, the main limiting factors in the development of trout farming in Eastern countries such as India are inefficient marketing and lack of cost-effective raw materials (Singh et al., 2017; Kheyrabadi et al., 2014).

The global aquaculture sector has been growing steadily over the last two decades (FAO 2016). The quality of fish feed is constantly increasing, gradually changing from traditional feed to plant-based feed, which along with animal and biologically active additives promote the absorption of plant proteins (Kamalam et al., 2019; Callet et al., 2017). Difficulties in supplying all aquaculture sectors with marine resources have been the main reason for replacing animal components with cereals and legumes (Collins et al., 2013; Oliva-Teles et al. 2015). Complete replacement of animal components with plant ones, for predatory fish species, leads to a decrease in growth rates, mainly due to numerous anti-nutritional factors and unbalanced amino acid profile (Lazzarotto et al. 2018). Thus, there is an urgent need for alternatives to animal protein products and sources, such as insects, microorganisms, microalgae, and yeast (Roques et al., 2018). In addition, given the prospects for the development of the industry, it should be noted the high

cost of feed, especially foreign producers. Therefore, producers of salmon products are interested in a comparative assessment of the quality and cost of feed when purchasing them (Martseniuk, 2008; Arru et al., 2019).

With intensive trout farming, a full balanced feeding becomes important. As fish feed is increasingly formed from a variety of protein sources, more attention needs to be paid to ensuring that fish requirements for essential essential amino acids are properly met (Katheline Hua, Dominique P.Bureau, 2019). It is known that the cost of feeding rainbow trout is about 50% of production costs, however, often due to irrational and unskilled feeding costs increase significantly. In practice, it is often difficult to balance maximum and optimal levels of feeding to avoid irrational feed costs, so in order to maximize growth, it is useful to investigate feeding norms (Kwong et al., 2006; Voorhees et al., 2018).

Fish need a well-balanced mixture of essential and essential amino acids, so a diet that provides the required level of amino acid composition maximizes growth through the use of a balanced diet (Comesana et al., 2018). It should also be noted that the quality of marketable trout, its aroma and taste are determined not only by free amino acids, but also by physiological, environmental and nutritional factors (Hrynzhevskyi et al., 2002; Martsikalis et al., 2011; Sabetian et al., 2012).

The main task of commercial trout farming is to grow fish in the shortest possible time and with minimal costs. One of the main factors influencing the growth rate of fish is maintaining optimal rearing conditions, for example, studies on trout farming using paddle generators have shown that fish had better weight gain and higher ash content and lower fat content ( Reiser et al., 2019). Thus, the urgency of the problem of intensive reproduction of the natural population of rainbow trout should be aimed at improving the technology of breeding and rearing using high-grade feed and modern technological methods of their production.

One of such methods can be considered the study of taste receptors in fish, which is of practical interest for the development of specially stimulating mixtures and modulation of feed consumption in aquaculture. Recently, researchers have found evidence of such receptors in the digestive system of fish, suggesting that the sensory properties of feed may also have a functional effect along with taste, so improving the taste of feed will increase their consumption (Morais, 2016; Librán-Pérez, 2015 ).

Thus, in the above brief analysis of the literature, there is a need to further study the impact of feed factors on the functional state of growth of rainbow trout and marketable indicators of fish products in a closed water supply.

The purpose and objectives of the study were to study the effect of feed "Aller Aqua" and "Biomar" on the functional state of growth and biochemical parameters of rainbow trout tissues.

**Materials and methods**

The object of research was the rainbow trout Oncorhynchus mykiss, which is grown in the conditions of PJSC "Bolshevtsi-Ryba", located in the village. Bolsheviks of Ivano-Frankivsk region. For the experiment, juvenile rainbow trout were selected on the principle of groups of analogues with an average weight of 65 g and formed three groups of 300 individuals in each, which were placed in three identical pools.

The studies were conducted in spring-summer and autumn-winter periods according to the scheme shown in table 1.

The temperature regime during the experiment, in general, was favorable for the cultivation of rainbow trout. The water temperature in the spring-summer period ranged from 8-9 to 16 ° C, and in the autumn-winter period 4-8 ° C. Complete replacement of water in the pools was carried out every 60 minutes. Water consumption per 1 kg of live weight of fish was 2 l / min. Water coming from an underground natural source contained insufficient oxygen, so it was further enriched with oxygen using aeration systems.

During the experiment, studies were conducted on the growth and development of rainbow trout. To do this, 10 specimens from each basin were studied monthly and selectively and the relative and absolute growth rates were determined. Also, qualitative indicators were determined: chemical, amino acid and lipid composition.

The amino acid composition was determined by the method of decomposition of samples by acid hydrolysis, with the transition of amino acids into free forms of phenylisothiocarbamyl derivatives (FTC derivatives), followed by their separation and quantification by capillary electrophoresis. Detection was performed in the UV region of the spectrum at a wavelength of 254 nm.

The following works were carried out: sampling, preparation of the capillary for work, preparation of calibrated solutions, calibration of the capillary electrophoresis system "Drops" and sample preparation.

The mass fraction of each amino acid (X,%) was calculated by formula (1):

$$X = \frac{100 \cdot V_{hydr} \cdot V_{fin} \cdot C_{det}}{100 \cdot m V_{al}} \quad (1)$$

Where, X is the mass fraction of amino acids in the sample,%;

$C_{det}$ - determined value of the mass concentration of amino acids obtained in solution, mg / dm³;

m is the mass of the sample, mg;

$V_{hydr}$ - total volume of hydrolyzate, cm³;

$V_{fin}$ - the volume of the final (test) solution, cm (;

$V_{al}$ is the volume of an aliquot portion of the hydrolyzate taken to obtain FTC derivatives, cm³;

100 - multiplier to express the results in percent;

1000 - indicator of coordination of dimension of units of volume.

In compliance with the recommended values of the volumes of solutions, the mass fraction of amino acids was calculated by formula (2):

$$. X = \frac{100 \cdot C_{det}}{m} \quad (2)$$

Mass fractions of amino acids were determined: arginine, lysine, tyrosine, phenylalanine, histidine, leucine and isoleucine (total), methionine, valine, proline, threonine, serine, alanine, glycine.

Mass fractions of potassium, sodium, magnesium and calcium were determined. The method is based on acid treatment of samples, subsequent separation and quantification of catons by capillary electrophoresis. Detection of components was performed by indirect absorption at a wavelength of 254 ("Drops-103RT / 104T").

The mass fraction of the component in the sample (X,%) was calculated by formula (3):

$$X = \frac{100 \cdot V_{HCl} \cdot V_{KOH} \cdot C_{виз}}{1000 \cdot m \cdot V_{ал}} \cdot Q_1 \cdot Q_2, \quad (3)$$

Where, X is the mass fraction of cation in the sample,%;

$C_{det}$ is the measured value of the mass concentration of the cation, mg / dm³;

m is the mass of the sample, mg;

$V_{HCl}$ is the volume of hydrochloric acid used to treat the sample, cm³;

$V_{fin}$ - volume of the final (experimental) solution, cm;

$V_{al}$ - the volume of an aliquot portion of the filtrate, which is taken for evaporation, cm;

100 - multiplier to express the results in percent;

1000 - coefficient of agreement of discrepancy of units of volume measurement;

Q1 is the dilution factor of the sample;

Q2 is the coefficient of additional dilution of the sample.

Sample studies were performed according to generally accepted methods in fish farming (Yevtushenko, 2013; Tupytska, Klikh, 2016; Svyrydenko, 2014).

Morphometric evaluation of trout was performed by measuring and weighing fish. For the studies, only healthy fish without visible damage were used, which were caught immediately before the study and were not fed for 24 hours.

The fat content in different parts of the muscles and liver was determined in the Soxhlet apparatus by conventional methods (Lebedev, Usovich, 1976). Based on the obtained data, the absolute amount of lipids and their ratio in different parts of the muscles were calculated.

Fish samples were dried in an oven until complete loss of moisture and ashed in a muffle furnace. Wet and dry matter, as well as the ash mass of the samples were weighed using electronic scales.

Statistical processing of research materials was performed according to the generally accepted methods of variation statistics with estimation (M), error (m) and calculation of the probability of differences using Microsoft Excel software.

**Results**

The period of our research corresponded to the change of stages of the annual cycle of fish, which consisted in the transition from wintering to feeding cycle and again to wintering. The feeding behavior of the fish was determined by a change in the feeding regime, which included determining the frequency of feeding and its amount, which varied according to the age of the studied fish, but was unchanged for all three groups of trout. The absolute amount of feed distribution gradually increased from March to June, and in July, due to high water temperatures, fish feeding decreased. The dynamics of trout weight gain in the three groups of fish was the same and was determined by the feeding regime, which can be observed in the tables below.

However, the intensity of trout weight gain between groups of fish differed and depended primarily on the composition of the feed, as other conditions for keeping fish were the same. The growth rate of fish directly depended on the amount of protein in the feed. However, the lipid component of feed is no less important for active growth, the content of which must be balanced, because relatively high levels of lipids lead to obesity in fish, and the deficiency has a negative impact on its cultivation.

The daily requirement of dry granular mixtures for growing this year and commercial trout was calculated depending on water temperature, fish weight and pellet size (Pivtorak, J.I., Bobel, I.Y., 2017).

One of the indicators that directly characterizes the growth and development of fish is the zoological length, which, to some extent, can be judged on the impact of the studied feed on this indicator, which we determined in the dynamics at the beginning (this year), in the middle (this year). and at the end of the experiment (commercial fish) (Table 2).

In the initial stage of the experiment, the linear growth of fish in all three pools averaged 14.55 cm. For 90 days, this figure in the fish of the third basin was within 21.8 cm, which is 9% more than the fish of the first basin. The predominant effect was observed at the end of the experiment. Thus, the linear length of the fish in the third basin at the end of the experiment was 9.5% higher, which indicates the better nutritional value of the feed "Aller Aqua" in combination with the initial stages of feeding Biomar feed.

A similar picture was observed by us in relation to such an economic indicator as the productive length of the fish. The results of which are shown in table 3.

nalysis of the results showed that the use in the diet of fish of different composition of granular feed could not equally affect this indicator, and in the initial period the productive length was within 12.6 cm At the end of the study period, the linear growth of fish increases significantly. The trout of the third basin had the highest result - 26.3 cm, which is 8.6% higher than the fish of the first basin and 9.5% of the second, which gives grounds to claim the higher efficiency of the combination at different stages of growing two types of feed "Biomar" and “Aller Aqua” for the functional state of growth and development of rainbow trout.

Observations of the functional state of fish in the experimental basins were carried out daily with the determination of morphometric parameters at the end of each month. The average data of these measurements are given in Tables 1 and 2. It should be noted that for the entire period of the study trout consumed almost the

same amount of feed. However, the use of the studied types of feed in fish feeding had a different effect on a number of morphometric parameters of rainbow trout.

It is important to emphasize that the positive differences in the morphometric parameters of the rainbow trout of the third experimental basin, which had the highest coefficient of fattening. The fish of this basin had a high marketable value during sale.

The dynamics of growth in length and weight of rainbow trout depends on the feeding regime of the fish. The differences in weight gain and growth rates in the studied period are shown, which are probably due to the most effective combination of compound feeds. We can say that the level of feed digestibility is close to 2%. The quality of feed determines the rate of increase in length and weight of fish, the intensity of which depends on the content of protein, structural lipids and ω3 of polyunsaturated fatty acids in feed.

To study the effect of different types of feed on metabolic processes in rainbow trout at the end of the study period, a study of the chemical composition of muscle tissue, the results of which are shown in table 4.

Analysis of the results showed that the highest content of primary moisture is observed in the muscle tissue of the trout of the control group.

The group of trout, which practiced mixed feeding with "Aller Aqua" and "Biomar" had the best result in terms of dry matter content in muscle tissue, which was 32.3%, respectively. Slightly less dry matter was found in the fish of the second basin, which consumed granulated feed only from Aller Aqua. The difference compared to the control pool was 0.71%.

According to the results of the chemical composition of the muscle tissue, the fish in the third basin contained a slightly higher amount of protein and fat in the muscles. The crude protein content, respectively, was 17.8%, which exceeds the fish of the control pool by 1.53% ($p < 0.001$), and fat by 1.2%. A similar situation is observed for the content of crude ash, which in the fish of the second basin was within 0.85%, against 0.9% in the first and 0.8% in the third basin.

Thus, the obtained results give grounds to claim that the effect of Aller Aqua granular feed on the chemical composition of rainbow trout muscle tissue in combination with Biomar feed is highly effective.

To better assess the effect of spicy feed on the marketable quality of rainbow trout, we conducted a study of muscle tissue on the content of amino acids, as well as lipids in adipose, muscle tissue and liver (Tables 5 and 6).

Biochemical analysis of the amino acid composition of rainbow trout muscle tissue proteins showed that it contains 16 proteinogenic amino acids as well as aspartic and glutamic acid, of which the predominant part, which is more than 65%, is essential for trout. The maximum number of amino acid groups was cystine + tryptophan + aspartic + glutamic acid and leucine + isoleucine, as well as lysine. The participation of these amino acids in the physiological metabolism in the body of fish is special, which is confirmed by their deposition in muscle tissue.

The data obtained in our studies allow us to conclude that there is a direct relationship between the total amino acid content in the muscle tissue of trout and the nutritional quality of feed. It is the use of Aller Aqua feed in the diet of rainbow trout in combination with "Biomar" for young trout, provides the optimal content of amino acids in muscle tissue samples compared to other types of feed.

The intensity of functional growth processes of rainbow trout in most cases is determined by the feed composition of the feed used in its cultivation (Dzhabarov, 2006; Sidorov, 1985).

Therefore, for the active growth and development of fish requires a high level of protein in the feed, which is mainly used only for plastic metabolism, and not for energy expenditure.

It is known that the main source of energy for the animal body are feed lipids, which in addition to energy, perform in the body of both animals and fish, a number of vital functions: structural, regulatory, and are precursors of many biologically active substances, including hormones (Nemova et al, 2011; Sargent, Tocher, Bell, 2002; Gümüş E, Ikiz, 2009)

The results of studies of the lipid content in the tissues of rainbow trout (Table 6) showed a significantly higher content of total lipids, both in internal fat and muscle tissue when used in feeding fish feed company "Aller Aqua" in combination with "Biomar", 73.02 - 13.7%, against 69.08 - 12.5%, in the control. The content of total lipids in liver tissues was slightly lower.

The basis for the modification of the level of total lipids in the internal fat of rainbow trout is the concentration of triacylglycerols, which dominate in these tissues and in our studies range from 52-53% of the sum of all lipids.

The second, quantitatively lipid fraction in the internal fat of rainbow trout were phospholipids, the share of which from total lipids in our studies was 32%. When comparing the concentration of phospholipids in the internal fat of fish 1 and 2 pools, some deviations in the direction of reduction were noted, which once again confirms the advantages of using a mixed type of feeding.

The concentration of another structural lipid - cholesterol in the internal fat of fish, between the studied pools did not differ, and had no significant effect on the concentration of total lipids in the studied tissues.

The content of cholesterol esters in the internal fat of trout was minimal among the studied fractions of all three basins and amounted to about 3% of the total lipids.

A somewhat similar pattern is observed in our studies and in the content of individual lipid fractions, under the influence of the studied factor, both in muscle tissue and in liver tissue.

Thus, salmon feeds differ in the ratio of structural and spare substances, which is associated with the use of different raw materials in their manufacture. Therefore, the content of lipid components in the tissues of rainbow trout depends on the composition of the feed.

**Discussion**

This paper presents studies based on changes in the chemical, amino acid and lipid composition of muscle tissue of different age groups of rainbow trout, with the use of different feed rations. As well as changes that are associated with the physiological characteristics of the studied groups and the influence of biotic and abiotic factors on them.

The composition of the feed primarily affects the metabolism of fish, which determines their intensity of growth and development, as well as the quality of marketable products. To date, scientists are actively studying the effect of different composition of feed on the morphological, physiological and biochemical characteristics of fish.

Egorov B. V. (2012) in his work considers the needs of trout in nutrients and biologically active substances. He notes that when developing feed rations for trout, it is necessary to take into account that the metabolism of fish accelerates with increasing water temperature, in addition, metabolism in young is higher than in adults, and excessive or insufficient oxygen supply limits metabolism. Also, the increase in water flow leads to an increase in the physical activity of trout, respectively, increases the activity of metabolism and the need for feed, more acutely affects the lack of basic food components. Egorov BV points out that when developing recipes for trout feed it is necessary to take into account the stages of trout development: larval, fry periods, period of intensive growth to marketable weight, spawning period, etc., because according to the stage of development, trout needs change in essential nutrients.

Mruk A. I. conducted morphological studies of two-year-old rainbow trout, the purpose of which was to determine at which commodity weight of fish the share of carcasses and fillets in rainbow trout is the largest. We can say that her conclusions about the most attractive in both economic and consumer aspects of commercial fish with an average weight of 250-300 g confirm our studies of morphological parameters and confirm the effectiveness of this method of cultivation.

Kalaida M. L. (2017) described the peculiarities of the chemical composition of young rainbow trout when grown in closed-cycle water supply, which states that the composition of macronutrients in the dry matter of rainbow trout markedly relative decrease in calcium concentration with age, which indicates an increase in the ratio "Muscle tissue - skeleton". The level of phosphorus and potassium in marketable trout remains high. The content of macronutrients according to Kalaida M. L. (2017) in%: Ca - 0.025; K - 0.377; Mg - 0.025; Na - 0.051, our studies showed slight differences, which were respectively Ca - 0.0769; K - 0.474; Mg - 0.0398; Na - 0.108.

One of the most informative indicators of fish metabolism are lipids, as they play an important role in plastic and energy metabolism, are precursors of steroid hormones.

The study of the influence of feed composition on the growth and lipid metabolism of fish is studied by many researchers of the world community, which indicates their relevance and importance (Burlachenko, 2008; Ostroumova, 2012; Tocher et al., 2008; Yun et al., 2011). They note that the content of lipid components in trout tissues has a direct relationship with their content in feed used in the diet of farmed trout, and largely depends on temperature fluctuations in the pools, which we noted in the study, so our goal was to create the same optimal growing conditions.

Nazarova M. A. (2017) studied the peculiarities of the seasonal dynamics of the lipid composition of internal fat, muscle and liver of rainbow trout depending on the feeding regime of fish and feed composition. According to her research, the content of total lipids in the muscles of rainbow trout of all groups ranged from 13.5 to 19.5% of dry weight. Which is a bit higher than our research. Phospholipids in trout muscle, as in our studies, were the second largest quantitative group of lipids after triacylglycerols. The content of total lipids in the liver of fish was also lower than in muscle and internal fat.

The data obtained from studies of the amino acid composition of trout tissues were compared with the results of scientists who studied them. For example, Galoyan L. L. et al. (2017) studied the level of amino acid absorption of feed protein, as well as established the amino acid composition of proteins in the muscles and liver of brown and rainbow trout under the conditions of feeding specialized food feed company "Aller Aqua". In the study of the amino acid composition of the liver and muscles of brown and rainbow trout, it was found that the maximum value of essential amino acids is the share of leucine, lysine, tryptophan and phenylalanine, the results of our studies showed that the highest values were cystine + tryptophan + aspartic acid and glutamic acid + isoleucine, as well as lysine.

We also note that the study of the effect of Biomar feed (Knyazeva L. M. , 2007) on the physiological state of young trout that ate these feeds, showed that the biochemical parameters of the fish were within the norm typical for trout grown in industrial conditions. There were small deviations from the norm of liver and internal fat indices, as in our studies, which suggests the need to monitor the physiological state of fish. It should be noted that this is due to the intensive method of feeding, which is based on obtaining maximum weight gain of fish.

Regarding the efficiency of Aller Aqua feed, a study was conducted by Hasanov L. Sh. (2012), which showed that the use of feed by the Danish company Aller Aqua provided a lower feed rate, which provides rapid growth and higher average daily gain compared to other feed producers, which confirms our research.

**Conclusions**

In this paper, we analyzed the patterns of changes in the biochemical parameters of the tissues of salmon fish, on the example of rainbow trout, using different feeding schemes. At the present stage of development of fish farming, the technology of feeding fish provides for the optimal use of feed to obtain high fish productivity with the lowest cost of live weight gain.

The analysis and generalization of the obtained experimental materials reflect the relationship between the marketable qualities of rainbow trout and the feed

consumed. Fish consumed in combination with Aller Aqua and Biomar had the best marketability in terms of protein and amino acid composition of muscle tissue.

The use of intensive cultivation techniques aimed at accelerating the accumulation of trout muscle mass, puts a significant load on the liver of fish, contributing to the development of fatty degeneration, as evidenced by the gradual increase in triacylglycerols throughout the study period.

In order to establish the optimal content of amino acids in the diet of rainbow trout, studies were conducted to determine them in feed and subsequent deposition in muscle tissue. According to the analysis of the obtained studies, the deposition of such amino acids as cystine, tryptophan, leucine, isoleucine, lysine, as well as glutamic and aspartic acids is observed. The total content of amino acids was higher in the experimental group, which was fed by the method of combining feed, compared with the control.

Thus, the conducted experimental studies give grounds to claim that the nutritional value of Aller Aqua granulated feed for feeding of yearlings and marketable fish is much better, as well as the optimal use and relatively better performance in feeding young trout with Biomar feed, which was confirmed on the basis farms. Therefore, we can recommend such a mixed type of rainbow trout feeding as the most rational.

Tables and measurement units

Table 1

**Scheme of research and production experiment, n = 300**

| Experimental pools and feeding features | | |
|---|---|---|
| Young trout | | |
| 1-control | 2-experimental | 3-experimental |
| Granulated trout feed is made according to the standard 114-1 Ukr. | The granulated forage of Aller Aqua firm | The granulated forage of Biomar Inicio firm |
| This year | | |
| 1-control | 2-experimental | 3-experimental |
| Granulated trout feed is made according to the standard 114-1 Ukr. | The granulated forage of Aller Aqua firm | The granulated forage of Aller Aqua firm |
| Freight fish | | |
| 1-control | 2-experimental | 3-experimental |
| Granulated trout feed is made according to the standard 114-1 Ukr. | The granulated forage of Aller Aqua firm | The granulated forage of Aller Aqua firm |

Table 2

**Characteristic changes in the zoological length of fish, cm (M ± m, n = 10)**

| Pools | Experimental periods | | |
|---|---|---|---|
| | Start | Middle | End |
| Granulated trout feed is made according to the standard 114-1 Ukr. | 14,5±0,19 | 20,7±0,78 | 26,5±0,73 |
| 2-feed company Aller Aqua | 14,5±0,20 | 20,3±0,80 | 26,3±0,72 |
| 3-feed company Biomar + Aller Aqua | 14,6±0,20 | 21,8±0,80 | 27,7±0,70 |

Note: * - p <0.05, ** - p <0.01, *** - p <0.001

Table 3

**Productive length of the studied trout, cm (M ± m, n = 10)**

| Pools | Experimental periods | | |
|---|---|---|---|
| | Start | Start | Start |
| Granulated trout feed is made according to the standard 114-1 Ukr. | 12,3±0,16 | 18,4±0,92 | 24,2±0,95 |
| 2-feed company Aller Aqua | 12,8±0,14* | 18,3±0,90 | 24,0±1,03 |
| 3-feed company Biomar + Aller Aqua | 12,8±0,14* | 19,0±0,87 | 26,3±0,90 |

Note: * - p <0.05, ** - p <0.01, *** - p <0.001

Table 4

**Chemical composition of muscle tissue of the studied trout (M ± m, n = 10)**

| Swimming pools | Moisture,% | Dry matter,% | Dry matter content,% | | |
|---|---|---|---|---|---|
| | | | Crude protein | Crude fat | Crude ash |
| 1 | 70,33±0,07 | 29,67±0,07 | 16,27±0,05 | 12,5±0,4 | 0,9±0,05 |
| 2 | 69,62±0,06*** | 30,38±0,06*** | 16,63±0,07*** | 12,9±0,5 | 0,85±0,08 |
| 3 | 67,70±0,06*** | 32,30±0,09*** | 17,8±0,07*** | 13,7±0,5 | 0,8±0,06 |

Note: * - p <0.05, ** - p <0.01, *** - p <0.001

Table 5

**Amino acid composition of rainbow trout muscle tissue,% (M ± m, n = 5)**

| Amino acids | Placement of trout in pools | | |
|---|---|---|---|
| | 1-control | 2-experimental | 3-experimental |
| Arginine | 1,36±0,08 | 1,2±0,05 | 1±0,03** |
| Lysine | 1,90±0,07 | 2,00±0,05 | 2,02±0,05 |
| Tyrosine | 0,44±0,01 | 0,68±0,01*** | 1,03±0,02*** |
| Phenylalanine | 0,88±0,03 | 0,93±0,02 | 0,92±0,04 |
| Histidine | 0,18±0,07 | 0,30±0,03 | 0,60±0,04*** |
| Leucine + isoleucine | 1,13±0,08 | 2,42±0,01*** | 2,49±0,02*** |
| Methionine | 0,53±0,19 | 0,55±0,02 | 0,56±0,01 |
| Valine | 0,98±0,07 | 1,12±0,10 | 0,98±0,11 |
| Proline | 0,69±0,06 | 0,45±0,03** | 0,58±0,04 |
| Threonine | 1,06±0,01 | 0,98±0,05 | 0,81±0,06** |
| Serine | 0,97±0,02 | 0,73±0,02*** | 0,70±0,05 |
| Alanine | 1,37±0,12 | 1,39±0,18 | 1,30±0,09 |
| Glycine | 1,15±0,02 | 1,05±0,05 | 1,07±0,06 |
| Cystine + Tryptophan + Asparagine + Glutamine acids | 3,19±0,03 | 4,00±0,05*** | 4,30±0,07*** |
| Total | 15,83 | 17,8 | 18,36 |

Note: * - p <0.05, ** - p <0.01, *** - p <0.001

Table 6

**The content of lipids in the tissues of rainbow trout,% dry things. (M ± m, n = 5)**

| Indicators | Internal fat | | | Muscle tissue | | | Liver | | |
|---|---|---|---|---|---|---|---|---|---|
| | Placement of trout in pools | | | | | | | | |
| | 1 - control | 2-experimental | 3-experimental | 1 - control | 2-experimental | 3-experimental | 1 - control | 2-experimental | 3-experimental |
| Total lipids | 69,08±2,3 | 70,12±1,6 | 73,02±1,8 | 12,5±0,4 | 12,9±0,5 | 13,7±0,5 | 12,2±0,3 | 12,1±0,2 | 13.5±0,3* |
| Triacylglycerols | 45,7±2,3 | 46,5±2,2 | 48,6±2,2 | 6,61±0,4 | 6,82±0,4 | 7,25±0,5 | 1,2±0,3 | 1,3±0,3 | 1,9±0,4 |
| Phospholipids | 17,3±0,5 | 17,2±0,5 | 18,5±0,4 | 4,07±0,2 | 4,19±0,2 | 4,45±0,3 | 7,4±0,2 | 7,3±0,2 | 8,1±0,3 |
| Cholesterol | 3,79±0,2 | 4,07±0,3 | 3,78±0,2 | 1,36±0,02 | 1,40±0,03 | 1,48±0,02** | 1,43±0,10 | 1,55±0,04 | 1,42±0,10 |
| Cholesterol esters | 2,29±0,2 | 2,35±0,2 | 2,14±0,1 | 0,46±0,02 | 0,49±0,04 | 0,52±0,02 | 0,90±0,02 | 1,0±0,03* | 1,0±0,03* |

Примітка: * - p<0,05, ** - p<0,01, *** - p<0,001

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