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UDC 159.9.072.423; 612.2

RESOURCE APPROACH TO DETERMINING HUMAN RESOURCES IN MEDICAL ORGANIZATIONS

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Abstract

The subject of the study is the personnel policy in a medical institution, on the example of the State Medical Institution "Serov City Hospital", which uses certain resources to form its levels.

Goal on the basis of theoretical analysis, resource and system approach to personnel policy, study of the personnel policy of a medical organization, develop recommendations of an applied nature aimed at improving the personnel policy in a medical organization.

Methodology. The research is carried out: theoretical: analysis, classification, synthesis of scientific theoretical literature on the problem of research; empirical: analysis of documents related to the activities of the enterprise, comparison, psychological testing of the state of a number of mental and psychophysiological functions of medical workers in the professional environment.

Results. The definition of the "personnel policy" in a medical organization has been clarified, taking into account the system and resource approach. Recommendations have been developed for the implementation of the personnel policy in the Serov City Hospital during the period of organizational changes and the implementation of preventive measures to prevent the spread of COVID-19

Conclusions. The use of a systematic approach in the formation of personnel policy, taking into account the proposed levels of organizational-economic, socio-psychological (humanizing), legal, technical (5S, lean manufacturing, medical organization of a new type), training- teaching (mentoring) in combination and interrelation with the determining role of socio-economic factors allows us to solve the most important issues of the sustainable functioning of a medical institution during organizational changes and the implementation of preventive measures to prevent the spread of COVID-19.

Keywords: healthcare organization, resource approach, personnel policy, organizational psychology, organizational culture, personnel process management.

Introduction

Personnel policy as the basis of management processes in a medical organization, first of all, is due to the need for scientific study of the problem of determining the "personnel policy" in terms of organizational, socio-economic, psychological conditions for the development of organizational culture in a medical institution, in order to optimize the socio-psychological climate in modern conditions, taking into account the possibility of restrictive measures (as in the period of COVID – 19). Personnel policy, influencing the organizational and corporate culture of a medical institution, along with the material assets of a medical organization, makes a significant contribution to the economic viability of a medical organization.

The problem of personnel policy and the personnel management system of a medical and preventive institution in the context of the reform of Russian healthcare has been repeatedly studied in the works of Blokhin A. B.; Bobovich O. A.; Boyko Yu. P., Bordovskaya N. O. and others.

Materials and methods

The theoretical and methodological basis of the research is based on the fundamental provisions and principles of the main theories and concepts, social management, state and municipal management, sociology of organizations and processes, as well as economics, psychology, and pedagogy, which are of particular importance for studying the socio-psychological problems of the development and implementation of the personnel potential of the Serov City Hospital.

The study used interdisciplinary, systematic, comparative, and structural-functional approaches. Thus, the interdisciplinary approach allowed us to attract and use the results of fundamental and applied research to substantiate the theoretical positions and conclusions formulated in the article.

The systematic approach contributed to the consideration of the problem in the context of the emerging

new institution of local self-government, and also provided an opportunity to analyze the state and reveal the features of the personnel potential of the GAU.

Results and discussion

Our research at the Serov City Hospital has shown that the personnel policy cannot be a frozen formation, it changes along with organizational changes, with all Russian legislation and society, and depends largely on social challenges and the mass media. The personnel management system at the Serov City Hospital is undergoing radical transformations in our time. This is also due to the change in the training of personnel in educational institutions, we currently come mainly with only theoretical knowledge and "competencies", but completely lack the necessary practical skills in the professional medical field, as well as communication skills, psychological interaction with colleagues and patients in young specialists. Changing approaches to postgraduate education leads to an outflow of specialists with work experience of 30 years or more, most of them can not cope with modern loads, the digitalization of healthcare. The lack of involvement, the lack of readiness of the employees themselves for organizational changes, came into conflict with the requirements of the development of the production forces and labor resources of the organization [10-14].

As our research has shown, the role-based type of organizational culture prevails in the Serov City Hospital, which is characterized by a strict distribution of roles and functional responsibilities of employees and the specialization of departments (departments). The divisions of the Serov City Hospital act on the basis of strictly regulated systems of rules, norms, procedures and standards of activity, following which can contribute to the development of efficiency.

The basis of the personnel policy at the Serov City Hospital is personnel management. The study of literary sources, in the course of our research, showed that it is possible to find examples of different interpretations of the concept of personnel policy. In the works of foreign and domestic economists, many definitions of this concept are presented [15-23]

During the theoretical stage, the analysis, classification, synthesis of scientific literature was carried out and the definition of "personnel policy" for medical organizations was clarified (Table 1.).

Table 1

Definition of the concept of " Personnel policy»

Source of literature	Suggested wording
Galenko V. P. et al., 1994 [15]	HR policy is a complex of interrelated economic, organizational and socio-psychological methods that ensure the efficiency of labor activity and the competitiveness of the enterprise.
Shekshnya S. V., 2002 [16]	HR policy is the provision of the organization with the necessary number of employees performing the required production functions. The effectiveness of personnel management is determined by the degree of implementation of the overall goals of the organization.
Maslov E. V., 1999 [6]	Personnel policy is a complex of interrelated economic, organizational and socio-psychological methods that ensure the efficiency of labor activity and the competitiveness of enterprises.
Spivak V. A., 2000 [17]	HR policy is the science of managing the leading factor of production.
Graham, H. T., and Bennett, R., 2003 [18]	HR policy is a part of management that concerns working employees and their relationships within the company.
Ivantsevich J., Lobanov A. A., 2006 [19]	HR policy as an activity performed at enterprises that promotes the most effective use of people (employees) to achieve organizational and personal goals
Maklakov A. G., 2008 [20]	HR policy is a complex applied science of organizational and economic, administrative and managerial, technological, legal, group and personal factors, methods and methods of influencing the personnel of the enterprise to improve efficiency in achieving the goals of the organization
Chernavsky A. F., (2019) (27)	HR policy is a personnel management carried out taking into account the proposed levels of organizational and economic, socio-psychological (humanizing), legal, technical (5S, lean manufacturing, medical organization of a new type), training and pedagogical (mentoring) in combination and interrelation with the determining role of socio-economic factors of the surrounding society.

The basis of the personnel policy in the Serov City Hospital is resources: finance, technology, information, people. Currently, scientific research conducted in our country and abroad has shown that the main, and often critical for the implementation of the tasks facing practical health care resources are people, human capital. This was especially evident when restrictive measures were taken during the new coronavirus infection COVID 19 [24, 25, 26].

In the course of the study, we combined two concepts, organizational and economic, into one level, since they are inextricably linked. The experience of working in the system of "Lean production" and "new model of medical organization" has shown that no organizational changes in a medical organization can be successful without an economic justification [27, 28].

One of the important problems that came to the fore in the State Medical Institution "Serov City Hospital" in 2020-2021 was professional stress, which occurs as a multi-faceted phenomenon, manifested in the form of emotional burnout, followed by a transition to the level of psychological, somatic reactions of the body and social phenomena, first to difficult situations in the activities of a medical organization, and then to any

stimuli. The impact of occupational stress on the social determinants of health and the quality of life of the patient and the staff of the medical organization is an urgent problem that should be addressed to improve the quality of life of the staff of the medical organization [29, 30, 31].

From the point of view of personnel management, medical institutions are among the most complex types of institutions, since they must not only diagnose and treat patients, solve administrative and economic tasks, meet various fire safety standards and sanitary and epidemiological requirements, but also provide comfortable conditions for patients, staff and medical workers, which cannot be solved only by lean production methods [32, 33]. When making interior solutions in medical offices, it is necessary to take into account not only the ergonomics of the working area, which offers lean manufacturing, but also psychological comfort for medical workers, which is successfully implemented in the trauma department of the Serov City Hospital. Let's list the areas of our activity when conducting the research:

From our point of view, humanizing is a concept aimed at reducing anxiety, stress and psychological discomfort in patients both from their stay in a medical institution and from the treatment process. It is necessary to understand from the staff of the medical organization that the quality of treatment and the quality of life of the patient depends, first of all, on the best adaptation to the conditions of the hospital and the patient's understanding of the treatment prescribed to him.

The legal level of personnel policy is fundamental in the activities of a medical organization and in relationships, both within the team and with the surrounding society. The relevance of knowledge in the field of medical law in the implementation of personnel policy is now particularly high-laws impose new requirements on participants in the process of providing medical care, and, often, these requirements lie outside the plane of medical knowledge. Therefore, even ordinary personnel and medical workers should, if not thoroughly master the subtleties of a particular regulatory document, then at least know in which document to look for this or that information. Experience shows that when trying to independently study the basics of medical law, important points set out in the so-called bylaws may be missed. In order to avoid such mistakes, we have carried out a classification of normative legal acts regulating the work of the State Medical Institution "Serov City Hospital".

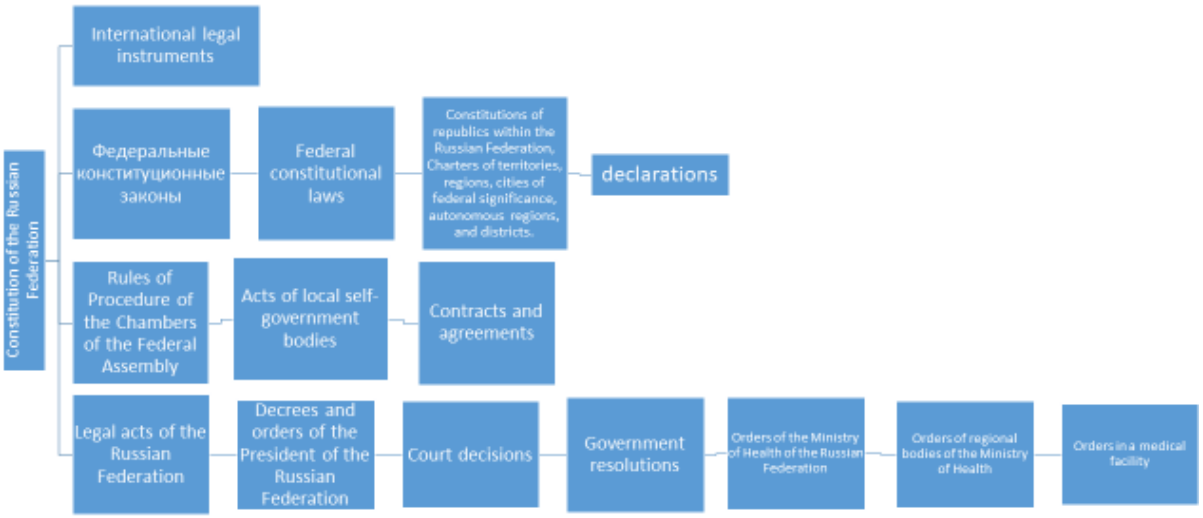

Figure 1. Hierarchy of sources of law in medicine

As can be seen from Figure 1, the legal level is difficult for the staff of the GAGH SR "Serovskaya City Hospital" to perceive, and working with the legal component requires special knowledge. The task of the personnel policy is to acquaint the staff and medical workers with the main requirements of the legislation, to provide regulatory and legal support for the work of the institution and legal support for medical activities.

The technical level of the personnel policy of the Serov City Hospital is a set of measures aimed at ensuring the safe and effective operation of medical and non-medical equipment and products. Regulatory and engineering support at all stages of the life cycle, from deliveries to decommissioning and disposal. Organization of processes in a medical institution with the use of TRM systems, visual management, standard operating processes(SOP, SOK), mapping, built-in quality, organization of places 5S (system of organization and rationalization of the workplace), kaizen (system of interrelated actions that lead to an increase in the quality of the organization's management process), Kanban (production and supply management systems). We will not dwell on this direction, it has been sufficiently studied, and the effectiveness of using these technologies in a medical organization has been proven [34, 35, 36].

For 2020-2021, the Serov City Hospital has developed a complex of interactive educational classes based

on information and telecommunications technologies, including video lectures, webinars, distance learning courses, placement of educational materials on Web sites, data exchange between tutors and trainees by e-mail, and remote testing.

Among the socio-economic factors in our study, we included: the state of living conditions for providing medical care (availability of hot water), the quality of medical care ("the number of doctors"), the level of social tension ("job satisfaction"), the level of demographic burden ("the share of pensioners"). Socio-economic factors allow us to solve the most important issues of the sustainable functioning of a medical institution in the period of organizational changes and restrictive measures.

Based on the data obtained in our study, the structure of the personnel policy in the State Medical Institution "Serov City Hospital" was formed (Fig. 2).

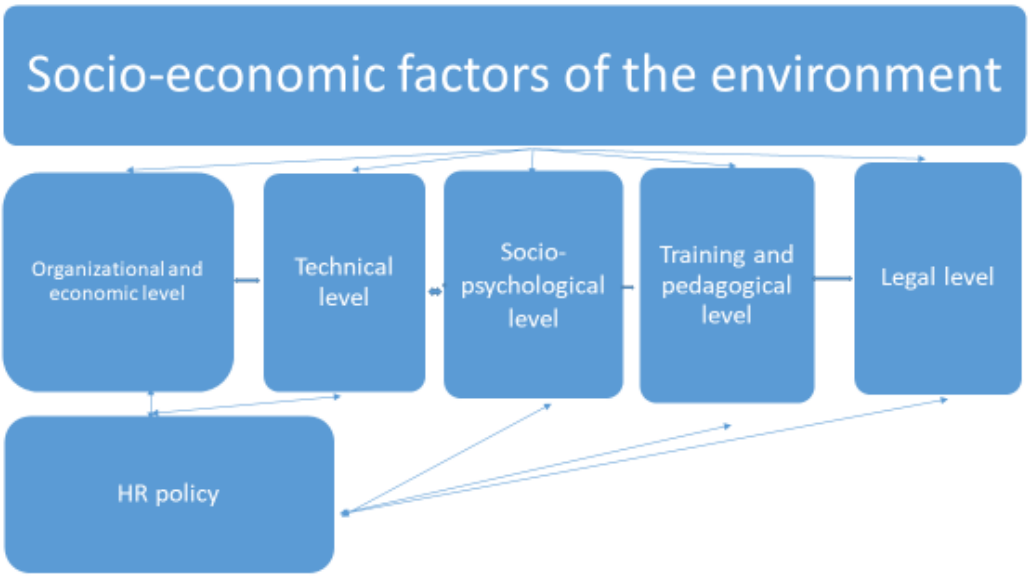

Fig. 2. Personnel policy of GAGH SR "Serov City Hospital".

Taking into account the results obtained during the socio-psychological study of the personnel situation of the State Medical Institution "Serov City Hospital", the following recommendations are proposed:

1. It is necessary to combine the tools of preventive and active policy in personnel management.
2. To conduct continuous monitoring of the situation with the preparation of forecasts for the development of the situation, starting from the level of heads of departments, in various divisions of the Serov City Hospital.
3. In accordance with the changes in society, to form the strategic objectives of the work of the GAGH SR "Serov City Hospital".
4. Timely and complete informing of employees about the tasks and directions of the principles of interaction with the team, receiving feedback.
5. At least once a quarter to analyze the available material resources that can be focused on the implementation of the goals of the personnel management system.
6. To test the methods of financial allocation and incentive procedures for employees before implementing them in a separate department.
7. At least once a half-year to conduct training of personnel in order to improve the level of competence.
8. Conduct a study of the compliance of the planned measures of the personnel policy with the main directions of the organization's development, identify problem areas and assess the potential of human resources at least once a half-year.

The main directions of the personnel policy, taking into account the recommendations based on the results of our research in the State Medical Institution SB "Serovskaya City Hospital", were:

1. elimination of duplication of functions between departments;
2. reallocation of functions within the divisions of the institution and between divisions during the period of restrictive measures;
3. transformation of the structure of medical personnel in the period of restrictive measures;
4. strengthening the position of secondary medical personnel at all levels of medical care;
5. modernization of workplaces, improvement of technical equipment and labor safety.
6. training and pedagogical training of medical and non-medical personnel in the conditions of restrictive measures during the COVID-19 period, training of legal literacy of employees, both in the professional and economic sphere.

Conclusions:

1. The personnel policy of a medical organization is a complex, multi-level phenomenon related to a socio-psychological phenomenon. HR policy affects the organization of the space of social interactions within the organization between its management, staff and the external environment. The nature of these interactions and their effectiveness depend on the content and structure of the value system, which serves as the ideological basis of the personnel policy of the medical institution.

The personnel policy is designed to ensure the adaptation of the medical organization to the requirements of the social environment and to increase the integration of elements within the system.

2. Our research at the Serov City Hospital has proved that the personnel policy in the medical institution provides continuous training and development of medical and non-medical personnel based on the use of new methods and technologies, and actively uses training and pedagogical training in its work.

3.The development of a "transparent" motivation system is important in the management of human resources of the Serov City Hospital. Staff motivation, financial and moral incentives allow managers to keep the staff of their institution in the most difficult moments.

4. The ultimate goal of the personnel policy in the Serov City Hospital was to meet the current and expected needs of medical and non-medical employees of the medical organization, the population in medical care, taking into account the climatic and geographical features of certain territories, the demographic situation, the needs of society to improve health, the financial availability of medical care and the completeness of coverage of different strata and groups of the population with medical measures.

Our definition: "Personnel policy is a personnel management carried out taking into account the levels of organizational and economic, socio-psychological (humanizing), legal, technical (5S, lean manufacturing, medical organization of a new type), training and pedagogical (mentoring) in combination and interrelation with the determining role of socio-economic factors of the surrounding society" is justified.

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SOME DATA RELATED TO SMOKING, ACCORDING TO A SURVEYOF FEMALE UNIVERSITY STUDENTS

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НЕКОТОРЫЕ ДАННЫЕ, КАСАЮЩИЕСЯ КУРЕНИЯ, СОГЛАСНО ДАННЫМ АНКЕТИРОВАНИЯ СТУДЕНТОК УНИВЕРСИТЕТА

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Abstract

According to the WHO, an average of 6 million people die each year from the effects of smoking. Most people understand that tobacco is a fast-acting drug that travels to the brain in 7 seconds and affects neurotransmitters. Tobacco smoke contains over 5,000 chemical compounds, of which more than 70 are known to be carcinogenic. One of the many harmful effects is the effect on the female body. We conducted a survey of female students of the Medical University 1-6 years of study on the subject of smoking and the state of their reproductive health. In the process of questioning, we find out how many female students are exposed to smoking.

Аннотация

По данным ВОЗ, 6 млн. человек в среднем каждый год умирают от последствий курения. Большинство людей понимают, что табак это быстродействующий наркотик, который за 7 секунд поступает в мозг и влияет на нейромедиаторы. В табачном дыме содержится свыше 5 000 химических соединений, известно, что из них более 70 соединений канцерогенны. Одним из многочисленных пагубных воздействий является воздействие на женский организм Нами было проведено анкетирование студенток 1-6 курсов медицинского университета на предмет курения и состояния их репродуктивного здоровья. В процессе анкетирования мы выясняем, сколько студенток подвержены курению.

Keywords: smoking, female university students, women's reproductive health.
Ключевые слова: курение, студентки вузов, репродуктивное здоровье женщин.

Репродуктивное здоровье женщин зависит, в основном, от двух групп факторов: 1) состоянии женской половой системы; 2) общего здоровья женщины. Эти факторы взаимозависимы, т. е. приверженность женщины здоровому образу жизни способствует и сохранению гинекологического здоровья. Важную роль в сохранении репродуктивного здоровья, как свидетельствуют данные литературы, играет отказ от вредных привычек, в частности, от табакокурения. На основании оригинальной анкеты, стоящей из 22 вопросов, в декабре 2020 г проведен опрос 115 студенток 1-6 курсов Гродненского государственного медицинского университета. Возраст 17-20 лет: 81.8 %; 21-23 года: 16.4%; старше 23 лет: 2.7%. Выяснялось распространенность и интенсивность курения среди студенток. Результаты: на вопрос о курении утвердительно ответили 16. 4%. Отрицали курение 83.6%. Курящие девушки потребляли ежедневно от 1-5 сигарет в день (36,8%); 6-10 сигарет (36,8%); 11-15 сигарет (15,8%); 16-20 сигарет (5,3%); вейп (5,3%). Стаж курения: до 1 года (5,88%); 1-2 года (23,6%); 3-4 года (23,6%); 5-6 лет (17,6:%); 7 лет (5,88%); 10 лет (11,77%). Выводы:1. Согласно анкетированию, курит малый процент девушек – студенток. 2. Выявленный анкетированием малый процент курящих вряд ли отражает реальность, т. к. противоречит данным литературы о распространённости курения среди студенческой молодёжи. Вероятно, он отражает боязнь осуждения курящих девушек (стигматизации).

Опрос

1.Ваш возраст?

a) 17-20
b) 21-23
c) 23 и выше

2. Какое образование получаете?

a) Высшее медицинское
b) Высшее
c) Среднее специальное

3. Курите ли вы?

a) Да
b) нет

4. Если да, то сколько сигарет в день?

5. Сколько лет вы курите?

6. Живете ли вы половой жизнью?

a) Да
b) Нет

7. Планируете ли иметь детей в дальнейшем?

a) Да
b) Нет
c) Не определилась

8. Пользовались ли вы когда-либо аральными контрацептивами ?

a) Да
b) Нет

9. С какого возраста вы прибегли к контрацепции?

a) Не использую
b) С …

10. Какие методы контрацепции вы используете?

a) Противозачаточные таблетки
b) Внутриматочные спирали
c) Внутриматочные гормональные системы (мирена, левонова)
d) Презервативы
e) Химические средства
f) Биологические методы (температурный, календарный, прерванный половой акт)
g) Гормональные пластыри
h) Иньекции\импланты
i) Другие методы

11. Страдаете ли вы гинекологическими заболеваниями?

a) Нет
b) Воспаление яичников
c) Эндометриоз
d) Киста яичников
e) Внематочная беременность
f) Поликистоз яичников
g) Миома матки
h) Нарушения менструального цикла
i) Бесплодие
j) Другие (название) …

12. Достаточно ли вам информации по применению различных контрацептических средств в СМИ?

a) Да
b) Нет

13. Какие источники информации о контрацептических средствах вы считаетет наиболее оптимальными?

a) Беседа врача
b) Информация фармацевта
c) Специальная литература
d) Средства массовой информации
e) Интернет
f) Друзья и знакомые
g) Другие (какие?) …

14.Какие контрацептические средства вы считаете наиболее важными?

a) Форма выпуска и упаковка
b) Способ применения
c) Простота использованияч
d) Побочные действия и противопоказания
e) Условия применения (необходима врачебная помощь или можно использовать самостоятельно)
f) Цена
g) Высокая надежность

15. Пользовались ли вы экстренной контрацепцией?
a) Да, как часто (однократно, постоянно)
b) Нет

16. Как часто вы пользовались этими препаратами?
a) Однократно
b) Более 1 раза
c) Не пользовалась

17. Как вы узнали о посткоетальной контрацепции?
a) Из интернета
b) Сказали знакомые или друзья
c) Посоветовал врач
d) Из средств массовой информации
e) Вообще не слышал о таком методе

18. Возникала ли аллергическая реакция после приема препарата?
a) Да
b) Нет

19. Если возникала аллергия, то на какие препараты?

20. Приходилось ли вам, после приема посткаетальных препаратов посещать гинеколога?
a) Да
b) Нет

21. Какие побочные эффекты вызывали у вас экстренные посткаетальные прпараты?
a) Не применяла их
b) Аллергическая реакция (виде чего?) …
c) Тошнота
d) Рвота
e) Диарея
f) Слабость
g) Головокружение и головные боли
h) Тянущие боли внизу живота

22. Перечислите препараты применяемые вами и что повлияло на выбор этих препаратов?

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PHARMACEUTICAL SCIENCES

THE ATTITUDE OF UNIVERSITY FEMALE STUDENTS TO CONTRACEPTION IN GENERAL AND ITS METHODS ACCORDING TO THE SURVEY OF UNIVERSITY FEMALE STUDENTS

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ОТНОШЕНИЕ СТУДЕНТОК УНИВЕРСИТЕТА К КОНТРАЦЕПЦИИ В ЦЕЛОМ И ЕЁ МЕТОДАМ ПО ДАННЫМ АНКЕТИРОВАНИЯ СТУДЕНТОК УНИВЕРСИТЕТА

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Abstract
The article contains discusses the issues of use and the degree of awareness of female students of a medical university about contraception. A survey was conducted among female students of 1-6 year of study on the use of postcoital and hormonal contraceptives, as well as on the use of other methods of contraception. The use of modern methods of preventing unwanted pregnancies reduces the frequency of abortions, which is the key to reducing the occurrence of gynecological diseases at the age of 17-23 years.

Аннотация
В статье рассматриваются вопросы использования и степень информированности студенток медицинского университета о контрацепции. Было проведено анкетирование среди 1-6 курсов на предмет использования посткоитальных и гормональных контрацептивов, а также по поводу применения других способов предохранения. Применение современных методов предохранения от нежелательной беременности снижает частоту абортов, что является залогом снижения возникновения гинекологических заболеваний в возрасте 17-23 лет.

Keywords: women's reproductive health, female students, sexual experience.
Ключевые слова: репродуктивное здоровье женщин, студентки, сексуальный опыт

Репродуктивное здоровье женщин зависит, в основном, от двух групп факторов: 1) состоянии женской половой системы; 2) общего здоровья женщины. Надлежащая контрацепция прямым образом связана с репродуктивным здоровьем. Цель исследования: выяснить отношение студенток университета к контрацепции в целом и её методам.

На основании оригинальной анкеты, стоящей из 22 вопросов, в декабре 2020 г проведен опрос 115 студенток 1-6 курсов Гродненского государственного медицинского университета. Возраст 17-20 лет: 81.8 %; 21-23 года: 16.4%; старше 23 лет: 2.7%. Выяснилось отношение студенток университета к контрацепции в целом и её методам. Результаты: На вопрос об опыте половой жизни утвердительно ответили 62.4% опрошенных. Детей планируют когда-нибудь иметь 76.9% , не определились 13.9%. Оральные контрацептивы (ОК) использовали 16.7%. Возраст начала использования контрацепции варьировал: 14 лет (2,22%); 16-17 лет (35,5%); 18-19 лет (37,7%); 20-21 (20,14%); 22- 26 (4,44%). Использовались следующие методы контрацепции: презервативы (81.4%); биологический или календарный метод (24.4%); прерванный половой акт (16.3%); ОК (4.7%); внутриматочные спирали (1.2%). Посткоитальной контрацепцией (экстренной контрацепцией) пользовались 15.4%. Эти препараты (Постинор, Эскапел) использовали только однажды 10.8% девушек, более 1 раза – 5.9%; не пользовались 83.3%. Выводы: 1. Механический способ контрацепции (презервативы) предсказуемо занимают первое место по популярности среди методов предохранения от беременности. 2. Почти половина студенток использует ненадёжные методы контрацепции (календарный метод и прерванный

половой акт). 3. Большинство девушек не пользуются посткоитальной контрацепцией. 4. Число девушек, использующих наиболее надёжный метод контрацепции – комбинированные ОК мал. 5. Целесообразны меры направленные на повышение информированности студенток о надёжных методах контрацепции, что позволит повысить уровень репродуктивного здоровья.

Опрос

1.Ваш возраст?

d) 17-20
e) 21-23
f) 23 и выше

2. Какое образование получаете?

d) Высшее медицинское
e) Высшее
f) Среднее специальное

3. Курите ли вы?

c) Да
d) нет

4. Если да, то сколько сигарет в день?

5. Сколько лет вы курите?

6. Живете ли вы половой жизнью?

c) Да
d) Нет

7. Планируете ли иметь детей в дальнейшем?

d) Да
e) Нет
f) Не определилась

8. Пользовались ли вы когда-либо аральными контрацептивами ?

c) Да
d) Нет

9. С какого возраста вы прибегли к контрацепции?

c) Не использую
d) С …

10. Какие методы контрацепции вы используете?

j) Противозачаточные таблетки
k) Внутриматочные спирали
l) Внутриматочные гормональные системы (мирена, левонова)
m) Презервативы
n) Химические средства
o) Биологические методы (температурный, календарный, прерванный половой акт)
p) Гормональные пластыри
q) Иньекции\импланты
r) Другие методы

11. Страдаете ли вы гинекологическими заболеваниями?

k) Нет
l) Воспаление яичников
m) Эндометриоз
n) Киста яичников
o) Внематочная беременность
p) Поликистоз яичников
q) Миома матки
r) Нарушения менструального цикла
s) Бесплодие
t) Другие (название) …

12. Достаточно ли вам информации по применению различных контрацептических средств в СМИ?

c) Да
d) Нет

13. Какие источники информации о контрацептических средствах вы считаетет наиболее оптимальными?

h) Беседа врача
i) Информация фармацевта
j) Специальная литература
k) Средства массовой информации
l) Интернет
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14.Какие контрацептические средства вы считаете наиболее важными?

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i) Способ применения
j) Простота использованияч
k) Побочные действия и противопоказания
l) Условия применения (необходима врачебная помощь или можно использовать самостоятельно)
m) Цена
n) Высокая надежность

115. Пользовались ли вы экстренной контрацепцией?

c) Да, как часто (однократно, постоянно)
d) Нет

16. Как часто вы пользовались этими препаратами?

d) Однократно
e) Более 1 раза
f) Не пользовалась

17. Как вы узнали о посткоетальной контрацепции?

f) Из интернета
g) Сказали знакомые или друзья
h) Посоветовал врач
i) Из средств массовой информации
j) Вообще не слышал о таком методе

18. Возникала ли аллергическая реакция после приема препарата?

c) Да
d) Нет

19. Если возникала аллергия, то на какие препараты?

20. Приходилось ли вам, после приема посткаетальных препаратов посещать гинеколога ?

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d) Нет

21. Какие побочные эффекты вызывали у вас экстренные посткаетальные прпараты?

i) Не применяла их
j) Аллергическая реакция (виде чего?) …
k) Тошнота
l) Рвота
m) Диарея
n) Слабость
o) Головокружение и головные боли
p) Тянущие боли внизу живота

22. Перечислите препараты применяемые вами и что повлияло на выбор этих препаратов?

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PHYSICAL SCIENCES

ANTIPODES IN SPACE [1]

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Abstract
The article shows that the special theory of relativity (STR) created in the last century was based on postulates due to the lack of the required experimental information and turned out to be incorrect, as its principle of light speed non-exceedance was refuted by studies of special processes in linear electric circuits in the 21st century. Therefore, an alternative version of the STR has been proposed. Its relativistic formulas imply the existence of numerous mutually invisible parallel universes and antiverses. It is explained how they can be seen. And in these antiverses are antimatter, as well as anti-space and anti-time.

Keywords: Imaginary numbers, Special theory of relativity, Invisible universes, Multiverse, Hyperverse, Antimatter, Anti-space, Anti-time

1. Introduction

In 1826, when Georg Simon Ohm discovered the law named after him, the science of physics did not yet exist. There was a natural philosophy. Alexander Grigorievich Stoletov wrote in this regard: "...physics especially tempted natural philosophers. What a favorable theme were electrical phenomena for the most riotous imaginations... Attractive and vague deductions were in the foreground: hard work of experimenter and exact mathematical analysis were not honored; they seemed superfluous and harmful in the study of nature...". And in 1828, Ohm was fired by personal order of Minister of Education for publishing his physics discoveries. The senior official believed that the use of mathematics in physics was unacceptable.

In 1897, Charles Proteus Steinmetz proposed his interpretation of Ohm's law in respect to linear AC circuits [1]. Now it is daily used by millions of engineers in their practice. Moreover, in addition to its direct purpose of calculating electrical circuits it also proved physical reality of imaginary numbers in the simplest and most convincing way, and thereby refuted generally accepted version of the special theory of relativity (STR).

However, the STR had to be first created and then refuted. And such a version of the STR was created by efforts of Joseph Larmor [2], Nobel laureate Hendrik Antoon Lorentz [3], Jules Henri Poincaré [4] and Nobel laureate Albert Einstein [5] in the 20th century. Due to the lack of experimental data required for its creation, that were obtained only in the 21st century, it was created using the postulates, i.e. assumptions from which the principle of light speed non-exceedance turned out to be incorrect.

But that's not a big deal. Ultimately, all scientific theories are created as a result of identifying and correcting the errors of previously created theories. And then, sooner or later, they are inevitably refuted by subsequent newer theories. Otherwise, science would not have developed. Therefore, this article further proposes a corrected version of the STR.

2. Refutation of the principle of light speed non-exceedance

Since the principle of light speed non-exceedance in the generally accepted version of the STR, set forth in all university and school textbooks of physics, has still been believed to be true, it will be necessary to explain why this is not so and why this principle, which is just a postulate, since it has never been proven by anyone, turned out to be in demand.

That is because the relativistic formulas obtained in the generally accepted version of the STR couldn't be explained by its creators. For example, the relativistic mass m, apparently, takes imaginary values at hyper-light speeds, when $v > c$, in the Lorentz-Einstein formula

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \qquad (1)$$

where m_0 is the rest mass of a moving physical body (e.g. elementary particle);

m is the relativistic mass of a moving physical body;

v is the velocity of a physical body;

c is the speed of light.

However, the authors of the STR did not know how to explain such a result. As well as no one could explain physical meaning of imaginary numbers 400 years before them. Admittedly, today no one can do it so far. Indeed, everyone knows what 2 kg is, but, no one knows what 2 i kg is, where $i = \sqrt{-1}$.

[1] This is an extended version of the article "Antonov A.A. 2021 Antimatter, anti-space, anti-time. Journal of Modern Physics. 12(5). 646-660".

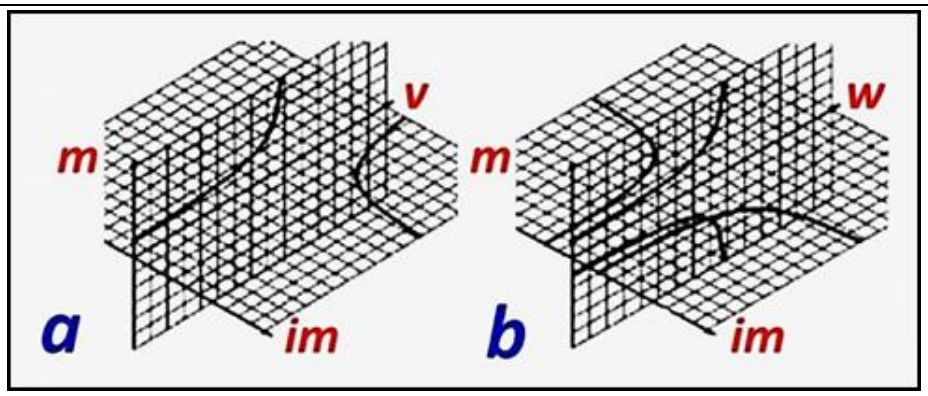

Figure 1. Graphs of functions (1) and (2)

Even if the relativistic mass $\boldsymbol{m}$ at hyper-light speeds, when $\boldsymbol{v > c}$, in function (1) corresponded to real numbers, then its graph would still be inexplicable in this velocity range (see Figure1a), since it corresponds to a physically unstable process that cannot exist in nature. Consequently, formula (1) is incorrect and that is why it could not be explained.

After all, physical reality of imaginary numbers has been proven and explained in publications [6] - [21]. In order not to repeat these proofs, we only note that it follows from them that if the principle of light speed non-exceedance were true:

- no shock oscillations such as tsunami, Indian summer, noise of bells, piano music could exist in nature, and even a kid's swing couldn't swing after being pushed by parents;
- there could be no resonance in electric circuits, as well as no electric filters could exist; and thus, there would be neither television, nor telecommunication, nor radiolocation, nor many other things without which modern life would be unthinkable;
- even Ohm's law in Steinmetz's interpretation would not exist.

Since, in accordance with Ohm's law in Steinmetz's interpretation, inductive and capacitive reactances the values of which are imaginary numbers, are measured by the devices available in each radio engineering laboratory, this unambiguously proves their physical reality. After all, it is exactly the ability to register with devices X-ray, radioactive, ultraviolet and infrared radiation, infra and ultrasound, magnetic field, atoms and subatomic particles, as well as many other physical entities that are not registered by the human senses, proves their physical reality. Why, then, a simple and cheap experiment using an ordinary tester (see Figure 2), in physics is less convincing in solving the problem of proving physical reality of imaginary numbers than the unique expensive OPERA and ICARUS experiments at the Large Hadron Collider?

In fact, since mathematics is the unique universal language of all exact sciences, the correct mathematical interpretation of, let's say, radio engineering and any other experiment is indisputably convincing for all other exact sciences. After all, the Nature is unique, and only people, solely because of their barrenness of intellect, invented many sciences to describe it.

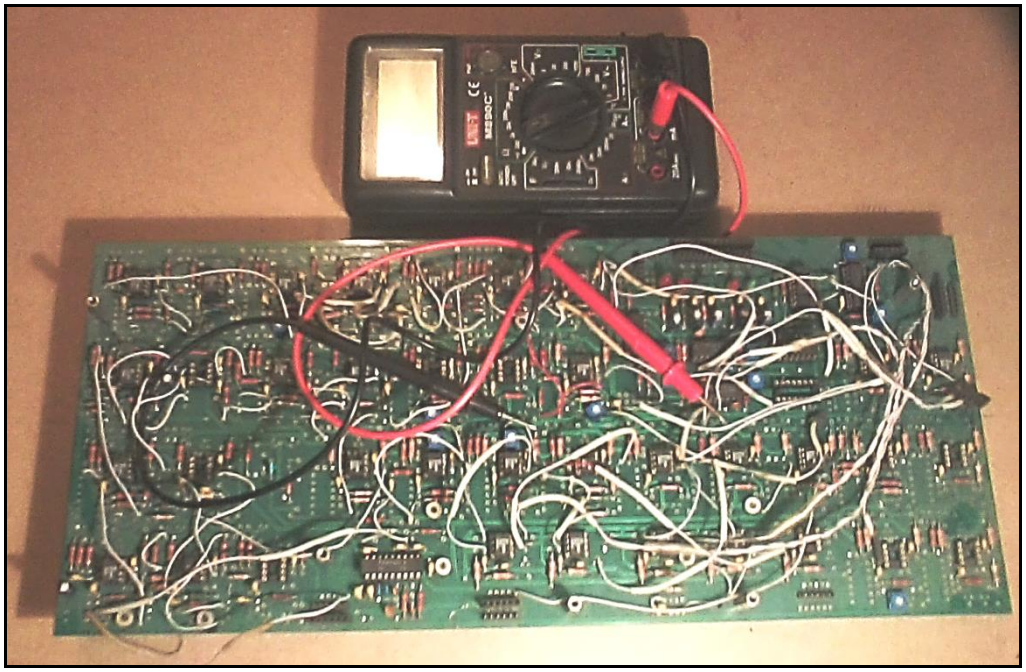

Figure 2. And this is all that is needed instead of the Large Hadron Collider for the experimental proof of the physical reality of imaginary numbers.

Due to experimental proof of the principle of physical reality of imaginary numbers in the STR, the principle of light speed non-exceedance is no longer required and there is a need for corrected relativistic formulas that allow explaining STR at speeds $v > c$.

3. Relativistic formulas of the corrected version of the STR

How can corrected relativistic formulas be obtained? Different approaches can, actually, be proposed to solve this issue. And one can reason as follows [22]. The graph of the corrected Lorentz-Einstein function in the range of velocities , must in some respect be similar to the graph of this function in the range of velocities . For example, as in Figure 1b. A simple and understandable analytical description can be offered for such a graph

$$m = \frac{m_0 (i)^q}{\sqrt{1-(v/c - q)^2}} = \frac{m_0 (i)^q}{\sqrt{1-(w/c)^2}} \quad (2)$$

where $q = \left\lfloor v/c \right\rfloor$ is the 'floor' function of argument v/c in discreet mathematics (see Figure 3a);

$w = v - qc$ is the local velocity (see Figure 3b), the meaning of which will be explained below.

Other relativistic formulas can be corrected in a similar manner.

4. Explanation of relativistic formulas of the corrected version of the STR

A simple explanation can be proposed for the simple formula (2). The quantity $q = 0$ obviously corresponds to our visible universe, which is assumed to be the one and the only in the existing version of the STR. However, this version turned out to be incorrect, as its principle of light speed non-exceedance had been refuted.

Therefore, the quantity $q = 1$ corresponds to another really existing universe, for which $v = w + 1c$ follows from $w = v - 1c$, i.e. we get $c \le v < 2c$ for $0 \le w < c$. In other words, another adjacent universe is beyond the event horizon and therefore is invisible to us. Therefore, let it for definiteness be called a tachyon universe, like subatomic particles possessing superluminal speed. Herewith, we get $m = m_0 i$ for a tachyon universe from the formula (2).

By a similar argument let our visible universe be called a tardyon universe. For our tardyon universe $m = m_0$.

Subsequently, the quantity $q = 2$ corresponds to one more really existing universe, for which $v = w + 2c$ follows from $w = v - 2c$, i.e. we get $2c \le v < 3c$ for $0 \le w < c$. Consequently, this one more universe is also beyond the event horizon and therefore is also invisible to us. It is also invisible to the adjacent universe that is closer to us. Herewith, we get $m = -m_0$ for this universe from the formula (2). That is, this universe can be called an antiverse in relation to our universe.

The quantity $q = 3$ corresponds to one more really existing universe, for which $v = w + 3c$ follows from $w = v - 3c$, i.e. we get $3c \le v < 4c$ for $0 \le w < c$. Consequently, this universe is also beyond the event horizon and therefore is also invisible to us and to other universes. We get $m = -im_0$ for this universe from the formula (2). And therefore let it be called a tachyon antiverse. Etc.

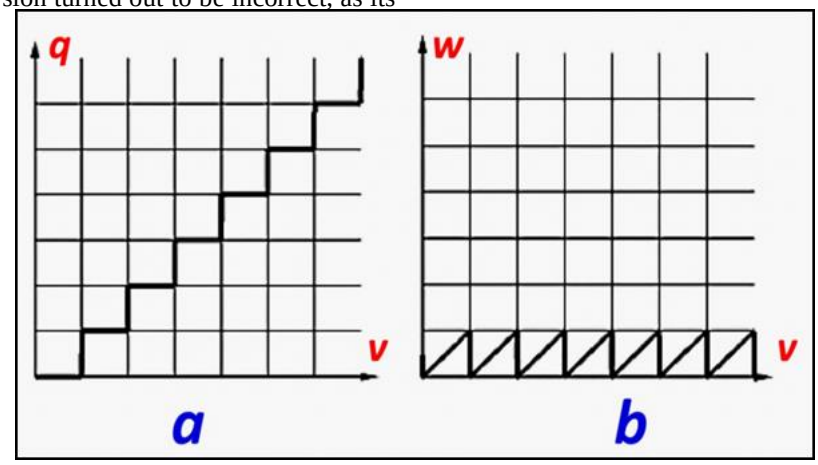

Figure 3. Graphs of functions $q(v)$ *and* $w(v)$

Hence, it turns out that we live in the Multiverse containing a plenty of mutually invisible universes, rather than in a unique visible universe as asserted in the generally accepted version of the STR. Let this Multiverse be called a hidden Multiverse [23] - [27].

5. Dark matter, dark energy, dark space

Many interesting hypotheses of the Multiverse have been proposed by now [28] - [35]. However, they all are unverifiable, i.e. their truth or falsity can be proven experimentally neither now nor in the distant future. Therefore, they are of limited interest. Another drawback is the fact that they do not anyhow explain extremely incomprehensible phenomena of dark matter and dark energy [36] - [48].

Such extreme incomprehensibility refers also to the hypothesis of the visible Monoverse in the generally accepted version of the STR, about which Albert Einstein spoke very clearly: "Insanity: doing the same thing over and over again and expecting different results"

However, the phenomena of dark matter and dark energy can be quite explicable within the framework of the hypothesis of the hidden Multiverse. Besides the

phenomenon of dark space can also be discovered and explained:

- invisibility of dark matter and dark energy is explained by the fact that they are actually neither matter, nor energy, nor any other material physical substance, but only images (though not optical and still less electromagnetic, but gravitational), a sort of a shadow;
- impossibility of detecting any of the chemical elements known to us in the composition of dark matter and dark energy is also explained by the absence of any material content in them, since they are just images;
- at the same time the phenomenon of dark matter is evoked by invisible parallel[2] universes of the hidden Multiverse adjacent to our visible universe;
- the phenomenon of dark energy is evoked by other universes except for our visible universe and invisible parallel universes of the hidden Multiverse adjacent to it;
- in addition, the phenomenon of dark space is similarly evoked by invisible universes outside the hidden Multiverse;
- universes located in and beyond the hidden Multiverse together form the Hyperverse.

6. Analysis of WMAP and Planck spacecraft data

However Albert Einstein did not exclude such correction of the STR in future. He wrote: "No single idea, which I would be sure that it will stand the test of time". And he was absolutely right. After all, if this were not so, then the development of science would be impossible.

An example of the structure of such a hypothetical hidden Multiverse is shown in Figure 4. As can be seen, the universes drifting in the extra spatial dimension are interconnected through portals

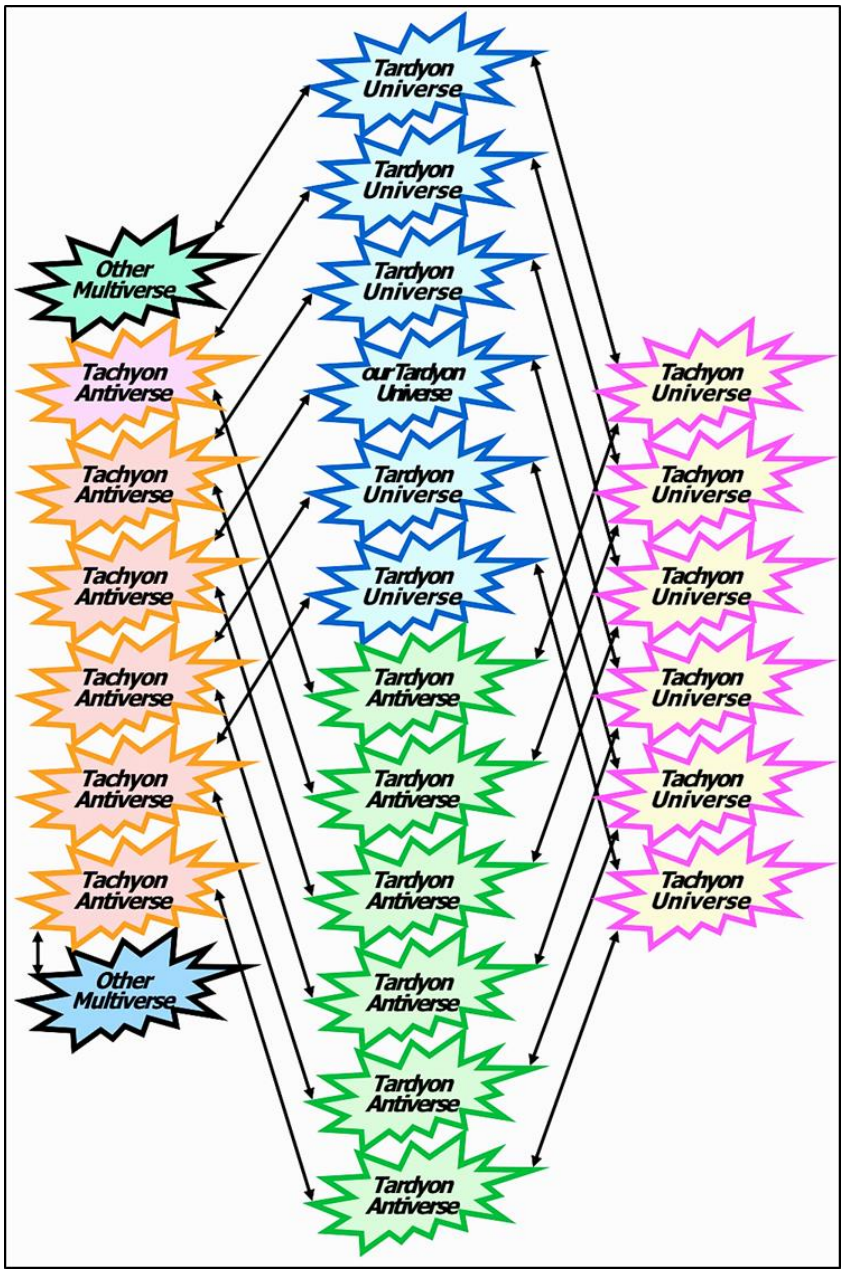

Figure 4. The screw structure of the hidden Multiverse corresponding to the formula (2), which illustrates the existence of other Multiverse beyond its borders

[2] *Since, despite their infinity, these universes do not intersect anywhere*

[49], [50] indicated by single two-sided arrows. The portals arise due to shallow mutual local penetration of the universes into each other. Moreover, the end universes in such a helical structure, evoking the phenomena of dark matter and dark energy, are connected with the universes of dark space.

In order not to repeat the mistake of Albert Einstein due to erroneous assumptions, it is useful to check these results for compliance with the data obtained in the 21st century by the WMAP [51] and Planck [52] spacecraft. According to the WMAP data, the entire universe (in fact, the entire hidden Multiverse, as suggested in the article) is 4.6% of baryonic matter, 22.4% of dark matter and 73.0% of dark energy. According to more recent Planck data, the entire universe (in fact, the entire hidden Multiverse) is 4.9% of baryonic matter, 26.8% of dark matter and 68.3% of dark energy.

Based on these data, it is conceivable that mass-energy of parallel universes of the hidden Multiverse has largely averaged over billions of years of existence as a result of the mutual exchange of their micro- and mini-content through the portals (even if for some reason their mass-energy in different universes turned out to be different immediately after the Big Bang) and it is equal to the mass-energy of our visible universe, with precise accuracy.

Thus:

• according to Planck data, the hidden Multiverse contains 100%/4.9%=20.4 parallel universes (according to WMAP data 100%/4.6%=21.8 parallel universes), i.e. probably 20 ... 22 parallel universes;

• according to Planck data, the hidden Multiverse contains 26.8%/4.9=5.5 parallel universes (according to WMAP data 22.4%/4.6%=4.9 parallel universes), evoking the phenomenon of dark space, i.e. probably 5 ... 6 parallel universes;

• according to Planck data, the hidden Multiverse includes 68.3%/4.9=13.9 parallel universes (according to WMAP data 73.0%/4.6%=15.9 parallel universes), evoking the phenomenon of dark energy, i.e. probably 14 ... 16 parallel universes.

However, these results do not correspond to the structure of the hidden Multiverse shown in Figure 4, since our visible universe should have not two, but 5…6 adjacent invisible universes.

Admittedly, each tardyon universe in Figure 4 is adjacent to one tachyon universe and one tachyon antiverse. And according to the above mathematical analysis of the data obtained by the WMAP and Planck spacecraft, each tardyon universe should have three tachyon universes and antiverses. Therefore, the assumption that the structure of the hidden Multiverse is described by complex numbers and has one extra spatial dimension turned out to be incorrect. In fact, the hidden Multiverse has three extra dimensions and is described by hyper-complex numbers $f_{q,r,s}(x,y,z)+i_1q+i_2r+i_3s$ [53], where the function $f_{q,r,s}(x,y,z)$ describes distribution of material content of the corresponding parallel universe with coordinates in coordinates x,y,z, and the imaginary units i_1,i_2,i_3 are connected by the following relations

$$i_1^2=i_2^2=i_3^2=1 \quad (3)$$

$$i_1i_2i_3=i_2i_3i_1=i_3i_1i_2=-1 \quad (4)$$

$$i_1i_3i_2=i_2i_1i_3=i_3i_2i_1=1 \quad (5)$$

Lisa Randall wrote in this regard: “We can be living in a three-dimensional space sinkhole in a higher-dimensional universe”. And she was right.

7. Correction of relativistic formulas of the corrected version of the STR

Repeatedly corrected relativistic Lorentz-Einstein formula will be written as follows

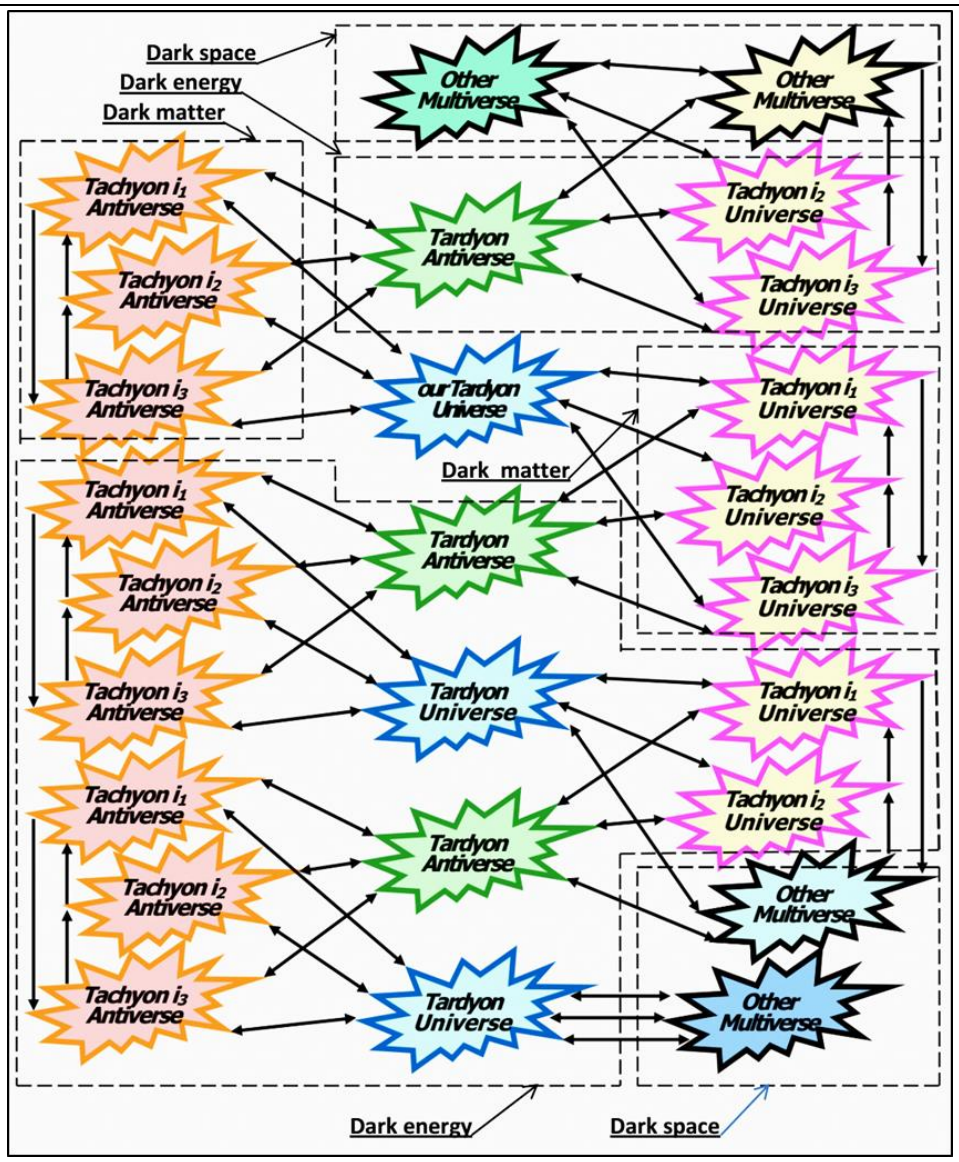

Figure 5. The structure of the hidden Multiverse corresponding to the formulas (6), (7) and (8)

$$m = \frac{m_0 (i_1)^q (i_2)^r (i_3)^s}{\sqrt{1-[v/c-(q+r+s)]^2}} = \frac{m_0 (i_1)^q (i_2)^r (i_3)^s}{\sqrt{1-(w/c)^2}} \quad (6)$$

where $w = v-(q+r+s)c$ is the local velocity for the corresponding universe, which can take values only in the range $0 \le w \le c$.

Other relativistic formulas can be corrected in a similar manner [54] - [57]

$$\Delta t = \Delta t_0 (i_1)^q (i_2)^r (i_3)^s \sqrt{1-[v/c-(q+r+s)]^2} = \quad (7)$$
$$= \Delta t_0 (i_1)^q (i_2)^r (i_3)^s \sqrt{1-(w/c)^2}$$

$$l = l_0 (i_1)^q (i_2)^r (i_3)^s \sqrt{1-[v/c-(q+r+s)]^2} = \quad (8)$$
$$= l_0 (i_1)^q (i_2)^r (i_3)^s \sqrt{1-(w/c)^2}$$

The structure of the hidden Multiverse corresponding to the formulas (6), (7), and (8) can be as shown in Figure 5. As can be seen, its quaternionics [58], [59] structure differ from the one shown in Figure 4 in that it contains three tachyon universes i_1, i_2, i_3 and three tachyon antiverses i_1, i_2, i_3, which provides three required extra dimensions. Thus, the six-dimensional space of the hidden Multiverse (see Figure 5) has three extra dimensions q, r, s, where parallel universes are located, and three dimensions x, y, z, where material content of each of these universes is located. Moreover, the structure of the hidden Multiverse corresponding to the formulas (6), (7) and (8) differs from the one shown in Figure 4 by the fact that it contains unidirectional portals corresponding to the formulas (4) and (5) in addition to bidirectional portals corresponding to the formula (3).

8. Antipodes in space

The 20th century turned out to be rich in outstanding physical discoveries, such as special and general theory of relativity, quantum mechanics, radio electronics, radioactivity, X-ray, dark matter, dark energy, etc. And if radioactivity and X-ray were almost immediately explained and used, dark matter and dark energy have remained unexplained to this day.

Antimatter [42], [60], [61] is another no less incomprehensible astrophysical object than dark matter

and dark energy. It is now generally accepted that the Big Bang produced not only matter, but also antimatter. Moreover, they were generated in equal quantities. However, no antimatter has been found in any noticeable quantities in our visible universe. It was obtained only in the form of subatomic antiparticles and some antiatoms, and also was found in some natural phenomena in negligible quantity for a very short time[3]. Synthesis of such antimatter was extremely expensive. Thus, one gram of anti-hydrogen would cost $ 662.5 trillion.

So, where can antimatter in the form of antiverses be found? And does it at all exist anywhere in this form? It cannot apparently be in our visible universe, since otherwise it

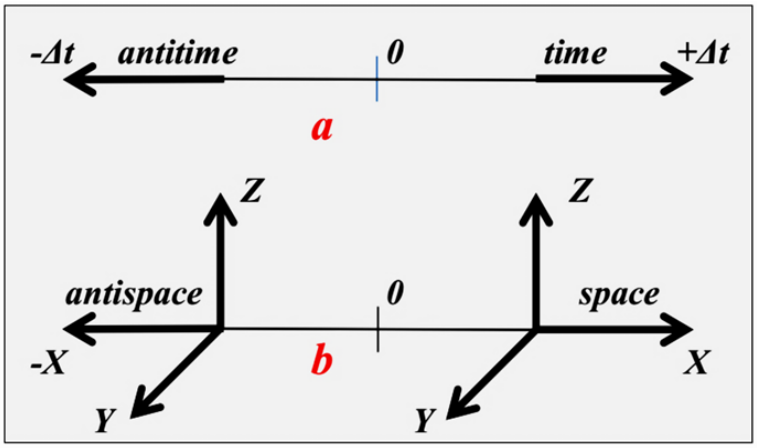

Figure 6. Geometric interpretation of the concepts "anti-time" and "anti-space"

would annihilate with matter and the universe would be destroyed. By the way, this fact is another refutation of the generally accepted version of the STR. Hence, it can be found only in another universe. And the hidden Multiverse, unlike other hypothetical Multiverse, is quite suitable for this role, since it has antiverses. Moreover, tardyon and tachyon universes and antiverses alternate in the hidden Multiverse in such a way that they assuredly prevent their mutual annihilation. Thus, the hypothesis of the hidden Multiverse completely solves the problem of the existence of antimatter.

But the most interesting thing is that, just as formula (6) implies the existence of antimatter in antiverses, from formulas (7) and (8) it follows that antispace and anti-time exist in the same antiverses. In the same way as in the antipodes on Earth, the directions of gravity are opposite to each other. Moreover, people would find nothing unusual in these antiverses (as antipodes on Earth), if they got there, since there operate the same physical, chemical and other laws of nature as in our visible universe.

Figure 6 shows a fairly obvious geometric interpretation of these new concepts. As can be seen, time and anti-time differ by the sign of the value appearing in formula (7), and space and anti-space differ by the sign of the value appearing in formula (8). Time and anti-time, in addition, can differ in their different distance on the time axis from the common origin, which depends on the time of occurrence of the corresponding universes and antiverse. Figure 6, for example, depicts a situation in which the universe and the antiverse arose simultaneously.

9. How to see invisible universes

Thus, the hidden Multiverse is quite unusual in many respects. This arouses some mistrust. Does it exist at all? Nature can give an unequivocal and convincing answer to this question only if its invisible universes are seen. And they can be seen as follows [62], [63].

Since the sky maps of invisible parallel universes are supposedly extremely different, their constellations can be confidently distinguished from those observed in the starry sky by observatories on Earth. Moving along the Earth portals between our visible universe and adjacent invisible universes, one can observe as the star map of one universe is gradually replaced by the star map of the adjacent universe. Therefore, all it takes to make sure of existence of invisible universes is to register differences between the constellations in the starry sky in the portals from the constellations

[3] *For example, in 1995, CERN achieved a sensational success at that time, having received nine antihydrogen atoms, which lasted 40 billionths of a second.*

Figure 7.
Main astronomical observatory of the National academy of science of Ukraine located in the anomalous zone

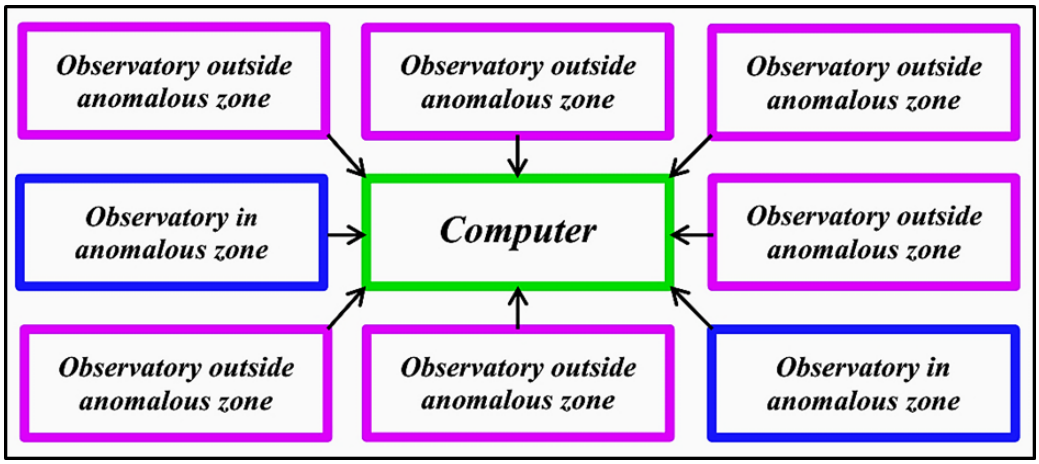

Figure 8. Scheme of an experiment to detect invisible universes by identifying differences as a result of comparing the constellations of the starry sky in anomalous zones and outside anomalous zones observed in the starry sky outside the portals.

What needs to be done to carry out such an experiment is to find a portal and perform the astronomical observation therein. And although it is clear that entrances to portals are located, at least, n some anomalous zones, which are quite numerous on Earth, no one has yet been engaged in the study of portals directly in portals, since no one has needed it. And besides, it is unsafe, since portals are a sort of invisible labyrinths. Therefore, one can get lost there without an appropriate portal orientation device (similar to marine compass). Such a danger can be minimized, if such observations are carried out at the very entrance to the portal, in the anomalous zone. It is conceivable that some astronomical observatories are already in the anomalous zones, without knowing it. As, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Holosiivskyi forest, just 12 km from Kiev, the capital of Ukraine (see Figure 7).

Therefore, an experiment in detecting invisible universes turns out to be very simple and inexpensive in this case. It consists in comparing computer images of the same area of the starry sky provided by several observatories located close to each other, at least one of which being located in the anomalous zone (see Figure 8); and in revealing differences in the relative position of the stars depicted in these images. If such an experiment is successful, its significance for human civilization will significantly exceed the significance of the discovery of America by Columbus.

10. Conclusions

The answer given in the article to one of the questions from the list of unsolved issues of modern physics ‘where is antimatter?’ turned out to be simple and quite logical: it is in the antiverses. At the same time, it has been explained that there are many pairs of universes-antiverses in nature. And therefore there are many antimatters. Moreover, it has been explained that, in addition to antimatter, there is anti-time and anti-space in the antiverses. And there are also many of them.

The concept of anti-time allowed us to answer another question from the list of unsolved problems of modern physics ‘why does time have a direction?’ It turned out that the ‘arrow of time’ concept is incorrect, i.e. contrary to popular belief, time can be not only positive, but also negative. This is how it happens in the cosmic antipodes - universes and anti-universes.

But in order to answer these questions, we first had to answer one more question from the same list 'are there invisible parallel universes?'. And the article not only makes it clear that they exist in the Multiverse, which we have called hidden, but also why they are parallel and invisible. It also clarifies how and where on Earth invisible universes can be seen.

But the answer to the third question was obtained in the process of answering two more questions from the list of unsolved issues of modern physics 'are there extra dimensions?' and 'what is dark matter and dark energy?'. Due to mathematical analysis of the data obtained by the WMAP and Planck spacecraft it has been concluded that our hidden Multiverse has a quaternion structure in six-dimensional space. And the phenomenon of dark matter and dark space is explained by the existence in our visible universe of a gravitational wave background generated by the rest of the invisible universes of the hidden Multiverse.

All these answers to the questions from the list of unsolved issues of modern physics became possible after receiving an answer to one more question, although from the list of unsolved issues of modern mathematics, 'can imaginary numbers be physically real?' An affirmative answer has been obtained as a result of theoretical and experimental studies of special processes in linear electric circuits, which made it possible to prove the general scientific principle of physical reality of imaginary numbers that, in its turn, refuted the principle of light speed non-exceedance in the STR. And this enabled us to assert that the relativistic formulas obtained in the generally accepted version of the STR are incorrect; they have been incorrectly explained and entailed wrong conclusions. Therefore, attempts to solve the above-mentioned and other physical issues within the framework of this theory were certainly destined for failure.

Thus, it is logical to conclude that the version of the STR presented in textbooks is outdated, since it does not correspond to the experimental data obtained in the 21st century, and therefore it hinders the development of modern physics.

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RECOMBINATION IN SILICON SOLAR CELLS

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Abstract

This article describes the recombination processes in silicon-based solar cells. Both the results obtained are given and theoretically analyzed.

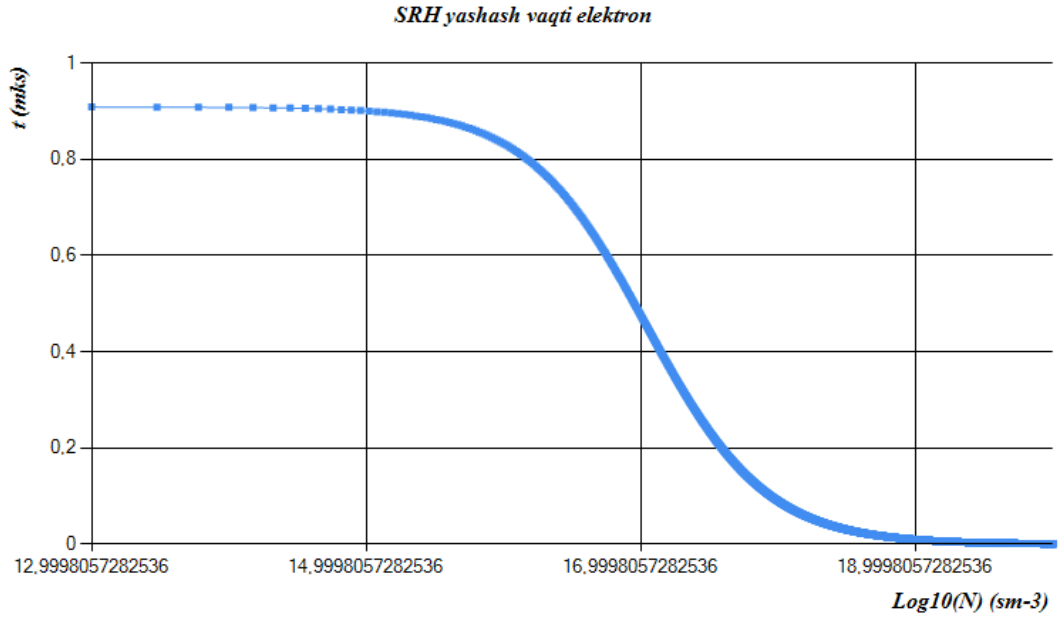
Keywords: silicon, recombination, generation, solar cell

The demand for solar cells is growing day by day [1]. The industry mainly produces silicon-based solar cells. This is because the cost of solar cells made of silicon is cheaper than the rest [2]. Every country has a different climate. Solar elements made of silicon are also sensitive to external influences. Climate change is affecting the photoelectric properties of silicon-based solar cells (SBSC) [3]. In our research, we studied the effect of temperature on the properties of silicon and SBSC. The conductivity of silicon is directly proportional to the temperature. That is, the higher the temperature, the higher the concentration of charge carriers [4]. This results in a narrowing of the width of the silicon restricted zone. As the zone narrows, it begins to absorb more spectral light. Hence, the efficiency of SBSC should increase. But there are also negative effects of temperature [5]. That is, the concentration of phonons in silicon increases with increasing temperature. This reduces the mobility of the charge carriers in silicon. This suggests that the efficiency of SBSC increases to a certain value, not continuously, with increasing temperature, and then decreases. The value of the temperature at which SBSC has the maximum efficiency is called the nominal operating temperature (NIT). Silicon-based solar cells typically have a NOCT value of 35 ° C.

Recombination of SRH depends on the defects, and the process of its formation is as follows. The electron in the conduction band first descends to a defective surface, then emits a phonon again, enters the valence band, and joins the cavity [6].

$$R^{SRH} = \frac{np - n_{i,e}^2}{\tau_p\left(n + n_1\right) + \tau_n\left(p + p_1\right)} \quad (1)$$

Each recombination process determines the lifetimes of electrons and cavities. That is, the less recombination, the longer the lifespan [7].



Graph 1. *Dependence of the SRH lifetime concentration of electrons in silicon-based solar cells on the input concentration*

Another type of recombination is surface recombination, which occurs mainly on the surface of the solar cell. To get rid of this, the surface of the solar cells is passivated [8].

$$R_{surf} = \frac{np - n_{i,eff}^2}{(n+n_1)/s_p + (p+p_1)/s_n} \quad (2)$$

The rate of recombination depends on the concentration of impurities on the surface and is expressed as follows.

$$s = s_0\left[1 + s_{ref}\left(\frac{N_i}{N_{ref}}\right)^{\gamma}\right] \quad (3)$$

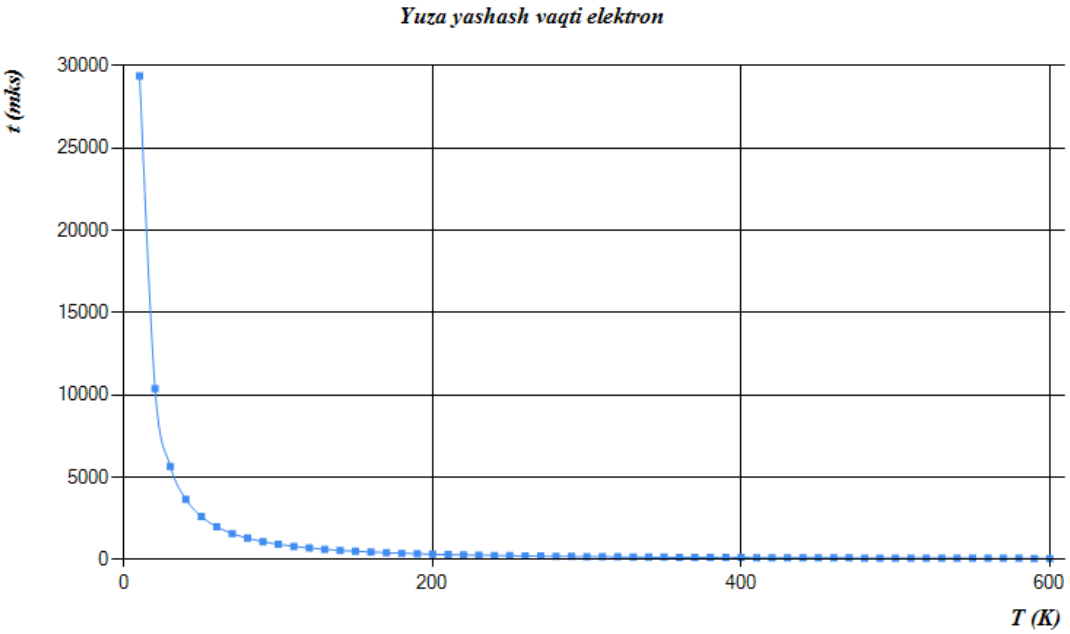


Figure 2. *Temperature dependence of the lifetime of electrons in silicon-based solar cells*

Nowadays, technology is evolving, which makes it easier for us to perform calculations. We also developed a program called “Suntulip-2 for silicon solar cell” to perform the above theoretical calculations in C # 6.0 programming language. All of the above values are obtained in this program. In short, in order to prolong the life of solar cells, we must first reduce the amount of recombination.

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THE LIFETIME OF CHARGE CARRIERS IN SILICON-BASED SOLAR CELLS

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Abstract

In this paper, the effect of temperature and input concentration on the lifetimes of electrons and cavities in silicon-based solar cells is theoretically analyzed.

Keywords: life time, silicon, temperature, model, donor, acceptor

Solar elements are now becoming the main source of energy. Because the world is running out of non-renewable energy sources [1]. The best solution for the economy at this time is, of course, renewable energy sources. There are many types of solar cells. The cheapest of these are silicon-based solar cells. Silicon is one of the most common elements in the world [2]. In order to increase the efficiency of a solar cell, we must first know more about its internal properties. For example, when electrons and cavities age, what is the efficiency of solar cells? Of course, if you have a long life. No feature is self-explanatory. They, in turn, are inextricably linked to many processes [3].

The lifetime is the time between particle generation and recombination. So to know more about life expectancy, we need to know more about recombination and generation [4].

Generation is the process of forming electrons and cavities. There are many types of generations. Avalanche, thermogeneration and photogeneration [5].

Photogeneration is the process of generating light. Its mechanism is based on the photo effect. But the photo effect is also divided into two. Internal and external photo effect [6]. An event in the solar system can be called an internal photo effect. It is called the photovoltaic effect by another name. Photogeneration in solar cells depends on the wavelength of light and the thickness of the solar cell, as well as the surface area of the solar cell [7].

$$G^{opt}(z,t) = I_0 F_t(t) F_{xy} a(\lambda, z) \exp\left(-\left|\int_{z_0}^{z} a(\lambda, z')dz'\right|\right) \quad (1)$$

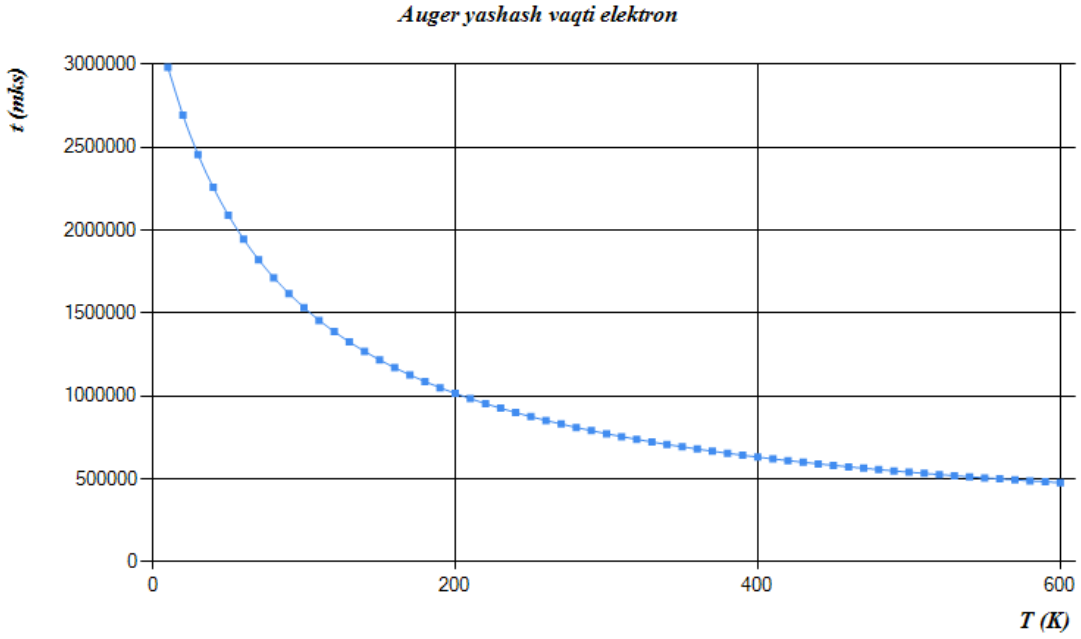
$$F_{xy} = \left[1+\exp\left(\frac{|\tilde{x}|-x_0}{s_x}\right)\right]^{-1} * \left[1+\exp\left(\frac{|\tilde{y}|-y_0}{s_y}\right)\right]^{-1} \quad (2)$$

$$\phi(x,y,z=0) = F_{xy} * \phi_0 \quad (3)$$

Recombination is the reunification of electrons and cavities. There are three main types of recombination. SRH, Auger, Radiation and surface recombination [8].

In silicon-based solar cells, the main part of recombination consists of SRH, Auger and surface recombination. This is because radiative recombination occurs only in solar cells made of substances with a properly restricted zone. An example of this is GaAs.

$$R_R = C\left(np - n_{i,eff}^2\right) \quad (4)$$



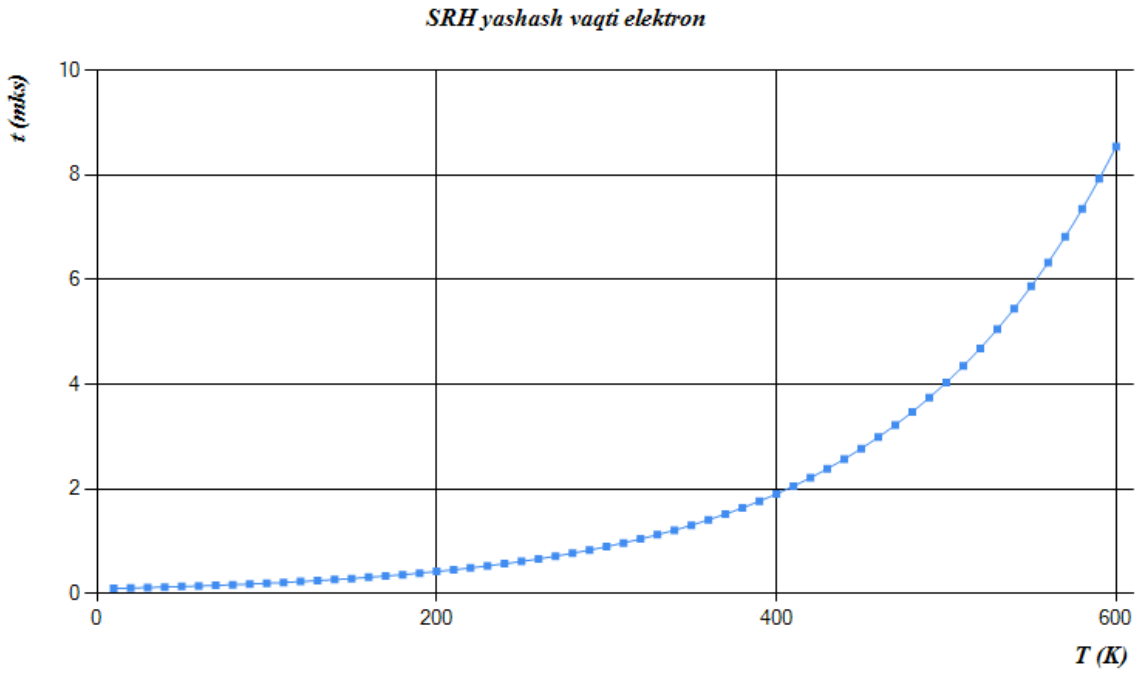
Graph 1. *Temperature dependence of the lifetime of an electron in a silicon-based solar cell*

Auger recombination is strongly related to the concentration of the input, and the mechanism of its formation is as follows. The pair of electrons descend from the conduction band to the valence band, and one of them absorbs the energy and returns to the conduction band [1].

$$R_A = \left(C_n n + C_p p\right)\left(np - n_{i,eff}^2\right) \quad (5)$$

$$C_n(T) = \left(A_{A,n} + B_{A,n}\left(\frac{T}{T_0}\right) + C_{A,n}\left(\frac{T}{T_0}\right)^2\right)\left[1+H_n \exp\left(-\frac{n}{N_{0,n}}\right)\right] \quad (6)$$

$$C_p(T) = \left(A_{A,p} + B_{A,p}\left(\frac{T}{T_0}\right) + C_{A,p}\left(\frac{T}{T_0}\right)^2\right)\left[1+H_p \exp\left(-\frac{p}{N_{0,p}}\right)\right] \quad (7)$$



Graph 2. *Temperature dependence of the SRH life time of electrons in silicon-based solar cells*

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TECHNICAL SCIENCES

MODEL MICROPROCESSOR DEVICE OF FOUR-WIRE SCHEME OF THE DIRECTION CHANGE

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Abstract
Train traffic control systems are a complex of technical and technological systems, the most important place in which is occupied by systems for ensuring the safety of the transportation process. These include systems for electrical and dispatch interlocking, automatic blocking and locomotive signaling. Significant advances in the development and implementation of microprocessor technology have created the necessary conditions for the design of train control systems with high safety, reliability, economy and technological efficiency. A significant reserve for increasing the efficiency of railway transport is the automation of the train traffic control process based on the use of modern interval control systems with expanded functionality [1, 3].

Keywords: single-track automatic blocking, change of direction, haulage, model, microcontroller

Introduction

On sections of the railway of the Republic of Uzbekistan, equipped with automatic blocking devices with a length of 950 km. mainly uses a four-wire direction change circuit [6]. At the same time, a morally and technically outdated four-wire relay circuit for changing direction is used, which has aware of about 70%. The road has taken a course towards the modernization of automation and telemechanic systems and begins to introduce information and microprocessor technologies in transport [3]. The purpose of this research work is to study the existing four-wire circuit for changing the direction of train movement and, on its basis, the development of a visual model on a microprocessor base that simulates the operation of the circuit [4].

With a single-track automatic blocking, it is required to change the direction of movement of trains along the section in order to exclude the possibility of departure of oncoming trains [7]. To date, to change the direction of movement, a scheme is used, with the help of which two stations and the adjacent section are connected in such a way that the traffic lights in the established direction are turned on, and in the unsettled direction they are turned off; one of the stations is in the "Departing" position, and the other is in the "Receive" position. The opening of the exit traffic light for the train departure is possible only at the "Departure" station, at the "Reception" station the output traffic lights are turned off, and their opening is excluded [1]

Main part

The existing scheme involves the use of various electromagnetic relays and other bulky structures, which, in turn, contributes to an increase in the cost of maintaining the system and for power supply. The proposed design is distinguished by the absence of electromagnetic relays and other electromechanical devices at the signal points of the haul, with the exception of travel relays that control the state of the block sections of the haul [7]. The built-in programmed microcontroller, in turn, programmatically checks a certain state of the path relay and, on this basis, implements all other dependencies [3].

There are two modes of changing the direction of movement - normal and auxiliary. The normal mode is applied only when the haul is free, the auxiliary mode is used if the haul is free, but the rail circuit of one of the block sections is faulty, which gives a false occupation of the haul. At this stage of the research work, the visual model provides for the implementation of the change of direction only in a normal mode. In the future, the implementation of the auxiliary regime is envisaged.

Before changing the direction of movement in normal mode, the person on duty should make sure that the line is free when the indicator light on the board is lit. When the control lamp lights up, it means that: all block sections of the stretch are free; weekend traffic lights at the Departure station are closed; there is no train sent by the wand key; no shunting movements are performed with access to the track. In normal mode, the duty officer at the "Reception" station changes the direction of movement. To do this, he presses a special button for changing the direction of the ChSN (NSN).

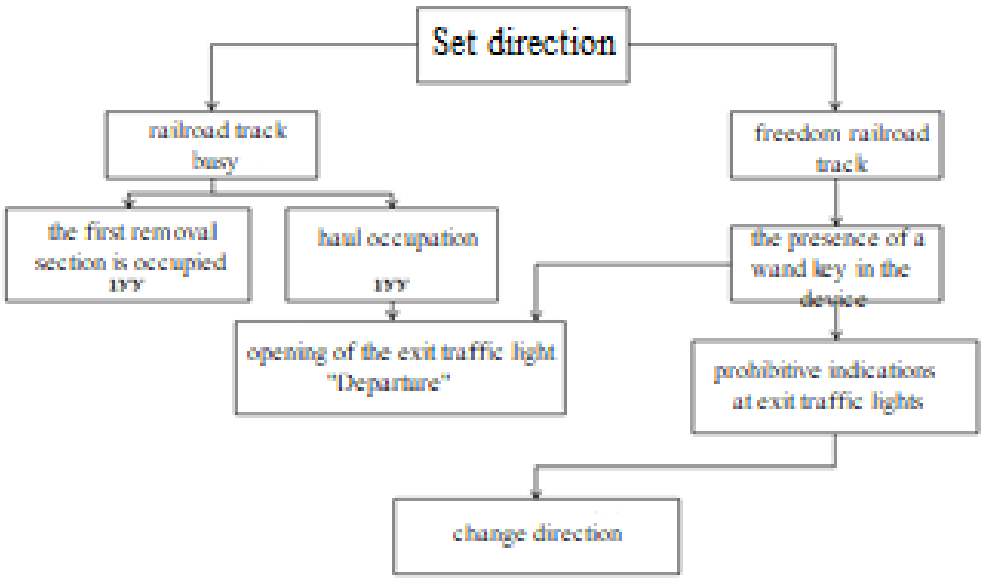

Fig. 1. Functional diagram of the visual model

The developed visual model checks only three conditions necessary for the change of direction: the freedom of all block sections of the stretch; prohibiting indication at the exit traffic lights of the Departure station; the absence of a train sent by the wand key. Figure 1 shows a functional diagram of a visual model.

Result

All the conditions and dependencies of the above presented functional diagram of the visual model are carried out programmatically, using code combinations recorded on the microcontroller of the PIC family, while in a relay-contact system, these dependencies are carried out using electromagnetic relays. This scheme assumes the use of two PIC16f877a microcontrollers at two adjacent stations, respectively. During operation, the microcontroller cyclically requests the state of all monitored objects. The microcontroller controls the corresponding indicators on the simulated board of the station attendant in accordance with the received code combination.

The PIC16F87X is an 8-bit RISC microcontroller manufactured by Microchip Technology. This family of microcontrollers is characterized by low cost, low power consumption and high speed. Microcontrollers have built-in program EEPROM, data RAM, a wide range of supply voltages from 2.0 V to 5.5 V and are available in 40-pin packages [2]. For security applications, each PIC has a privacy bit that can be programmed to prohibit reading of the program code and data ROM. When programming, the program code is first written, checked for correctness, and then the security bit is set.

One such development for road sections is the four-wire direction change circuit shown in Figure 2.

Before the design stage of the proposed model, a schematic model was developed in the Proteus 8 Professional debugging environment.

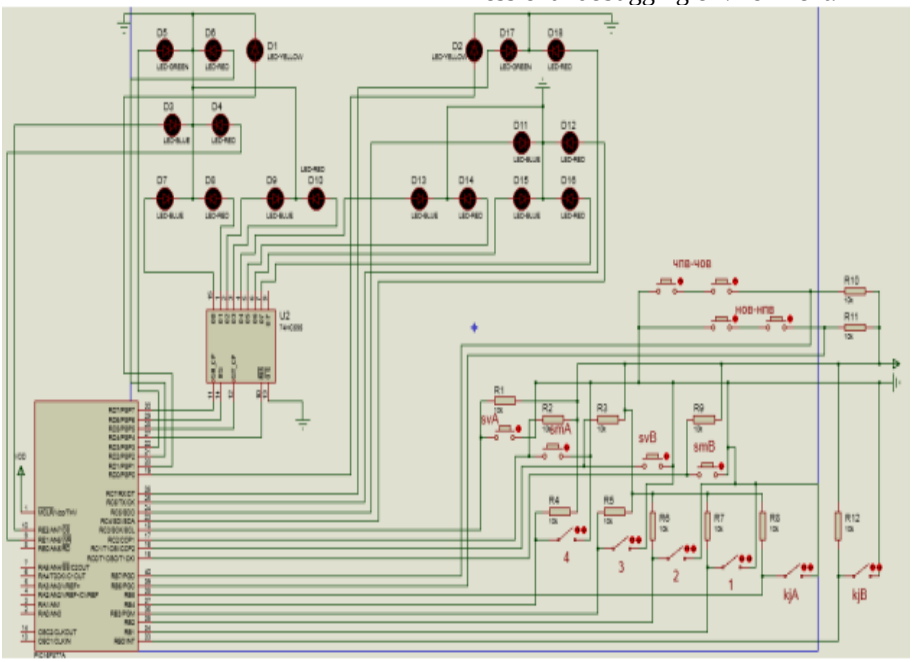

Fig. 2. Schematic diagram of direction change

The proposed scheme for changing direction on the microcontroller provides for a reduction in power consumption by 60%, costs for materials and spare parts by 90%, and a decrease in labor costs for maintenance on average by 48%.

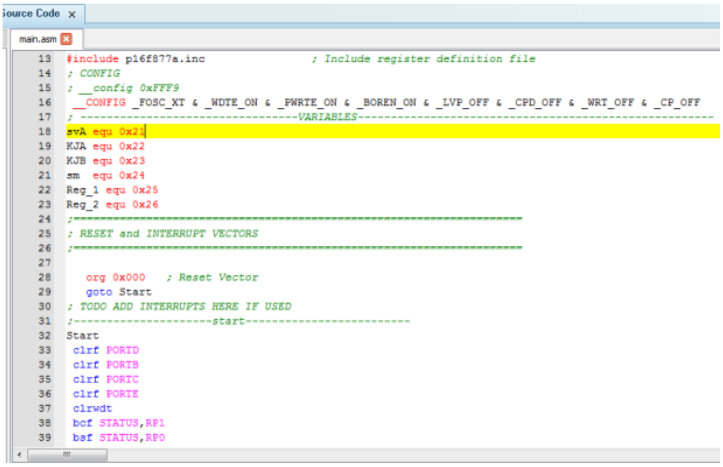

Fig. 3. VSM Studio Code Editing Window

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TESTING I-V CHARACTERISTICS OF SILICON SOLAR PANELS UNDER SUNLIGHT

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Abstract

This article describes the collection of solar panels and some of the problems in this process. In addition, the volt-ampere characteristic of a silicon-based solar cell measured in natural light is given.

Keywords: silicon, solar panel, light beam, solar cell

The 0.6V voltage and 2A current generated by the solar cells are not sufficient for consumption. In addition, solar cells cannot be used outdoors [1]. Because it is mechanically very delicate. It is assembled in the form of solar panels to protect the solar cells from external influences and increase their total current and voltage [2].

In solar panels, the solar elements are connected in parallel and in series. Cu metal tapes are widely used to connect them together. There are basically two sizes [3]. Metal tapes with a width of 1.6-2 mm and a thickness of 0.12-0.2 mm are used to connect the first two solar cells, and the second is used with metal strips with a width of 5-6 mm and a thickness of 0.2-0.3 mm to connect each row of solar cells together [4]. Metal tapes are not only made of Cu, their surface is coated with Sn96.5 / Ag3 / Cu0.5 alloy salts to improve its chemical, mechanical and thermal properties [5].

When the solar cells are connected in parallel, their voltage does not change but the currents are added (Figure 1).

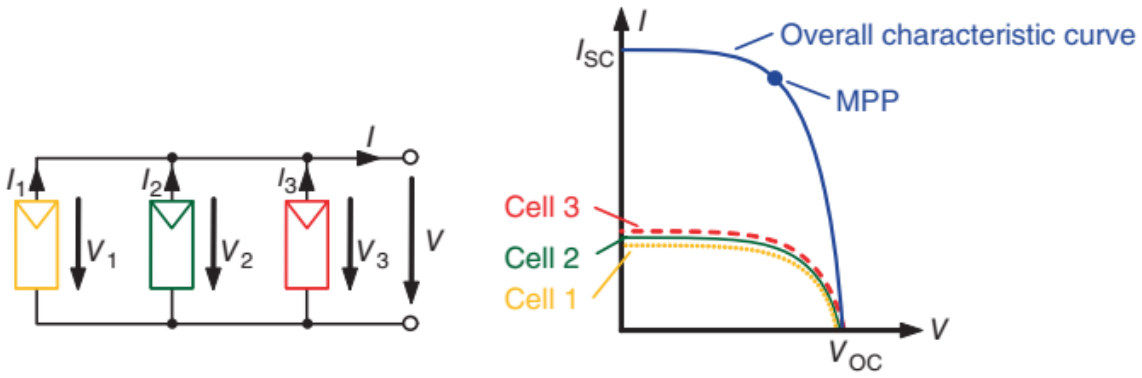

Figure 1. Parallel connection of solar elements

When the solar cells are connected in series, the current does not change, and the voltage is the sum of the voltages of each solar cell (Figure 2).

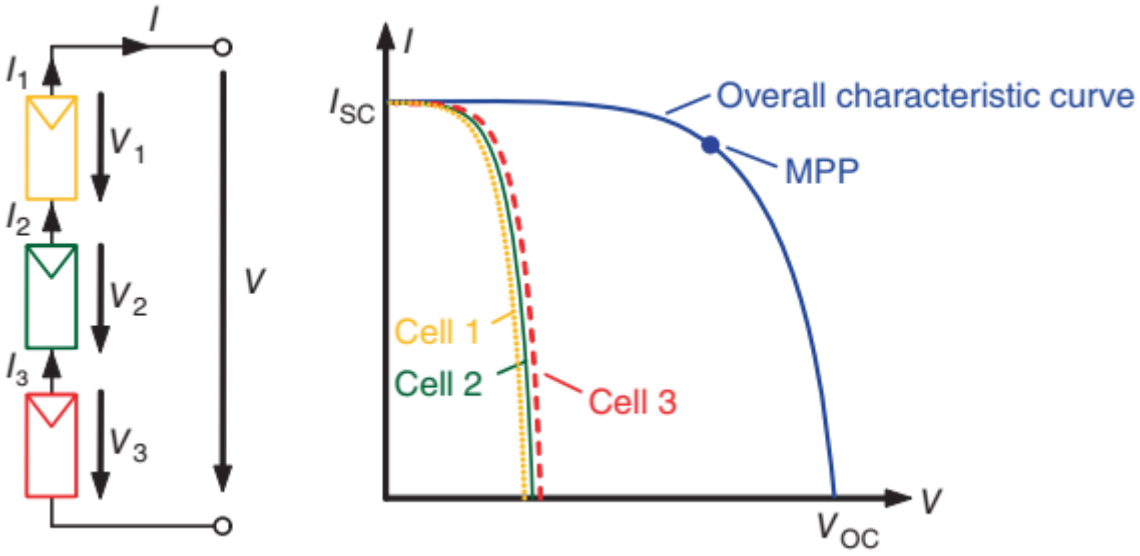

Figure 2. Connecting solar elements in series

Modern solar panels consist of 36, 48, 60 or 72 solar elements.

The next step is to encapsulate the solar elements connected to each other [6]. EVA (Ethylene Vinyl Acetate) is used for encapsulation. The solar cell is sandwiched between two EVA films. And the pressure in the vacuum through the lamination device was laminated at ostdia 1500C [7]. The only disadvantage of EVA film is that it is flexible, so it is necessary to cover it with an additional layer on top and bottom. EVA film protects solar cells from moisture, dust and vibration. It also ensures that the electrical circuit made of solar cells is not damaged. The EVA layer is an optically very transparent material. It transmits light very well [8].

The back of the solar panel is covered with an additional layer of PVF (polyvinylfluoride).

The front of the solar panels is covered with heated glass in addition to the EVA layer. Heated glass is 6 times more resistant to mechanical stress than ordinary glass. Its surface is embossed. This is because the light falling on its surface reaches the sun's element perpendicular to it.

The edges of the solar panel are mainly framed using aluminum profiles. This makes it easy to install and mount the solar panels.

Experiments try to bring the spectrum of a light source closer to the spectrum of light coming from the sun. But the effect of the sun's heat is different from that of an experimental light source. Therefore, it is important to study solar panels in natural light in practice.

The photoelectric parameters of a solar panel differ from the photoelectric parameters of the solar elements it contains. We measured the volt-ampere characteristics of a single-crystal silicon-based solar panel with the staff of the Renewable Energy Sources Research Laboratory at Andijan State University (Figure 3). The experiment was conducted on 11.01.2021.

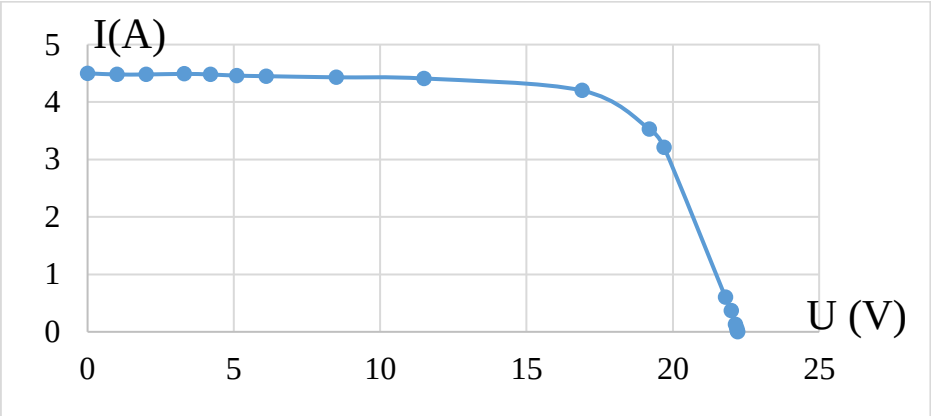

Figure 3. Volt-ampere characteristics of a single crystal silicon-based solar panel.

In the experiment, the short-circuit current of the solar panel was 4.5A, the rated ignition voltage was 22.18V, the current at the maximum power point was 4.2A and the voltage was 16.9 V, and the fill factor was 0.71. The experiment was conducted at 13:00. Due to the fact that the time of the experiment coincided with the winter, its current was lower. In winter, the intensity of sunlight in Uzbekistan is low.

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COMPARATIVE ANALYSIS OF THE INFLUENCE OF THE SURFACE TENSION ON THE EFFICIENCY BY RECTIFICATION IN PRESENCE OF DEFOAMING AGENT SIHA SILICONE SE

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Abstract

Foam formation is unavoidable part in various technological processes. The extensive formation of foam might cause serious problems so special additives are used called "defoaming agents" or "defoamers" to subdue the formation of foam or eliminate the foam formed.

The aim of the present work is to study experimentally the influence of the anti-foam agent SIHA Silicone SE on the height of the gas-liquid layer, the change of the surface tension and, respectively, the degree of separation by the rectification of binary mixture methyl alcohol – water in laboratory column with one sieve plate.

As a result from the experimental and calculation procedures carried out, it was found that the presence of anti-foam agent gives decrease of the foam height 2 – 2.5 times while the values of the local efficiency are by 10% lower. This certainly confirms the fact that the lower foam height, i.e. the smaller interphase results in lower

separation efficiency. Besides, it was found that in presence of defoamer, the values of the local efficiency decrease (from 87,3% to 84,65%) with the increase of the M-index. Thus, it can be assumed that the surface tension does not exert significant effect on the degree of separation.

Keywords: rectification, surface tension, defoaming agent, local efficiency

Rectification is one of the most widely spread methods for separation of liquid homogeneous multi-component mixtures. In broad interpretation, it involves partial evaporation of an individual mixture followed by condensation of the vapor obtained, carried out repeatedly in various types of rectification columns. A characteristic of the operation of these columns is the formation of stable foam which might cause ineffective performance of the column. The control and regulation of the foam is a key issue for producers in many industries and this is why special additives called "defoaming agents" or "defoamers" are used to subdue the formation of foam or eliminate the already formed one. [1,2,3]

By the rectification of some mixtures (e.g. of so called positive mixtures where, according to Zuiderweg and Harmens [4], the easily volatile component of the mixture has lower value of the surface tension compared to the hardly volatile one, i.e. $\Delta\sigma \succ 0$), the foam height observed is quite high (developed interphase area) and the use of defoamer in the initial mixture affects the separation efficiency.

The aim of the present work was to study the influence of the defoamer on the height of the gas-liquid layer, the change of the surface tension and, hence, the degree of separation by rectification. For this purpose, experiments were carried out in a laboratory glass column with one sieve plate with mixture of methyl alcohol – water in presence and absence of defoaming agent at the same concentration of the volatile component in the initial mixture.

The experimental studies of the model mixture methyl alcohol – water in preence and absence of defoamer were carried out in laboratory glass column with one sieve plate [5]

For these experiments, defoaming agent SIHA Silicone SE was used. This defoamer is a white liquid emulsion containing poly-dimethylsiloxane (alpha-octadecyl-omega-hydroxy-polyglycol-ether) with chemical name: Octadecan-1-ol, ethoxylated. The criterion for the choice of defoamer was made with respect to safety (should be non-flammable and should not contain hazardous substances) and taking into account the action mechanisms of silicon defoamers [6].

On the basis of the experimental data obtained, the local efficiency was calculated by the formula [7]:

$$E_{OG} = \frac{(y_n - y_{n-1})}{(y^* - y_{n-1})}, \qquad (1)$$

y_n, y_{n-1} – average composition of the vapor flows outgoing and incoming at the n^{th} plate, respectivly

y^* - composition of the vapor in equilibrium with the liquid with composition x_n going out of the plate

To estimate the effect of surface tension of the local efficiency (E_{OG}), stabilization index was selected called M-index. It is the product of the process driving force for the liquid phase and the gradient of the surface tension for the composition of the liquid phase. It is calculated by the formula [8]:

$$M = -\left(x - x^*\right)\frac{\Delta\sigma}{\Delta x} \qquad (2)$$

x – concentration of the volatile component in the mixture, mol/mol

x^* - equilibrium concentration

$\Delta\sigma/\Delta x$ - change of the surface tension by the change of volatile component content in the liquid phase

Fig.1 shows the experimental data for the height of the gas-liquid layer as function of the content of the volatile components. As can be seen from the figure, the foam height varied in the interval form 24 to 50 mm in presence of defoamer while, at the same concentrations but without defoamer, foam height varied from 30 to 80 mm. it mans that the presence of defoamer significantly decreased the foam height at comparatively the same vapor velocity.

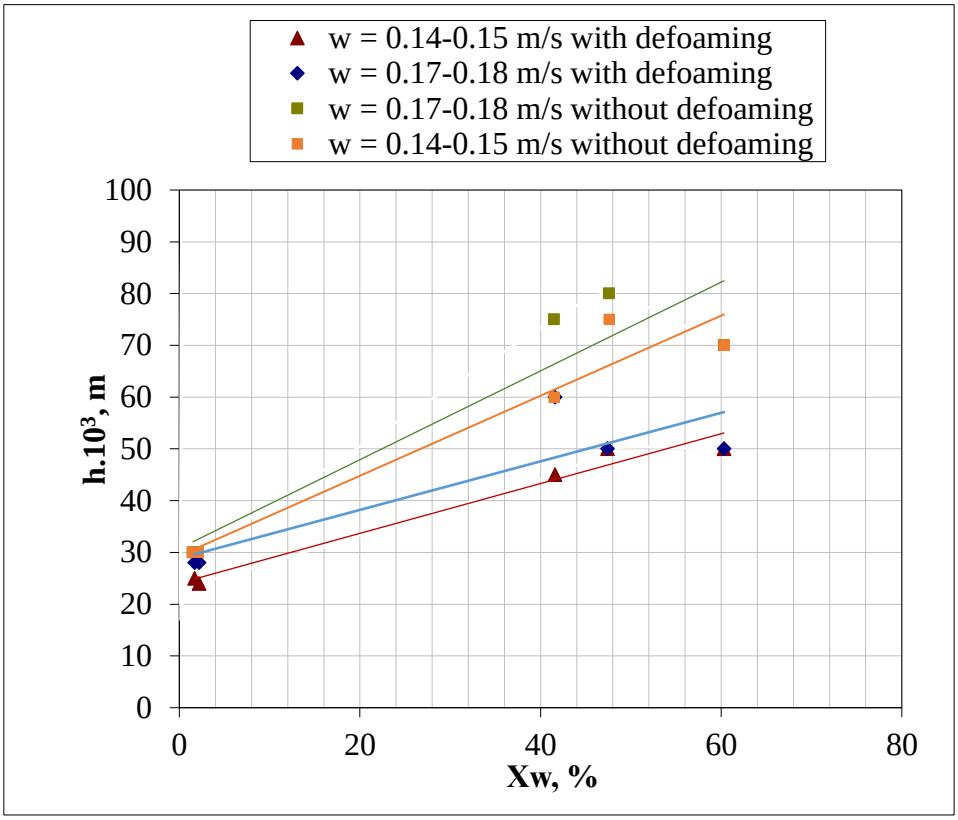

Fig. 1. Dependence of foam height on the composition of the binary mixture methyl alcohol – water with and without defoaming agent in column cube x_w and the velocity of the vapor in the column (w_n)

In Fig.2, a comparative analysis of the foam height of the gas-liquid layer as function of the vapor velocity in the column is made for the model mixture studied with and without defoamer. It is obvious from the figure that the foam height varied from 17 to 76 mm in presence of defoamer while, at the same concentrations, foam height varied from 20 to 95 mm. the presence of defoaming agent resulted in decrease of foam height about 2 – 2.5 tims at approximately the same vapor velocity in the column.

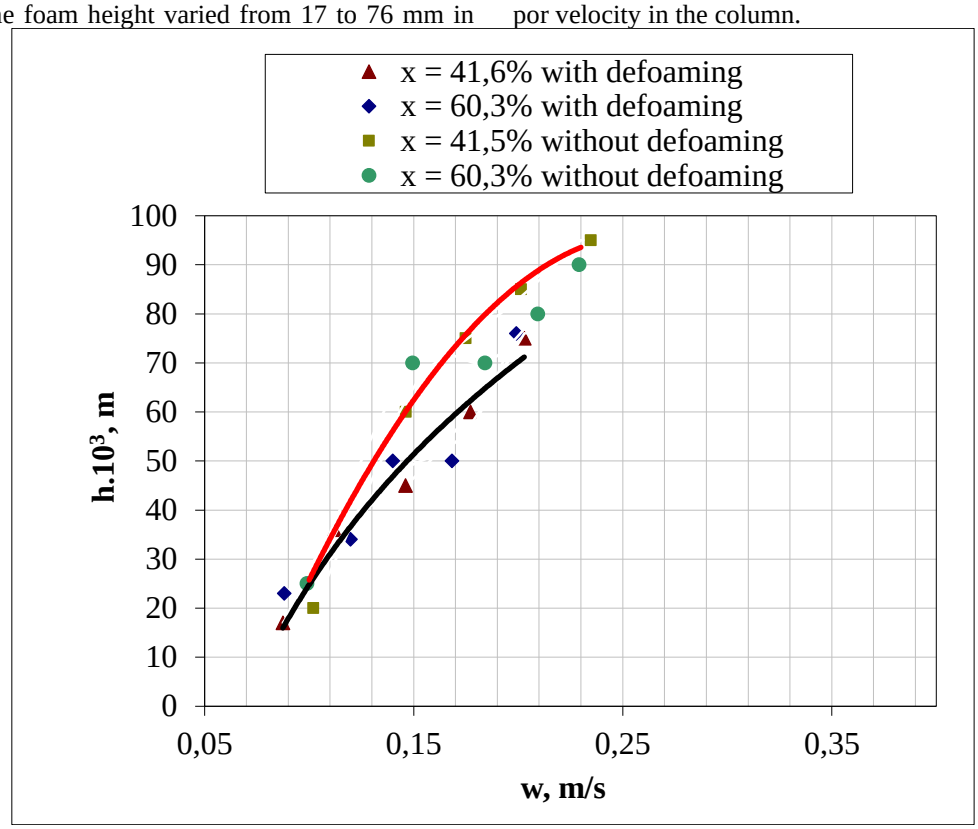

Fig. 2. Dependence of the height of the gas-liquid layer on the apparent velocity of the vapor in the column (w_n) with and without defoamer

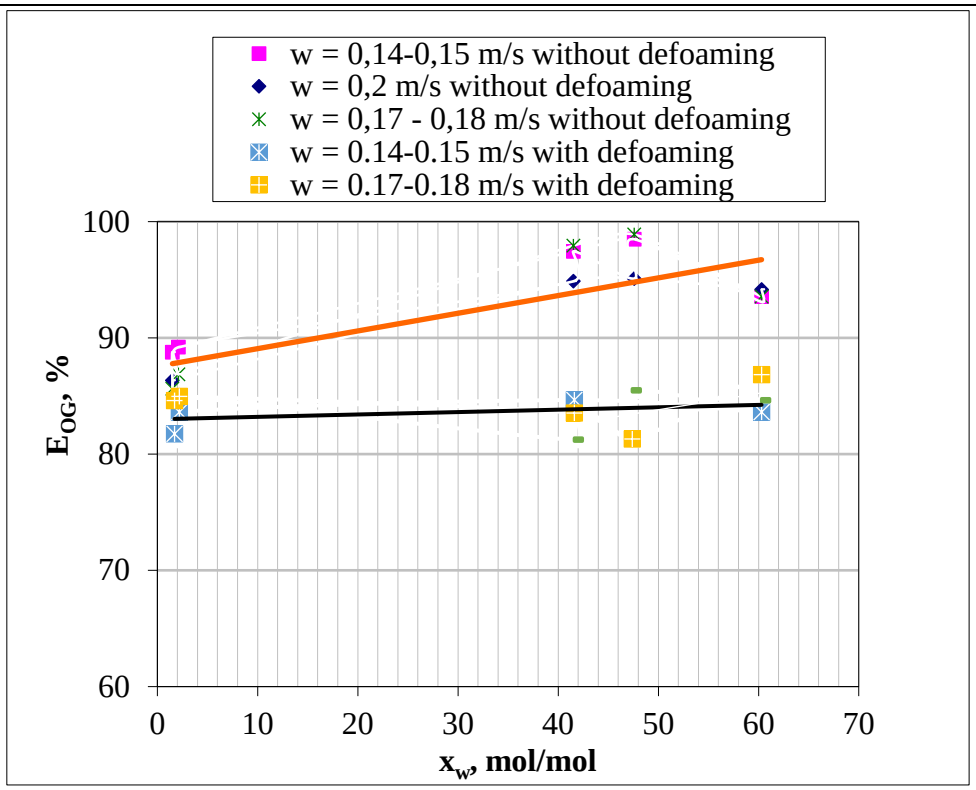

Fig. 3. Dependence of the local efficiency on the composition of the binary mixture Methanol – Water without defoamer incolumn cube x_w

Fig.3 shows the dependence of the local efficiency on the composition of the binary mixture methyl alcohol – water in presence and absence of defoamer at given velocities. As can be seen from the plot, in the range of velocities studied from 0.14 m/s to 0,2 m/s he change of the concentration of the volatile component exerts substantial influence on efficiency of separation in absence of defoamer. In the concentration interval 1,5%, 2,1%, 41,5%, 47,6% and 60,3%, the local efficiency significantly increased with the increase of volatile component content in the initial mixture. For the model mixture studied, the change of the content of methyl alcohol in the initial mixture from 1,5 to 60,3% resulted in change of the local efficiency from 85,61% to 98,89%.

In the same range of velocities 0.14 m/s to 0,2 m/s and concentration interval 1,7%, 2,2%, 41,6%, 47,4% and 60,3% for the mixture methanol – water in presence of defoamer, the change of volatile component concentration in the mixture had negligible effect on the efficiency of separation (the change of the local efficiency was from 81,24% to 86,83%).

Fig.4 shows the experimental data for the influence of vapor velocity ($w_п$) on the local efficiency (E_{OG}) where a comparison is made between model mixtures methanol – water with and without defoamer.

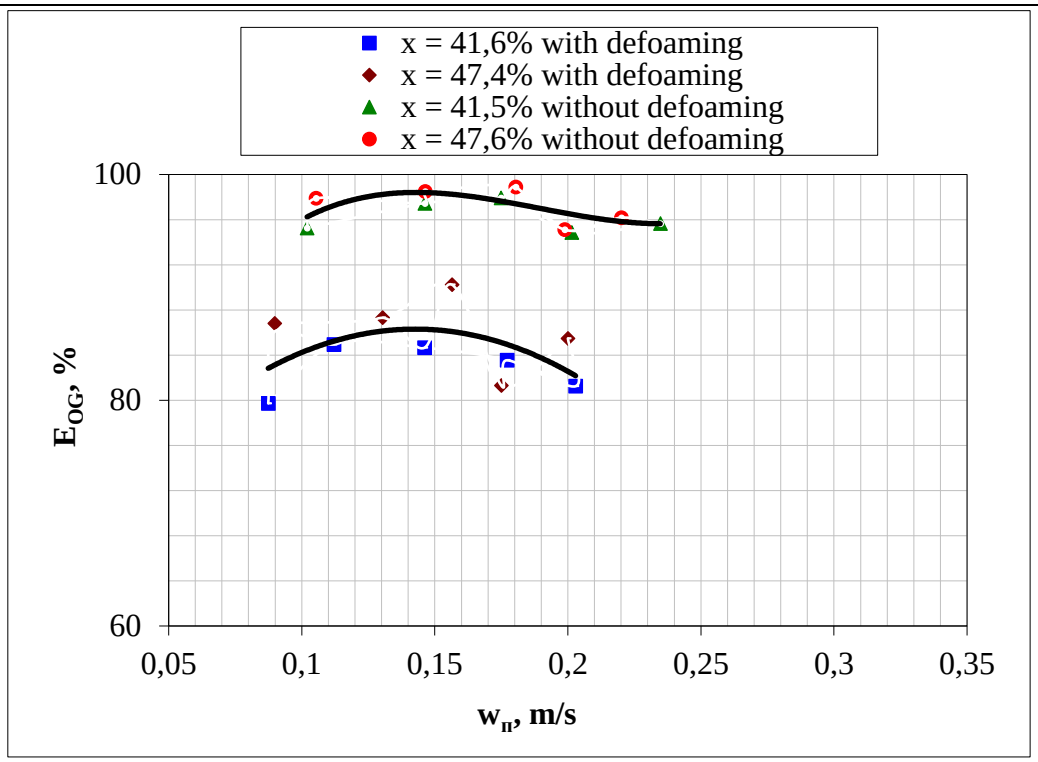

Fig. 4. Dependence of the local efficiency on the vapor velocity in the column w_n and composition of the binary mixture in the column:

x_W =41,6 mol/% и x_W =47,4 mol/% in presence of defoamer;
x_W =41,5 mol/% и x_W =47,6 mol/% without defoamer

Obviously, at volatile component concentration in the initial mixture 41,6 mol% and 47,4 mol%, the values of the local efficiency in presence of defoamer are by 10% lower. This certainly confirms the fact that the lower foam height in the presence of defoamer, i.e. the smaller interphase area, leads to decrease of the efficiency of the process.

An attempt was made to obtain quantitative estimation of the effect of surface tension on the local efficiency (E_{OG}). The results are presented in Fig. 5 for the mixture methanol – water in presence and absence of defoamer.

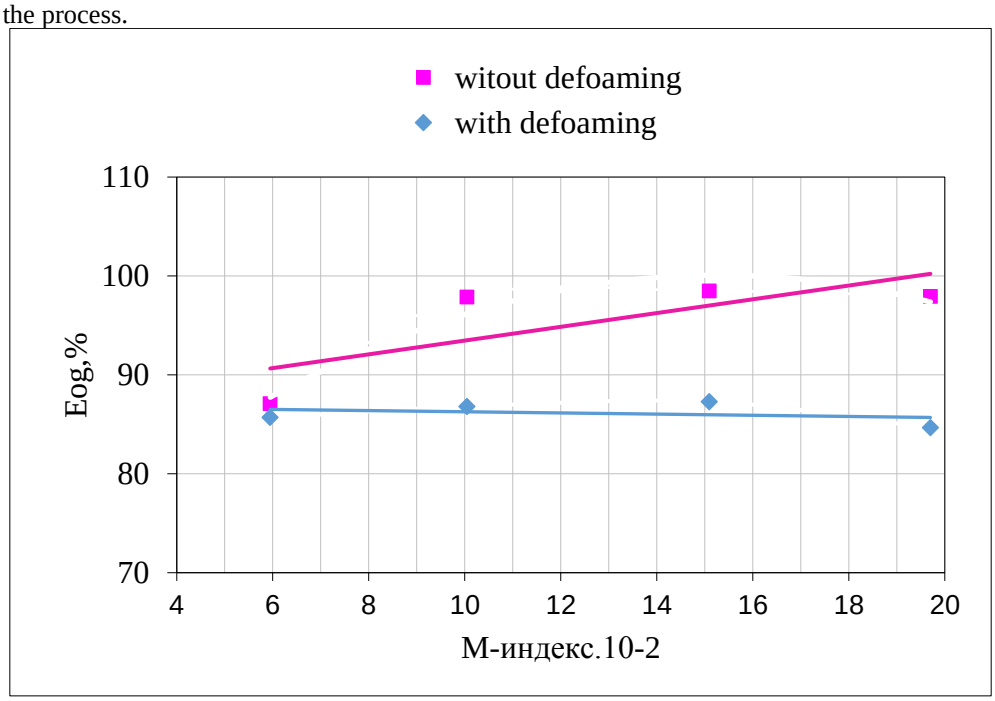

Fig.5. Dependence of local efficiency on the m-index for the mixture methanol – water in presence and absence of defoamer

The values of the local efficiency for the mixture methanol – water without defoamer increased with the increase of M-index and a linear dependence was observed between the change of the local efficiency and the M-index. In presence of defoamer, however, the increase of the M-index caused decrease of the local efficiency from 87,3% to 84,65%, i.e. it can be assumed that when defoamer is added then the surface tension does not exert significant effect on the degree of separation.

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EXPLORING SOLAR CELLS BY PROGRAMMING LANGUAGES AND SSTANDART PROGRAMS

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Abstract

In this article provides information about digital modeling programs and programming languages, besides models and programs which are created based on them.

Keywords: TCAD, solar cell, model, program

Until the twentieth century, there were two different methods of studying the object in science, theoretical and practical methods. In the middle of the twentieth century, computer technology flourished. This led to a new approach to science and a new style of research. In the process of complex computing, it is preferable to use computer technology. Because it increases the speed and accuracy of the calculation.

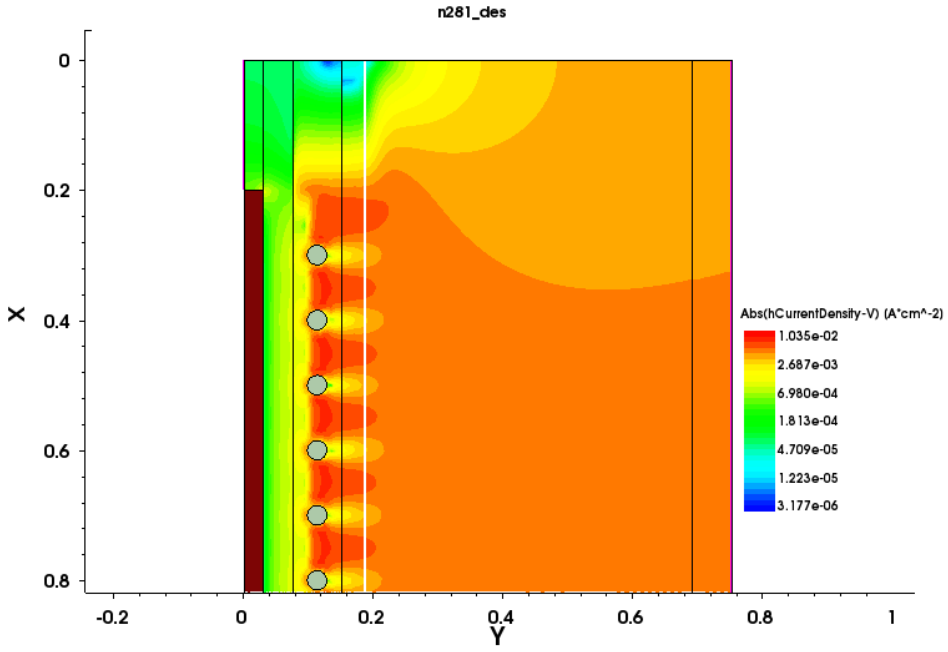

Figure 1. 2D model of a silicon-based solar cell embedded in a nanoparticle generated in Sentaurus TCAD.

Computer modeling is a combination of theory and practice. There are many modeling programs. These include Synopsys's Sentaurus TCAD (Technology Computing Aided Design) and Silvaco Atlas TCAD, which are widely used in modeling semiconductor devices. In these modeling programs, TCL (Tool Command Language) is used to create the model [4]. This requires programming skills from the user. The advantage of this software package is the ability to create models in 3D and 2D. If we want to model a semiconductor device in 2D, we need to pay attention to the symmetry of the device. Suppose we want to create a model of a simple p-n transition solar cell [5]. In order to do this, we need to have knowledge about the process of making the solar cell, its structure, and the physical processes that take place inside it. But the results obtained in these modeling programs are very close to the results obtained in the experiment. That is, the error rate is very low. Together with the staff of the Renewable Energy Sources Scientific Laboratory, we experimentally measured the photoelectric parameters of the solar cell and created a model of this solar cell using the Sentaurus TCAD [6]. The results obtained proved that the accuracy of the modeling program was in fact high. In addition, scientists around the world also acknowledge that the results obtained at the Sentaurus TCAD are close to reality. So far, we have modeled the construction of many solar cells using the Sentaurus TCAD [7]. A clear example of this is the model of a solar cell embedded in a nanoparticle (Figure 1) [1]. There are also purpose-built modeling programs. For example, the PVLighthouse online program is designed to model solar cells only. We use PVLighthouse's Wafer Ray Tracer module to determine the optical properties of textured and optically coated solar cells (Figure 2) [8].

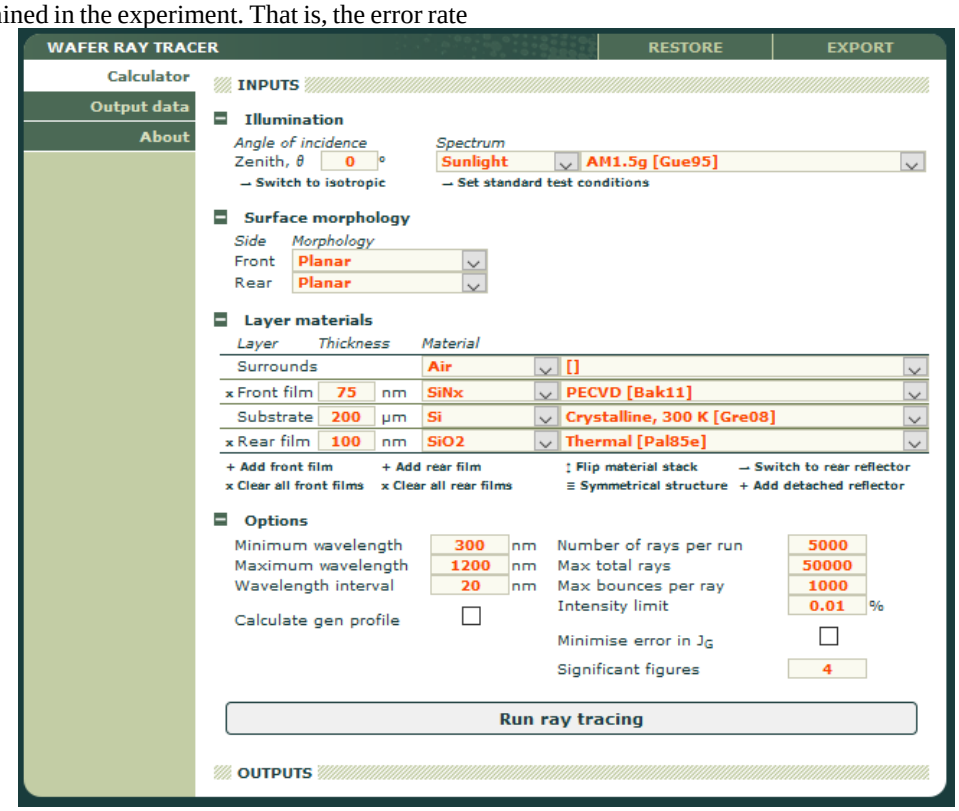

Figure 2. Working window of Wafer Ray Tracer model inside PVlighthouse

We can model a whole system, not just one solar element. In this case, we mainly need knowledge of 3D graphics. That is, we need to create a 3D or 2D view of the system we want to model. One of the most widely used programs in engineering is Comsol Multiphysics. The reason this program is evolving is that it does not require knowledge of programming in use. We just need to create a 3D geometric model and the physical processes that take place in it. In our research, we used this program to model the flexo-photovoltaic effect on silicon-based solar cells. The ability to model semiconductor devices was created by adding the Semiconductors library in version 5.5 of Comsol Multiphysics, released on November 14, 2019.

We use programming languages to translate the sequence of actions we are thinking of into machine language. There are many programming languages. It makes sense to choose a programming language based on the program we are creating. Today, programming languages have developed to such an extent that they are widely used in all fields. To study solar elements, we use C #, Python, and Visual Basic programming languages. These include Suntulip-AGAUz [3] for determining the optical properties of solar cells using the C # programming language, STGRAPH for processing the results obtained in the PVlighthouse, STTemperature for determining the effect of temperature on the kinetic characteristics of silicon-based solar cells, and a new We have developed STVertical [2] programs that determine the effect of geometric dimensions on the photoelectric and thermal properties of a 3D photoelectric power device. From the C # programming language, we develop programs for the Windows operating system with high graphics and fast calculations. For the first time, we created a new library for the C # programming language to make it easier to calculate the optical properties of solar elements. Another feature of

the C # programming language is that in Unity we can write a script so that the object obeys the laws of physics. Because Visual Basic is a syntax and functional language, we use it to perform simple calculations.

Python programming language has emerged as the highest level programming language to date. This is because it has open source and soda syntax. Python programming language is widely used in all fields. That's because it has so many libraries. There are PVlib and Solcore libraries for studying solar panels and modeling semiconductor solar cells. Fluctuations occur when we plot a graph of experimental results. Nonlinear regression is used in mathematical statistics to eliminate it and create a clear graph. One of the fastest growing areas of programming is Machine Learning. We use the Machine Learning algorithm in the Python programming language to determine the optimal values obtained in experiments.

In conclusion, the use of a software package for modeling in the study of semiconductor devices increases productivity and accuracy.

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MANUFACTURE OF FLAT CELLULOSE ACETATE MEMBRANES

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ВИГОТОВЛЕННЯ ПЛОСКИХ АЦЕТАТЦЕЛЮЛОЗНИХ МЕМБРАН

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Abstract

The article considers the fabrication of flat cellulose acetate membranes by the phase inversion method. The scheme of complex production of flat cellulose acetate membranes for reverse osmosis, ultrafiltration and microfiltration is presented. The composition of the molding solution, possible solvents of cellulose acetate, technological processes of production are considered.

Анотація

В статті розглянуто виготовлення плоских ацетатцелюлозних мембран методом інверсії фаз. Представлено схему комплексного виробництва плоских ацетатцелюлозних мембран для зворотного осмосу, ультрафільтрації і мікрофільтрації. Розглянуто склад формувального розчину, можливі розчинники ацетату целюлози, технологічні процеси виробництва.

Keywords: cellulose acetate, solvents, molding solution, membranes.

Ключові слова: ацетат целюлози, розчинники, формувальний розчин, мембрани.

Мембрани для баромембранних установок мають характеризуватися певним комплексом властивостей (пористістю, міцністю, стійкістю до температури, pH, агресивних середовищ тощо), що визначаються молекулярною й надмолекулярною структурою полімерів, на основі яких вони отримані, а також їх макроскопічною структурою [1]. Отже роздільна здатність мембран, їх продуктивність та стабільність характеристик залежить не лише від природи полімеру, з якого вони виготовлені, а й від особливостей технології їх отримання. [2, 3].

Найпоширенішими для баромембранних процесів стали мембрани на основі ацетату целюлози (СА) [1–5]. СА характеризується досить високою кристалічністю, що є функцією ступеня ацетилування. У набухлому СА молекули води концентруються в аморфних областях за рахунок утворення водневих зв'язків з атомами кисню карбонільних груп і, особливо, з незаміщеними ОН-групами целюлозного каркаса. За низького ступеня ацетилування целюлози (як у целофані) вологовміст таких плівок є високим. Однак вони мають порівняно низьку затримувальну здатність. При підвищенні ступеня ацетилування кристалічність зростає, однак ступінь набухання у воді й кількість вільної води в полімері знижуються. Зв’язана вода, що взаємодіє безпосередньо з полімером, має знижену розчинювальну здатність. При підвищенні ступеня ацетилування целюлози до 40 % (у повністю заміщеному триацетаті целюлози міститься 62,4 % ацетатних груп) зростає затримувальна здатність і знижується проникність мембран. Зазвичай для формування мембран використовують СА приблизно з 38 %-м ступенем ацетилування (діацетат целюлози), оскільки в цьому випадку досить висока затримувальна здатність супроводжується прийнятною проникністю.

Для формування ультрафільтраційних СА мембран зазвичай в якості розчинника використовують суміш ацетону з формамідом (пороутворювач – перхлорат магнію), а у вигляді коагулянту (осаджувача) – воду [4]. Для одержання асиметричних СА мембран, придатних для ультрафільтрації, у якості розчинників використовують N-метил-α-піррολідон, оцтову кислоту, 1,4-диоксан та інші, а у вигляді осаджувачів – ізопропанол, гептан [4]. Розчинювальна здатність знижується в ряді N-метил-α-піррολідон > оцтова кислота > 1,4-диоксан, а здатність до осадження — у ряді ізопропанол > вода > гептан. Встановлено, що зі зниженням розчинювальної здатності осаджувача середній радіус пор у мембрані зменшується, що обумовлено особливостями процесу структуроутворення при її формуванні. Зміна молекулярної маси вихідного полімеру в широких межах мало впливає на розділові властивості мембрани, однак за низького ступеня полімеризації (< 150) СА мембрани мають невисокі механічні властивості, тоді як за високого ступеня полімеризації (> 600-700) значно підвищується в'язкість розчинів, що утрудняє полив при формуванні мембран.

Процес виготовлення плоских СА мембран включає: розчинення полімеру у розчиннику, отримання формувального розчину, вилив цього розчину на гладку скляну пластину, випаровування розчинника за низької температури, коагуляцію в крижаній воді та кінцевий відпал у гарячій воді [6]. У типовому формувальному розчині міститься (у мас. %): 22,0 % СА; 1,1 % перхлорату магнію; 10,0 % води; 66,7 % ацетону. Середня молекулярна маса та розподіл молекулярної маси сирого порошку СА не є особливо важливим. Однак затримувальна здатність може бути значно покращена за високого вмісту ацетильних груп в СА в межах його розчинності в ацетоні. Зазвичай рекомендують вміст ацетильних груп 39,8 %.

Розчин виливається на гладку скляну пластину за температури від – 5 до – 10 °С. При цьому розчинник випаровується на повітрі впродовж 3 хв. В цей момент формується щільний тонкий шар. Сформована плівка потім поміщається у крижану воду приблизно на 1 год для вимивання електроліту та гелеутворення. На цій стадії мембрана є надто пористою і має низьку механічну міцність і селективність, проте високу продуктивність. Одна, якщо сформована мембрана поміщається в гарячу воду, пори мембрани стискаються і зростає товщина тонкого шару. Селективність і механічна міцність, відповідно, значно зростають.

З підвищенням температури води, у якій витримується мембрана, проникність знижується, а селективність зростає. Здатність мембран до ущільнення є корисною властивістю. Наприклад, для знесолення відпал слід проводити за температури 65 – 85 °С впродовж 5 хв. Анізотропні СА мембрани, що приготовлені таким чином, мали проникність $3 \cdot 10^5$ кг/(м^2 · с) і селективність понад 99 % за тиску 10 МПа. Пізніше [6] почали виготовляти мембрани з СА без електроліту. Формувальний розчин складався (у мас. %) з: 25 % СА; 30 % формаміду; 45 % ацетону. Формування мембран стало значно простішим (за кімнатної температури).

На практиці найбільш широко використовують формування мембран мокрим і сухо-мокрим способами [2, 7]. Остаточна структура мембрани та її властивості залежать від таких параметрів [8]: концентрації і складу полімерного розчину; матеріалу підкладки; товщини шару поливального розчину полімеру на підкладці; природи та складу осаджувача (чи суміші осаджувач-розчинник); температури навколишнього середовища та полімерного розчину, коагуляційної та термообробної ванн; тривалості стадії випаровування перед коагуляційною ванною; вологості повітря та швидкості паро-, газообміну над поверхнею розчину.

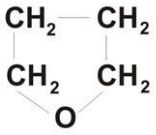
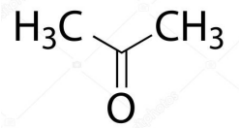
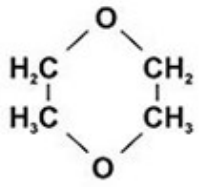
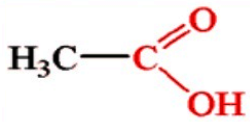
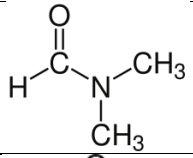
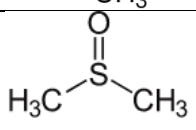
Процес формування плоскої мембрани складається з чотирьох основних стадій [4]: 1) нанесення розчину полімеру на плоску поверхню (наприклад, на нетканий поліефірний матеріал чи на скляну пластину); 2) випаровування розчинника з поверхні полімерного розчину (етап передформування мембрани); 3) занурення плівки в осаджувальну ванну (етап коагуляції), де відбувається гелеутворення (як

осаджувач зазвичай використовують воду); 4) термічна обробка (відпал). Під час попереднього випаровування розчинника з розчину полімеру нанесеного на поверхню підкладки, формується активний шар мембрани. Його затримувальна здатність залежить від тривалості випаровування (кількості випарюваного розчинника), температури, швидкості випаровування та вологості навколишнього середовища. Збільшення температури випаровування призводить до формування мембран з більш щільним поверхневим шаром [9]. Цього ж можна досягти зменшенням товщини формувального розчину [10]. Товщина поливального розчину також впливає на формування макропустот в мембрані [11]. При формуванні мембран з розчину складу ацетат целюлози + ацетон + вода макропустоти формуються лише при товщині шару розчину 500 мкм. При зануренні рідкої полімерної плівки в осаджувальну ванну утворюється широкопориста основа мембрани [12].

Закономірність формування мембрани при зануренні сформованої плівки у нерозчинник визначається взаємодією між трьома компонентами – полімером, розчинником та нерозчинником. [3]. Розчинник та нерозчинник починають змішуватися за рахунок дифузії. Проникнення нерозчинника в плівку відбувається по всьому поперечному перетину у вигляді фронтальних дифузій, за якими рухається фронт коагуляції (осадження, затвердіння) полімеру. Дія осаджувача полягає у швидкому розкритті того полімерного каркасу, який існував у рідкому стані в розчині. Поява гелю спостерігається візуально при помутнінні розчину в плівці. Як правило, відбувається ущільнення плівки в міру витіснення розчинника за рахунок виникнення сил міжмолекулярної взаємодії в полімері. Основною обставиною, що визначає пористість і розмір пор мембран, є відношення швидкості фронту дифузії та фронту коагуляції. Якщо коагуляція протікає швидко після витіснення розчинника, то в плівці фіксується таке розташування макромолекул, яке вони займають у розчині. Якщо коагуляція відбувається із запізненням, встигає проходити релаксація, макромолекули вибудовуються в нову, більш щільну структуру, аж до кристалічної. Якщо розчинник швидко уходить з плівки, пористість збільшується. Регулювання цього процесу можна здійснювати: підбором пари «розчинник-осаджувач», додаванням до осаджувальної ванни розчинника, зміною температури осаджувальної ванни [3]. Для СА найкращим осаджувачем є вода. За зменшенням хімічної спорідненості з водою (зверху до низу) розчинники можна розташувати в ряд (табл. 1).

Таблиця 1

Розчинники ацетату целюлози та їх властивості [13 – 16]

Розчинник	Формула	Властивості
Тетрагідрофуран (ТГФ)		Рідина, з характерним запахом, добре розчинний у воді. Температура кипіння – 66 °С, густина – 0,8892 г/см^3 за температури 20 °С. Добре розчинний у воді. Молярна маса (ММ)– 72,11 г/моль
Ацетон (А)		Рідина без кольору з характерним запахом; температура кипіння 56,1°С при 760 мм.рт.ст.; густина 0,798 г/см^3. Добре розчинний у воді та в багатьох органічних розчинниках. ММ – 58,08 г/моль
Диоксан		Рідина без кольору; температура кипіння 101 °С; густина 1,03 г/см^3. Добре розчинний у воді та в багатьох органічних розчинниках. Молярна маса – 88,11 г/моль
Оцтова кислота		Рідина без кольору з характерним запахом; температура кипіння 117,87 °С за тиску 101,3 кПа; густина 1,0446 г/см^3. Добре розчинний у воді та в багатьох органічних розчинниках. ММ – 60,053 г/моль
Диметилформамід (ДМФА)		Рідина без кольору, добре розчинний у воді, спирті, етері. Температура кипіння –153°С, густина –0,948 г/см^3. ММ – 73,09 г/моль
Диметилсульфоксид (ДМСО)		Прозора рідина, добре розчинний у воді, спирті. Температура кипіння – 189°С, густина – 1,1 г/см^3 за 20 °С. ММ – 78,13 г/моль

Відпал сприяє виникненню водневих зв'язків між полімерними ланцюгами і, як наслідок, більш щільною упаковці надмолекулярної структури. Завершуються релаксаційні процеси, а для їх прискорення температура відпалу повинна відповідати початку переходу в високоеластичний стан [3]. Вважається, що кількість пор в мембрані при відпалі не змінюється, лише зменшується їх розмір. При цьому деформація структури щільного шару більше, ніж матриці через більше скупчення внутрішніх напружень в ньому на стадії коагуляції.

Процес розчинення полімеру є дуже відповідальною операцією, оскільки співвідношення компонентів розчину, його структура помітно впливають на властивості мембран. Тривалість розчинення полімеру і однорідність розчину значно залежать від типу апарату, в якому проводять розчинення, від режиму перемішування, порядку завантаження компонентів, температури процесу. У випадку приготування формувальних розчинів низької в'язкості використовують апарати з пропелерними мішалками. Для отримання висококонцентрованих розчинів високої в'язкості застосовують апарати з рамними, лопатевими та спіральними мішалками чи апарати зі шнеками. Частота обертання мішалки складає 5 – 50 $хв^{-1}$ [2].

Для кращого розчинення полімеру завантаження компонентів здійснюють частинами. Спочатку в апарат заливають приблизно половину розчинника і за включеної мішалки невеликими порціями вводять розпушений полімер. Далі вводять решту розчинника і продовжують перемішування (зазвичай 6 – 24 год) до повного розчинення полімеру. В цей період у сорочку апарату подають тепло- чи холодоносій для пришвидшення процесу розчинення. Агент набухання та інші компоненти вводять вже в готовий розчин або попередньо змішують з розчинником чи полімером.

Фільтрування розчину є необхідною та відповідальною операцією, що забезпечує видалення набухлих частинок полімеру (гель-частинок), мінеральних домішок, нерозчинених часток різного походження. Зазвичай фільтрування проводять у декілька ступенів. Для цього застосовують рамні, металокерамічні або керамічні фільтри, а також фільтри з намивними шарами. Фільтруючий матеріал обирають залежно від в'язкості, забрудненості розчину та природи розчинника. В ряді випадків розчин підігрівають для зниження в'язкості. Граничне значення тиску при фільтруванні залежить від в'язкості розчину і конструкції фільтру, і зазвичай не перевищує 2,5 МПа, хоча в окремих випадках може досягати 10 МПа.

Необхідність видалення повітря чи іншого газу з формувального розчину викликане тим, що бульбашки газу, потрапляючи в мембрану, можуть утворити у ній дефекти. Розчинене повітря може виділятися в процесі формування за зміни температури формувального розчину і також стати причиною появи дефектів у мембрані. Видалення повітря здійснюють періодичним або неперервним способом. У випадку періодичного способу розчин довго витримують у баках за атмосферного чи зниженого тиску. Тривалість операції залежить від в'язкості і висоти шару розчину, а також залишкового тиску в апараті.

Видалення повітря з розчинів, що містять малолетючі розчинники, може здійснюватися неперервно за високої температури і під вакуумом. Для цього застосовують апарати, в яких розчин стікає по похило встановленим всередині апарата конусам.

Формування мембрани із розчину відбувається за допомогою філь'єр, конструкцію яких вибирають залежно від необхідної форми мембрани, в'язкості розчину і летючості компонентів розчину. Регулювання товщини шару розчину, з якого буде сформована мембрана, здійснюють не лише зміною величини зазору між ножем і підкладкою, що рухається, але й за рахунок зміни швидкості руху останньої. За рахунок тертя шарів об ніж філ'єри у верхніх шарах плівки, що утворюється, встановлюється певна орієнтація полімерних ланцюгів, яка може впливати на властивості мембрани. Від ретельної шліфовки нижнього краю ножа філ'єри багато в чому залежить рівномірність структури мембрани.

На рис. 1 представлено схему комплексного виробництва плоских ацетатцелюлозних мембран для зворотного осмосу, ультрафільтрації і мікрофільтрації.

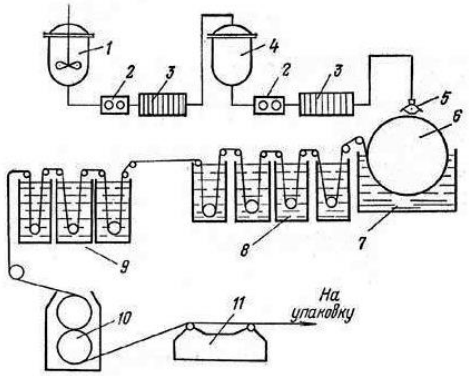


Рис. 1. Схема виробництва мембран з СА: 1 – апарат для приготування формувального розчину; 2 – насос; 3 – фільтр; 4 – бак для видалення повітря з формувального розчину; 5 – філь'єра; 6 – формувальний барабан; 7 – осаджувальна ванна; 8 – машина для промивання мембрани; 9 – машина для оброблення мембрани; 10 – сушарка; 11 – пристрій для дефектоскопіювання

Тривалість передформування можна регулювати за рахунок зміни довжини шляху рідкої плівки до занурення її в осаджувальну ванну, зміною в зоні передформування температури і концентрації парів розчинника, а також швидкості руху повітря.

Основними технологічними параметрами стадії формування є температура осаджувальної ванни та її склад, швидкість руху формованої плівки. На стадії формування в осаджувальній ванні утворюється гель, що імпрегнований сумішшю розчинника і осаджувача. Підтримування стабільної температури в осаджувальній ванні здійснюється теплообмінниками, що розташовані ззовні формувальної машини, змійовиками, що укладено в барці, або поміщенням барки в термостатичну сорочку.

Основними параметрами стадії відмивання мембран від залишкового розчинника є температура, швидкість руху промивної рідини та її склад. Регулюючи ці параметри, можна змінювати кінетику процесу та ступінь його завершеності. Для СА температура склування у суміші води з розчинником не перевищує 50 ºС, а нагрівання промивної води вище цієї температури може спричинити деформацію мембрани при протягуванні її через промивні барки.

Після промивання мембрани для зворотного осмосу піддають гідротермічному обробленню (відпал) впродовж 1 – 10 хв гарячою водою за температури 70 – 100 ºС. При цьому підвищується селективність мембран і їх стійкість до підвищених тисків. Під час відпалу уникають натягу плівки. Для збільшення продуктивності ацетатцелюлозних мембран після гідротермічного оброблення їх обробляють аліфатичними спиртами [6].

Перед сушінням, для запобігання незворотної усадки, мембрани імпрегнують труднолетючими рідинами, наприклад, гліцерином чи його водними розчинами. Іноді до нього додають поверхнево-активні речовини (ПАР). Тривалість операції, залежно від пористості мембрани і температури, складає від 2 до 30 хв. Після імпрегнування мембрану піддають сушінню. Вода з неї випаровується, а гліцерин (чи інша труднолетюча рідина) залишається в мембрані, заповнюючи пори. Сушіння мембран для зворотного осмосу і ультрафільтрації, що отримані методом мокрого формування, не є обов'язковим. Його здійснюють для мікрофільтраційних мембран, причому до сушіння їх не імпрегнують. Температура сушіння – 50 – 90 ºС. Може застосовуватися контактне чи конвективне сушіння.

Далі передбачають дефектоскопіювання мембран – візуальний огляд поверхні на наявність пошкоджень, сторонніх включень та ін. Його здійснюють перемотуванням мембран над поверхнею скляного столика, що підсвічується знизу. Готові мембрани упаковують в рулони або у вигляді дисків, квадратів та аркушів іншої форми.

Кроком вперед є процес виготовлення плоских ультрафільтраційних СА мембран, що пропонують автори [17]. Мембрани готували методом інверсії фаз, з використанням ацетату целюлози як полімеру, LiCl та $CaCl_2$ як пороутворювачів та метил-(S)-лактату як розчинника. Всі складові формувального розчину, що використані в цій роботі, отримують із відновлюваних ресурсів; вони біологічно розкладаються, є нетоксичними та нелеткими органічними сполуками. Проникність мембран складає 13 – 177 $дм^3/(м^2 \cdot год \cdot бар)$.

Висновки. СА-асиметричні мембрани застосовується в широкому діапазоні процесів фільтрації (від зворотного осмосу до мікрофільтрації). Обумовлено це відносно низькою вартістю СА, відновлюваною сировинною базою [5], відносно нескладною технологією виготовлення. Змінюючи ступінь заміщення СА, можна в широких межах варіювати його гідрофільністю. А змінюючи параметри технологічного процесу виробництва, можна впливати на основні властивості мембрани. Наступний огляд буде присвячений методам модифікації СА мембран.

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ANALYSIS OF THE POWER OF THE EXPANDER-GENERATOR UNIT DEPENDING ON THE TEMPERATURE OF THE LOW-POTENTIAL HEAT SOURCE

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АНАЛИЗ ЗАВИСИМОСТИ МОЩНОСТИ ДЕТАНДЕР – ГЕНЕРАТОРНОГО АГРЕГАТА ОТ ТЕМПЕРАТУРЫ НИЗКОПОТЕНЦИАЛЬНОГО ИСТОЧНИКА ТЕПЛА

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Abstract

The article deals with the problem of using secondary energy resources in the natural gas transportation and distribution system, and the possibility of generating electricity without burning fuel by reducing high-pressure natural gas at gas distribution stations. The analysis of the influence of the temperature of a low - potential heat source on the preheating of the gas at the inlet to the expander-generator unit and, consequently, on the power is given.

Аннотация

В статье рассматривается проблема использования вторичных энергоресурсов в системе транспорта и распределения природного газа, и возможность производства электроэнергии без сжигания топлива редуцированием природного газа высокого давления на газораспределительных станциях. Приведён анализ влияния температуры низкопотенциального источника тепла на предварительный подогрев газа на входе в детандер - генераторный агрегат и, следовательно, на мощность.

Keywords: secondary energy resources, natural gas, expander-generator, low-potential heat source, preheating, power.

Ключевые слова: вторичные энергоресурсы, природный газ, детандер - генератор, низкопотенциальный источник тепла, предварительный подогрев, мощность.

Одно из направлений энергосбережения в системе добычи и транспортировки газа связано с применением детандер-генераторных агрегатов (ДГА) для выработки электроэнергии за счет использования технологического перепада давления транспортируемого природного газа. Детандер-генераторный агрегат представляет собой устройство, в котором теплосодержание транспортируемого потока природного газа сначала преобразуется в механическую энергию в детандере, а затем в электричество в генераторе [1].

Снижение давления газа при использовании ДГА на ГРС и ГРП происходит за счет его расширения в детандере. Существует также принципиальная возможность одновременного с выработкой электроэнергии производства и полезного использования тепла и холода [2]. Установив утилизационные установки, использующие избыточный потенциал давления газа, можно получить электрическую энергию как на ГРС и ГРП, так и на других узлах редуцирования [3].

На рисунке 1 представлена принципиальная схема включения ДГА.

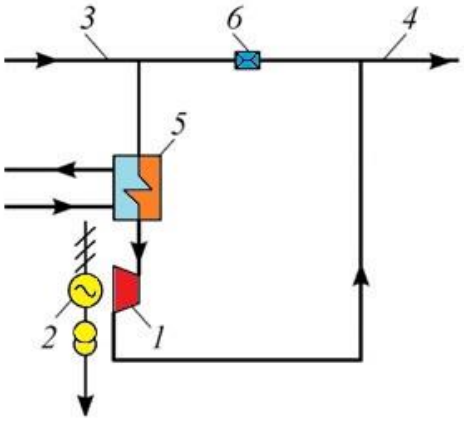

Рис.1. Схема газорасширительного комплекса ГРП (ГРС) с ДГА

Расширитель подключается параллельно дроссельному устройству, заменяя его частично или полностью. Когда газ расширяется в детандере, температура потока падает намного больше, чем при дросселировании. Без предварительного подогрева перед детандером температура газа может быть ниже температуры, при которой эксплуатация газопроводов невозможна. По этой причине, помимо детандера и подключенного к нему электрогенератора, ДГА включает в себя теплообменник для подогрева газа перед детандером [4].

Подогрев газа до ДГА можно производить до некоторого значения, так как температура выхода из ДГА необходимо придерживать в пределах от 22 до 30 ^{0}C. Это связано в первую очередь с тем, что существует воздействие газа, при температурах выше допустимой, на трубопровод, который может привести к износу.

Температура подогрева лежит в пределах от 30 до 100 ^{0}C. Выбор температуры производится из технико-экономического соображения, так как дальнейшее повышение температуры приводит к затратам при подводе стороннего источника тепла. Источником тепла может служить отработанное тепло с ТЭС (если ГРС или ГРП находится по близости), теплонасосная установка.

В том случае, если источником тепла служит теплонасосная установка, то необходимо учесть и температуру низкопотенциального источника тепла.

Для расчёта были приняты данные представленные в таблице 1.

Таблица 1

Исходные данные для расчёта мощности ДГА

Расход газа Q, $м^3/ч$	**Входное давление $P_{вх}$,** Мпа	**Выходное давление $P_{вых}$,** Мпа
41000	19	6

Полученные данные при расчёте по приведённым первоначальным данным представлены в таблице 2.

Таблица 2

Зависимость мощности ДГА при различных температурах газа

Температура газа на входе в ДГА, ^{0}C	Мощность ДГА, кВт
30	923,8
40	954,2
50	984,7
60	1015,2
70	1045,7
80	1076,2

Оптимальные значения температур для подогрева газа до ДГА, представлены на графике зависимости полезной мощности ДГА при различных температурах низкопотенциального источника тепла (рис.2.).

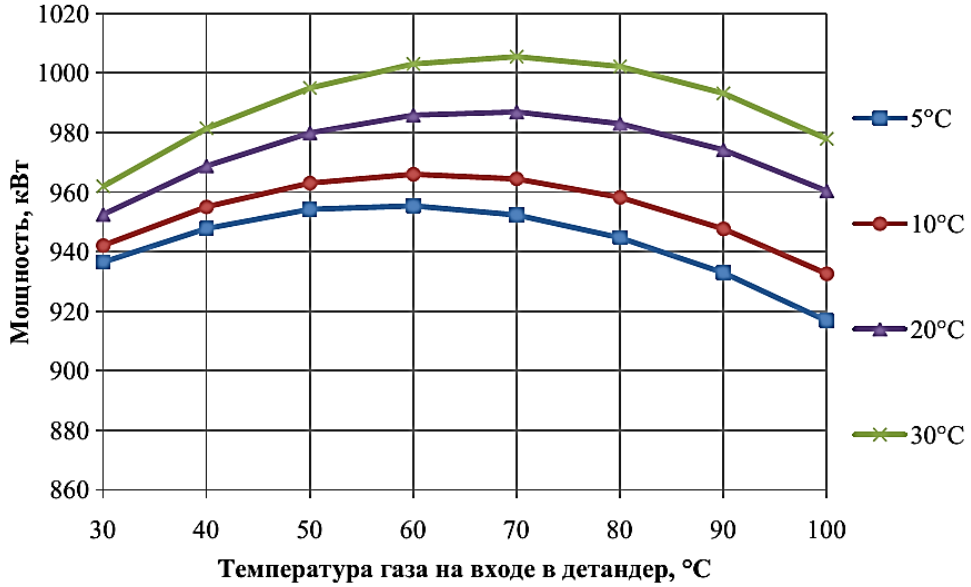

Рис.2. Зависимость полезной мощности ДГА от температуры газа на входе в детандер и температуры источника низкопотенциальной теплоты

Результаты исследований показывают [5], что оптимальное значение температуры газа, поступающего в детандер, соответствует максимальной полезной мощности системы. Из графика видно, что оптимальное значение температуры газа на входе в детандер увеличивается с 60 до 70 ^{0}C при изменении температуры источника тепла с низкотемпературным потенциалом от 5 до 30 ^{0}C.

Максимальная полезная мощность ДГА соответствует температуре на входе в расширитель 70 ^{0}C и низкой температуре источника тепла 30 ^{0}C. Доля мощности, подаваемой ДГА, монотонно уменьшается с увеличением температуры газа на входе в расширитель. Эта зависимость объясняется соотношением мощности, вырабатываемой детандером, и мощностью собственных нужд установки.

Мощность детандера увеличивается с увеличением температуры газа на входе детандер, в то время как мощность собственных нужд также увеличивается (в основном из-за увеличения мощности, потребляемой компрессором теплонасосной установки).

Температура низкопотенциального источника тепла имеет большое влияние на величину доли мощности, вырабатываемой с помощью ДГА. При повышении температуры низкопотенциального источника тепла от 5 до 30 ^{0}C часть отпускаемой мощности увеличивается на 2,6 – 5,0 %, чем выше температура газа перед детандером, тем больше влияние оказывает изменение температуры источника низкопотенциальной теплоты.

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BENCHMARKING OF TECHNOLOGICAL TRANSPORT

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БЕНЧМАРКИНГ ТЕХНОЛОГИЧЕСКОГО ТРАНСПОРТА

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Abstract

Technological transport is involved in a large number of technological processes of the main production activity. To improve the efficiency of technological transport, it is necessary to constantly regulate its activities based on the analysis of activities. For a more effective analysis, it is necessary to revise the principles of its conduct and key assessment indicators.

Аннотация

Технологический транспорт в организациях участвует в большом числе технологических процессов основной производственной деятельности. Для повышения эффективности деятельности технологического транспорта необходимо постоянно регулировать его деятельность на основе анализа деятельности. Для более эффективного проведения анализа необходимо пересмотреть принципы его проведения и ключевых показателей оценки.

Keywords: benchmarking, technological transport, mono-analysis.
Ключевые слова: бенчмаркинг, технологический транспорт, моно-анализ.

Бенчмаркинг (от англ. Bench – уровень, высота и mark – отметка) – это метод управления предприятием, предполагающий непрерывный процесс оценки и сравнения характеристик товаров/ услуг и способов организации работы с эталонными показателями ведущих компаний для сбора информации, которая поможет рассматриваемому предприятию определить цель своего совершенствования и провести мероприятия по улучшению работы [1].

Актуальность применения бенчмаркинга как инструмента анализа деятельности предприятия, а именно технологического транспорта имеет высокий потенциал. На данный момент все крупные компании «гиганты» используют бенчмаркинг для регулирования своей деятельности с целью повышения эффективности. Деятельность транспорта в таких компаниях имеет важную роль, так как он используется в технологии производственных процессах. Регулирование деятельности транспорта в

априори связано с экономической эффективностью, а по тому на практике анализ деятельности транспорта проводится за счет экономических показателей, что является не рациональным по ряду причин. Одной из которых выступает качество обслуживания производственных процессов. Также важнейшим показателем является мобильность осуществления технологических процессов, которая подразумевает использование техники по необходимости, а не в рамках обозначенной эксплуатации. Контроль деятельности также играет важную роль, которая проявляется в возможности планирования технологических параметров деятельности транспорта. На основании вышеизложенного и беря во внимание практику применения бенчмаркинга технологического транспорта констатируется не достаточная эффективность анализа деятельности технологического транспорта.

Для эффективного анализа требуется пересмотреть ключевые параметры бенчмаркинга, что на данный момент времени не проводится. Вся суть проводимого анализа является возможность перехода на аутсорсинг, для снижения уровня себестоимости деятельности технологического транспорта предприятия. Для осуществления полного бенчмаркинга необходимо провести двухступенчатый анализ, который должен включать внутренний моноанализ (анализ деятельности технологического транспорта структурной единицы предприятия) и стерео-анализ (анализ деятельности технологического транспорта структурных единиц внутри компании). Предложенный многоуровневый анализ не противоречит основам и методологии проведения бенчмаркинга. Алгоритм проведения бенчмаркинга не имеет строгой регламентации, но зачастую в нем выделяют шесть основных этапов. [2].

Важным уровнем проведения анализа является моно-анализ, так как стерео-анализ будет осуществляться на его основе. Бенчмаркинг связан с поиском, изучением и подбором соответствующих методов организации бизнес-процессов, позволяющих компании достичь поставленных целей [3]. Для проведения первого и второго уровня анализа необходимо определить ключевые параметры технологического транспорта. Кроме того, для дальнейшего использования данных и как следствия их регулирования необходимо обеспечить достаточно удобную форму их представления. Предлагается применять , на основе ключевых показателей деятельности. Паспорт деятельности технологического транспорта предприятия (за отчетный год) и карту анализа деятельности технологического транспорта предприятия, которая представлена по годам включая два предыдущих года с представлением информации об изменении в абсолютном и относительном виде (Рисунок 1).

Представленный анализ с применением паспорта деятельности технологического транспорта предприятия, позволяет помимо оценки провести анализ возможного регулирования деятельности предприятия. Применение бенчмаркинга в представленном виде позволяет контролировать натуральные и эксплуатационные показатели предприятия, кроме того производить сравнение и контроль деятельности структурных подразделений осуществляющих транспортную деятельность. В случае применения на долгосрочной основе в период определенного времени, данный анализ представляет возможность в определение ориентиров деятельности и дальнейшему повышению эффективности транспортной деятельности в виде оптимизации и усовершенствования различных эксплуатационных и управленческих решений.

ТЕХНИКА / ПАРАМЕТР	Автобусы	Легковой транспорт	Грузовой транспорт	Специальная техника	Строительно-дорожная техника	Подъемно транспортные машины	Прочее	Общий
АВТОПАРК								
Кол-во								
Использующие бензин								
Использующие ДТ								
Использующие ГМТ								
Средний возраст								
Максимальный возраст ТС								
К.В.П.								
К.Т.Г.								
АВАРИИ								
Кол-во								
По вине предприятия								
По вине 3-их лиц								
РЕМОНТ								
Кол-во ТО								
Кол-во ТР								
Кол-во КР								
Техника, ед. ТО								
Техника, ед. ТР								
Техника, ед. КР								
РАСХОД								
Кол-во топлива израсходованного								
Бензин								
ДТ								
ГМТ								
Топливо в час								
Бензин								
ДТ								
ГМТ								
ПРОБЕГ								
Общий пробег								
Средний пробег 1 ед. ТС								
Средний пробег в час. 1 ед. ТС								
АУТСОРСИНГ								
Кол-во техники сторонних организаций								
Абсолютный показатель аутсорсинга								

Рис. 1. Карта оценки деятельности технологического транспорта

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VETERINARY SCIENCES

THERAPEUTIC EFFICACY OF THE VETERINARY DRUG "MASTOVET" IN THE TREATMENT OF COWS WITH CHRONIC NECROTIC PODODERMATITIS

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ТЕРАПЕВТИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ВЕТЕРИНАРНОГО ПРЕПАРАТА «МАСТОВЕТ» ПРИ ЛЕЧЕНИИ КОРОВ С ХРОНИЧЕСКИМ НЕКРОТИЧЕСКИМ ПОДОДЕРМАТИТОМ

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Abstract

We have developed a treatment regimen for cows with chronic necrotic pododermatitis, using the veterinary drug "Mastovet", which provides a faster restoration of the function of damaged tissues. Mastovet has antiseptic, anti-inflammatory and wound-healing effects, which is due to the components of the drug.

Аннотация

Нами была разработана схема лечения коров с хроническим некротическим пододерматитом, с применением ветеринарного препарата «Мастовет», которая обеспечивает более быстрое восстановление функции поврежденных тканей. Мастовет обладает антисептическим, противовоспалительным и ранозаживляющим действиями, что обусловлено компонентами препарата.

Ключевые слова: некротический пододерматит, копытца, крупный рогатый скот, мастовет.
Key words: necrotic pododermatitis, hooves, cattle, mastovet.

Введение. На современном этапе развития республик, входящих в СНГ и происходящие изменения в их экономике, социально-общественной сфере выдвигают на первый план проблемы аграрного сектора. В связи с этим особую актуальность приобретают вопросы продовольственной безопасности, вывода аграрного сектора из создавшегося кризиса, а также научное обеспечение повышения эффективности сельскохозяйственного производства. В этой связи основной задачей ветеринарной науки и практики является разработка и внедрение современных, наиболее эффективных и экологически чистых методов, профилактики и лечения заболеваний животных.

Болезни дистального отдела конечностей коров в последние 20 лет являются наиболее актуальной проблемой животноводства, так как наносят значительный экономический ущерб хозяйствам, за счет выбраковки большого количества больных животных, причем самых высокопродуктивных, при этом заболеваемость копытец у коров в отдельных хозяйствах доходит до 70-80% от общего поголовья.

Основными причинами заболеваний копытец у крупного рогатого скота по мнению большинства ученых являются: нарушение технологических принципов содержания; несбалансированное кормление по основным питательным веществам, макро- и микроэлементам; механические повреждения роговой капсулы и мягких тканей; отсутствие или недостаточный моцион; широкое внедрение в производство высокопродуктивных пород скота со слабым копытцевым рогом [1, 2, 3].

Исходя из актуальности, **целью** наших исследований явилось разработать схему лечения коров с хроническим некротическим пододерматитом с применением ветеринарного препарата «Мастовет».

Материалы и методы исследований. Для оценки терапевтической эффективности ветеринарного препарата «Мастовет» при лечении крупного рогатого скота по принципу условных аналогов было сформировано две группы животных (по 5 голов) с клиническими признаками хронического некротического пододерматита.

Животным опытной группы после функциональной ортопедической расчистки и хирургической обработки копытец вначале местно использовали сложный порошок, в состав которого входят: калия перманганат – 50%, борная кислота – 13%, сульфаформ – 13%, стрептоцид – 12%, тилозин – 12%, а затем, начиная с третьих суток, применяли ветеринарный препарат «Мастовет» с наложением бинтовой повязки. При лечении коров контрольной группы схема лечения была схожей, но вместо ветеринарного препарата «Мастовет» при наложении повязок применяли 10% ихтиоловую мазь.

Всех подопытных животных визуально осматривали в состоянии покоя, обращая внимание на положение и постановку конечностей, состояние и форму копытец (особенно уделяли внимание на «гипертрофированные» копытца), наличие отечности мягких тканей. При местном осмотре пораженных копытец устанавливали размер, форму патологических процессов в пораженной части копытец.

Результаты исследований. До начала лечения коров с пораженными копытцами нами отмечалась схожая клиническая картина течения хронического некротического пододерматита для всех исследуемых животных. У большинства коров на пораженных конечностях отмечались на подошве и мякишах углубления темного цвета. Часть из углублений сливалась и образовывались борозды. Рог подошвы представлял собой шероховатую фрагментированную поверхность.

У животных исследуемых групп данное заболевание вызвало ряд осложнений: разрыхление подошвы, поражение аксиальной борозды, поражение пяточной части копытец, заболевание белой линии и поражения в области межпальцевой щели.

В ходе проводимой функциональной расчистки копытец у коров опытной и контрольной групп поражения различной формы и размеров отмечали на подошвенной поверхности. В контрольной группе площадь патологического процесса составила – 15,42±2,54 см^2, в опытной группе – 14,97±3,11 см^2.

Спустя 5 суток после начала лечения у всех животных заживление некротического пододерматита происходило с разной степенью интенсивности, в зависимости от локализации поражения. Зона поражения была заполнена гнойным экссудатом. В среднем площадь раневых дефектов в контрольной группе уменьшилась на 34%, в опытной группе соответственно на 38,6%.

Спустя 10 суток после начала лечения у некоторых животных в контрольной группе отмечали заполнение полости дефекта грануляционной тканью, на поверхности которой имелся налет гнойного экссудата, часть дефектов заполнялась роговой тканью, плотной консистенции, болезненность при пальпации незначительная. У животных опытной группе дефект заполнялся роговой тканью. В среднем площадь очагов гнойного воспаления в области основы кожи копытец в контрольной группе уменьшилась на 46,6%, в опытной группе на 51,4%.

На 21 сутки динамика заживления некротического пододерматита у коров исследуемых групп

носила однотипный характер: формирование роговой ткани по площади дефекта, это заметно уменьшало площадь поражения, в среднем у животных контрольной групп она была на 78,2% меньше. У коров опытной дефектов не обнаружено.

В опытной группе на 21-е сутки все животные клинически выздоровели, патологический процесс был полностью закрыт копытцевым рогом. В контрольной группе на 26-е сутки после начала лечения у всех коров диагностировали полное выздоровление.

Заключение. Разработанная нами схема лечения коров с хроническим некротическим пододерматитом с применением ветеринарного препарата «Мастовет» обеспечивает более быстрое восстановление функции поврежденных тканей. Мастовет обладает антисептическим, противовоспалительным и ранозаживляющим действиями, что обусловлено компонентами препарата.

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