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TOG‘ YONBAG‘IRLARI VA QIYALIKLARIDA KO‘CHKI XAVFINI BAHOLASH

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ANNOTATSIYA

Ushbu maqolada tog‘li hududlar hamda tog‘ yonbag‘irlari abtomobil yo‘llaridagi tog‘ ko‘chkilari va qiyaliklarning surilish xavfi bilan bog‘liq bo‘lgan texnik asoslovchi tushunchalar va tog‘ ko‘chkilariga kompleks yondashuvdagi ma‘lumotlar aks etgan. Tog‘li hudud sharoiti va avtomobil yo‘llarining o‘zaro bog‘liqligi orqali ro‘y berish ehtimoli yuqori bo‘lgan tog‘ qiyaliklaridagi ko‘chki xavfini tahlil qilish va baholash uchun zaruriy bo‘lgan dastlabki ma‘lumotlarni yig‘ish, ko‘chki paydo bo‘luvchi ehtimoliy nuqtalari, ko‘chkini keltirib chiqaruvchi faktorlar va elementlarning muhim jihatlari o‘rganilgan. Tog‘li hududlardan o‘tuvchi avtomobil yo‘llarida yuz beradigan ko‘chkilar juda katta yo‘qotishlarga olib keladi va avtomobil yo‘lidagi harakat xavfsizligiga ham katta ta‘sir o‘tkazadi. Ushbu maqoladagi izlanishlar xalqaro ahamiyatdagi A-373 “Toshkent-O‘sh” avtomobil yo‘li misolida yoritilgan.

Kalit so‘zlar: *Avtomobil yo‘li, Tog‘ ko‘chkilari, Ko‘chki xavfi, Yonbag‘irlar, Dovon, Intensivlik.*

ABSTRACT

This article presents technical rationale concepts related to landslide and slope hazards in mountainous and hillside areas and provides information on an integrated approach to landslides. Collection of preliminary data necessary for the analysis and assessment of the risk of landslides on mountain slopes with a high probability of occurrence due to the interaction of mountainous terrain conditions and highways, important aspects of possible landslide points, factors and elements that cause landslides have been studied. Landslides that occur on highways passing through mountainous areas cause enormous damage and have a major impact on road safety. The research in this article is carried out using the example of the A-373 Tashkent-Osh international highway.

Keywords: *Highway, Landslides, Landslide hazard, Slopes, Pass, Intensity*

1. KIRISH

Tog‘ yonbag‘irlari va qiyaliklarida joy relefining beqqarorligi hamda tashqi ta‘sirlar natijasi har yili avtomobil yo‘llariga salbiy oqibatlarga olib kelmoqda. Jumladan, tog‘ ko‘chkilari, qiyalikdagi gruntlarning surilishi kabi ofatlar natijasida avtomobil yo‘llari xususan, harakat jadalligi yuqori va xalqaro ahamiyatga ega bo‘lgan A-373 “Toshkrnt-O‘sh” avtomobil yo‘lidagi “Qamchiq” dovonida bu kabi hodisalar juda ko‘plab kuzatilmoqda [1-3]. Tog‘ qiyaliklarining beqarorligi va tez-tez ro‘y beradigan ko‘chkilar natijasida nafaqat infratuzilma ob‘ektlari, balki atrof muhit hamda ekologiyaga ham jiddiy ta‘sir qilmoqda. Jumladan qiyaliklarning tabiiy holati va mustahkamligining o‘zgarishi natijasida relefning keskin o‘zgarishlariga sabab bo‘lmoqda.

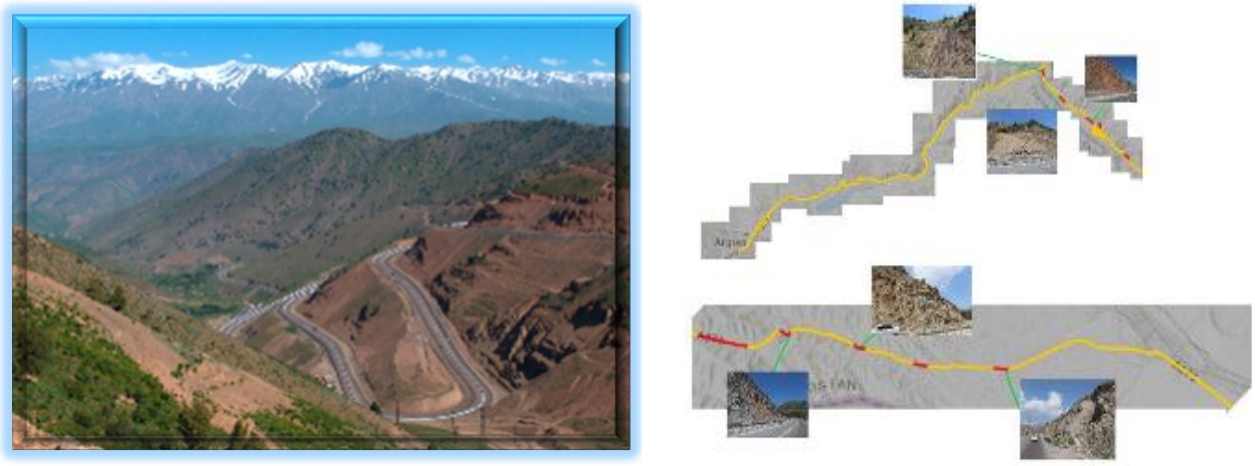
Tog‘ qiyaliklarining surilishi va ko‘chkilarning asosiy sabablari geologik, gidrogeologik va geomorfologik sharoitlar hisoblanib, bundan tashqari tog‘ yonbag‘irlarining tabiiy geodinamikasi o‘simlik, yerdan foydalanish va inson faoliyati kabi omillar ta‘siri ham muhim rol o‘ynaydi [4,5].

Yuqorida keltirilgan ma‘lumotlarni tahlil qilish, tog‘ ko‘chkilarining ro‘y berish ehtimolligini baholash va yo‘llarga ta‘sirini prognozlash bo‘yicha aniq yo‘nalishlar tanlab olish hamda ko‘chkini xarakterlovchi matematik ifodalar ishlab chiqish ma‘lum darajada muammoni hal qilish imkonini yaratadi.

2. KO‘CHKI XAVFI MAVJUDLIGINI BAHOLASH

A-373 “Toshkent-O‘sh” avtomobil yo‘li O‘zbekiston Respublikasi uchun muhim strategik ahamiyatga ega bo‘lgan xalqaro ahamiyatga ega bo‘lgan avtomobil yo‘li hisoblanadi. Ushbu avtomobil yo‘li Respublikaning vodiy viloyatlarini qolgan barcha viloyatlar bilan bog‘lovchi hamda boshqa aylanma va alternativi mavjud bo‘lmagan avtomobil yo‘li hisoblanadi (1-rasm).

A-373 “Toshkent-O‘sh” avtomobil yo‘lining tog‘li qismidan o‘tuvchi “Qamchiq” dovonida tog‘ ko‘chkilari muntazam uchrab turadi. Ushbu “Qamchiq” dovonining uzunligi 100 km. bo‘lib A-373 avtomobil yo‘lining 185-285-km.larida joylashgan.



1-rasm. A-373 “Toshkent-O‘sh” avtomobil yo‘li “Qamchiq” dovoni

Tog‘ yonbag‘irlarida ko‘chki xavfini aniqlash, xavfli ko‘chkilarning ma‘lum bir intensivligiga ta‘sir qiluvchi muayyan elementlar hamda tog‘ ko‘chkisini ro‘y berish davrini quyidagi matematik funksiya yordamida baholash mumkin [6]:

$$R_{ie|t}=f(H_i, V_e)|t \qquad (1)$$

Bu yerda:

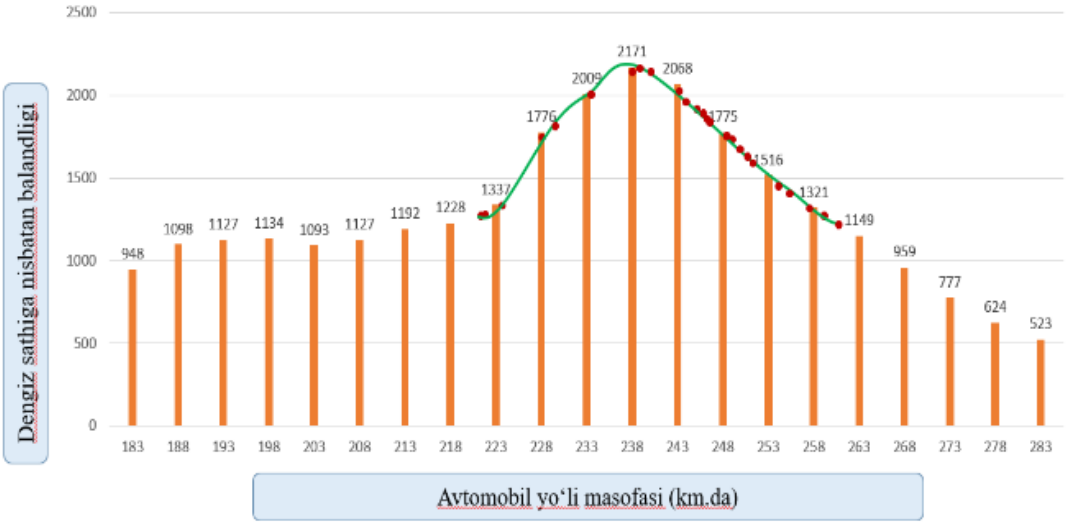
$R_{ie|}$ - *ko‘chkining ro‘y berish davridagi xavf;*

V_e – *yonbag‘ir elementlarining zaifligi;*

H_i – *intensivlik xavfi.*

Yuqoridagi formula shuni ko‘rsatadiki, ko‘chki xavfi intensivligi ma‘lum bo‘lganda, tog‘ qiyaligi elementlarining zaifligi bilan bog‘liq holda ko‘chkining ro‘y berish davrini ifodalaydi. Bu esa ko‘chki xavfini hisoblashda sodir bo‘ladigan yo‘qotishlar ehtimoli sifatida tushuniladi.

Tog‘li hududlardagi avtomobil yo‘llariga ta‘sir ko‘rsatuvchi ko‘chki va surilishlarga qiyaliklarning zaifligi, ularning geologik tarkibi, yog‘ingarchilik miqdori kabi asosiy sabablar bilan bir qatorda avtomobil yo‘li o‘tgan hududning nisbiy sath balandligi ham muhim rol o‘ynaydi. Chunki tog‘li joylarda dengiz sathidan nisbiy balandlik qanchalik ortgan sari shu qadar ko‘chki ehtimoli ham ortaveradi [7, 8]. Bunga sabab esa tog‘larning balandligi ortgan sari qiyaliklardagi gravitatsa hamda yog‘in miqdorining han parallel ortishi bilan bog‘liqdir. Bunga misol tariqasida “Qamchiq” dovonida yuzaga kelgan tog‘ ko‘chkilarining intensivligi dengiz sathidan 1100 metr balandlikdan keyin ortgani bilan ko‘rishimiz mumkin (2-rasm).



2-rasm. “Qamchiq” dovonidagi ko‘chkilarning intensivligi bilan avtomobil yo‘lining dengiz sathidan nisbiy balandligining bog‘liqligi

Ko‘chkilarning tabiiy xavfi – bu ma‘lum bir davrda ma‘lum intensivlikga ega bo‘lgan tog‘ qiyaliklarida yuzaga kelishi mumkin bo‘lgan ehtimoli potensial halokatli hodisa sanaladi.

Qiyaliklardagi gruntlarning sezgirligi ko‘chki xavfi uchun tetiklantiruvchi hodisa hisoblanadi. Ushbu munosabatni quyidagi ifoda orqali ifodalash mumkin bo‘ladi:

$$H_i=f(S, P)/t \qquad (2)$$

Ushbu formulada xavf (H) ning funksiyasi ekanligini bildiradi, ko‘chkiga sezuvchanlik (S) hamda ko‘chkining yuzaga kelish ehtimoli yoki halokatli hodisa (P) ni ifodalaydi.

Ko‘chkiga sezuvchanlik osonlik bilan ifodalanishi mumkin. Bunda ko‘chki hodisasi mahalliy relefga ko‘ra sodir bo‘lishga moyil sharoitlarni hisobga olish zarur.

Usbu maqolada ham ko‘chkiga sezuvchanlikni baholash tomonlama taklif qilingan matematik ifodalar bir qator ko‘chkini keltirib chiqaruvchi omillarni o‘rgangan holda amalga oshirilgan. Jumladan ko‘chki xavfi oqibatida avtomobil yo‘llariga yetishi mumkin bo‘lgan salbiy oqibatlar natijasi va ko‘chki xavfi R ni aniqlash uchun matematik jihatdan quyidagi ifoda ishlab chiqilgan:

$$R=\sum_i Hi*[\sum_i Vji*Ci] \qquad (3)$$

Bu yerda:

Hi= *intensevlik xavfi;*

Vji= *j elementi uchun zaiflik;*

Ci= *zarar qiymati.*

Ko‘chkilarni yuzaga kelish ehtimolini ifodalashda oldin sodir bo‘ldan ko‘chki xususiyatlari, sabablari statistikalrini ham o‘rganish kerak bo‘ladi. O‘rganilayotgan hududda ko‘chki ehtoimolligini baholashda oldim sodir bo‘lgab davri va sikli yoki yilning qaysi paytida eng ko‘p ko‘chkil sodir bo‘lgabligini o‘rganish zarur.

Ko‘chki xavfining paydo bo‘lish ehtimoli bilan ma‘lum bir vaqt oralig‘ida ma‘lum bir kattalikdagi ko‘chki sodir bo‘lish ehtimolligini quyidagi tenglama yordamida hisoblash mumkin.

$$P_x=1-(1-P_a)^x \qquad (4)$$

Bu yerda:

P_a – *ma‘lum bir davr uchun ehtimollik;*

P_x – *uzoq vaxt davomidagi ko‘chki ehtimolligi;*

X – *qaytalanish yillari.*

Ko‘chkilarning qaytarilish muddati asosan yog‘ingarchilikning keskin ortishi hamda o‘sha hududdagi sodir bo‘ladigan zilzilalar kuchiga ham bog‘liqdir. Shu boisdan ko‘chki xavfini baholashda (x) takrorlangan yillar oralig‘i olinadi [3].

Ko‘chki ehtimolligini baholashda quyidagicha usullardan ham foydalanish mumkin:

❖ O‘rganilayotgan hududda oldin sodir bo‘lgan tarixiy ma‘lumotlarning o‘xshash xususiyatlilaridan foydalanish;

❖ Ekspetr xulosasi asosida to‘g‘ridan to‘g‘ri baholash;

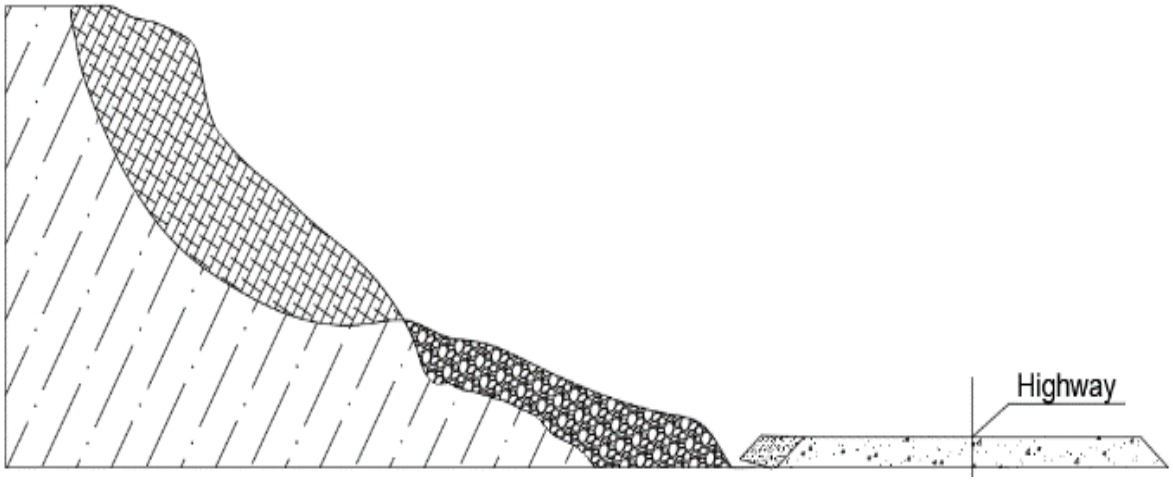
❖ Statistic va deterministic usullar qo‘llash.

Statistic usullar ko‘proq taxminlarga asoslangan bo‘ladi. Bunda ko‘chkilar sodir bo‘lgan hudud, muhitni o‘rgangan holda ko‘chkilarning yuzaga kelishga moyilligi tarixda shunga o‘xshash jarayonlarning taxminiy chastota diapazoniga asoslangan holda yuzaga kelish ehtimoli va qaytarilish davri prognozlanadi.

Ko‘chki xavfini baholashda statistic usulni qo‘llash tog‘li zonalarda juda katta aniqlikni talab qiladi [1]. Mumkin bo‘lgan keltirib chiqruvchi omillarni tahlil qilish

hamda relef sharoitlarini o‘rganish baholashning aniqligini sezilarli darajada o‘zgartiradi.

Deterministik usullar ehtimollik asosida hisoblash imkonini beradi. Bunda qiyaliklarning barqarorlik tahlili bo‘yicha mavjud va ehtimoliy yoriqlar, yuzalar va ularga mos keladigan tabiiy omillar hisobga olinadi. Ushbu natijalar 3-rasmda ko‘rsatilganidek ko‘chki xavfining oqibatini aniqlashga imkon beradi.



3-rasm. Ko‘chki xavfining fazoviy ta‘sirining tasviri

Haligacha ko‘chki xavfini tasniflash uchun xalqaro standartlar mavjud bo‘lmasa ham, baholashni amalga oshirish uchun ko‘chki xavfini tasniflashning 3 ta shkalasi bo‘yicha ehtimollik diapazonini joriy qilish mumkin bo‘ladi (1-jadval).

1-jadval
Ko‘chki xavfini diapazonlash uchun tavsiya etilgan qiymatlar

Ko‘chki xavfi	Statistik xavfsizlik omillai	Psevdostatik xavfsizlik omillari	Izoh
Past	1.5<	1.15<	Ushbu stanistik tahlil ketma-ketligi yog‘ingarchilikka muvofiq o‘zgarib turadi
O‘rta	1.2 – 1.5	1.0 – 1.15	
Yuqori	<1.2	<1.0	

3. XULOSA

Tog‘ ko‘chkilarini o‘rganish borasidagi olib borilgan izlanishlar natijasi shuni ko‘rsatmoqdaki: ko‘chkilarning ro‘y berishi, ta‘sir doiralari va oqibatlarini yengillashtirish uchun ko‘chkilarning xarakteristikasini chuqur o‘rganish hamda xavf xatarlarni oldindan prognozlash ko‘chkidan keladigan talofatlarni yumshatishga xizmat qiladi.

Avtomobil yo‘llariga ta‘sir ko‘rsatuvchi ko‘chkilarni sodir bo‘lish xavfini baholash bizga quyidagicha samaradorliklarni olib kelshi mumkin ekan:

✓ Xavflarni oldindan baholash orqali ko‘chkiga qarshi chora-tadbirlarni olish imkonini beradi;

✓ Ko‘chish ehtimolini prognozlash avtomobil yo‘lidagi yuzaga kelishi mumkin bo‘lgan talofatlarni minimal darajaga tusgirishga xizmat qiladi;

✓ Ma‘lum bir matematik ifodalar ko‘chkini tasniflashga va xususiyatlarini o‘rganishga ximat qiladi.

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РАЗНОВИДНОСТИ МИКРООРГАНИЗМОВ И ИХ СИСТЕМАТИКА

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АННОТАЦИЯ

В данной статье в результате пятилетних исследований изучена богатая и разнообразная микрофлора бактерий и дрожжей плодовых и ягодных деревьев, представленная во всех эколого-географических зонах Республики Узбекистан.

***Ключевые слова**: разнообразия микроорганизмов, дрожжи, Saccharomyces, Hanseniaspora, бактерии, Pseudomonas, Bacillus.*

ABSTRACT

In this article, as a result of five years of research, the rich and diverse microflora of bacteria and yeasts of fruit and berry trees, represented in all ecological and geographical zones of the Republic of Uzbekistan, was studied.

ВВЕДЕНИЯ

Изучение разнообразия микроорганизмов и определение видового состава бактерий и дрожжей – один из актуальных вопросов микробиологии.

Целью наших исследований являлось виделение микроорганизмов (бактерий, дрожжей) из биоценозов плодовых деревьев и нефтеносных почв Узбекистана, изучение их систематического положения и биохимических особенностей.

ЛИТЕРАТУРА И МЕТОДОЛОГИЯ

Отбор проб для исследования производили на плодого – ягодных плантациях НИИ садоводства, виноградарства и виноделия имени академика М.Мирзаева Наманганской области , а также из ассоциаци фруктовых деревьев, произростающих в селских районах; Мингбулак, Чартак, Нарин, Туракурган. А также из загрязнённой нефтью почвы и нефтепродуктов нефтеперерабатывающего завода ферганской области, что соответствует северной, восточной, центральной и юго-западной географическим зонам республики.

Эпифитную микрофлору изучали в динамике созревания винограда: начиная с появления зеленых ягод до их полной зрелости. Представители преобладающих групп микроорганизмов были выделены в чистую культуру для определения их видового состава.

Разнохарактерные колонии бактерий отвивали на мясопептонный агар, дрожжи, сусло-агар, и производили их расчистку методом многократных пассажей. Классификация микроорганизмов проведена на основании изучения их культуральных, морфологических и физиологических признаков.

При определении систематического положения изолированных культур микроорганизмов пользовались определителями Берги (1997), В.И.Кудрявцева (1954), J.Lodder, Van Rij Krieger(1958).

РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ.

Наманганской области является регионам Республики Узбекистан где выращиваются плодого-ягодные и фруктовые деревья, культивируемая в небольших отдельными чистями в десятках районов.

Наибольшую массу эпифитной микрофлоры плодов и ягод составили бактерии, в основном, аеробные формы. Выделенные из биоценозов плодово-ягодных деревьев бактерии распределились по родам следующим образом: *Pseudomonas* – 20, *Micrococcus* – 15, *Bacillus* – 9, *Bacterium* – 6, *Streptococcus* – 4 штамма. Преобладающими были бактерии рода *Pseudomonas*,в значительном количестве – *Chromo bacterium*. Чаще других обнаруживались *Pseudomonas, Bacillus,* вид *Micrococcus albus.* Меньшим разнообразием был представлен род *Sarcina.* Значительное место в микрофлоре занимают дрожжи. В результате микробиологического анализа 30 образцов выделено 65 штаммов дрожжевых и дрожжеподобных микроорганизмов. С поверхности ягод и плодов изолированы

аспорогенные дрожжи преимущественно с аэробным типом дыхания, а также слизеобразующие и пигментные формы дрожжей.

Изучение физиологических свойств дрожжей, выделенных с поверхности растений показало, что виды внутри одного рода отличаются между собой по усвоению не только десяти сахаров , применяющихся для таксономического познания дрожжей, но и других углеводов.

Выделенные штаммы отнесены к двум семействам спорогенных и аспорогенных дрожжей.

Семейство *Saccharomycetaceae* представлено родами *Saccharomyces*, семейство *Saccharomycedaceae* – родом *Hanseniaspora*.

Видовой состав (диагностика) микроорганизмов (бактерий, дрожжей) выделенных из биоценозов плодово-ягодных деревьев и почв, и частота их нахождения приведены в таблице.

Диагностика доминирующих микроорганизмов природных ниш Наманганской области.

№	Вид	Частота встречаемости
1	*Pseudomonas turcosa*	++
2	*Bacillus mesentericus*	+++
3	*Bacillus megaterium*	+++
4	*Pseudomonas herbicola*	++++
5	*Pseudomonas aerogenosa*	+
6	*Chromobacterium sulferium*	++
7	*Micrococcus album*	+++
8	*Bacillus subtilis*	++++
9	*Pseudomonas sinuosa*	++
10	*Hanseniaspora apiculata*	+++
11	*Torulopsis bacillaris*	++
12	*Torulopsis candida*	++++
13	*Trichosporon cutaneum*	+++
14	*Torulopsis ernobi*	++
15	*Candida tropicalis*	+++
16	*Candida tenius*	++

ЗАКЛЮЧЕНИЕ

Таким образом, наибольшую массу микроорганизмов составляют бактерии, окрашенные в в жёлтый цвет: *Pseudomonas,Chromobacterium sulferium*, цветные кокки – *Micrococcus album*. Встречаются *Bacillus album, Bacillus aerophilum, Pseudomonas sinuosa* и спороносные бактерии *Bacillus mesentericus, Bacillus megaterium.*

Основную часть дрожжевой флоры плодов и ягод представляют *Hanseniaspora apiculata* (50%), *Torulopsis* (10%) и пленчатые дрожжи.

Рис.1. Двухсуточные клетки доминирующих дрожжей *Torulopsis bacillaris*

Ув.680.

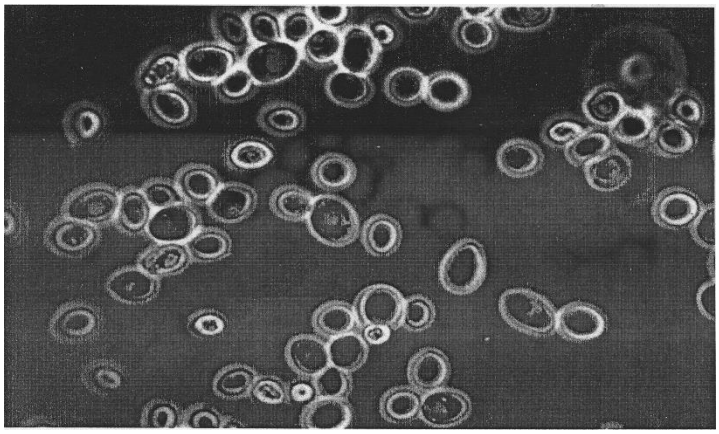

Рис.2. Двухсуточные клетки доминирующих дрожжей *Candida tropicalis*

Ув.680.

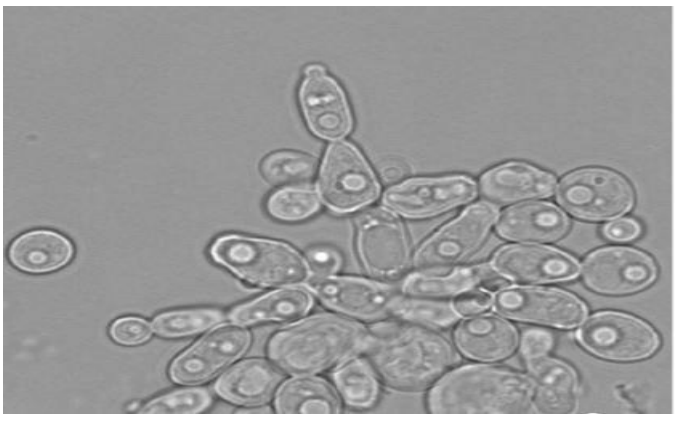

Рис.3. трёхсуточные клетки доминирующих бактерий *Micrococcus album*

Ув.680.

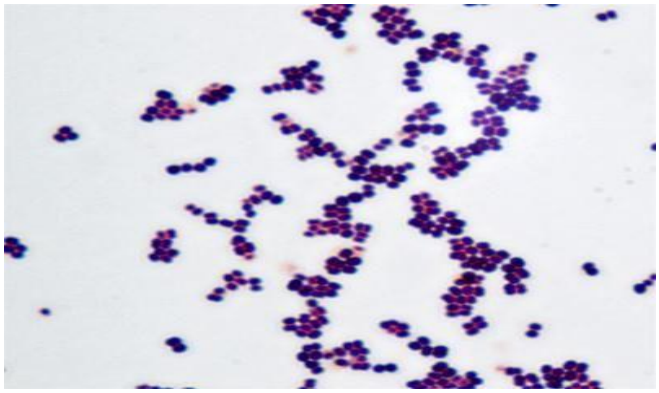

Рис.4. трёхсуточные клетки доминирующих бактерий *Bacillus megaterium*

Ув.680.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

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PREPARATION FOR MATHEMATICS OLYMPIADS FOR UNIVERSITY STUDENTS

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ABSTRACT:

This article presents a sample mock exam to prepare for Mathematical Olympiads. It presents complex problems and their solutions from fields such as algebra, mathematical analysis, topology, combinatorics, number theory. Necessary for solving given problems, important theorems and affirmations are given. Modern and unusual methods for solving mathematical problems are described. For each problem, a marking scheme is also given that complies with the requirements of International Mathematical Olympiads.

Keywords: *Cauchy-Buniakowski inequality, fixed point, idempotent matrices, Sylvester rank inequality, sequence, Darboux sum, Bolzano-Weierstrass theorem, limit point, prime number, field, invertible, pigeonhole principle, Cayley-Hamilton theorem, characteristic polynomial, eigenvalues, algebraic closure, continuous function, Euclidean plane, uncountable set, neighbourhood, injective, surjective, bijective, simple graph, planar graph, subgraph, Kuratowski's Theorem, Euler's formula, metric space.*

At the Olympiads in mathematics, mainly unconventional problems are used. Among them is the olympiads of mathematics for students. In this, in addition to general mathematical knowledge, the participant will need skills and qualifications such as creativity, logical thinking, a theorem corresponding to a given issue, a lemma, the ability to identify affirmations. Among the most famous of the Mathematical Olympiads for university students are IMC (Bulgaria), AKHIMO (Uzbekistan), NCUMC (Russia), OMOUS (Turkmenistan), RUDN MATH OLYMP (Russia), NMC (Russia), SEEMOUS (Europe) and others. Below we bring a sample mock exam for students to prepare for these Olympiads, as well as an marking scheme for each problem.

MOCK EXAM FOR MATHEMATICS OLYMPIADS FOR UNIVERSITY STUDENTS

Problem 1. If $a_i > 0$ for all $i \in \{1,2,\ldots,n\}$ then, prove that:

$$\left(\frac{a_1}{a_2}\right)^{2023} + \left(\frac{a_2}{a_3}\right)^{2023} + \ldots + \left(\frac{a_n}{a_1}\right)^{2023} \geq \frac{a_1}{a_2} + \frac{a_2}{a_3} + \ldots + \frac{a_n}{a_1}$$

Solution: We define $x_i = \frac{a_i}{a_{i+1}}$ for all $i \in \{1,2\ldots n\}$ where $a_{n+1} = a_1$, then $x_1 \cdot x_2 \cdot \ldots \cdot x_n = 1$. (1.1). By Cauchy-Buniakowski inequality we know that:

$$x_1^{2023} + x_2^{2023} + \ldots + x_n^{2023} \geq \frac{(x_1 + x_2 + \ldots + x_n)^{2023}}{n^{2022}} =$$

$$= (x_1 + x_2 + \ldots + x_n) \cdot \left(\frac{x_1 + x_2 + \ldots + x_n}{n}\right)^{2022} \geq (x_1 + x_2 + \ldots + x_n)$$

Hence:

$$\left(\frac{a_1}{a_2}\right)^{2023} + \left(\frac{a_2}{a_3}\right)^{2023} + \ldots + \left(\frac{a_n}{a_1}\right)^{2023} \geq \frac{a_1}{a_2} + \frac{a_2}{a_3} + \ldots + \frac{a_n}{a_1}$$

Marking scheme:

(a) If shown to be (1.1).....+2 points.

(b) For any complete proof .....10 points.

Problem 2. Prove that, given $f: [0; 1] \to [0; 1]$ a continuous function has at least one fixed point.

Solution: We define $g(x) := f(x) - x$, this function is coninuous in the segment $[0; 1]$. We have the following two cases:

(i) $f(1) = 1$ or $f(0) = 0$ then f has at least one fixed point.

(ii) The first case is not appropriate, then $f(1) < 1$ and $f(0) > 0$. Hence, $g(0) > 0$ and $g(1) < 0$. From $g(0) \cdot g(1) < 0$, (2.1) there is at least one point $c \in (0; 1)$, such that $g(c) = 0$, because g is continuous. This c be fixed point for f function. (2.2)

Hence, given $f: [0; 1] \to [0; 1]$ a continuous function has at least one fixed point.

Marking scheme:

(a) If function g is chosen .....+3 points.

(b) If it is shown that g is continuous .....+1 points.

(c) If (2.1) is proved .....+4 points.

(d) If shown to be (2.2).....+2 points.

Problem 3. Let $A_1, A_2, \ldots, A_k$ be idempotent matrices $(A_i^2 = A_i)$ in $M_n(\mathbb{R})$. Prove that

$$\sum_{i=1}^{k} N(A_i) \geq rank\left(I - \prod_{i=1}^{k} A_i\right)$$

where $N(A_i) = n - rank(A_i)$ and $M_n(\mathbb{R})$ is the set of square $n \times n$ matrices with real entries.

Solution: Fix an index i and note that because A_i is idempotent, then $A_i(I_n - A_i)X_i = O_n$ for any matrix X_i. Hence, by Sylvester rank inequality:

$$n - rk(A_i) \geq rk\big((I_n - A_i)X_i\big) - rk(O_n) = rk((I_n - A_i)X_i\,). \qquad (3.1)$$

for any matrix X_i. By summing and using the supra-additivity $(rk(A) + rk(B) \geq\geq rk(A + B))$ of the rank we may infer

$$\sum_{i=1}^{k}\big(n - rk(A_i)\big) \geq \sum_{i=1}^{k} rk\big((I_n - A_i)X_i\big) \geq rk\left(\sum_{i=1}^{k}(I_n - A_i)X_i\right). \qquad (3.2)$$

By letting $X_1 = I_n$ and $X_i = A_1A_2 \ldots A_{i-1}$ for $i \geq 2$ the conclusion immediately follows.

$$\sum_{i}^{k} N(A_i) \geq rank\left(I - \prod_{i}^{k} A_i\right)$$

Note: Sylvester rank inequality:

$$rank(A) + rank(B) \leq rank(AB) + n$$

where $A, B \in M_n(\mathbb{R})$.

Marking scheme:

(a) If (3.1) is proved .....+3 points.

(b) If (3.2) is proved .....+3 points.

(c) If X_i are chosen and proof is complete.....+4 points.

Problem 4. Let $s_n = \int_0^1 sin^n(nx)dx$.

(i) Prove that $s_n \leq \frac{2}{n}$ for all odd n.

(ii) Find all the limit points of the sequence $s_1, s_2, s_3, \ldots$

Solution: We proceed with each part as follows:

(i) By the substitution $x \mapsto \frac{x}{n}$ may consider $s_n = \frac{1}{n}\int_0^1 sin^n(x)dx$. Note that because $sin(x) = -sin(x + \pi)$, we have $sin^n(x) = -sin^n(x + \pi)$ for odd n. Let $k \equiv n\ (mod\ 2\pi)$. By the parity of $sin^n(x)$, we know that $\int_0^{2\pi} sin^n(x)dx = 0$. Hence,

$$\frac{1}{n}\int_0^n sin^n(x)dx = \frac{1}{n}\int_0^k sin^n(x)dx \leq \frac{1}{n}\int_0^\pi sin^n(x)\,dx = \frac{2}{n}$$

as required.

(ii) We shall prove that the only limit point is 0. We already know that $s_n \to 0$ for odd n, so it suffices to prove that $s_n \to 0$ for even n. To do so, we will bound the function from above using rectangles, i.e. we shall take an appropriate upper Darboux sum to bound $\int_0^1 sin^n(x)dx$.

For a sufficiently small $\delta > 0$, we define the partition

$$P_\delta(n) = \left\{\left[0;\frac{\pi}{2} - \delta\right), \left[\frac{\pi}{2} - \delta;\frac{\pi}{2} + \delta\right), \left[\frac{\pi}{2} + \delta;\frac{3\pi}{2} - \delta\right), \ldots, \left[\frac{X\pi}{2} \pm \delta; n\right]\right\}$$

For each interval in $P_\delta(n)$ containing some multiple of $\frac{\pi}{2}$, we bound $sin^n(x)$ by a rectangle of height 1. Otherwise, we can bound the interval by $sin^n(x)$ by a rectangle of height $sin^n\left(\frac{\pi}{2} - \delta\right) = cos^n(\delta)$, where we note that $cos^n(\delta) \to 0$ as $n \to \infty$. We

note that there are less than n multiples of $\frac{\pi}{2}$ in the interval $[0;\ n]$, so the sum of the areas of these rectangles is at most $2n\delta + ncos^n(\delta)$, and hence

$$s_n = \frac{1}{n}\left(2n\delta + ncos^n(\delta)\right) = 2\delta + cos^n(\delta) \to 2\delta, \quad \text{as} \quad n \to \infty.$$

Now suppose for the sake of contradiction that $2\varepsilon > 0$ was a limit point of the sequence. By selecting $\delta < \varepsilon$, we show that the terms of s_n are eventually inside the interval $(0;\ 2\varepsilon)$, a contradiction. Then the sequence is bounded in the interval $[0;\ 1]$ but has no limit point greater than 0, hence by Bolzano-Weierstrass theorem, the only limit point is 0.

Marking scheme:

(a) If part (i) is proved .....$+4$ points.

(b) If part (ii) is proved .....$+6$ points.

(c) For any complete proof .....10 points.

Problem 5. Let $p > 3$ be a prime number. A sequence of $p-1$ integers $a_1, a_2, \ldots, a_{p-1}$ is called *wonky* if they are distinct modulo p and $a_i a_{i+2} \not\equiv a_{i+1}^2 \ (mod\ p)$ for all $i \in \{1, 2, \ldots, p-1\}$, where $a_p = a_1$ and $a_{p+1} = a_2$. Does there always exist a *wonky* sequence such that

$$a_1a_2, \quad a_1a_2 + a_2a_3, \quad \ldots, \quad a_1a_2 + \ldots + a_{p-1}a_1$$

are all distinct modulo p?

Solution: Throughout this solution all congruences are taken modulo p. Our construction will be $a_i \equiv \frac{1}{i} \ (mod\ p)$ (5.1). We now verify this construction works. Note that:

$$a_i \equiv a_j \Rightarrow \frac{1}{i} \equiv \frac{1}{j} \Rightarrow i \equiv j \Rightarrow i = j$$

Then if $k < p-1$,

$$\sum_{j=1}^{k} a_j a_{j+1} \equiv \sum_{j=1}^{k} \frac{1}{j(j+1)} \equiv \sum_{j=1}^{k} \left(\frac{1}{j} - \frac{1}{j+1}\right) \equiv 1 - \frac{1}{k+1} \qquad (5.2)$$

which are all distinct since

$$1-\frac{1}{k+1}\equiv 1-\frac{1}{m+1}\Rightarrow \frac{1}{k+1}\equiv\frac{1}{m+1}\Rightarrow k=m \qquad (5.3)$$

Moreover

$$\sum_{j=1}^{p-1}a_ja_{j+1}\equiv\sum_{j=1}^{p-2}a_ja_{j+1}+a_{p-1}a_1\equiv 1-\frac{1}{p-1}-1\equiv 1,$$

and $1-\frac{1}{k+1}\neq 1\ \forall\ k$ so this is distinct from all the previous terms (5.4). Finally if $i<p-2$:

$$a_ia_{i+2}\equiv\frac{1}{i(i+2)}\neq\frac{1}{i(i+2)+1}\equiv\frac{1}{(i+1)^2}\equiv\ a_{i+1}^2$$

Additionally if $i\in\{p-2;p-1\}$, $a_ia_{i+2}\equiv-\frac{1}{2}\neq 1$ since $p\neq 3$ (5.5).

Marking scheme:

(a) If (5.1) is chosen .....+3 points.

(b) If (5.2) is proved .....+3 points.

(c) If (5.3) is proved .....+1 points.

(d) If (5.4) is proved .....+1 points.

(e) If (5.5) is proved .....+2 points.

Problem 6. Let A be a square matrix with entries in the field $\mathbb{Z}/p\mathbb{Z}$ such that A^n-I is invertible for every positive integer n. Prove that there exists a positive integer m such that $A^m=0$.

Note: A matrix having entries in the field $\mathbb{Z}/p\mathbb{Z}$ means that two matrices are considered the same if each pair of corresponding entries differ by a multiple of p.

Solution 1: Note that there are finitely many matrices under consideration. Let the number be $k\in\mathbb{N}$. Then by pigeonhole principle, two of the $k+1$ matrices $A, A^2, A^3, \ldots, A^{k+1}$ must be equal. Suppose that they are A^r and A^s, where $r>s$. Then note that:

$$A^r - A^s = 0 \Leftrightarrow A^s(A^{r-s} - I) = 0 \Leftrightarrow A^s = 0, \quad (6.1)$$

since $A^{r-s} - I$ is invertible.

Marking scheme:

(a) If it shows that the number of matrices is finite .....$+2$ points.

(b) If the pigeonhole principle is used .....$+3$ points.

(c) If (6.1) is proved .....$+5$ points.

Solution 2: We shall prove the statement using eigenvalues and the Cayley-Hamilton theorem.

By the Cayley-Hamilton theorem, the characteristic polynomial c_A of A satisfies $c_A(A) = 0$.

Consider the eigenvalues of A over the algebraic closure of $\mathbb{Z}/p\mathbb{Z}$. The closure is countable, but all elements have finite order. Suppose for the sake of contradiction that some eigenvalue λ is not zero. Then there exists $m \in \mathbb{N}$ such that $\lambda^m = 1$. However this implies $det(A^m - I) = 0$, and $A^m - I$ is therefore not invertible, which is a contradiction.

Since all eigenvalues are 0, the characteristic polynomial must be $c_A = X^n$. Thus, $c_A(A) = A^n = 0$, as required.

Problem 7. Let S be a set with 10 distinct elements. A set T of subsets of S (possibly containing the empty set) is called *union-closed* if, for all $A, B \in T$, it is true that $A \cup B \in T$. Show that the number of *union-closed* sets T is less than 2^{1023}.

Solution: Let $f(n)$ denote the number of union-closed sets T over a set $S_n = \{1, 2, \ldots, n\}$. We bound $f(10)$ by showing that $f(n) \leq f(n-1)^2$.

Let T be a *union-closed* set over S_n, for $n \geq 1$. We partition T into A and B, where $A = \{t \in T : n \notin t\}$, and $B = \{t \in T : n \in t\}$. Then define $B' = \{b \setminus \{n\} : b \in B\}$. Note that both A and B' are *union-closed* sets over S_{n-1}, and furthermore, T uniquely partitions into A and B' by the above method. Since there are $f(n-1)^2$ choices of A and B', we have $f(n) \leq f(n-1)^2$ (7.1), as desired (we have an inequality here since not all T generated by arbitrary

A and B' will be union-closed over S_n).

We now count that $f(2) \leq 14$, since $\left|P\left(P(S_2)\right)\right| = 16$ (7.2), but $\{\{1\},\{2\}\}$ and $\{\emptyset,\{1\},\{2\}\}$ are not *union-closed*. Hence $f(10) \leq f(2)^{2^8} = 14^{256} < 2^{1023}$, since $\left(\frac{14}{16}\right)^{256} < \frac{1}{2}$.

Marking scheme:

(a) If A and B sets are chosen .....+2 points.

(b) If (7.1) is proved .....6 points.

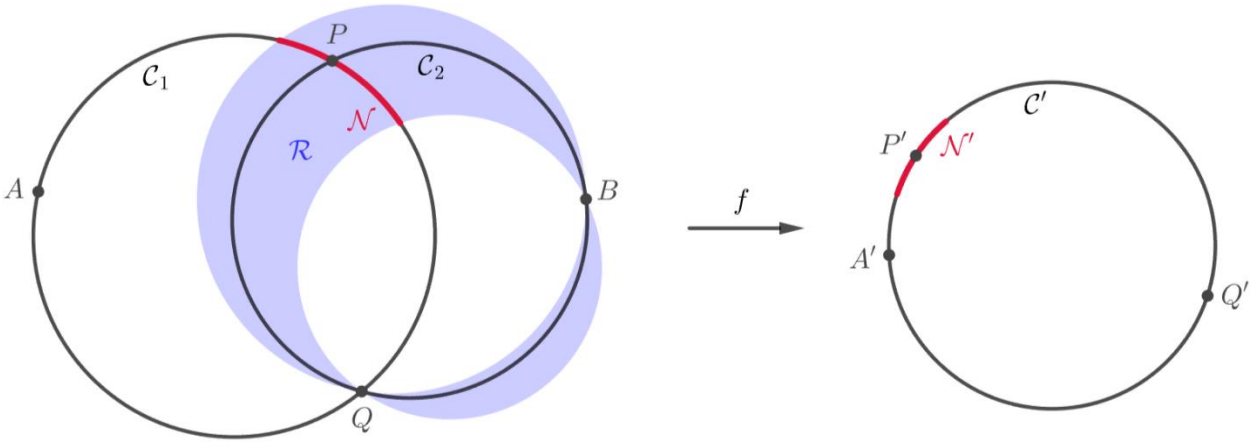
(c) If (7.2) is calculated .....+2 points.

(d) If the proof is completed correctly .....+2 points.

Problem 8. Let $\mathbb{R}^2$ denote the Euclidean plane. A continuous function $f: \mathbb{R}^2 \to \mathbb{R}^2$ maps circles to circles. (A point is not a circle.) Prove that it maps lines to lines.

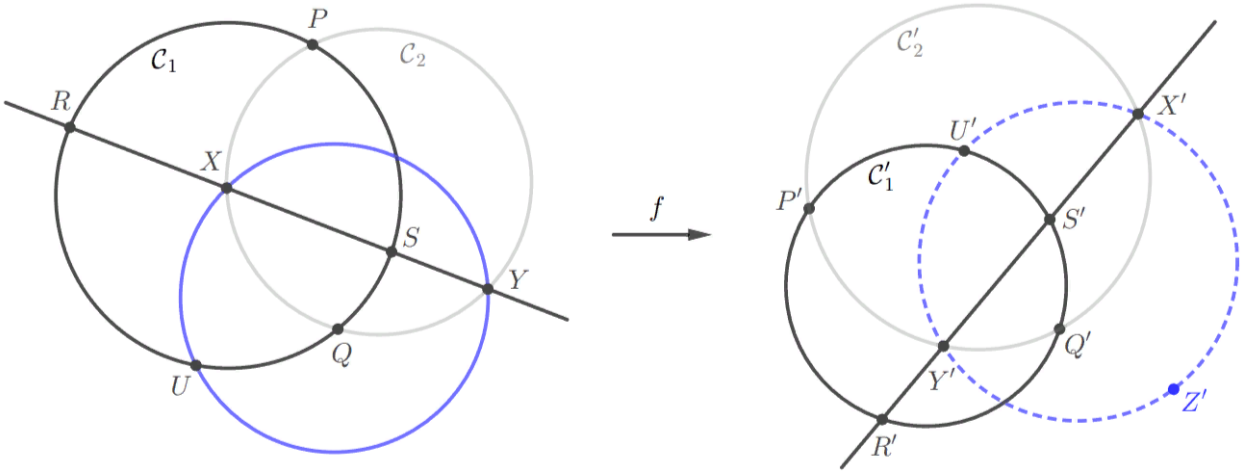
Solution: In this proof, we use the notation $X' := f(X)$. The proof can be broken down into four main steps.

***f* is injective:** Suppose that A and B are distinct points such that $A' = B'$. Since the range of the function is at least a circle, which is an uncountable set, there must exist points P and Q so that A, B, P, Q lie in general position, and A', P', Q' are distinct. Let $\mathcal{C}_1$ be the circle passing through APQ and $\mathcal{C}_2$ be the circle passing through BPQ. Note that $\mathcal{C}_1'$ and $\mathcal{C}_2'$ both map to the circumcircle $\mathcal{C}'$ of $A'P'Q'$, which must exist.



Now, since f is continuous, there exists a neighbourhood $\mathcal{N}$ of P on $\mathcal{C}_1$ which maps to a subset of $\mathcal{C}' \setminus \{A'; Q'\}$. Consider a perturbation of the circle $\mathcal{C}_2$, such that it still passes through B and Q, but now passes through a point in $\mathcal{N}$ distinct from P. Each of these circles in the perturbation must then also map to $\mathcal{C}'$ by the same argument as above. Hence, this perturbation creates a region $\mathcal{R}$ such that $f(\mathcal{R}) = \mathcal{C}'$. However, note that any circle contained entirely within $\mathcal{R}$ must then also map to exactly $\mathcal{C}'$. This implies that there are arbitrarily small circles which map to $\mathcal{C}'$, contradicting the continuity of f. Hence f is injective.

***f* is surjective:** Since f is injective, we now know that $\mathcal{C}_1'$and $\mathcal{C}_2'$ must intersect only at P' and Q'. Let $X, Y \in \mathcal{C}_2$ so that $\mathcal{C}_1$ separates X from Y. By injective continuity we can deduce that $\mathcal{C}_1'$ separates $arc\ P'X'Q'$ from $arc\ P'Y'Q'$, and hence X' from Y'. Let the intersection of $X'Y'$ with $\mathcal{C}_1'$ be R' and S'. WLOG, assume that S is not an intersection of XY with $\mathcal{C}_1$, then the circumcircle of XYS must map to the circumcircle of $X'Y'S'$, a contradiction. Hence R and S must be the intersection of XY with $\mathcal{C}_1$.

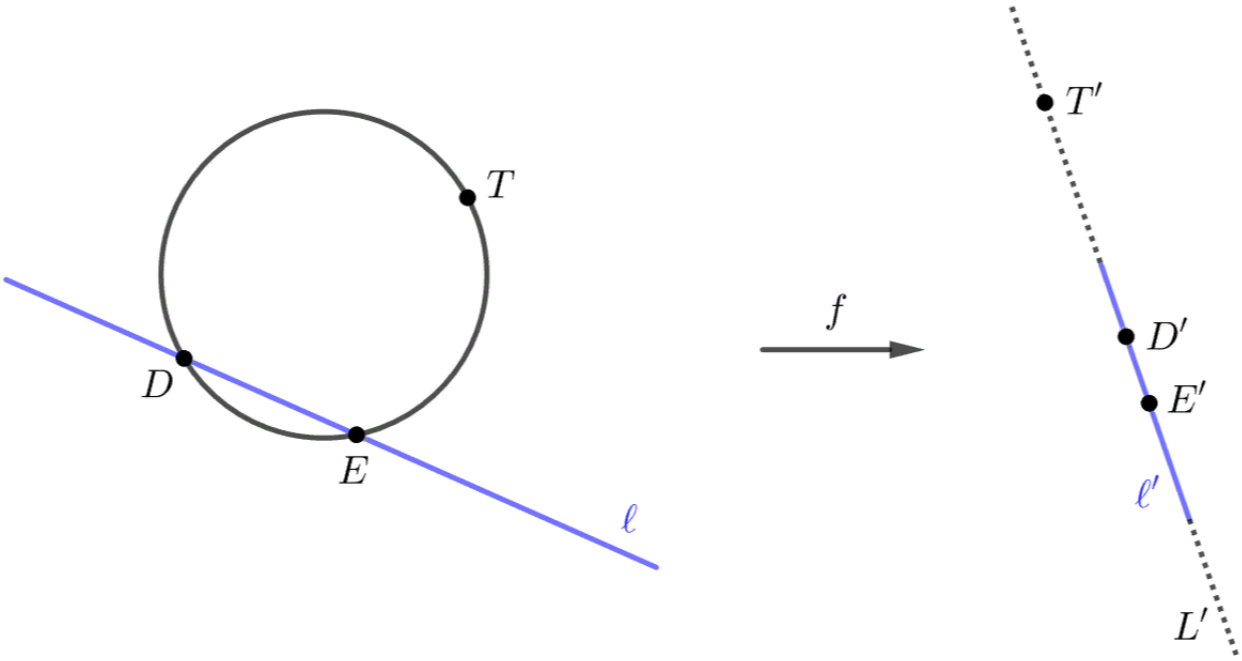


Consider any point Z' not on the line $X'Y'$. Let the circumcircle of $X'Y'Z'$ intersect $\mathcal{C}_1'$ at U'. We know this intersection point exists because the circumcircle of $X'Y'Z'$ passes through X' and Y', which are separated by $\mathcal{C}_1'$. Since f is injective, U is distinct from S and R, and hence the circumcircle of XYU which must map to the circumcircle of $X'Y'U'$, which passes through Z'. Hence any point Z' not on the line $X'Y$' is in the image of f.

Repeating this argument replacing X with a different point W on the $arc\ PXQ$ shows that every point is in the image of f. This proves that f is surjective and thus bijective.

f preserves collinearity: Above, we proved that the family of circles passing through X' and Y' is mapped to by some circle passing through X and Y. Conversely, any circle passing through X and Y must map to a circle passing through X' and Y'. Hence, the family of circles passing through X and Y maps to the family of circles passing through X' and Y'. Since f is bijective the complement of the family must map to the complement of the image family. This shows that for any point T on the line XY , T' must lie on the line $X'Y'$.

f maps lines to lines: Finally, since f is bijective and preserves collinearity, a line ℓ must map to a subset ℓ' of a line L'. Let $T' \in L'$. If $T \notin \ell'$, then T must lie off the lie ℓ. Consider a circle passing through T and two points $D, E \in \ell$. This must map to a circle, but $T'D'E'$ forms a line, a contradiction. Hence, lines must map to lines.



Marking scheme:

(a) If it is proved that f is injective .....+3 points.

(b) If it is proved that f is surjective .....+3 points.

(c) If it is proved that f preserves collinearity .....+2 points.

(d) If it is proved that f maps lines to lines .....+2 points.

Problem 9. Let G be a simple graph with n vertices and m edges such that no two cycles share an edge. Prove that $2m < 3n$.

Note: A simple graph is a graph with at most one edge between any two vertices and no edges from any vertex to itself. A *cycle* is a sequence of distinct vertices $v_1, \ldots, v_n$ such that there is an edge between any two consecutive vertices, and between v_n and v_1.

Solution 1: Every cycle contains ≥ 3 edges, but every edge is in ≤ 1 cycle. Denote the number of cycles by C, then we have $C \leq \frac{m}{3}$ (9.1). Delete an edge from each cycle to obtain the graph G'. G' has no cycles, so it has at most $n-1$ edges. (This is a well-known fact.) Then $m = |E(G)| = C + |E(G')| \leq \frac{m}{3} + n - 1 << \frac{m}{3} + n$, and hence $\frac{2m}{3} < n$ as required (9.2).

Marking scheme:

(a) If (9.1) is proved .....+2 points.

(b) If G‘ is chosen .....+3 points.

(c) If (9.2) is proved .....+5 points.

Solution 2: G must be planar. This can be most quickly shown using *Kuratowski's Theorem.* Suppose G is not planar, then it contains a subgraph $K_{3,3}$ or K_5 , which contradicts the assumption that cycles in G do not share an edge.

Therefore G is planar, so every cycle contributes 1 to the number of faces. Since the number of cycles C satisfies $C \leq \frac{E}{3}$ (9.1), and $F = C + 1$, applying *Euler's* formula $F - E + V = 2$ completes the proof (9.3).

Note: *(Kuratowski's Theorem:)* A graph is planar if and only if it does not contain any subdivision of $K_{3,3}$ or K_5.

Marking scheme:

(a) If (9.1) is proved .....+2 points.

(b) If (9.3) is proved .....+3 points.

(c) If it is proved that G is planar .....+5 points.

(d) If it is not shown that G is planar .....−1 points.

Problem 10. Let $(X;\ d)$ be a nonempty connected metric space such that the limit of every convergent sequence, is a term of that sequence. Prove that X has exactly one element.

Solution: Suppose $|X| > 1$. Take $x \in X$ and consider $A = \{x\}, B = X - \{x\}$.(so B becomes non empty) Since X is connected we must have either $cls(A) \cap B \neq \phi$ or $cls(B) \cap A \neq \phi$. But $cls(A) = A$ and so $cls(A) \cap B = A \cap B = \phi$. So we must have $cls(B) \cap A \neq \phi \Rightarrow x \in cls(B)$ (10.1). So every $x \in X$ is a limit point of X. So for all $\varepsilon > 0$ we must have $X \cap B_\varepsilon(x)$ is infinite. So exist a convergent sequence $\{x_n\}$ going to x and none of x_n equals to x. Now for any small $\varepsilon > 0$ exist $x \neq x_{n_\varepsilon}$ such that $d(x, x_{n_\varepsilon}) < \varepsilon$. Now we know for all such $n\_\varepsilon, x_{n_\varepsilon}$ is a limit point of X. Now any subsequence of $\{x_n\}$ can't go to x_{n_ε} so exist $y_{n_\varepsilon} \neq x_{n_\varepsilon}$ and not equals to any term of the sequence $\{x_n\}$ such that $d(x_{n_\varepsilon}, y_{n_\varepsilon}) < \varepsilon \Rightarrow d(x, y_{n_\varepsilon}) < 2\varepsilon$ (10.2). So we get a sequence $\{y_{n_\varepsilon}\}$ going to x while no terms of $\{y_{n_\varepsilon}\}$ is a term of sequence $\{x_n\}$. Now as per given condition we know x is a term of $\{y_{n_\varepsilon}\}$ as well as of $\{x_n\}$ but that's impossible (10.3). So, $|X| = 1$. Here $cls(S)$ denotes closure of set S.

Marking scheme:

(a) If (10.1) is proved .....+3 points.

(b) If it is shown that x_{n_ε} .....+1 points.

(c) If y_{n_ε} is chosen .....+2 points.

(d) If (10.2) is proved .....+2 points.

(e) If (10.3) is proved .....+2 points.

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ХРОМАТОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ ТЕРМОКАТАЛИТИЧЕСКОГО ПРЕВРАЩЕНИЯ ПЛАСТМАСС В ЖИДКОЕ ТОПЛИВО В ПРИСУТСТВИИ ГЛИНЫ

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Аннотация: *В этой статье описывается исследование методов хроматографии и рентгенофазовного анализа термокаталитического превращения пластмасс в жидкое топливо в присутствии каолина и глины. Проведен анализ жидких топлив, полученных из пластмасс, методом хроматографии и изучен состав катализатора, приготовленного методом РФА на основе каолина и глины. Также представлена технологическая схема и методологическая часть термокаталитического превращения пластмасс в жидкое топливо.*

Ключевые слова: *вторичное сырье, пластмассы, жидкое топливо, катализаторы, термокаталитическая конверсия, рентгенофазовый анализ, хроматография, глина.*

Введение

В настоящее время проблема переработки полимерных отходов обретает все большую актуальность, так как в условиях дефицита полимерного сырья пластиковые отходы становятся потенциальными сырьевыми и энергетическими ресурсами. С учетом невозобновляемости ископаемого углеводородного сырья задача переработки пластиковых отходов в жидкое топливо представляется перспективной. Термокаталитическая конверсия является одним из способов, который позволяет получать жидкие продукты необходимого диапазона углеводородов.

Интересно, что каталитическая активность талька была обнаружена случайно [1]. Данный материал часто является наполнителем полипропилена (ПП), повышающий его жесткость. Выходы и составы продуктов из чистого ПП и ПП с наполнителями показали значительные отличия. Это указывает на более высокую степень деструкции ПП с наполнителями, что, скорее всего, является результатом каталитического действия талька. Это дало гораздо более высокий выход газа (76,3 масс.%) и незначительный выход воска.

Khan and Hussain также сообщили о каталитической активности талька (французский мел, как упоминалось в работе) [2]. Они указали, что продукты пиролиза не содержат воск и дают высокий выход жидких углеводородов. Также было зафиксировано образование газообразных продуктов.

Результаты, полученные для сепиолита, показывают, что, несмотря на низкую каталитическую активность, данный глинистый материал обладает достаточными каталитическими свойствами для снижения температуры разложения ПЭ и ПП [3]. Однако стерические эффекты, связанные с заместителями ПС и ЭВА, уменьшают каталитический эффект. Опыты по термоокислительной деструкции показали, что заметного снижения температуры, которое может быть связано с присутствием глины, не происходит.

Катализаторы Co/вермикулит и Ni/вермикулит в работе Chen et al. имели более высокую селективность по фракциям с числом атомов углерода больше C_{13} [4]. Органический вермикулит и Co-Ni/вермикулит обладали более высокой селективностью по фракциям с числом атомов углерода менее C_{13}. Возможность образования большого количества дизельного топлива, дистиллята нефтепродуктов и H_2 в газообразных продуктах связана с кислотностью катализатора, обусловленной структурными свойствами.

Пирофиллит, обработанный кислотой, также показал хорошие каталитические характеристики в отношении разложения полистирола в жидкие углеводороды [5]. По сравнению с термической деструкцией присутствие

катализатора показало гораздо более высокую селективность по этилбензолу и незначительный выход C_{16}–C_{21} (8,5 масс.%).

Filip и др. исследовали процессы термической деструкции при 420 °C смеси пластиковых отходов (ПС, ПЭТФ, ПВХ) в отсутствие и в присутствии двух типов катализаторов на основе природных румынских глинистых материалов [6]. Результаты показали, что жидкие фракции содержали в основном моноароматические соединения. Наибольшее количество стирола образуется в результате термического разложения полистирола, который был основным компонентом пластиковой смеси. Глина Ваду Кришулуй отмечена как наиболее эффективный катализатор термического разложения пластиковой смеси.

Подводя итоги, можно сказать, что самые высокие выходы жидкости были получены для ПЭНП на катализаторе Фуллеровой земли (91,0 масс.%) [2]; ПП на природном глинистом минерале из Индонезии, импрегнированном нано частицами $LaFeO_3$ (88,8 масс.% на 5-м цикле) [7]. Следует подчеркнуть, что в последнем случае рост выхода целевых продуктов обеспечивался специфическим эффективным промотором – ферритом лантана. Это существенное отличие катализатора привлекает внимание к перспективам некислотной модификации глин [8,9].

Результаты многочисленных исследований свидетельствуют о том, что основными экспериментальными параметрами термокаталитической конверсии пластмасс являются температура реакции, кислотность модифицированных катализаторов и соотношение катализатор: пластик. Варьируя параметры, можно добиться существенного увеличения выхода жидких углеводородов в процессе конверсии пластмасс [8].

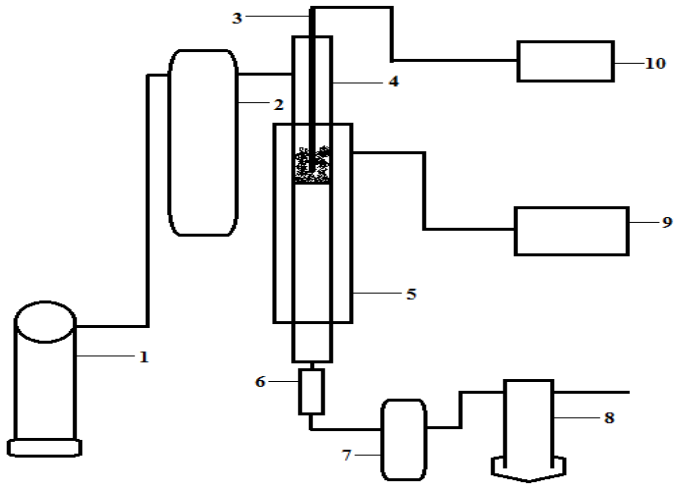
ЭКСПЕРИМЕНТАЛЬНАЯ ЧАСТЬ

Методика приготовления реакционной смеси

Предварительно измельченный образец полимера и моторное масло помещали в фарфоровую чашку и оставляли на 1 час при комнатной температуре. Массовое соотношение полимер: моторное масло составляло 1:1. Далее смесь нагревали до получения вязкого раствора полимера, и в горячий раствор вносили навеску порошка катализатора при непрерывном перемешивании. Полученную смесь оставляли при комнатной температуре до получения твердой пленки. Массовое соотношение полимер: моторное масло:катализатор составляло 1:1:1. Полученные твердые пленки измельчали до размера 2-3 мм и загружали в каталитический реактор.

Методика проведения каталитического разложения полимеров

Эксперименты по термокаталитическому превращению проводили в каталитической установке с использованием реактора проточного типа с неподвижным слоем катализатора и реагента (рис. 1).



1 – баллон с аргоном, 2 – реометр, 3 – хромель-алюмелевая термопара, 4 – реактор, 5 – трубчатая печь, 6 – обратный холодильник, 7 – приемник, 8 – барботер с неполярным растворителем, 9 – милливольтметр, 10 – ЛАТР

Рисунок 1 – Принципиальная схема установки для проведения каталитической деструкции полимеров

Навеску измельченных пленок реакционной смеси помещали в реактор с впаянной пазухой для термопары. Температуру поднимали постепенно, изотермически выдерживали при 300°С, либо 350°С. Температурный режим задавали и поддерживали с помощью ЛАТР а и хромель-алюмелевой термопары. Сбор жидких продуктов осуществляли в приемник, установленный на выходе из реактора. Конверсию смеси полимер – моторное масло проводили в инертной атмосфере аргона, поток которого регулировали с помощью реометра; скорость потока составляла 4800 $см^3$/ч.

Степень превращения полимеров оценивали по массовому выходу жидких продуктов деструкции (масс.%) с учетом суммарной массы полимера и растворителя.

Методика проведения хроматографического анализа

Состав жидких продуктов деструкции изучали на газовом хроматографе марки Gas Chromatograph Agilent 7890A, снабженном ионизационно-пламенным детектором. Разделение вели на кварцевой капиллярной колонке HP – 5ms (длина 30 м, внутренний диаметр 0,25 мм, толщина фазы 0,25 мкм) с неподвижной жидкой фазой (5%-фенил)-метилполисилоксан с программированным подъемом температуры от 27°С до 260°С со скоростью 5°С/мин.

РЕЗУЛЬТАТЫ И ИХ ОБСУЖДЕНИЕ

Термокаталитическое конверсия полипропилена в жидкое топливо

Как показал анализ литературы, проблемой утилизации полимерных отходов с целью получения жидких моторных топлив с использованием недорогих и доступных катализаторов занимаются ведущие ученые различных стран. На кафедре общей химии Белгородского государственного национально-исследовательского университета уже была разработана методика переработки полиолефинов в нефтеподобный набор углеводородов с использованием в качестве катализаторов глины Белгородской области. Однако существует проблема обеспечения контакта полимеров с поверхностью катализатора. Данный фактор оказывает непосредственное влияние на скорость протекания процесса, выход и состав получаемых продуктов. В качестве растворителя полимеров в настоящей работе предложено использовать моторное масло.

Эксперимент по термокаталитическому превращению полиэтилена и полипропилена с моторным маслом в присутствии образцов исходной и модифицированной глины показал, что природа и выход продуктов деструкции существенным образом зависят от типа катализатора и особенностей строения полимера.

Для смеси полиэтилен – моторное масло на всех исследуемых катализаторах в условиях проведения опыта жидкие продукты не наблюдали. Образовывались лишь маслянистые продукты желтого цвета.

Термическую деструкцию полипропилена и моторного масла не проводили, так как полученная реакционная смесь после высушивания представляла собой мягкую, маслянистую на ощупь, пленку и ее загрузка в каталитический реактор не представлялась возможным. Результаты термокаталитического превращения смеси полипропилена и моторного масла в присутствии исходного и модифицированных образцов глинистого материала представлены в таблице 1.

Таблица 1

Выход жидких продуктов каталитической деструкции смеси полипропилена и моторного масла

Образец катализатора	Образец	Выход жидких продуктов (масс.%) (±2%)
Исходный образец глинистого материала	ГП	34
Полученный обработкой 2н H_2SO_4	Г-2S	42
Полученный обработкой 4н H_2SO_4	Г-4S	44
Полученный обработкой 2н HCl	Г-2Cl	37
Полученный обработкой 4н HCl	Г-4Cl	51
Полученный обработкой 2н HNO_3	Г-2N	51
Полученный обработкой 4н HNO_3	Г-4N	45

Согласно полученным результатам, все исследуемые катализаторы способны осуществлять деструкцию смеси полипропилен - моторное масло до жидких углеводородов. Варьирование условий кислотной обработки позволяет не только произвести ионный обмен кальция, магния и других катионов глин на протоны, но и регулировать кислотность глинистого материала [9]. Согласно полученным данным, природа и концентрация кислоты, используемой для обработки образца глины, оказывает существенное влияет на результат конверсии смеси полипропилен – моторное масло. Исходная глина оказывает наименьшую каталитическую активность. Наибольший выход целевых продуктов 51 масс.% получен на катализаторах, обработанных 4 н соляной и 2 н азотной кислотами. Для серной и соляной кислот повышение концентрации растворов способствует росту количества получаемых продуктов от 42 до 44 масс.% и от 37 до 51 масс.% соответственно. В случае обработки глинистого материала азотной кислотой наблюдается обратная зависимость.

Каталитическая активность алюмосиликатов во многих процессах определяется наличием кислотных центров. Бренстедовская и льюисовская кислотность соединений обусловлена наличием атомов алюминия. Согласно

данным таблицы 2 содержание алюминия (масс.%) для всех образцов практически одинаков, а силикатный модуль варьируется в небольшом интервале значений 8,0 – 8,9. Также стоит отметить, что образец ГИ имеет наименьшее значение SiO_2/Al_2O_3, однако он показал наименьший выход жидких продуктов. Данный факт требовал дополнительных исследований.

Характеристики исходного глинистого материала и образцов катализаторов, полученных на его основе, представлены в таблице 2.

Таблица – 2

Характеристики исходного глинистого материала и исследуемых катализаторов, полученные на его основе

Образец катализатора	Химический состав		Площадь удельной поверхности по одноточечному методу БЭТ, $м^2/г$, S±5%	Общий объем, $см^3/г$, V±5%	Средний размер пор, А, (±5%)
	Al, масс.% (ω=±3)	SiO_2/Al_2O_3			
ГИ	11,7	8,0	39	0,055	57
Г-2S	11,3	8,5	37	0,065	70
Г-4S	11,5	8,2	52	0,067	52
Г-2Cl	11,1	8,9	50	0,066	53
Г-4Cl	11,2	8,6	51	0,066	53
Г-2N	11,1	8,7	51	0,067	54
Г-4N	11,4	8,5	50	0,.068	54

При кислотной обработке исходный глинистый материал претерпевает значительные изменения химического и фазового состава. Химический состав катализаторов, полученных кислотной обработкой, по данным энергодисперсионного анализа приведен в таблице 3.

Таблица – 3

Химический состав катализаторов, полученных кислотной обработкой

Образец катализатора	Содержание основных составляющих, масс.%							
	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O
ГИ	54,60	16,08	5,08	0,91	17,80	2,32	0,40	2,71
Г-2S	72,47	14,44	6,89	0,87	0,99	1,54	0,12	2,68
Г-4S	70,92	14,64	7,65	1,32	1,11	1,48	0,15	2,73
Г-2Cl	74,29	14,13	5,48	0,89	0,80	1,43	0,16	2,81
Г-4Cl	72,70	14,35	6,87	0,95	0,81	1,49	0,15	2,68
Г-2N	72,18	14,11	7,51	1,05	0,84	1,44	0,13	2,74
Г-4N	72,51	14,52	7,04	1,01	0,58	1,48	0,23	2,63

Рентгенофазовый анализ

Согласно данным таблицы 3, при кислотной обработке исходного глинистого материала происходит удаление катионов K^+, Na^+, Ca^{2+}, Mg^{2+}, Fe^{3+}, которые являются обмен способными на ионы водорода. Незначительный выход в раствор алюминия может свидетельствовать о разрушении кристаллической структуры и частичной аморфизации алюмосиликата.

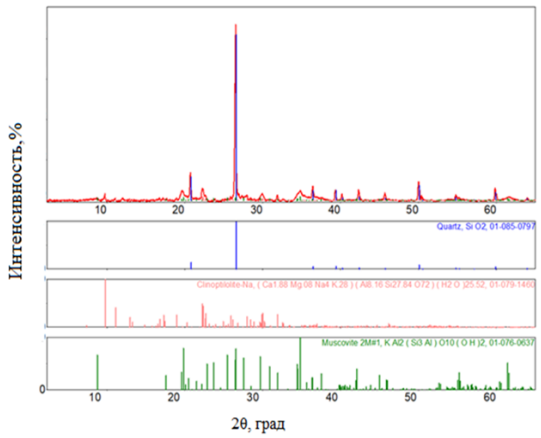


Рисунок 2 – Рентгеновские порошковые дифрактограммы образцов катализаторов

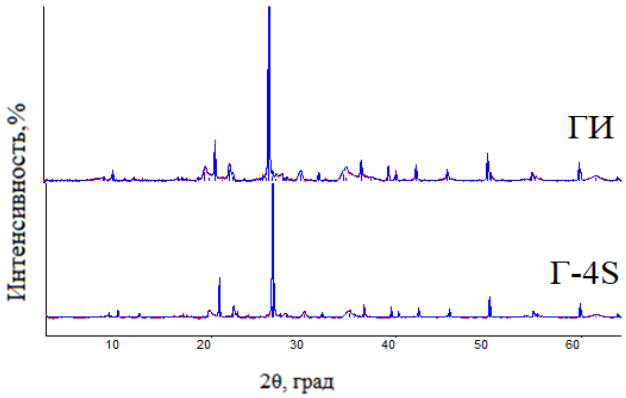


Рисунок 3 – Рентгеновская порошковая дифрактограмма образца исходного глинистого материала

Это подтверждается результатами РФА. Дифрактограммы для образцов ГИ и Г-4S приведены в качестве примера на рисунке 2,3. При кислотном воздействии на порошковых дифрактограмм наблюдается уменьшение интенсивности рефлексов с их небольшим расширением, что свидетельствует о частичной аморфизации структуры составляющих компонентов глинистого материала.

Анализ методом газовой хроматографии.

Активность исследуемых катализаторов проводили методом сравнения хроматограмм (рис. 4). Данный метод дает возможность провести качественную обработку хроматограмм. Полученные результаты показали различие компонентного состава продуктов деструкции для всех исследуемых образцов катализаторов. Максимумы наблюдаются в достаточно широком диапазоне значений времени удерживания. Узкое распределение продуктов по числу углеродных атомов фиксируется для образца Г-2N. Данный факт дает возможность утверждать, что исходный и модифицированные образцы глинистого материала дают возможность направленно регулировать состав получаемых продуктов в реакции термокаталитической конверсии.

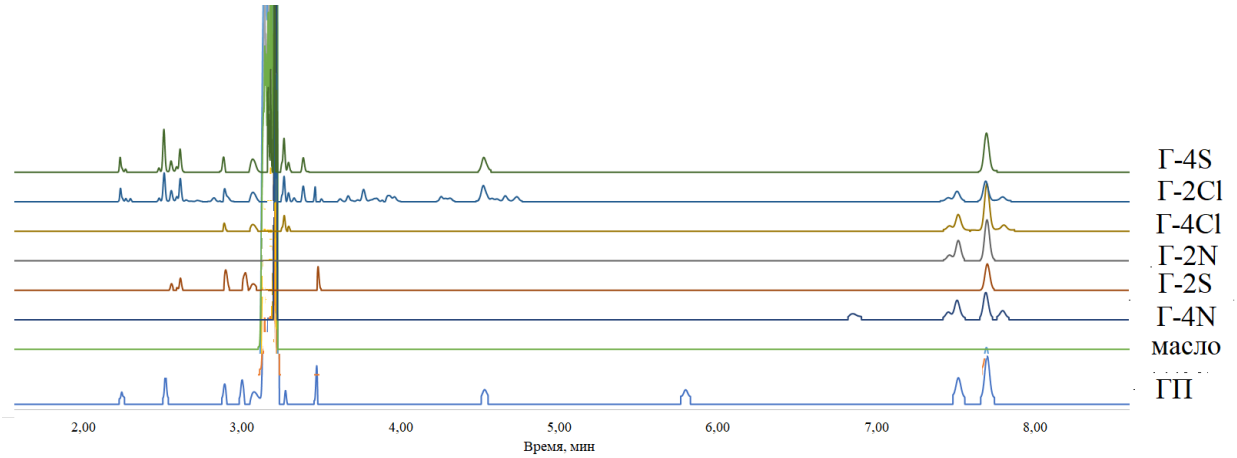


Рисунок 4 – Хроматограммы образцов жидких продуктов конверсии полипропилена и моторного масла в присутствии исследуемых катализаторов

Выводы

Кислотная обработка глинистого материала оказывает влияние на концентрацию поверхностных кислотных центров. Способность исследуемых катализаторов превращать смесь полипропилен-моторное масло в жидкие углеводороды зависит количества и их доступности кислотных центров определенной силы. Выполнен комплексный анализ исходного глинистого материала и образцов, полученных кислотным модифицированием, на его основе методами РФА и хроматографии.

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SHO‘RLANGAN MAYDONLARDA YEM-XASHAK EKINLARINING O‘SISHI VA RIVOJLANISHI

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Kirish. Bugun global iqlim o‘zgarishi sharoitida qishloq xo‘jaligida, ayniqsa sug‘orma dehqonchilik sohasida ilmiy tadqiqotlarni olib borish juda katta masalaga aylanmoqda, aholi sonining ortib borayotganligi va shu bilan birga qishloq xo‘jaligi va sanoatning yangi tarmoqlarining vujudga kelishi suv is’temoli ko‘lamini yanada kengaytirib yubormoqda, bu jarayon uzluksiz davom etmoqda. Qishloq xo‘jaligi va boshqa tarmoqlarni suv bilan ta’minlashda suv omborlarining ahamiyati juda yuqori hisoblanadi. Sug‘orma dehqonchilik sohasi keng tarqalgan AQSh, Xitoy va Hindiston kabi mamlakatlarda sug‘orish suvining asosiy qismi suv omborlari hisobidan ta’minlanadi. Lekin, ayrim tabiiy va antropogen omillar ta’sirida to‘g‘onlarda yorilish, o‘pirilish, yuvilish holatlari sodir bo‘lib kelmoqda. Natijada suv toshqini oqibatida insonlar hayoti, sog‘lig‘i, uy joylari hamda daromadlariga ancha salbiy ta’sir ko‘rsatmoqda.

Tadqiqot natijalari. Jo‘xorining o‘sish va rivojlanishini hisobga olib borish. Suv toshqining ta’sir doirasida tabiiy-texnogen holatlar ta’siri o‘simlikning o‘sish va rivojlanish davrida yaqqol ko‘zga tashlandi. Ko‘p tajribaga ega bo‘lgan dehqonlarning fikriga ko‘ra va kuzatishlarimizda ekilgan ekinlarning barchasida o‘sish va rivojlanish jarayoninig sust kechishi kuzatilib turdi. Buni olingan natijalar ham tasdiqladi. Jo‘xorining o‘sish va rivojlanishini kuzatib borish maqsadida unda biometrik hisoblashlar olib borildi.

Jo‘xoridagi birinchi biometrik hisoblashlar o‘tkazilgan tajriba variantlarida o‘simlikning bo‘yi o‘rtacha 28,1 sm. bo‘lib, 7-chi barg chiqish boshlangan bo‘lsa, keyingi rivojlanish davrlarida o‘sish jadal kechgan va 1.07.da o‘tkazilgan hisoblashlarda o‘simlikni bo‘yi 78,1 sm va bargi shunga mos holatda 11,0 ta. bo‘lgan va nihoyat o‘simlikda biometrik hisoblashlar o‘tkazilgan uchinchi muddatda 1.08. da o‘simlikning bo‘yi 150,4 sm va barg soni 13,4 tani tashkil qildi. Jo‘xorining ko‘k massa va pichan hosilini hisoblash. Jo‘xorini ko‘k massa va pichan hosilini hisoblashda har bir qaytariqdan 25 tadan jami 100 ta o‘simlik sanab olindi. Ajratib olingan o‘simliklar yig‘ishtirib olinib, dastlab ho‘l massa so‘ngra quruq holatida o‘lchandi. Har bir delyanka bo‘yicha hosildorlik hisoblab chiqilgandan keyin uni gektar hisobiga aylantirildi.

Tadqiqotda birinchi qaytariqda ho‘l massa 2978 g. yoki quruq massa 856,0 g/ni, ikkinchi qaytariqdan olingan hosil 2978 g, quruq massa 856,0g uchinchi qaytariqdan olingan ho‘l massa 3005 gni tashkil etdi. Tadqiqotda jo‘xorini quruq massa hosilini (silos) hisoblash ham shu tartibda olib borildi. Bunda ham dastlab variantlar bo‘yicha, so‘ngra o‘rtacha hosil hisoblandi.

Bedaning o‘sishi va rivojlanishi va hosildorligi. Bedaning biologiyasi bo‘yicha o‘sish va rivojlanish fazasi qayd etilgan bo‘lib, tadqiqotda suv toshqinidan keyingi yetishtirish texnologiyasi ishlab chiqishda 3tasi fenologik kuzatish olib borish imkoniyati bo‘ldi. 1 m^2 dagi poyalar soni sanaldi, Bedani shonalash fazasiga kirishi, Gullash fazasini boshlanishi; Beda 25% gullash fazasiga kirishi bilan o‘rildi. Bunda 1 m2 dagi ko‘k massa, so‘ngra quritilgan holda hisoblab chiqildi. Tadqiqotda loyqadan keyin o‘sib rivojlangan beda poyalarining o‘sish va rivojlanishi bo‘yicha tajriba variantlarida fenologik kuzatishlar olib borildi. Kuzatishlarga asoslanib 1 m2 da ikkinchi yili ko‘karib chiqqan maysalar soni hisobga olindi. Bunda 1 m2 dagi ko‘karib chiqqan maysalar soni 60 tani tashkil etib, jami poyalar soni 240 tani tashkil etdi. Bunda dastlabki beda maysalari o‘g‘itlanib, sug‘orilgandan keyin keyin 7-8 kunda ko‘karib chiqa boshladi va 15-16 kunlari dastlabki poyalar paydo bo‘ldi. Beda kuzatuvlarning 25-28 kunlari dastlabki shonalashga kirdi va nihoyat 39-42 kunlari gullar paydo bo‘ldi.

Ushbu tuproqlar sharoitida beda yetishtirish va uning hosildorligini belgilovchi ko‘rsatgichlar 1m^2dagi poyalar soni, bedaning ko‘k va quruq massa hosili, har bir o‘rimlarda olingan faktik hosil miqdori va nihoyat ularning s/ga hisobidagi hosildorligidir.

Tadqiqotda bedaning ko‘k massa va pichan hosilini hisoblash quyidagi tartibda olib borildi. Hisoblashlar har bir o‘rimdan oldin o‘tkazildi. Dastlab, takrorlashlar

bo‘yicha 1 m^2 dagi poyalar soni, ko‘k va quruq massa, hamda delyankalar bo‘yicha hosildorlik alohida olingan tartibda hisoblab chiqildi. Vegetatsiya davrida beda 2-marta o‘rib olindi. O‘rib olingan beda dastlab delyankalar bo‘yicha so‘ngra gektarga ko‘paytirilib oldin ho‘l massa so‘ngra quruq pichan hosili hisoblab chiqildi. Birinchi tajriba maydonidagi bedaning quruq massa hosildorligi o‘rtacha birinchi va ikkinchi o‘rimda 150-161 sentr quruq pichan hosili olindi. 3-tajriba maydonidagi 1 yillik bedaning pichan hosildorligi 1-o‘rimda 134 s/ga bo‘lsa, ikkinchi o‘rimda bu ko‘rsatkich 120 s/ga pichan hosildorligi olindi.

Xulosalar. Sardoba suv toshqini natijasida sug‘oriladigan yerlarning meliorativ holatini yaxshilash maqsadida loyqa cho‘kindi qalinligi 0-15sm, 15-30 sm va >30 smdan yuqori bo‘lgan sharoitda jo‘xori va bed ekinlari ekib yetishtirildi va hosildorlik oshirishga, tuproq tarkibidagi tuzlar miqdorining kamayishiga olib keldi.

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SHO‘RLANGAN MAYDONLARDA SOYANING SUG‘ORISH TARTIBLARI

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Annotatsiya. *Ushbu maqolada Sardoba suv ombori toshqinidan keyingi sug‘oriladigan yerlarning eko-meliorativ holatini yaxshilash, unumdorligini saqlash va oshirish maqsadida soya o‘simligini yetishtirishda sug‘orish oldi tuproq namligi, sug‘orish tartiblari, sonlari va ma’sumiy suv iste’moli ko‘rsatkchilari bo‘yicha ma’lumotlar keltirilgan.*

Kalit so‘zlar*: Sardoba, suv ombori, loyqa cho‘kindisi, sug‘orish tartibi, sug‘orish soni.*

Kirish. Dunyo aholisining oshib borayotganligi, aholi sonining o‘sishi bilan bog‘liq ravishda qishloq xo‘jaligi va sanoatning yangi tarmoqlarining vujudga kelishi suv is’temoli ko‘lamini yanada kengaytirib yuboradi va bu jarayon uzluksiz davom etmoqda. Qishloq xo‘jaligi va boshqa tarmoqlarni suv bilan ta’minlashda suv omborlarining ahamiyati juda yuqori hisoblanadi. Dunyoda dehqonchilik maqsadida barcha qilingan to‘g‘onlar soni, umumiy to‘g‘onlar soniga nisbatan yarmidan ko‘prog‘ini tashkil etadi. Sug‘orma dehqonchilik keng tarqalgan Xitoy, Hindiston, AQSh va boshqa mamlakatlarda sug‘orish suvining asosiy qismi suv omborlari yordamida ta’minlanadi. Lekin, ayrim tabiiy va antropogen omillar ta’sirida to‘g‘onlarda o‘pirilish, yorilish, yuvilish holatlari sodir bo‘ladi. Natijada suv toshqini oqibatida insonlar hayoti, sog‘lig‘i, uy joylari va daromadlariga katta salbiy ta’sir ko‘rsatadi. Dunyo aholi sonining mutassil oshib borayotganligi, aholi sonining o‘sishi

bilan bog‘liq ravishda xalq xo‘jaligi va sanoat yangi tarmoqlarining vujudga kelishi suv is’temoli ko‘lamini yanada kengaytirib yuboradi

Tadqiqot natijalari. Tadqiqot ishi natijalarining ilmiy ahamiyati shundan iborat, loyqa cho‘kindilari qalinligi 0-15, 15-30, >30 santimetrdan yuqori bo‘lgan sharoitda moyli soya, kungaboqar, yem-xashak jo‘xori va beda o‘simlik navlarini yetishtirish, sug‘orish tartiblari, sizot suvlar sathi, uning minerallashganlik darajasi, suv va tuz balanslari dinamikasi, moyli va yem-xashak ekinlarini sug‘orish me’yori, tartibi hamda mavsumiy suv-oziqa iste’moli ko‘rsatkichlari tuproqqa loyqa qalinligi bo‘yicha turlicha ishlov berish aniqlanganligi bilan izohlanadi. Sirdaryo viloyati Sardoba suv toshqini natijasida sug‘oriladigan yerlarning eko-meliorativ holatini yaxshilash borasida olib borilgan tadqiqotlar natijasida loyqa cho‘kindilari qoplami qalinligi 0-15 sm bo‘lgan Oqoltin tumani “Bekzafarlik chorvadorlar” fermer xo‘jaligida amal davri boshida sug‘orish ishlarini tashkil qilishda muhim hisoblangan tuproqning cheklangan dala nam sig‘imini aniqlash ishlarida o‘rtacha bir metr qatlamda 22,5 % ga teng bo‘ldi. Sardoba tumanida joylashgan “Temir yo‘l agro” fermer xo‘jaligi dalarida loyqa cho‘kindi qalinligi 15-30 sm qalinlikda olib borilgan tajriba natijalarida tuproqning ChDNS o‘rtacha bir metr qatlamda 22 % bo‘ldi. Sardoba suv omboriga 1,5-2 km uzoqlikda joylashgan “Jasoratli Oybek” fermer xo‘jaligi dalalarida o‘rganilgan dala tajribalarida tuproqning mexanikaviy xossasi qum bo‘lgan sharoitida o‘rtacha 1-metr qatlamda 20,1% ga teng bo‘lganligi aniqlandi, va ushbu ko‘rsatkichlar bo‘yicha hisob kitob ishlari amalga oshirildi.

Loyqa cho‘kindi qalinligi 0-15 sm, 15-30 sm va >30 smdan yuqori bo‘lgan tajriba dalalarida moyli ekinlardan soya o‘simligi xar bir sug‘orish oldi tuproq na’munalari olinib, termostat tarozi usulida aniqlandi va tuproqning Cheklangan dala nam sig‘imiga nisbatan 70-70-65% sug‘orish oldi tuproq namligi bo‘yicha, sug‘orishda tuproqning hisobiy qatlami 0-70 sm ni hisobga olgan holda sug‘orish ishlari amalga oshirildi. 2021-yilda soya o‘simligini loyqa cho‘kindi qalinligi 0-15 sm bo‘lgan maydonlarda sug‘orishdan odin namlik 15,6-69,3% bo‘lganda 1-sug‘orish agrotadbiri o‘tkazildi. 2-sug‘orish ishlari 15,7-69,7% bo‘lganda amalga oshirildi. Shu tartibda xar bir sug‘orishdan oldin tuproq na’munalari olindi va +-2% atrofida ushlab turildi va sug‘orish tashkil etildi. Soya o‘simligini sug‘orish oldi tuproq namligi cheklangan dala nam sig‘imiga nisbatan 70-70-65 % tartibda, sug‘orishda 0-70 sm tuproqning hisobiy qatlami bo‘yicha amalga oshirildi. 2021/2022-yillarda olib borilgan tajriba natijalarida quyida natijalar olingan

Loyqa cho‘kindi qalinligi 0-15sm bo‘lgan sharoitda 2021-yilda 1-sug‘orishda 760 m^3/ga suv sarflangan, 2-sug‘orishda 749 m^3/ga, 3-suvda 738 m^3/ga me’yorda, 4-

suvda 727 m^3/ga, 5-sug‘orishlarda 870 m^3/ga sug‘orish suvlari bilan sug‘orilgan, jami 5 marta sug‘orish agrotadbiri o‘tkazilgan bo‘lib, masumiy sug‘orishning me’yori esa 3844m^3/gani tashkil etgan, loyqa cho‘kindi qalinligi 15-30 sm tajriba dalasida sug‘orishlar bo‘yicha 1-suv 765m^3/ga, 2-sug‘orish esa 754 m^3/ga, sug‘orishning 3-davrida 733 m^3/ga, 4-suvda 821^3/ga va 5-sug‘orishda esa 897 m^3/ga sug‘orilib, jami 3970 m^3/ga mavsum davomida sug‘orish suvlari sarf etildi. Loyqa cho‘kindi qalinligi >30 sm bo‘lgan tajriba dalasida o‘tkazilgan tadqiqotlar natijasi quyidagicha aniqlandi, sug‘orish suvlari 1-marta 664 m^3/ga, 2-sug‘orishda 697 m^3/ga, 3-sug‘orishda 708 m^3/ga, 4-5sug‘orishlarda 652 m^3/gadan, 6-sug‘orishlarda 753 m^3/ga me’yorda sug‘orildi.

Yuqoridagi tajriba olib borgan sharoitga mos ravishda 2022-yilda soya o‘simligini bir galgi sug‘orish me’yori va mavsumiy sug‘orish me’yori aniqlangan tajriba dalasida 0-15 sm tuprqoning hisobiy qatlami loyqa cho‘kindilari qoplagan maydon bo‘yicha o‘simlik vegetatsiya davri davormida 5 marta sug‘orilgan bo‘lib xar galgi sug‘orishning me’yorlari 716, 705, 694, 749, 847 m^3/ga sug‘orishlarning mavsum davomida jami 3711 m^3/ga sug‘orish suvlari sarf etildi. Loyqa cho‘kindi qalinligi 15-30 sm qalinlikdagi tajriba dalasida sug‘orishning bir galgi me’yorlari 731, 777, 710, 699, 876 m^3/ga me’yorlarda jami 5 marta sug‘orishlar o‘tkazilgan bo‘lib, mavsum davomida jami 3793 m^3/ga suv sarf etildi. Loyqa cho‘kindi qatlami qalinligi >30 sm bo‘lgan maydonda sug‘orishlar soni ortishi jami 6 marta sug‘orildi va ularning bir galda sarf etilgan me’yorlari quyidagicha 664, 697, 708, 653, 653, 752 m^3/ga sug‘orishning mavsum davomida sarflanganligi 4127 m^3/ga sug‘orish suvlari sarf etilganligi tajriba natijalarida o‘z isbotini topdi.

Xulosa. Sardoba suv toshqinidan keyin ekilgan soya o‘simligini o‘rganilgan tajribalarda loyqa cho‘kindi qalinligi 0-15, 15-30 sm bo‘lgan tajriba dalalarida 5-marta sug‘orildi sug‘orishning umumiy me’yorlari o‘rtacha ikki yilda 3844-3970 m^3/ga va 3711-3793 m^3/gani tashkil etdi. Loyqa cho‘kindi qalinligi >30sm bo‘lgan maydonda 6 marta sug‘orilgan bo‘lib, 4126-4127 m^3/ga sug‘orish suvlari sarflanganligi aniqlandi.

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DUAL SYSTEM TEACHING OF ENGLISH

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Annotation: *The main content of this article is that higher education English teachers provide recommendations and methods on how to help students learn English in ability-based classes and how to improve their knowledge. In addition, this article explores effective methods of teaching English in mixed classrooms.*

Key words: *dual education, upper classes, classroom communication, classification dynamics, classroom assignments, communicative language.*

Аннотация: *Основное содержание данной статьи заключается в том, что преподаватели английского языка в высших учебных заведениях предоставляют рекомендации и методы, как помочь студентам изучать английский язык на занятиях, основанных на способностях, и как улучшить свои знания. Кроме того, в данной статье исследуются эффективные методы преподавания английского языка в смешанных классах.*

Ключевые слова: *дуальное образование, старшие классы, классное общение, классификационная динамика, классные задания, коммуникативный язык.*

INTRODUCTION

Classes with large differences in ability, motivation for learning English, needs, interests, educational background, learning styles, anxieties, experiences, and other factors are known as mixed-ability classes. Teaching a group of students with distinctly varying levels of language proficiency is quite challenging. They may have varied English proficiency levels from the outset or learn the language at very different rates. This is a very typical issue.

LITERATURE REVIEW AND METHODOLOGY

Very frequently, the instructor must figure out how to address the demands of a class that has two or more clearly differentiated levels of ability. Naturally, there are no simple answers to this dilemma, thus it would be incorrect to pretend that there are any.

The class should be informed about the problem and told that it is something that the entire class must cope with. This is an important first step. Most effectively, this should be conducted in the pupils' native language. It is crucial to emphasize the value of collaboration among the class members and the requirement that they utilize English whenever feasible in classroom discussion because the majority of solutions to problems require their participation.

If you want to include every student in the class, pair and group work are crucial. The utilization of surveys and interviews is a key strategy here. You may ensure that every student participates to the fullest by partnering up weaker and stronger students and including them in the development and administration of the questionnaire. The stronger pupils can then interview the weaker ones, and vice versa. Naturally, this may frustrate the stronger individuals, but if they are able to view their position as one of "helper" or even mentor, it may also have a good impact.

Project work is a second activity that can be fruitful in mixed ability classrooms. Another technique is to establish groups that are around the same level and assign various tasks that are appropriate to each group's level. This may also be done successfully utilizing mixed groups where the stronger support the weaker. You may give each group a task that it can do effectively by altering the assignment's difficulty, giving the more capable pupils the right amount of challenge without demotivating the less capable ones.

Homework makes up a third category. No of the level, if you assign the identical homework to the entire class, you can anticipate extremely inconsistent outcomes. Similar to progress exams, homework should serve to reinforce what students have learned in class. To this purpose, assigning easier assignments to less capable pupils can aid in both motivating them and providing them more experience in language-related skills they have not yet mastered.

The stronger pupils in the group should be given more difficult assignments to complete in order to keep them engaged and moving forward. Although it requires the instructor to do more effort, the end result ought to be results. Drilling with the choir is a good approach to engage timid or underachieving youngsters. It may provide good practice in rhythm and intonation, as well as reinforcing word order and grammatical structure, if used sparingly (i.e., not all the time). Finally, use tact while you're asking

questions. By choosing weaker students to be the first to respond to a question in open class, try to avoid putting them "on the spot." Instead, make an effort to foster a culture of attentive listening in the classroom by asking a better student a question before asking a weaker student to repeat it. This type of contact may take some getting used to, but once it does, it may be highly beneficial for class dynamics. In conclusion, there is some degree of mixed ability in all courses. Extreme situations, when near native speakers are mixed with novices, can be quite difficult for the teacher.

RESULTS AND DISCUSSION

In these situations, it's crucial to keep in mind that all of your students will learn something from the lesson, if perhaps not exactly what you intended to teach them or the same thing. For instance, the weaker students may start to be able to employ a new tense, while the novices may start to understand your classroom language.

Mixed levels are inherently problematic. It might be challenging to teach pupils who have varying levels of learning. However, teachers may deliver content in a way that will simultaneously engage all students on all levels by learning to discern learning capacities.

They may have varying initial English proficiency levels, or this may occur for a variety of reasons, but mostly due to various learning preferences, learning rates, degrees of desire, and, very frequently, logistical considerations.

Very frequently, the instructor must figure out how to address the demands of a class that has two or more clearly differentiated levels of ability. Naturally, there are no simple answers to this dilemma, thus it would be incorrect to pretend that there are any.

It is crucial to emphasize the importance of teamwork and for the class to use English whenever feasible in classroom communication because the majority of the solutions to the issue depend on cooperation between the class members. Here are some methods teachers can use to instruct a group of pupils with various learning styles. These are a few approaches a teacher can use to handle this circumstance.

1. Supportive Learning Environment. It's critical to provide a positive learning atmosphere in the classroom where students feel comfortable and able to give their best effort. The term "learning environment" simply refers to the classroom setting and how students interact with it. No of their learning styles, teachers must design a classroom that will benefit all of their pupils. If in-class tasks are required, for instance, create a basic list of prerequisites and then provide students with supplementary instructions on a case-by-case basis to meet their learning styles. Make sure the classroom has areas where kids may focus and concentrate in peace. Or offer them the chance to collaborate with others. Ensure that the class is aware that the alternatives are available since every student performs best in a different environment.

2. Needs assessment. Use a needs analysis to urge the students to consider their learning preferences, linguistic requirements, learning techniques, love of learning, drive, and language strengths and limitations. What types of classroom activities do you enjoy or benefit from, for example? Which linguistic ability do you most want to hone? Do you like working alone or with a partner better? Would you want to work in a group throughout the session or just sit and listen to the teacher? In pairs or small groups, students compare their solutions. You should gather the data and provide a statistical breakdown of the main inquiries and responses. This will support the growth of the class′s feeling of collective community.

3. Teamwork. Use a variety of engagement styles in the classroom. Students should collaborate in teams, couples, and independently. Groupings must to be switched up often to provide students a chance to interact with other students. It will be easier to accommodate the range of levels in the class if students′ work in the class is varied. There is a chance that these groupings will have comparable or mixed levels. In a smaller group, it is hoped that the weaker student would feel more capable of contributing. Divide the information among the pupils if the group is working with a certain set of facts, pushing them to cooperate. Consider assigning various levels or quantities of work to each group by splitting your class into levels for the duration of the course. The class′s discussion of this tactic should aid in preventing stigmatization.

4. Work in pairs. Strong and weak can be paired, as well as strong and weak. Perhaps the strong with the weak will function nicely in a carefully restricted activity. Perhaps using strong with strong will be advantageous in a more liberated action. Here, variety in the pairings is vital, and you should also pay attention to the connections in general.

5. The entire class mingle. This is one of my preferred approaches.

During a mingle exercise, students must converse or engage with a large number of different classmates quickly in order to complete a task. This implies that every student will interact with students who are working at varying levels and will have greater and worse communication. This helps the less capable kids and gives the more capable ones opportunity.

6. Giving Different Students Different Instruction.

Because of the input of the more accomplished students, the average and lower performing students are encouraged to attempt and expand their knowledge. Teachers may adapt to a wide range of diverse interests, cultural backgrounds, and global knowledge by using differentiated education, which leads to more engaging classroom engagement. Setting the stage for the acceptance of diversity begins with the mindset of the instructor.

7.Process. Process refers to how students interact with and absorb material. This is crucial because it gives pupils the chance to give new information time to fully sink in. Students get the chance to assess what they may or may not comprehend via the process. Teachers can monitor and evaluate a student's development using this procedure. For instance, John McCarthy, an educational consultant, advises instructors to create "one or two processing experiences for every 30 minutes of instruction." Through these interactions, both students and teachers may take a break and determine who requires extra education and who does not.

8.Products. Products are tasks or projects that motivate students to apply knowledge in both inside- and outside-the-classroom contexts. For instance, when the material has been covered and students have had time to comprehend it, encourage them to create a project of their own that best demonstrates what they have learned. For instance, smaller kids can produce a poster board with images and labeling, while older students might write a little play or draw illustrations. Teachers might wish to provide pupils with a menu of possibilities and even let them work in groups.

CONCLUSION

In my conclusion, be courteous in your questioning strategies. By choosing weaker students to be the first to respond to a question in open class, try to avoid putting them "on the spot." Instead, make an effort to foster a culture of attentive listening in the classroom by asking a better student a question before asking a weaker student to repeat it. This type of contact may take some getting used to, but once it does, it may be highly beneficial for class dynamics. If you only teach a few more differentiated lessons, even the teacher could find it enjoyable. Dare to be different, and you never know what you could discover. Be honest, and display your vitality and excitement!

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GLITSIN AMINOKISLOTASINING KVANT-KIMYOVIY HISOBLASHLARI

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Annotatsiya: *Maqolada glitsin aminokislotasining kimyoviy xossalari va kvant-kimyoviy hisoblashlarini o‘rganishga bag‘ishlangan adabiyotlar tahlil etilib, natijalar o‘rtasidagi bog‘liqlik o‘rganiladi. ORCA va Gaussian dasturlarida glitsinning geometriyasini to’liq optimallashtirish bilan elektron tuzilishini hisoblash DFT - funktsional zichlik nazariyasi usulida B3LYP/6-311G(d,p) va M062X/6-311++G** hamda B3LYP/6-31++G valent bo’lingan asosli to’plamlar doirasida amalga oshirildi. Shuningdek, glitsin molekulasining biologik faolligi – PASS analizi va molekulyar doking usullarida baholandi.*

Kalit so‘zlar: *aminokislota, kvant-kimyoviy hisoblash, DFT, Mulliken, zaryad, elektron tuzilish, HOMO, LUMO, glitsin, IQ-spektroskopiya, PASS analiz, molekulyar doking.*

Kirish

Aminokislotalar — molekulasida amin va karboksil guruhi bo‘lgan organik birikmalar, o‘simlik hamda hayvon oqsilining asosiy elementi hisoblanadi. A- rangsiz, suvda eruvchan kristall moddalar. 200 ta tabiiy Aminokislotalar ma’lum. Lekin oqsillar tarkibida faqat 20 Aminokislotalar va ularning 2 ta amidi uchraydi. Qolganlari oqsillar tarkibiga kirmaydi. Aminokislotalarning D-yoki L-qatorga tegishligini N va NH_2 guruhning uglerod atomida qanday joylashganligi ko‘rsatadi. Deyarli barcha tabiiy A L-qatoriga kiradi. D-qatorga mansub Aminokislotalar tabiatda kamdan-kam bo‘lib, mikroorganizmlar tarkibida topilgan. Aning L-formasi o‘simliklar tomonidan yaxshi o‘zlashtiriladi va u moddalar almashinuvining barcha jarayonlarida qatnashadi, lekin

D-formalarini o‘simliklar o‘zlashtira olmaydi, ba’zan ular moddalar almashinuvi jarayonlarini to‘xtatib qo‘yadi. Bu organizmning fermentativ sistemasi Aminokislotalarning L-qatoriga moslashganligidan darak beradi. Aminokislotalar organizmda erkin holda va oqsillar yoki boshqa birikmalar tarkibida uchraydi. Oqsillar sintezi uchun a formali 20 Aminokislotalar- proteinogen Aminokislotalar (lizin, gistidin, arginin, aspartat kislota, asparagin, treonin, serin, glutamat kislota, glutamin, prolin, glitsin, alanin, sistein, izoleysin, leysin, metionin, valin, tirozin, fenilalanin va triptofan)dan foydalaniladi [1].

Glitsin — glikokol, aminosirka kislota, NH_2—CH_2—COOH, rangsiz kristall modda. Glitsin nomi qadimgi yunon tilidan olingan bo‘lib, glycys - shirin, aminokislotalarning shirin ta’mi tufayli shunday nom berilgan. Suyuqlanish temperaturasi 232—236° (parchalanadi), Mr=75,07, zichligi 1595 kg/m^3. Suvda yaxshi eriydi, ko‘pchilik organik erituvchilarda erimaydi. Oqsil moddalarning muhim tarkibiy qismi hisoblanadi [1, 6-9].

Glitsin — amin sirka kislotasi, eng oddiy almashadigan amin kislotasi. Barcha oqsillarning tarkibiga kiradi, tirik organizmda bo‘shda uchraydi. Glitsin — ko‘plagan proteinlar bilan biologik birikmalarning (glutation, kreatin v.h.) tarkibiga kiradi. Tirik hujayralarda glitsindan porfirinlar va purin asoslari tuziladi. Glitsin kislota bo‘lib, metall ionlari bilan murakkab tuzlar (glisinatlar yoki xelatlar) hosil qiladi: natriy glitsinat , temir glitsinat, mis glitsinat, rux glitsinat, marganets glisinat va boshqalar [2,3,8,9].

Eksperimental qism

Glitsin molekulasining reaksion qobiliyati va koordinatsion bog‘lanish imkoniyatlarini va korroziya ingibatorlik xossalarini o‘rganish maqsadida kvant-kimyoviy hisoblashlar amalga oshirildi. Barcha hisoblashlar Gaussian va ORCA dasturlaridan foydalangan holda amalga oshirildi [10,11, 15, 16]. Hisoblash natijalarini tahlil etish va vizuallashtirish uchun Avogadro va Chemcraft dasturlaridan foydalanildi [12, 13].

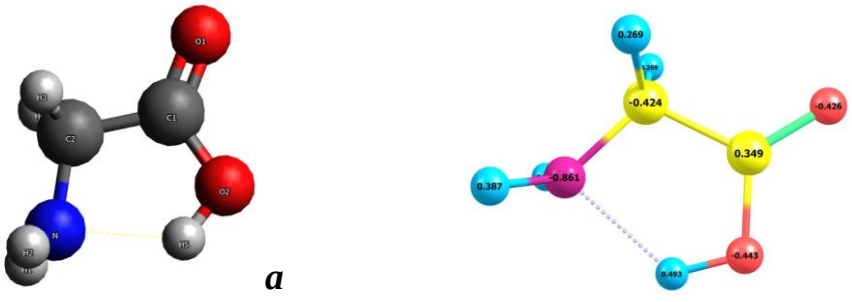
Beckning uch parametrli funksional gibridini LYP funksional korrelyatsiyasi bilan birgalikda ishlatish (B3LYP) eng mustahkam gibrid oilalardan biri hisoblanadi [15, 16, 18, 19]. Gaussiandagi hisoblangan out fayllari Gauss View dasturi yordamida vizualizatsiyalashtiriladi [15, 16, 19]. Elektron xossalarni, YuBMO-QBMO/(HOMO-LUMO) energiyalarni, zaryadlarning atomlar bo‘yicha Malliken taqsimotini hisoblashlar funksional zichlik nazariyasi (DFT) (B3LYP) usuli yordamida 6-311G++ (d, p) asosli to‘plam bilan amalga oshirildi.

Ushbu maqolada alaninning biologik faolligi PASS – komputer dasturi yordamida bashorat qilindi. Bu dastur PASS (Prediction Activity Structure Substances – Moddalarning tuzilishiga asosan faolligini bashorat qilish) Rossiyalik olimlar V.V. Poroikov hamda D.A. Filimonovlar tomonidan yaratilgan [20]. PASS online dasturi (https://www.way2drug.com/PASSOnline/index.php) biologik faolligi ma'lum bo'lgan 30 000 dan ortiq biologik faol moddalarni o'z ichiga olgan majmuani o'z ichiga oladi va 400 dan ortiq farmakologik ta'sirlarni, ta'sir qilish mexanizmlarini, shuningdek mutagenlik, kanserogenlik, teratogenlik va embriotoksiklikni qamrab oladi [21]. PASS ochiq tizim bo'lib, foydalanuvchi mavjud o'quv majmuasiga qo'shimcha moddalar qo'shishi yoki uni qayta yaratishi va tizimni qayta tayyorlashi mumkin.

Alanin aminokislotasining zamburug'ga nisbatan faolligi ***Vertisilium dalhliae*** zamburug'idan olingan oqsil (PDB ID: 5xmz) ga CB-Dock2 onlayn serveri yordamida o'zaro ta'sirini o'rganildi va natijalar maqolaning muhokama bo'limida bayon etildi [22, 23].

Olingan natijalar va ularning tahlili

1 va 2 rasmlarda Gaussian dasturi B3LYP/6-31**G va MO62X/3-311+G** usullarida optimizatsiyalangan glitsin molekulasi tuzilishi va mulliken zaryad taqsimoti keltirilgan.



a ***b***

1-rasm. B3LYP/6-31++G usulida optimizatsiyalangan glitsin molekulasining tuzilishi (***a***) va Mulliken zaryad taqsimoti (***b***)

a ***b***

2-rasm. M062X/6-311++G** usulida optimizatsiyalangan glitsin molekulasining tuzilishi (***a***) va Mulliken zaryad taqsimoti (***b***)

3-rasmda esa ORCA dasturi B3LYP/6-311(d,p) usulida optimizatsiyalangan glitsin tuzilishi va zaryad taqsimoti keltirilgan.

a ***b***

3-rasm. ORCA dasturida B3LYP/6-311G(d,p) usulida optimizatsiyalangan glitsin molekulasining tuzilishi (***a***) va Mulliken zaryad taqsimoti (***b***)

1-jadval

Gaussian va ORCA dasturlarida optimizatsiyalangan glitsin molekulasining Mulliken zaryad taqsimoti

Gaussian B3LYP/6-31++G	Gaussian M062X/6-311++G**	ORCA B3LYP/6-311G(d,p)
0 C 0.385064	0 C 0.331444	0 C 0.332021
1 N -0.856574	1 N -0.520540	1 N -0.512233
2 C -0.467237	2 C -0.175185	2 C -0.170313
3 O -0.427835	3 O -0.330863	3 O -0.331458
4 O -0.463841	4 O -0.294792	4 O -0.308679
5 H 0.381939	5 H 0.222998	5 H 0.215561
6 H 0.401161	6 H 0.221924	6 H 0.214820
7 H 0.255927	7 H 0.146927	7 H 0.144829
8 H 0.279330	8 H 0.151310	8 H 0.159100
9 H 0.512066	9 H 0.246777	9 H 0.256352

1-jadvaldagi glitsinning mulliken zaryad taqsimoti tahlil etilganda COOH-karboksil guruhidagi C=O ning kislorodi uchun -0.426 (B3LYP/6-31++G), -0.291 (M062X/6-311++G**) va -0.331 (B3LYP/6-311G(d,p)) ga teng bo‘ladi. COOH-

karboksil guruhidagi O–H gidroksil ioni kislorodi uchun esa -0.443 (B3LYP/6-31++G), -0.211 (M062X/6-311++G**) va -0.295 (B3LYP/6-311G(d,p)) ga teng bo‘ladi. Shuningdek, $–NH_2$ amino guruhning azot atomida manfiy zaryadlar taqsimoti -0.856 (B3LYP/6-31++G), -0.520 (M062X/6-311++G**) va -0.512 (B3LYP/6-311G(d,p)) ga teng bo‘ladi.

2-jadval

Gaussian va ORCA dasturlarida optimizatsiyalangan glitsin molekulasining dipol momenti qiymatlari

Hisoblash dasturi va usuli	Gaussian M062X/6-311++G**	Gaussian B3LYP/6-31++G	ORCA B3LYP/6-311G(d,p)	Gaussian B3LYP/6-311++G(3df,2p)
Dipol moment	5.7130	6.4899	5.57090	7.20; 13,07 [9]

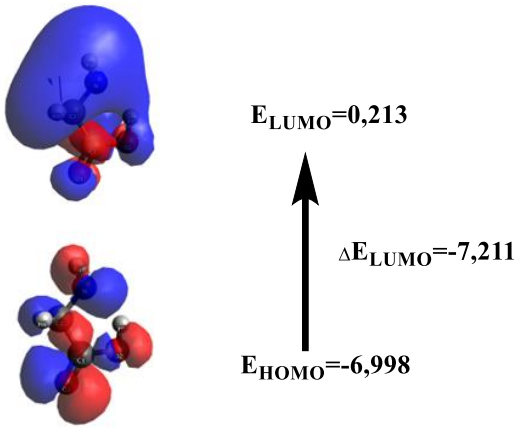
Turli dastur va usullardan foydalangan holda kvant-kimyoviy hisoblash natijalariga ko‘ra glitsin molekulasining umumiy dipol moment qiymatlari μ=5.7130 D (M062X/6-311++G**), μ=6.4899 D (B3LYP/6-31^{++}G) va μ=5.57090 D (B3LYP/6-311G(d,p)) ga teng bo‘ladi (2-jadval). [24] adabiyotda glitsin molekulasining svitter-ion holati shaklida modellashtirlishi amalga oshirilgan bo‘lib, unga ko‘ra dipol momenti qiymati glitsin molekulasining barqaror konformerida μ=7.20 D dan μ=13.07 D ga qadar oshganini va bu qiymat konformerga nisbatan 1,8 martaga ortiq ekanligi belgilangan. Yana bir e’tiborli jihati shundaki, glitsinngin svitter-ion holdagi konformeri Gly(ZW) PMC modeli bo‘yicha umumiy energiya qiymati 7,908 kj/mol ga ortiq bo‘lgan. Hisoblashlarda glitsin va suv molekulalari nisbatiga ko‘ra natijalar tahlil etilganda Gly(IIp)+ H_2O sistemasi uchun dipol momenti qiymati μ=13.47 D ga va umumiy energiyasi 15,081 kj/mol ga teng bo‘ladi. Suv molekulasi sistemada ortishiga qarab dipol momenti ko‘rsatgichi μ=15.42 D va μ=18.06 D ga teng bo‘lgan. Mualliflar tomonidan olib borilgan kvant-kimyoviy hisoblashlarda esa umumiy energiya qiymati -284,(3-4) oralig‘ida bo‘ldi (3-jadval).

3-jadval

Gaussian va ORCA dasturlarida optimizatsiyalangan glitsin molekulasining umumiy energiya qiymatlari

Hisoblash dasturi va usuli	Gaussian M062X/6-311++G**	Gaussian B3LYP/6-31++G	ORCA B3LYP/6-311G(d,p)
Umumiy energiyasi, a.u.	-284.408	-284.348	-284.369

*Izoh. 1 a.u. energiya birligi = 2625 kJ/mol = 627.51 kcal/mol = 27.21 eV ga teng.



4-rasm. ORCA dasturida B3LYP/6-311G(d,p) usulida optimizatsiyalangan glitsin molekulasining energetic taqsimoti

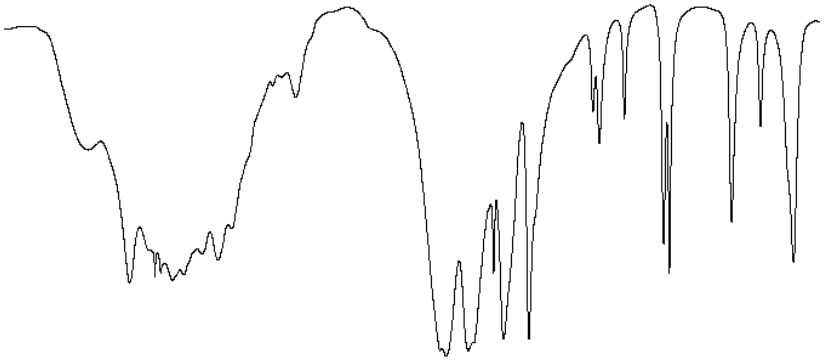
Glitsin molekulasining funksional zichlik nazariyasi DFT asosida reaksion qobiliyati elektromanfiylik (χ), kimyoviy potensial (μ), umumiy qattiqlik (η), umumiy yumshoqlik(S), σ-absolut yumshoqlik va elektrofillik indeksini (ω) hisobga olgan holda aniqlangan. Boshqacha qilib aytganda, bu parametrlar molekulalarning reaktivligining global deskriptorlarini aniqlaydi va Koopmans teoremasi asosida global reaktivlik tendensiyalarini muvaffaqiyatli ravishda oldindan ko‘rsatib beradi. Ushbu reaktivlik xususiyatlari E_{HOMO}, E_{LUMO} $\chi = -1/2(E_{LUMO} + E_{HOMO})$, $\mu = -\chi = 1/2 (E_{LUMO}+E_{HOMO})$, $\eta = 1/2 (E_{LUMO}- E_{HOMO})$, $\sigma = 1/\eta$, $S = 1/2\eta$ i $\omega = \mu^2/2\eta$ kabi chegara molekulyar orbitallarining energiyasidan foydalangan holda hisoblab topildi (4-jadval, 4-rasm).

4-jadval

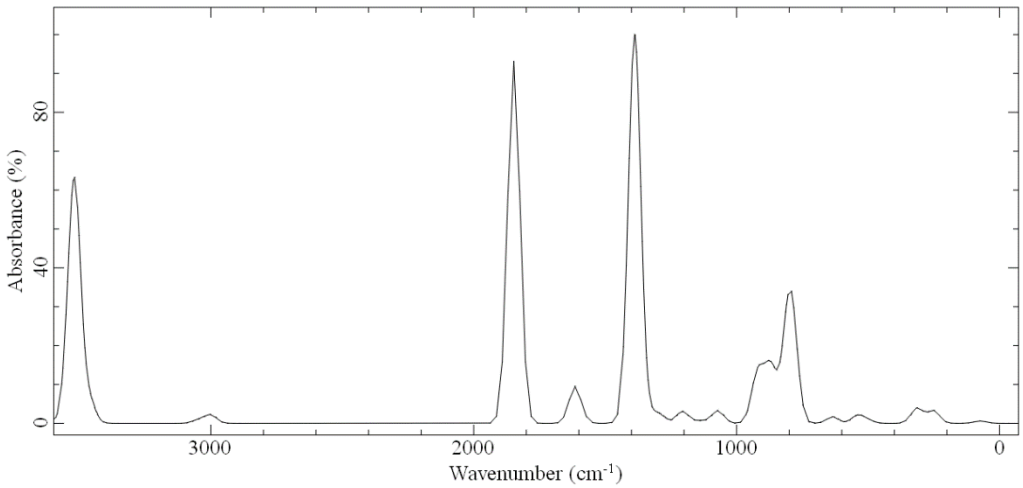
Glitsinning kvant-kimyoviy hisoblash usullari bilan aniqlangan energetik parametrlari

Hisoblash dasturi va usuli	$E_{(HOMO)}$ eV	$E_{(LUMO)}$ eV	ΔE	χ	η	σ	μ	S	ω
ORCA/ B3LYP/ 6-311G(d,p)	-6.998	0.213	-7.211	3.3925	-3.6725	-0.272	-3.3925	-1.836	-1.567
Gaussian/M062X/ 6-311++G**	-9.210	-0.568	-8.642	4.889	-4.321	-0.231	-4.889	-2.1605	-2.765
Gaussian/B3LYP/ 6-311G(d,p)	-7.296	-1.003	-6.293	4.1495	-3.1465	-0.317	-4.1495	-1.573	-2.736
MOPAC 7.0/SCF-MO/PM3 [102]	− 9.9053	0.9046	-10.8099	4.50035	5.40495	0.18501	-4.50035	0.0925	1.8735
NWChem-6.6/ 6 –311++G**	− 7.39	− 0.92	-6.47	4.155	3.235	0.3091	-4.155	0.1545	2.6683

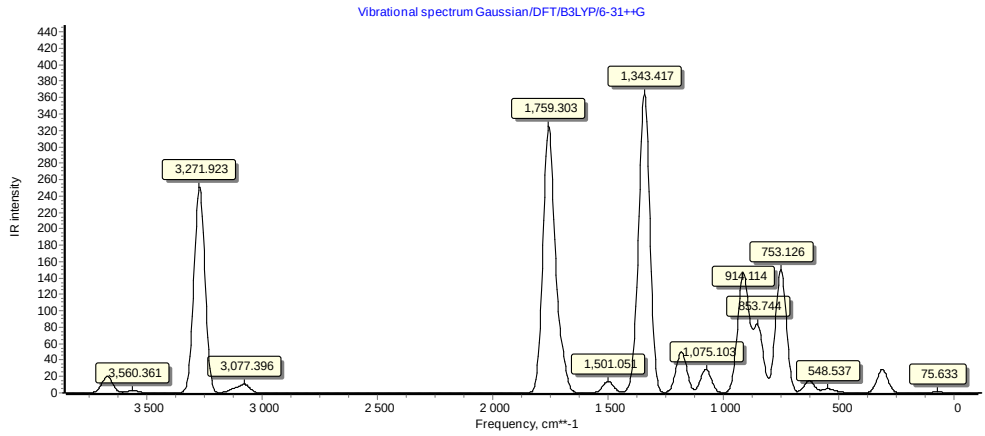
2100 va 2600 sm^{-1} mintaqalarida glitsin kukuni spektrlarida juda zaif va keng cho‘qqilar kuzatiladi, ular suv qo‘shilishi bilan kamayadi. Bu cho‘qqilar dimerlarning shakllanishi bilan bog‘liq bo‘lishi mumkin va suv qo‘shilishi ularning nisbati pasayishiga olib keladi. 2900 sm^{-1} dan yuqori bo‘lgan hududda 2974 sm^{-1} da intensiv o‘tkir chiziq va 3009 sm^{-1} da sezilarli darajada kamroq intensiv chiziq C–H cho‘zish tebranishlariga to‘g‘ri keladi va 3100–3200 sm^{-1} mintaqasida zaif keng chiziq kuzatiladi (5-7-rasmlar, 5-jadval). Oxirgi tarmoqli N-H va O-H cho‘zilgan tebranishlarga tegishli bo‘lishi kerak. Spektrlarning qiyosiy tahlili faol guruhlar -COOH va $-NH_2$ ning qo‘shni glitsin molekulalari va suv molekulalari bilan o‘zaro ta’siri haqida xulosa chiqarishga imkon beradi.



5-rasm. Glitsinning IQ spektri



6-rasm. M062X/6-311++G** usulida optimizatsiyalangan glitsin molekulasining IQ spektri



7-rasm. B3LYP/6-31++G usulida optimizatsiyalangan glitsin molekulasining IQ spektri

5-jadval

Turli kvant-kimyoviy usullarda hisoblangan glitsin molekulasining IQ spektr tebranish sohalari

M062X/6-311++G**		B3LYP/6-31++G		Funksional guruh
Tebranish chastotasi	IQ intensivligi	Tebranish chastotasi	IQ intensivligi	
76.7849	2.6358	76.1658	1.1264	
257.3983	14.1191	305.3341	5.255	
321.8624	17.0381	314.0091	23.4867	
516.4455	3.5189	507.1092	1.2941	

555.7607	8.4409	550.6392	4.8504	
655.4487	7.3644	629.0774	14.6822	
815.7254	118.4713	751.5683	150.645	
837.9575	46.2537	851.8354	80.4809	
897.4073	61.4634	911.1729	96.8371	
948.4771	56.9355	923.126	52.2236	
1103.813	14.2041	1076.719	29.0076	
1173.321	2.8836	1180.416	0.9667	
1243.263	13.184	1183.362	48.9535	
1332.791	9.276	1342.794	358.6844	
1372.712	7.5588	1359.165	1.046	
1430.847	437.028	1378.367	18.243	
1474.735	3.4752	1500.246	14.2316	
1664.356	41.8225	1708.361	52.9928	
1904.527	407.8664	1758.954	320.9282	
3093.06	9.3881	3075.74	10.0441	
3141.066	3.6074	3125.668	4.4383	
3570.081	25.6056	3270.933	251.4155	
3627.263	263.6828	3561.03	2.8808	
3654.936	23.1689	3670.508	20.3153	

Glitsinning PASS analizi

PASS dasturi stereoizomerlarning biologik faollikning namoyon bo‘lishiga ta’sirini baholashga imkon bermaydi, chunki hozirgi vaqtda ko‘plab moddalarning fazoviy tuzilishining xususiyatlarini hisobga oladigan dasturiy ta’minot mavjud emas. Tabiiyki, PASS dasturi tomonidan bashorat qilingan biologik faolliklarini tahlil qilishda eksperimental sinovlarning real imkoniyatlarini hisobga olish kerak. Bunday holda, biologik faollikni eng ko‘p ehtimoldan eng kam ehtimolgacha ketma-ket o‘rganish tavsiya qilinadi.

PASS dasturi yordamida alifatik monoamino- monokarbon kislota –glitsinning biologik faolliklari o‘rganildi (6-jadval).

6-jadval

Glitsinning PASS online dasturi bo‘yicha birikmalarning yuqori biologik faollik turlari va ko‘rsatkichlari

P_a - Faollik	**P_i - Nofaollik**	**Biologik faollik turi**
0,943	0,001	Mucinaminylserine mucinaminidase inhibitor
0,941	0,002	NADPH peroxidase inhibitor
0,937	0,003	Monodehydroascorbate reductase (NADH) inhibitor
0,930	0,002	Fucosterol-epoxide lyase inhibitor
0,930	0,004	Methylenetetrahydrofolate reductase (NADPH) inhibitor
0,924	0,003	Superoxide dismutase inhibitor
0,923	0,002	Peptide agonist
0,919	0,004	Sphinganine kinase inhibitor
0,917	0,003	Glucose oxidase inhibitor
0,914	0,003	Protein-disulfide reductase (glutathione) inhibitor
0,910	0,001	D-alanine 2-hydroxymethyltransferase inhibitor
0,909	0,001	Glycopeptide alpha-N-acetylgalactosaminidase inhibitor
0,905	0,005	Polyporopepsin inhibitor
0,905	0,004	Pro-opiomelanocortin converting enzyme inhibitor
0,902	0,004	Arylacetonitrilase inhibitor

Glitsinning molekulyar dokingi

Glitsinning biologik faolligini o‘rgsnish maqsadida ***Vertisilium dalhliae*** (PDB ID: 5xmz) zamburug‘idan olingan oqsilga ta’sirini o‘rganish maqsadida CB-Dock2 va Arguslab dasturlaridan foydalanildi [22, 23, 28-32].

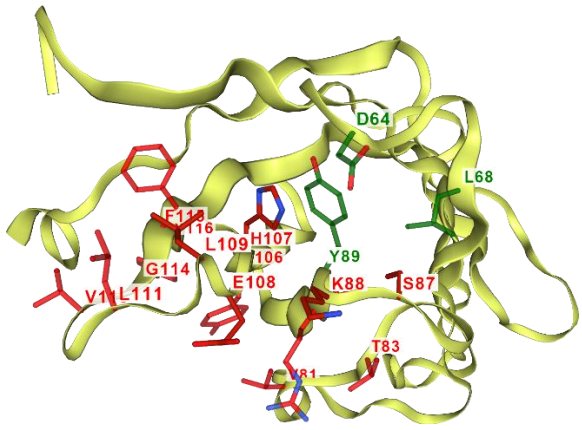
CB-Dock2 onlayn serveri yordamida dastlab 5XMZ oqsilining ligand bilan ta’sirlashish bo‘shliqlari izlandi, bunda 103, 92, 88, 55 va 48 Å3 hajmdagi 5 ta faol bo‘shliq markazi aniqlandi (8-rasm). So‘ng ligand va oqsil serverga yuklanib, molekulyar dokingi amalga oshirildi.

7-jadval

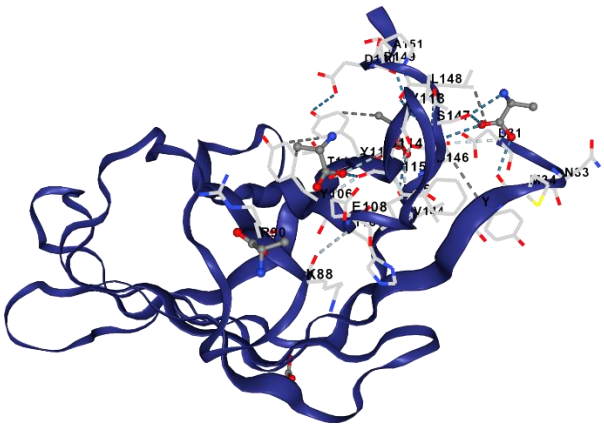
Glitsinning 5XMZ oqsiliga molekulyar doking natijalari

Bo‘shliq raqami	Bo‘shliq hajmi (Å^3)	Markaz (x, y, z)	Bo‘shliq o‘lchami (x, y, z)	Bo‘shliq raqami	Vina score	Bo‘shliq hajmi (Å^3)	Markaz (x, y, z)	Doking hajmi (x, y, z)
C1	103	-11, 31, 2	12, 9, 6	C3	-4.0	88	-24, 27, -4	15, 15, 15
C2	92	-21, 37, 0	8, 5, 5	C1	-3.3	103	-11, 31, 2	15, 15, 15
C3	88	-24, 27, -4	6, 7, 7	C5	-2.9	48	-10, 22, -22	15, 15, 15
C4	55	-7, 36, -4	7, 5, 8	C4	-2.8	55	-7, 36, -4	15, 15, 15
C5	48	-10, 22, -22	5, 5, 3	C2	-2.7	92	-21, 37, 0	15, 15, 15

Oqsil va ligandning o‘zaro ta’siridan yuqoridagi keltirilgan bo‘shliqlarga mos ravishda -4,0; -3,3; -2,9; -2,8 va -2,7 kcal/mol energiyaga ega faollik kuzatildi (9-rasm). Natijalar shuni ko‘rsatadiki hajmi eng katta va eng kichik bo‘shliqda ligandning faolligi yuqori bo‘ladi.



8-rasm. Bo‘shliqlarni qidirish natijalari



9-rasm. 5XMZ oqsilining izlangan bo‘shliqlariga ligandning o‘zaro ta’siri

Xulosalar

Xulosa o‘rnida olngan tadqiqot natjilari asosida quyidagilarni ta’kidlash mumkin:

- kvant-kimyoviy hisoblashlar asosida korroziya ingibitorlik xossasi aniqlandi.

- DFT hisoblashlari va eksperimental olingan IQ spektr parametrlari taqqoslab, tahlil etildi.

- biologik faolliklari PASS analizi va molekulyar doking asosida baholanib, 40 dan ortiq biologik faollik hamda 5XMZ oqsiliga nisbatan -4,0 kcal/mol ta'sir energiyasi aniqlandi.

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ALANIN AMINOKISLOTASINING DFT HISOBLASHLARI, PASS ANALIZI VA MOLEKULYAR DOKINGI

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ANNOTATSIYA

*Maqolada alanin aminokislotasining kimyoviy xossalari va kvant-kimyoviy hisoblashlarini o‘rganishga bag‘ishlangan adabiyotlar tahlil etilib, natijalar o‘rtasidagi bog‘liqlik o`rganiladi. Gaussian dasturida alaninning geometriyasini to‘liq optimallashtirish bilan elektron tuzilishini hisoblash DFT - funktsional zichlik nazariyasi usulida B3LYP/6-31**G va B3LYP/6-311++G(d,p) hamda M062X/6-311++G** valent bo‘lingan asosli to‘plamlar doirasida amalga oshirildi. Shuningdek, alanin molekulasining biologik faolligi – PASS analizi va molekulyar doking usullarida baholandi.*

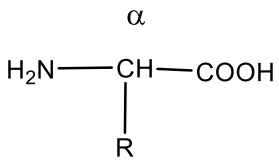
Kalit so`zlar: *aminokislota, kvant-kimyoviy hisoblash, DFT, HOMO, LUMO, alanin, PASS analiz, molekulyar doking.*

Kirish

Barcha oqsillarning asosiy qurilish elementlari aminokislotalar ekanligi ko‘pdan buyon ma’lum bo‘lsa ham, oqsillarning to‘la aminokislotali tarkibi faqat XX asrning 30-yillaridagina batamom belgilandi. Buning sababi, bir tomondan aminokislotalar hali yaxshi o‘rganilmagani, oqsil tarkibiga qaysi aminokislotalar kirganligi aniq ma’lum bo‘lmaganligi bo‘lsa, ikkinchidan ularning ayrim vakillarini sifat va miqdor analizi usullari hali mukammal bo‘lmaganligi edi. Bu muammo faqat 40- yillarning boshlarida qog‘oz xromotografiyasi usuli qo‘llanilishi bilan hal bo‘ldi [1-6].

α - aminokislotalar - geterofunktsional birikmalardir. Ular tarkibida karboksil - COOH va aminokislota -NH_2 guruhlari mavjud. Amino-guruh barcha proteinogen

aminokislotalarda α - uglerod atomida joylashganligidan, ular α - aminokislotalar qatorini tashkil qiladilar. Ularning umumiy formulasi quyidagicha:



Demak, barcha aminokislotalar bir-biridan faqat tarkibidagi R - radikali bilan farqlanadi. − $CH(NH_2)$ − COOH qismi esa hamma aminokislotalarda bir xil.

Peptidlar, umuman oqsil molekulalarining aminokislota tarkibi yozilganda, ularning nomi boshlang‘ich uch harfdan tuzilgan qisqartmalaridan foydalaniladi [4, 6]. Masalan, Alanin - Ala, Fenilalanin - Fen. Radikal (R) ning tabiati, unda qo‘shimcha amino-, karboksil- va boshqa funktsional guruhlarning mavjud bo‘lishiga qarab aminokislotalar turli guruhlarga bo‘linadi.

Ushbu maqolada aminokislotalarning bir turi – alaninning kvant-kimyoviy hisoblash usulida olingan natijalar muhokamasi va biologik faolligini baholashning – PASS analiz hamda molekulyar doking usulida o`rganilgan tadqiqot natijalari bayoni keltirilgan.

Eksperimental qism

Alanin molekulasining kvant-kimyoviy hisoblashlash ishlari shaxsiy kompyuterda Frisch va boshqa hammualliflikda yaratilgan Gaussian 09W dasturiy ta’minoti amalga oshirildi [7-11]. Beckning uch parametrli funksional gibridini LYP funksional korrelyatsiyasi bilan birgalikda ishlatish (B3LYP) eng mustahkam gibrid oilalardan biri hisoblanadi [7, 10, 11]. Gaussiandagi hisoblangan out fayllari Gauss View dasturi yordamida vizualizatsiyalashtiriladi [7]. Elektron xossalarni, YuBMO-QBMO/(HOMO-LUMO) energiyalarni, zaryadlarning atomlar bo'yicha Malliken taqsimotini hisoblashlar funksional zichlik nazariyasi (DFT) (B3LYP) usuli yordamida 6-311G++ (d, p) asosli to'plam bilan amalga oshirildi.

Ushbu maqolada alaninning biologik faolligi PASS – komputer dasturi yordamida bashorat qilindi. Bu dastur PASS (Prediction Activity Structure Substances – Moddalarning tuzilishiga asosan faolligini bashorat qilish) Rossiyalik olimlar V.V. Poroikov hamda D.A. Filimonovlar tomonidan yaratilgan [12]. PASS online dasturi (https://www.way2drug.com/PASSOnline/index.php) biologik faolligi ma'lum bo'lgan 30 000 dan ortiq biologik faol moddalarni o'z ichiga olgan majmuani o'z ichiga oladi va 400 dan ortiq farmakologik ta'sirlarni, ta'sir qilish mexanizmlarini, shuningdek mutagenlik, kanserogenlik, teratogenlik va embriotoksiklikni qamrab oladi [13]. PASS ochiq tizim bo`lib, foydalanuvchi mavjud o'quv majmuasiga qo'shimcha moddalar qo'shishi yoki uni qayta yaratishi va tizimni qayta tayyorlashi mumkin.

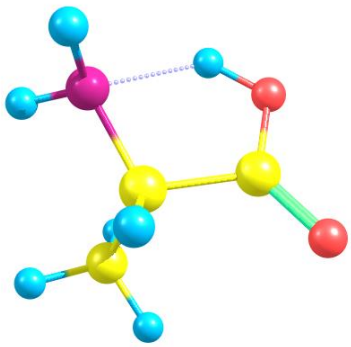
Alanin aminokislotasining zamburug`ga nisbatan faolligi ***Vertisilium dalhliae*** zamburug‘idan olingan oqsil (PDB ID: 5xmz) ga CB-Dock2 onlayn serveri yordamida o‘zaro ta’sirini o‘rganildi va natijalar maqolaning muhokama bo`limida bayon etildi [14, 15].

Olingan natijalar va ularning muhokamasi

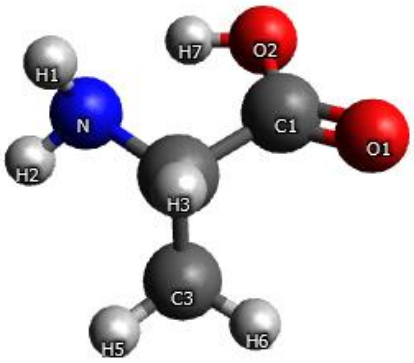
Alanin — aminopropion kislotasi. Har turli oqsillarning tarkibiga kiradi. Qon plazmasida bo‘sh uchraydi; oqsil tarkibiga kiradigan 20-ta aminokislotalarning biri: CH_3-CH-(NH_2)-COOH tabiatda aminokislotaning 2 izomeri turida keng tarqagan [4, 6]. Aminokislotalardan glitsin va leysinga xos kvant-kimyoviy hisoblashlar mualliflar tomonidan amalga oshirilgan tadqiqot natijalari sifatida nashr etilgan bo`lib, ushbu maqolada alanin molekulasining kvant-kimyoviy hisoblashlari muhokama etilgan [16, 17, 18].

DFT hisoblashlari

Alanin molekulasining infraqizil, Raman va elektron spektrlari qattiq va suvli eritmada o'rganilgan. Neytral va uning svitter-ion shaklidagi alaninning asosiy holatlari va quyi bo`sh elektron holatlarining energiyalari uchun tebranish chastotalari DFT usullari yordamida turli xil asos to'plamlari bilan hisoblab chiqilgan. Gaussian dasturi B3LYP/6-31**G va MO62X/3-311+G** usullari bilan gaz fazasida L -alaninning tebranish chastotalari bo'yicha hisoblashlar amalga oshirildi (1-2-rasmlar).



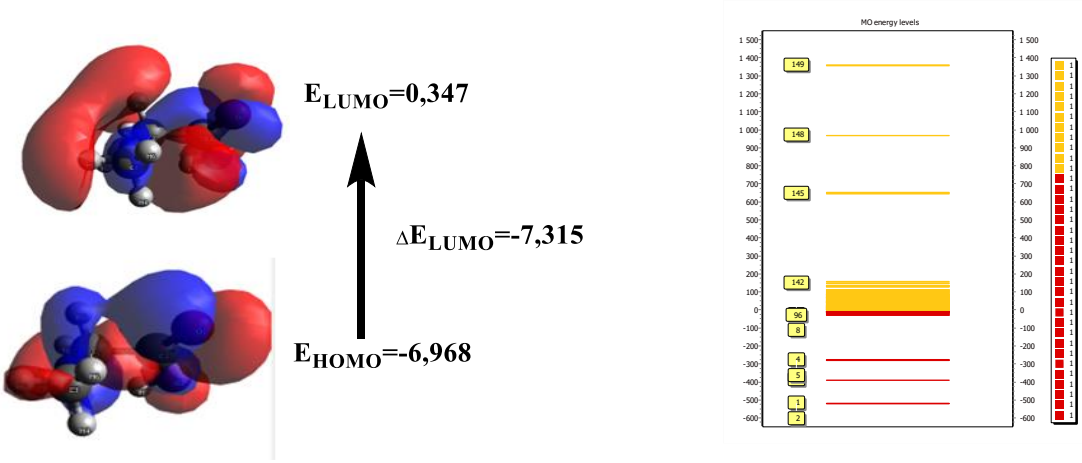
1-rasm. B3LYP/6-31++G usulida optimizatsiyalangan alanin molekulasining tuzilishi



2-rasm. MO62X/3-311+G** usulida optimizatsiyalangan alanin molekulasining tuzilishi

1-jadvalda turli hisoblash usullari (PM6, PM3, AM1, RM1 va MNDO) yordamida gaz va suvli fazalardagi o'rganilayotgan alanin uchun hisoblangan ba'zi energetik parametrlarining qiymatlari ko'rsatilgan. Chegara molekulyar orbitallarning energiyalari (yuqori band molekulyar orbitalning energiyasi E_{HOMO} va quyi bo'sh molekulyar orbitalning energiyasi E_{LUMO}) kimyoviy moddaning reaktivligini aniqlash uchun muhim parametrlardir. Korroziyani ingibirlash samaradorligi va bir nechta kvant kimyoviy parametrlari, jumladan E_{HOMO} va E_{LUMO} o'rtasida yaxshi bog'liqlik

asosida topiladi. E_{HOMO} bo'sh molekulyar orbital bilan mos keladigan qabul qiluvchiga elektronlarni berish uchun inhibitor molekulasining joylashishi bilan bog'liq. Shunday qilib, E_{HOMO} qiymatini oshirish adsorbsiyani rag'batlantirishi va shuning uchun inhibisyon samaradorligini oshirishi mumkin.



3-rasm. Alaninning molekulasi YuBMO va QBMO energetik diagrammasi

Boshqa tomondan, E_{LUMO} alanin molekulasining elektronlarni qabul qilish qobiliyatini ko'rsatadi, bu o'rganilayotgan aminokislotalarning ingibirlash samaradorligi E_{LUMO} qiymatlarining pasayishi bilan oshishi kutilayotganligini anglatadi (3-rasm). E_{HOMO} va E_{LUMO} uchun olingan natijalarga asoslanib, o'rganilayotgan aminokislotalarning ingibirlash samaradorligi eksperimental natijalardan olingan tendentsiyaga mos kelishini aytish mumkin.

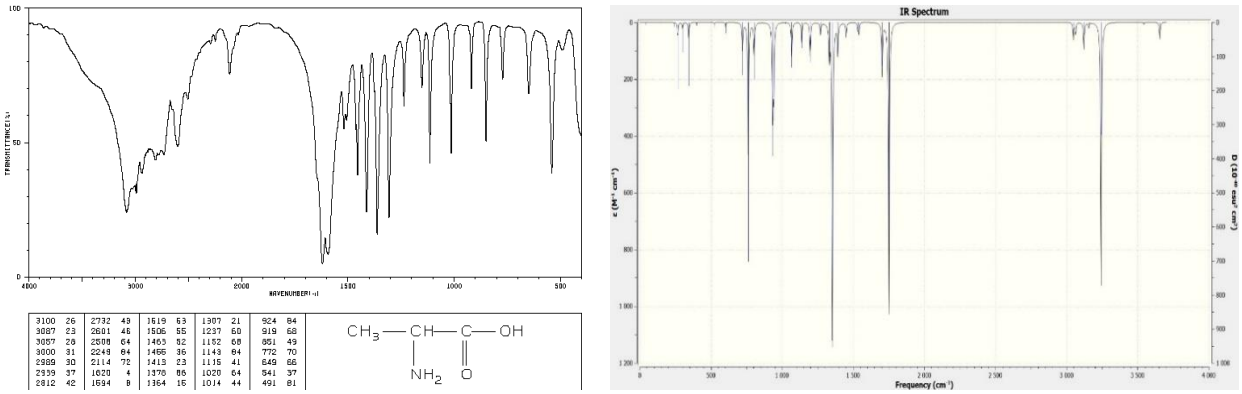
Shuningdek, 1-jadvalda alanin molekulasining turli yarim empirik usullar bilan hisoblangan dipol moment qiymatlari ham keltirilgan. Aminokislota dipol momentining pasayishiga asoslanib, ingibirlash samaradorligining kutilayotgan tendentsiyasi ham chegara molekulyar orbitallarning energiyasiga asoslangan tendentsiyaga mos keladi [19].

1-jadval

Gaz fazada va suv muhitida hisoblangan alanin molekulasining energetik parametrlari

Hisoblash usullari	Gaz fazada				Suv muhitida			
	L (Debye)	*E*HOMO (eV)	*E*LUMO (eV)	*E*L–H (eV)	L (Debye)	*E*HOMO (eV)	*E*LUMO (eV)	*E*L–H (eV)
PM6	2.02	–8.97	0.49	9.46	2.80	–9.10	0.22	9.32
PM3	1.61	–8.68	1.07	9.75	2.20	–8.71	0.94	9.65
AMI	1.52	–9.31	1.27	10.58	2.06	–9.34	1.11	10.45
RM1	1.51	–9.27	1.21	10.48	2.04	–9.32	1.05	10.37
MNDO	1.37	–9.68	1.06	10.74	1.89	–9.70	0.97	10.67
B3LYP/6-31++G	5.38	-6.968	0.347	7.315	5.42	-6.972	0.334	7.306

Alanin molekulasining infraqizil spektrlari Spectral Database for Organic Compounds, SDBS. spektral ma`lumotlar bazasidagi spektrlari tebranish chastotalari DFT usullari yordamida Gaussian dasturi B3LYP/6-31**G usuli bilan gaz fazasida hisoblangan L -alaninning IQ spektroskopik valent va deformatsion tebranish chastotalari taqqoslab o`rganildi (4-rasm).



4-rasm. Alaninning eksperimental va hisoblangan IQ spektrlari

PASS analizi

PASS dasturi stereoizomerlarning biologik faollikning namoyon bo'lishiga ta'sirini baholashga imkon bermaydi, chunki hozirgi vaqtda ko'plab moddalarning fazoviy tuzilishining xususiyatlarini hisobga oladigan dasturiy ta`minot mavjud emas. Tabiiyki, PASS dasturi tomonidan bashorat qilingan biologik faolliklarini tahlil qilishda eksperimental sinovlarning real imkoniyatlarini hisobga olish kerak. Bunday holda, biologik faollikni eng ko`p ehtimoldan eng kam ehtimolgacha ketma-ket o'rganish tavsiya qilinadi.

Shuni ta'kidlash kerakki, PASS dasturi ma'lum bir moddaning dori vositasiga aylanishini oldindan aytib bera olmaydi, chunki bu bir qator turli omillarga bog'liq. Biroq, bashorat, tahlil qiluvchining qaysi biologik faolliklari uchun birinchi navbatda sinovdan o'tkazilishi kerakligini va qaysi moddalar kerakli faollikni namoyon etishi mumkinligini aniqlashga yordam beradi. PASSda qo'llaniladigan matematik algoritm maqsadli tahlil qilish va shunga o'xshash muammolarni hal qilish uchun ko'p sonli turli usullarning samaradorligini taqqoslash orqali tanlangan. PASS tizimini amaliy qo'llash uchun 85% bashorat qilishning aniqligi etarli, chunki 780 turdagi faoliyatdan birini tasodifiy taxmin qilishning kutilayotgan ehtimoli taxminan 0,1% ni tashkil qiladi [12, 13, 20].

PASS dasturi yordamida alifatik monoamino- monokarbon kislota –alaninning biologik faolliklari o`rganildi (2-jadval).

2-jadval

Alaninning PASS online dasturi bo`yicha birikmalarning yuqori biologik faollik turlari va ko`rsatkichlari

P_a - Faollik	P_i - Nofaollik	Biologik faollik turi
0,963	0,002	Acylcarnitine hydrolase inhibitor
0,955	0,002	NADPH peroxidase inhibitor
0,949	0,001	Dimethylargininase inhibitor
0,945	0,001	NADPH-cytochrome-c2 reductase inhibitor
0,943	0,002	Arginine 2-monooxygenase inhibitor
0,942	0,001	Aspartate-ammonia ligase inhibitor
0,943	0,002	Arylacetonitrilase inhibitor
0,938	0,004	Membrane integrity agonist
0,935	0,003	Superoxide dismutase inhibitor
0,932	0,002	Glutamine-phenylpyruvate transaminase inhibitor
0,929	0,001	S-alkylcysteine lyase inhibitor
0,925	0,002	Mucinaminylserine mucinaminidase inhibitor
0,926	0,004	Sphinganine kinase inhibitor
0,924	0,002	Lysine 2,3-aminomutase inhibitor
0,922	0,001	Glycine dehydrogenase (decarboxylating) inhibitor
0,924	0,004	Chymosin inhibitor
0,924	0,004	Saccharopepsin inhibitor
0,924	0,004	Acrocylindropepsin inhibitor
0,925	0,004	Methylenetetrahydrofolate reductase (NADPH) inhibitor
0,923	0,003	Antiseborrheic
0,921	0,002	Fragilysin inhibitor
0,920	0,002	Pseudolysin inhibitor
0,920	0,002	Omptin inhibitor
0,918	0,004	Phobic disorders treatment
0,915	0,002	Threonine aldolase inhibitor
0,917	0,004	Pro-opiomelanocortin converting enzyme inhibitor
0,916	0,003	Monodehydroascorbate reductase (NADH) inhibitor
0,915	0,002	Fusarinine-C ornithinesterase inhibitor
0,916	0,004	Beta-adrenergic receptor kinase inhibitor
0,916	0,004	G-protein-coupled receptor kinase inhibitor
0,913	0,003	Protein-disulfide reductase (glutathione) inhibitor
0,910	0,002	Levanase inhibitor
0,908	0,001	D-alanine 2-hydroxymethyltransferase inhibitor
0,907	0,002	Leucolysin inhibitor
0,909	0,005	Polyporopepsin inhibitor
0,906	0,002	Methylamine-glutamate N-methyltransferase inhibitor
0,906	0,003	Fucosterol-epoxide lyase inhibitor
0,908	0,006	Mucositis treatment
0,901	0,002	Hydrogen dehydrogenase inhibitor
0,901	0,004	Peptidyl-dipeptidase Dcp inhibitor

Alaninning 5XMZ oqsiliga molekulyar dokingi

Molekulyar doking usuli kimyo va biologiyada reseptor-substratning o‘zaro ta'siriga asoslangan yangi biologik faol birikmalarni aniqlash uchun keng qo‘llaniladi. Bundan tashqari, usul bizga ligand yoki kompleksning makromolekula bilan o‘zaro ta'sir mexanizmini o‘rganishga va oqsilning faol markazida ligandning qulay konformasiyasini topishga imkon beradi. Shuni inobatga olgan holda biz aminokislotalarning ***Vertisilium dalhliae*** (PDB ID: 5xmz) zamburug‘idan olingan oqsilga CB-Dock2 onlayn serveri yordamida o‘zaro ta’sirini o‘rgandik va natijalar ushbu bo’limda bayon etildi [14, 15, 21-25].

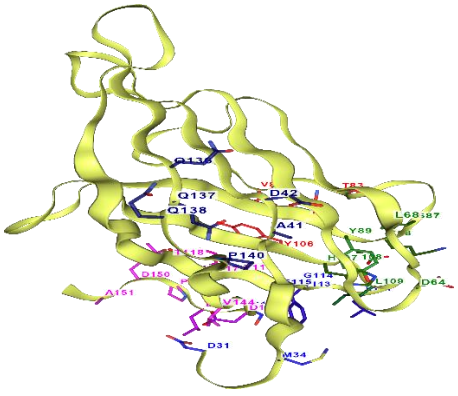
CB-Dock2 onlayn serveri yordamida dastlab 5XMZ oqsilining ligand – alanin bilan ta'sirlashish bo‘shliqlari izlandi, bunda 103, 92, 88, 55 va 48 $Å^3$ hajmdagi 5 ta faol bo‘shliq markazi aniqlandi (5-rasm, 3-jadval). So‘ng ligand va oqsil serverga yuklanib, molekulyar dokingi amalga oshirildi.

3-jadval

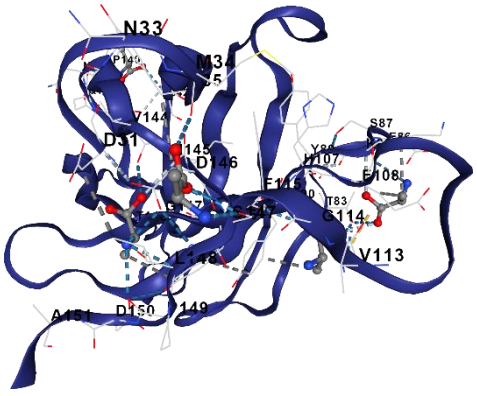
Alaninning 5XMZ oqsiliga molekulyar doking natijalari

Bo‘shliq raqami	Bo‘shliq hajmi ($Å^3$)	Markaz (x, y, z)	Bo‘shliq o‘lchami (x, y, z)	Bo‘shliq raqami	Vina score	Bo‘shliq hajmi ($Å^3$)	Markaz (x, y, z)	Doking hajmi (x, y, z)
C1	103	-11, 31, 2	12, 9, 6	C3	-4.0	88	-24, 27, -4	15, 15, 15
C2	92	-21, 37, 0	8, 5, 5	C1	-3.3	103	-11, 31, 2	15, 15, 15
C3	88	-24, 27, -4	6, 7, 7	C5	-2.9	48	-10, 22, -22	15, 15, 15
C4	55	-7, 36, -4	7, 5, 8	C4	-2.8	55	-7, 36, -4	15, 15, 15
C5	48	-10, 22, -22	5, 5, 3	C2	-2.7	92	-21, 37, 0	15, 15, 15

Oqsil va ligandning o‘zaro ta'siridan yuqoridagi keltirilgan bo‘shliqlarga mos ravishda -4,0; -3,3; -2,9; -2,8 va -2,7 kcal/mol energiyaga ega faollik kuzatildi (6-rasm). Natijalar shuni ko‘rsatadiki hajmi eng katta va eng kichik bo‘shliqda ligandning faolligi yuqori bo‘ladi.



5-rasm. Bo‘shliqlarni qidirish natijalari



6-rasm. 5XMZ oqsilining izlangan bo‘shliqlariga ligandning o‘zaro ta’siri

Xulosalar

Xulosa o`rnida olngan tadqiqot natjilari asosida quyidagilarni ta`kidlash mumkin:

- kvant-kimyoviy hisoblashlar asosida korroziya ingibitorlik xossasi aniqlandi.
- biologik faolliklari PASS analizi va molekulyar doking asosida baholanib, 40 dan ortiq biologik faollik hamda 5XMZ oqsiliga nisbatan -4,0 kcal/mol ta`sir energiyasi aniqlandi.

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GEOGRAFIYA ILIMINE QARASLARDÍŃ TARIYXÍY BAǴDARLARÍ

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Ájiniyaz atındaǵı Nókis mámleketlik pedagogikalıq institutı Geografiya oqıtıw metodikası kafedrası assistent oqıtıwshısı
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Ájiniyaz atındaǵı Nókis mámleketlik pedagogikalıq institutı Geografiya hám ekonomikalıq bilim tiykarları tálim baǵdarı 1-kurs studenti

Annotaciya: *bul ilimiy maqalada geografiya ilimine qaraslardıń tariyxıy baǵdarları haqqında sóz baradı.*

Tayanısh túsinikler: *A.Gumboldt, I.Kant, K.Ritter, F.Rixtgofen, N.Baranskiy, tábiyiy geografiya, ekonomikalıq-sociallıq geografiya, "Kosmos", "Zamanagóy geografiyanıń wazıypaları hám metodları".*

Kirisiw. Geografiya ilimi úlken tariyxqa iye ilimlerdiń biri esaplanıp, ótken tariyxıy dáwirler dawamında bul ilimge ilimpazlar hár qıylı kózqarastan baha bergen. Bunıń nátiyjesinde geografiya iliminiń úyreniw obyekti hám predmeti máselesinde túrlishe pikirler júzege kelgen.

Geografiya sózi grek tilinen alınǵan bolıp, "geo" - jer, "grafo" - jazaman degen mánisti bildiredi. Bul ilim júdá erte dáwirlerden baslap qáliplesken bolıwına qaramastan, oǵan usı atamanı b.e.sh. III ásirde grek ilimpazı Eratosfen bergen. Geografiya ilimi búgingi dáwirge shekem birqansha rawajlanıw basqıshların basıp ótti. Hár bir dáwirde oǵan bir-birinen parıq qılatuǵın kózqaraslar menen múnásibette bolındı.

Tiykarǵı bólim. Ullı geografiyalıq ashılıwlardan keyin de geografiyanıń ilimler sistemasındaǵı ornı máselesinde bir-birinen parıq qılatuǵın pikirler kóp boldı. Ullı tábiyattanıwshı ilimpaz A.Gumboldt óziniń bes tomnan ibarat "Kosmos" atlı miynetinde geografiyaǵa tiyisli kózqarasların bayan etti. Ol geografiyanı tábiyattanıw ilimi dep esaplaǵan, onı jerdiń tábiyiy jaǵdayın súwretlewshi ilim dep ataǵan hám onıń maqseti "kópliktegi birlikti biliw, ulıwma nzamlıqlardı úyreniw" dep aytıp ótken. Gumboldt organikalıq tirishiliktiń jansız tábiyatqa baylanıslılıǵın úyreniwdi jerdegi hádiyselerdegi sebeplik qatnasıqlardı túsiniwdiń tiykarǵı wazıypası dep esapladı [16]. Ósimlik qaplamı hám klimat ortasındaǵı baylanıslılıqtı úyrenip, eń áhmiyetli

geografiyalıq nızamlıqlardı - keńlik zonaların hám bálentlik poyasların belgilep berdi. Ol insandı tek ǵana tábiyattaǵı “jerdegi kúshlerge” tásiri kózqarasınan úyrengen. A.Gumboldt aymaqlardıń tábiyatı bir pútinlik, yaǵniy Jer sharı hám pútkil kosmos penen baylanıslı halda kórip shıǵılıwı kerek ekenligin aytadı.

A.Gumboldttıń zamanlası K.Ritter basqa baǵdardaǵı hám tiykarınan kabinet ilimpazı bolıp, Kanttan geografiyanıń xorologiyalıq kórinisin qabıl qıldı. Ritterdiń pikirine qaraǵanda, geografiya tariyxtı úyreniw ushın dáslepki sharayatlardı jaratıwı hám Jerdi tábiyiy dene sıpatında tábiyattanıw kózqarasınan emes, al onıń ruwxıy tárepten jaqsılanıwı ushın joqarıdan insan jasaytuǵın orın sıpatında úyreniwi kerek ekenligin aytadı. Kontinentlerdiń geometriyalıq formalarında ilimpaz jaratıwshınıń jasırın jobasın kórdi, onıń insaniyat táǵdiri ushın áhmiyetin ashıp beriwge umtıldı.

Karl Ritterdiń shákirti Ferdinand Rixtgofen 1883-jılda “Zamanagóy geografiyanıń wazıypaları hám metodları” miynetinde geografiya jerdi súwretlewshi ilim emes, al hádiyseler hám obyektler, jer betindegi sebeplik baylanıslar menen shuǵıllanatuǵın jer júzi haqqındaǵı ilim ekenligin aytqan hám geografiya iliminiń wazıypaları sıpatında tómendegilerdi belgilegen: 1) litosfera, gidrosfera hám atmosferanı materiallıq quram, transformaciyalar hám kelip shıǵıwı kózqarasınan úyreniw; 2) ósimlik hám haywanat dúnyasın birdey kózqarastan úyreniw; 3) insandı hám onıń materiallıq hám ruwxıy mádeniyatınıń júzege keliwin birdey principler tiykarında úyreniw [15].

Juwmaqlaw. Biz geografiya ilimine qaraslar haqqındaǵı pikirler máselesinde, Ferdinand Rixtgofenniń pikirine qosılamız. Sebebi, geografiya tek ǵana tábiyattı úyreniw menen sheklenip qalmastan, onda jasawshı xalıqtı, olardıń turmıs iskerligin, xojalıǵın úyreniwshi ilim bolıp esaplanadı. Usı orında F.Rixtgofenniń geografiya ilimi haqqındaǵı pikirine qosımsha retinde, geografiya tiykarınan aymaqlıq tarqalıw máseleleri menen shuǵıllanıwın esapqa alıw kerek. F.Rixtgofenniń anıqlamasında mine usı másele esapqa alınbaǵan. A.Gumboldt geografiyanı tábiyattanıw ilimi dep esaplawına sebep, onıń sayaxatshı hám tábiyat haqqındaǵı máselelerge qızıǵıwshı ilimpaz bolǵanlıǵı esaplanadı. Bul pikir geografiya iliminiń bir tarawı bolǵan tábiyiy geografiyanıń anıqlamasına tuwra keledi. Al, geografiyanıń ekinshi áhmiyetli tarawı esaplanǵan ekonomikalıq hám sociallıq geografiya tábiyattı súwretlewshi ilim emes, insan hám onıń xojalıq iskerligi, sonday-aq, olardıń aymaqlıq shólkemlestiriliwi máselelerin úyrenedi. Geografiya mine usı eki úlken taraw, yaǵniy tábiyiy hámde ekonomikalıq-sociallıq geografiyanıń birliginen turıwshı kólemli ilim bolıp tabıladı. Bul eki tarawdı bir-birinen bólek jaǵdayda emes, olardı óz ara baylanıslı halda úyreniw geografiyalıq izertlewlerdiń tiykarǵı mazmunın quraydı. Bul eki taraw geografiya ushın qustıń eki qanatı sıyaqlı áhmiyetke iye esaplanadı. Belgili geograf ilimpaz

N.N.Baranskiy aytqanınday, tábiyiy geografiya insandı, al ekonomikalıq-sociallıq geografiya tábiyattı umıtpawı kerek.

Joqarıda kórsetilgenindey ilimpazlar geografiya ilimine túrlishe kózqarastan baha beredi. Geografiya ilimine bolǵan kózqaraslardıń hár túrliligi onıń tábiyiy hám social-ekonomikalıq qanatların bir-birinen ajıratıw máselelerin de kórip shıǵıwdı alǵa súrdi. Biraq, uzaq jıllıq tájiriybe sonı kórsetedi, bul eki tarawdı bir-birinen ajıratıw múmkin emes. Sebebi, geografiya jer júziniń tábiyatı menen birgelikte onıń xalqı hám onıń xojalıq iskerligin úyrenedi.

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ELEKTRON TA'LIM TIZIMIDA TALABA BILIMINI BAHOLASH UCHUN KLASTERLASH ALGORITMI: K YAQIN QO'SHNI (KNN) ALGORITMIDAN FOYDALANISH.

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Annotatsiya. *Bugungi IT sohasi rivojlanib borayotgan davrda elektron ta'lim hamda unda talabalar bilimini baholash masalasi davr talabi sanaladi. Talaba bilimini baholashda ma'lumotlarni intellektli tahlil qilish ham dolzarb masaladir. Intellektli tahlil jarayon algoritmlari, ma'lumotlar ham holisona baholashga xizmat ko'rsatmog'i kerak. Ushbu maqolada talaba bilimini baholashda muhim o'rin tutadigan barcha attributlar va ularning qiymatlari e'tiborga olindi. Tuzilgan data set yordamida K yaqin qo'shni algoritmi asosida hisoblashlar amalga oshirildi. Talaba bilimini baholashda ushbu algoritmning afzallik hamda kamchilik jihatlari keltirib o'tildi.*

Kalit so'zlar: *Klasterlash, Evklid algoritmi, Xemming algoritmi, nominal attribut, numerik attribut.*

Аннотация. *В данной статье рассмотрены все атрибуты и их значения, играющие важную роль в оценке знаний учащихся. Расчеты проводились на основе алгоритма K ближайших соседей с использованием созданного набора данных. Отмечены преимущества и недостатки данного алгоритма при оценке знаний учащихся.*

Ключевые слова: *кластеризация, алгоритм Евклида, Манхэттенский алгоритм, номинальный атрибут, числовой атрибут.*

Abstract. *In this article, all the attributes and their values that play an important role in evaluating student knowledge are considered. Calculations were made based on the K nearest neighbor algorithm using the created data set. Advantages and disadvantages of this algorithm were mentioned in the assessment of student knowledge.*

Key words: *Clustering, Euclidean algorithm, Manhetin algorithm, nominal attribute, numerical attribute.*

KIRISH

Hozirgi globallashuv davrida elektron ta’lim shakli ta’lim jarayonida muhim ahamiyatga ega. Elektron ta’lim o‘zida ta’limning innovatsion yondashuvini qo‘llagan holda ta’lim sifati va imkoniyatlarini oshirish uchun multimediya va zamonaviy internet texnologiyalarini qo‘llashga asoslangan ta’lim shakli sanaladi. [1] Elektron ta’lim tizimida talaba bilimini baholashda tahlil ma’lumotlari juda katta ahamiyatga ega. Holislikni amalga oshirish uchun tahlil ma’lumotlari va ularning qiymatlari to‘g‘ri tanlanmog‘i kerak.

Axborot kommunikatsion texnologiyalarning tez su’ratlarda rivojlanishi axborot tizimlarining ko‘payishi va axborot hajmini keskin tarzda oshib borishiga sabab bo‘ldi. Natijada, axborotlarni avtomatik tarzda tahlil qilib, katta hajmdagi axborotlarni qayta ishlash, ko‘rsatkichlarning bir-biri bilan bog‘liqligi, bashoratlash va xulosalar chiqarish kabi masalalar bugungi kunda dolzarb mavzuga aylanib bormoqda.[2], [3], [4], [5], [6] Ma’lumotlarni intelektual tahlil qilish aynan shunday masalalarni yechishga yo‘naltirilgan.

Bugungi kunda klasterizatsiya masalasini yechish uchun ko‘plab usullar va ular asosida bir nechta algoritmlar ishlab chiqilgan. Klasterlash bu klaster so‘zidan kelib chiqqan bo‘lib guruhlarga ajratish degan ma’noni anglatadi . [7], [8]Klasterlashdan maqsad yangi bir testlanayotgan data setni klass ya’ni sinfini topish sanaladi. Klasterlash algoritmlaridan K yaqin qo‘shni algoritmi ham berilgan namunalar asosida yangi testlanayotgan namunaning (class) sinfini topish uchun keng qo‘llaniladigan algoritm sanaladi.[9], [10].

ADABIYOTLAR TAHLILI.

Ta’lim sifatini intellektual tizimlar asosida doimiy takomillashtirishga qaratilgan loyihalarni amaliyotga tatbiq etish borasida ko‘plab tizimli ishlar olib borilmoqda. Odatda katta hajmli ma’lumotlarni qayta ishlashda ma’lumotlarning intellektual tahlili usullaridan foydalaniladi. Ta’limda ma’lumotlarning intellektual tahlili (Educational Data Mining, EDM) – ta’lim sifatini oshirishga qaratilgan foydali ma’lumotlarni olish usuli hisoblanadi. Ta'lim sohasidagi ma'lumotlarni tahlil qilishda asosan ikkita usuldan foydalaniladi: o‘quv analitikasi (Learning Analytics) hamda ta'limda ma'lumotlarning intellektual tahlili (Educational Data Mining, EDM).

Ma’lumotlarni intellektli tahlil qilish hamda katta hajmdagi ma’lumotlarni qayta ishlash borasida xorijiy va O‘zbekistonlik olimlar tomonidan ishlar olib borilmoqda. Shu o‘rinda mavzuga oid adabiyotlar sifatida quyidagi ishlarni keltirishimiz mumkin.

Ushbu[11] maqola mualliflari tomonidan ma’lumotlarni intellektli tahlil qilish usullari hamda sun’iy intellektning amaliy sohalarda qo‘llanilishi haqida to‘xtalib o‘tilgan. Ushbu masala bo‘yicha neyron to‘rlar va uning tadbiqini esa ushbu maqola mualliflari ishida ko‘rishimiz mumkin.Data scince va uning algoritmlari tadbiqini esa ushbu maqolalar mualliflari ishida yoritilgan [12], [13], [14], [15], [16], [17].

TADQIQOT METODOLOGIYASI.

Bugungi IT sohasi rivojlanib borayotgan kunda har bir sohani avtomatlashtirish davr talabi sanaladi. Shuningdek ta'lim sohasini ham . Elektron ta'lim tizimida talaba bilimini baholashni optimallashtirishda biz sun'iy intellekt algoritmlaridan foydalangan holda baholash modelini qurishimiz kerak. Ushbu maqolada Klasterizatsiya algoritmlaridan K yaqin qo'shni algoritmi ko'rib chiqildi.

K-Yaqin qo'shni (KNN) - bu mashinani o'rganish (Machine Learning) texnikasi va algoritmi regressiya va tasniflash vazifalari uchun ham foydalanish mumkin. K-Yaqin qo'shnilar (KNN) kontseptual jihatdan sodda, ammo juda kuchli algoritm bo'lib, shu sabablarga ko'ra u mashinani o'rganishning eng mashhur algoritmlaridan biridir. KNN yoki K-eng yaqin qo'shni algoritmi nazorat ostidagi o'rganish algoritmi bo'lib, u bir-biriga yaqin joylashgan har bir ma'lumot nuqtasi bir sinfda keladi degan printsip asosida ishlaydi. Bu yerda asosiy taxmin shundaki, bir-biriga yaqin bo'lgan narsalar bir-biriga o'xshaydi.

Algoritm quyidagi ketma-ketlik asosida ishlaydi.

1. Data set shakllantiriladi.
2. Yangi obyekt bilan data setdagi barcha obyektlar orasidagi masofa aniqlanadi.

   2.1 Masofani hisoblashda biz attributni turiga e'tibor qaratamiz. Agar attribut numerik bo'lsa ya'ni sonlardan tashkil topgan bo'lsa biz masofani hisoblashda Evklid algotirmi (metrikasi)dan foydalanamiz.

$$d(x_i, x_j) = \sqrt{\sum_{m=1}^{n}(x_{im} - x_{jm})^2}$$

   2.2 Agar berilgan attribut nominal bo'lsa Xemming masofadan foydalanib hisoblashlar amalga oshiriladi.

   Xemming masofasi: Bu usul ikkita qiymatni solishtirish uchun ishlatiladi. Agar ikki qiymat bir xil bo'lsa, masofa 0, agar farqli bo'lsa, masofa 1 deb belgilanadi.

   Masofa(A, B) = 0, agar A = B bo'lsa
   Masofa(A, B) = 1, agar A ≠ B bo'lsa

3. K qiymatini oldindan kiritib olamiz va k ta eng yaqin qo'shnisini ajratib olamiz. Shu o'rinda izoh sifatida to'xtalib o'tsam, biz kiritadigan k qiymatni odatda toq son qilib berish maqsadga muvofiq sanaladi. Bunga sabab agar juft son kiritadigan bo'lsak eng yomon holat ya'ni 50 ga 50 holati yuzaga kelib qolishi mumkin. Bunday holatni oldini olish maqsadida K ning qiymati ko'p hollarda toq son qilib kiritiladi.

4. Hisoblash jarayoni tugagach masofalar o‘sish tartibida saralanadi , albatta klass o‘zgarmagan holda.
5. Ajratib olingan K ta qiymatning klasslari orasida qaysi biri ustun bo‘lsa natijamiz o‘sha klassga tegishli deb klassifikatsiya qilinadi.

Data setda 4 ta klass (qoniqarsiz, qoniqarli, yaxshi, a’lo) hamda quyidagi attributlar joylashgan :

1. Studentning ism familiyasini nomer ID bilan almashtirdik va albatta bu shaxsiy ma’lumotlarni himoyalash maqsadida
2. Talabaning davomati – bunda qiymatlarimiz 3 ga bo‘linadi : A’lo, Yaxshi, Qoniqarli
3. Darsda qatnashishi- Har doim, Ba’zan , hech qachon
4. Amaliyot bahosi- baholar 5 lik baholash sistemasiga binoan 3,4,5 ko‘rinishida
5. Mustaqil ta’lim bahosi – bu ham amaliyot baho singari 3,4,5
6. Daftar – Daftar yozilishiga mavzular to‘liqligiga qarab To‘liq, Yaxshi, Yomon kabi qiymatlarga ajraladi.
7. Qo‘shimcha ish – Bunda qo‘shimcha ishning turiga ham e’tibor qaratdik ya’ni darslardan tashqari o‘z sohasiga oid , sohaga oid bo‘lmagan , Umuman ishlamasligi mumkinligi keltirib o‘tildi
8. To‘garak yoki kurs- Darslardan bo‘sh payti to‘garak yoki kurslarga qatnashishi ha yoki yo‘q kriteriya bo‘ylab belgilandi.
9. Laboratoriya bahosi – Amaliyot , Mustaqil ta’lim singari bu ham 3,4,5 kabi baholandi
10. Class – bu yakuniy natija sanaladi , unda qiymatlarimiz mos ravishda qoniqarsiz, qoniqarli, yaxshi, a’lo kabi belgilandi .

Ushbu masala uchun yaratilgan data set namuna sifatida faqat bir guruh birinchi bosqich talabalarning “ Dasturlash asoslari” fani bo‘yicha olingan natijalari asosida tashkil qilindi.

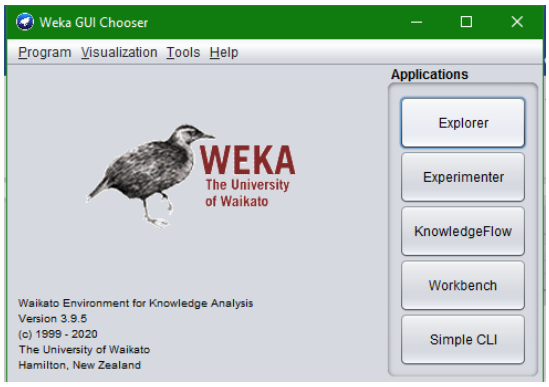
Biz yaratgan data setda numeric hamda nominal attributlarni ikkalasi ham qatnashgan bo‘lib, algoritmning ishlash prinsipi asosida hisoblashlarni amalga oshiramiz.

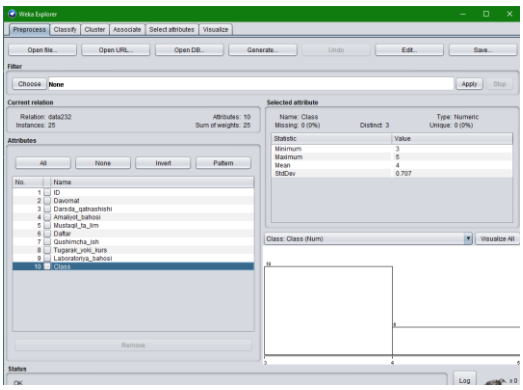
Yaratilgan data set ko‘rinishi , undagi attributlar, qiymatlari quyidagicha:

ID	Davomat	Darsda_qatnashishi	Amaliyot_bahosi	Mustaqil_ta_lim	Daftar	Qushimcha_ish	Tugarak_yoki_kurs	Laboratoriya_baho	Class
1	A_lo	Har_doim	4	5	Yaxshi	Yuq	Ha	5	5
2	A_lo	Har_doim	5	5	Yaxshi	Ha_sohaga_oid	Ha	5	5
3	A_lo	Har_doim	5	4	Tuliq	Yuq	Ha	4	4
4	A_lo	Har_doim	5	5	Yaxshi	Ha_sohaga_oid	Ha	5	5
5	Yaxshi	Har_doim	4	4	Yaxshi	Yuq	Yuq	4	4
6	A_lo	Har_doim	4	4	Yaxshi	Yuq	Ha	4	4
7	Yaxshi	Har_doim	4	4	Yaxshi	Yuq	Ha	4	4
8	A_lo	Ba_zan	5	4	Yaxshi	Yuq	Yuq	4	4
9	A_lo	Har_doim	4	4	Tuliq	Yuq	Ha	4	4
10	Yaxshi	Ba_zan	3	3	Yaxshi	Yuq	Yuq	3	3
11	A_lo	Har_doim	4	4	Tuliq	Yuq	Ha	4	4
12	A_lo	Har_doim	5	5	Tuliq	Yuq	Ha	5	5
13	Yaxshi	Har_doim	4	4	Tuliq	Yuq	Yuq	4	4
14	Yaxshi	Ba_zan	3	4	Yaxshi	Yuq	Yuq	4	3
15	Yaxshi	Ba_zan	3	3	Yaxshi	Yuq	Yuq	3	3
16	Yaxshi	Ba_zan	3	3	Yaxshi	Yuq	Yuq	3	3
17	A_lo	Har_doim	5	5	Yaxshi	Ha_sohaga_oid	Ha	5	5
18	Yaxshi	Har_doim	5	5	Yaxshi	Yuq	Ha	5	5
19	A_lo	Har_doim	4	4	Yaxshi	Yuq	Ha	4	4
20	A_lo	Ba_zan	3	4	Yaxshi	Yuq	Ha	4	3
21	Yaxshi	Har_doim	4	4	Yaxshi	Yuq	Yuq	4	4
22	Yaxshi	Har_doim	4	4	Yaxshi	Yuq	Yuq	4	4
23	A_lo	Har_doim	4	4	Yaxshi	Yuq	Ha	4	4
24	A_lo	Har_doim	4	4	Yaxshi	Yuq	Ha	4	4
25	Qoniqarli	Ba_zan	3	3	Yaxshi	Ha_sohaga_oid_emas	Yuq	3	3

1-rasm

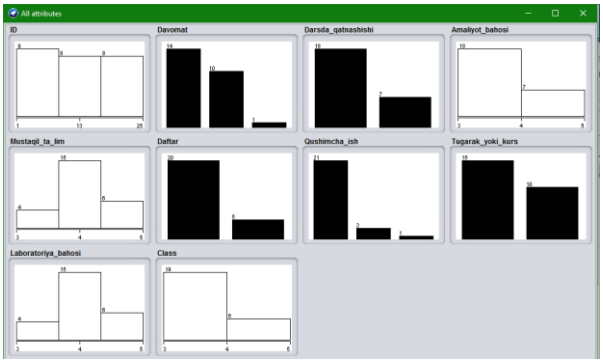
Yaratilgan data set Weka dasturiga yuklandi.

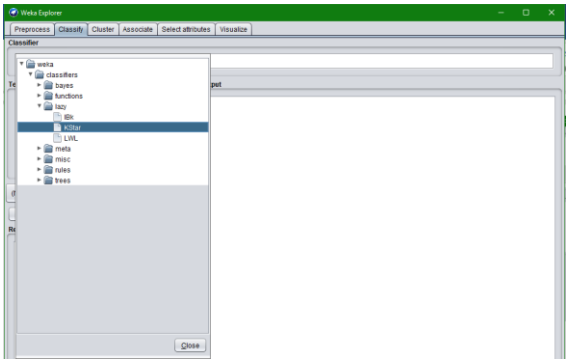




2-rasm **3-rasm**

Attributlarning vizual tasviri hamda qo‘llaniladigan algoritm ko‘rinishi quyidagicha:

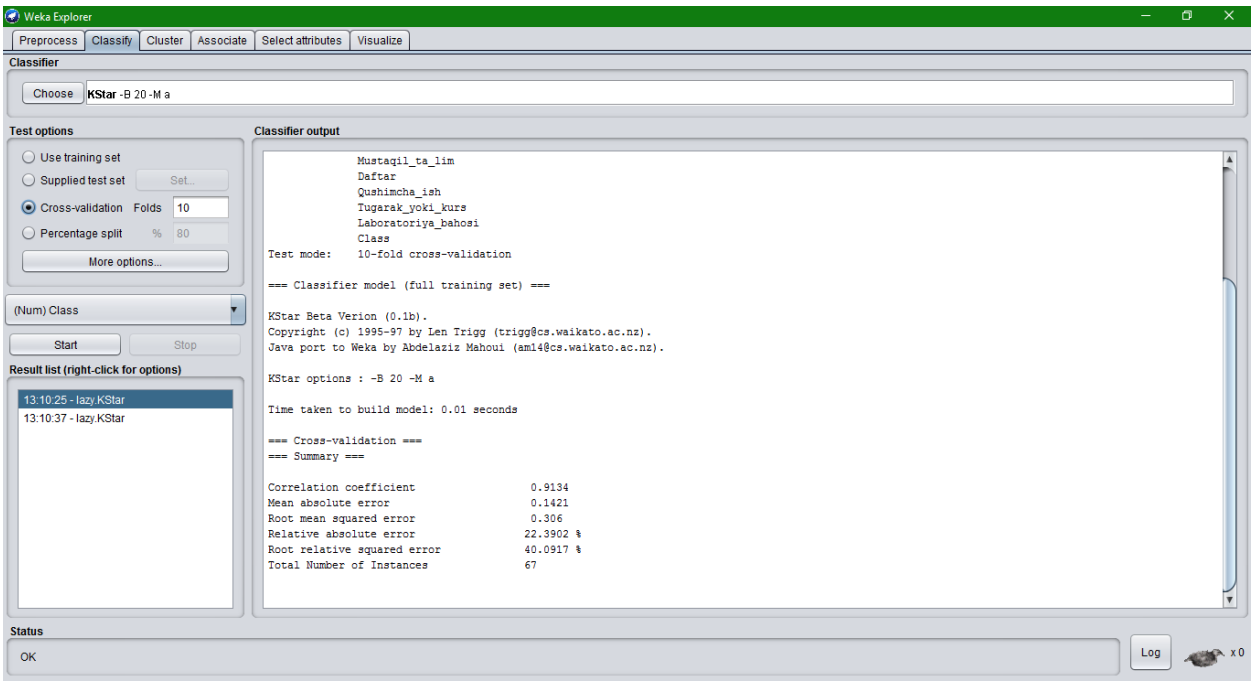




4-rasm **5-rasm**

Olingan natija esa quyidagicha:

KNN (K Star)algoritmini qo‘llashda biz Cross-validation qismini tanlab , uning qiymatini 10 qilgan holatda ushbu natijaga ega bo‘ldik.

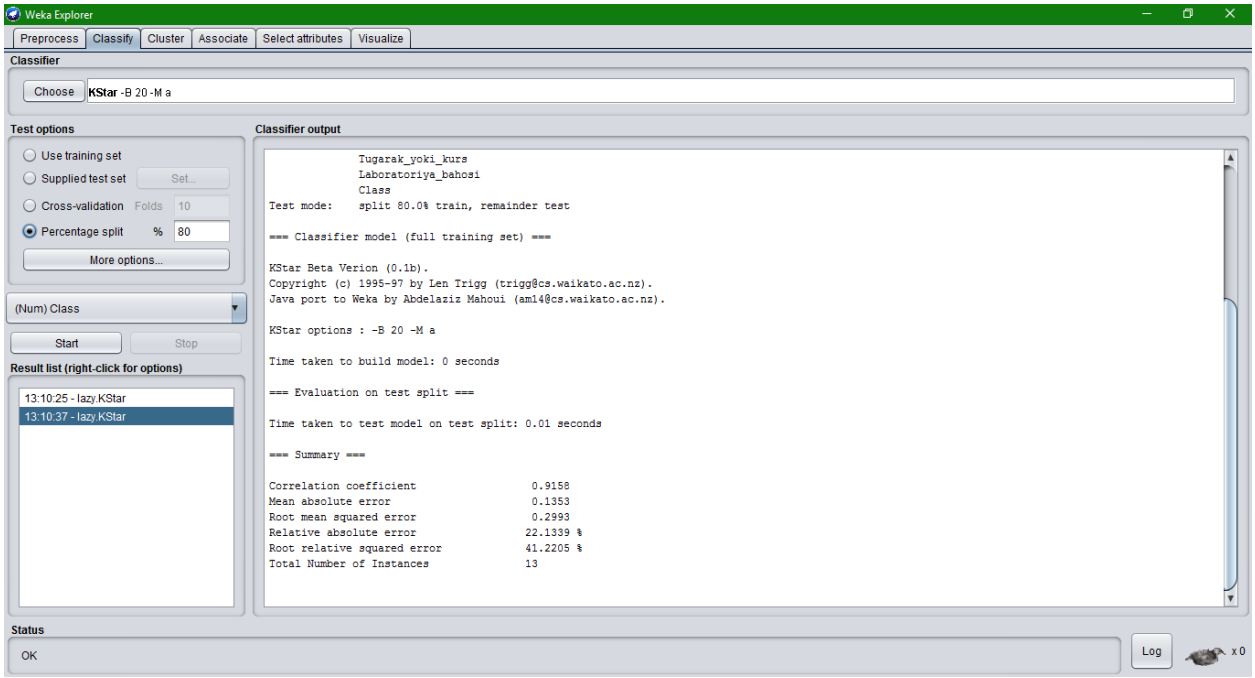


6-rasm

Yaratilgan data set KNN algoritmi hamda Cross -validation qo‘llanilganda model aniqligi 91% ni tashkil qildi. (6-rasm)

Shu o‘rinda Cross validation haqida to‘xtalib o‘tsak.

Cross-validation asosan modelni o‘rganish va sinovdan o‘tkazish jarayonida ishlatiladi. Ushbu jarayonning asosiy maqsadi modelni yaxshi ishlashi va uni yig‘iladigan ma'lumotlar (training) va sinovdan o‘tkazish (testing) jarayonlarida sinab ko‘rishdir. Bunday ko‘rsatkichlar yordamida modelni o‘rganishning samaradorligini aniqlash mumkin.



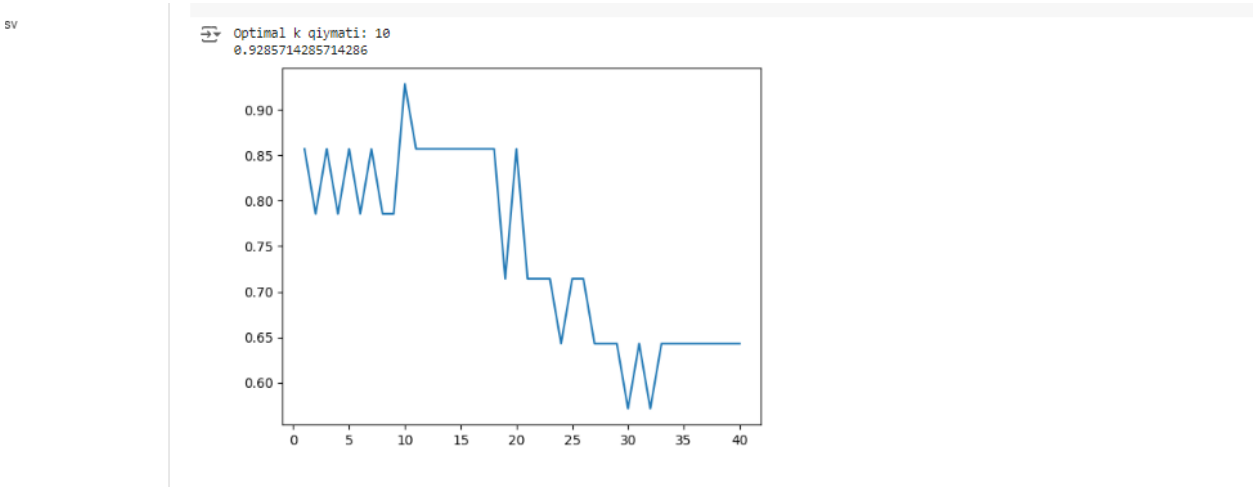
7-rasm

Yaratilgan data set KNN algoritmi hamda training va test datani 80 va 20 qilib ajratgandagi model aniqligi 91% ni tashkil qildi. (7-rasm)

Data set uchun qo‘llanilgan usullar natijalari bir xil qiymatni tashkil qildi, ya’ni model aniqligi: 91% ni tashkil qildi. Ushbu masalaga muvofiq python dasturlash muhitida, bulutli hisoblash texnologiyasi (Google colab) asosida dasturiy ta’minot shakllantirildi.

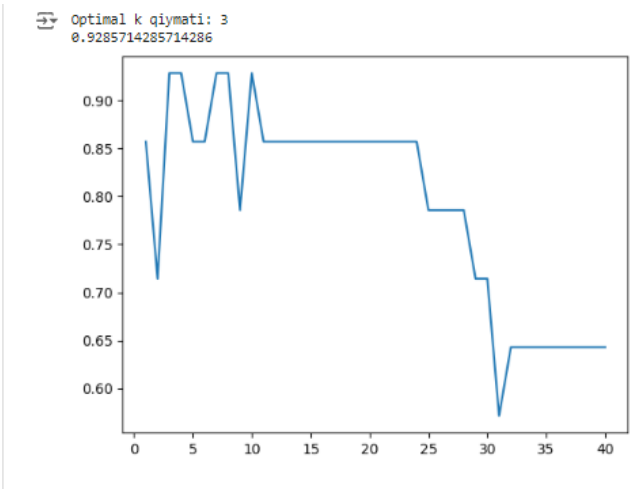
Masalani yechish uchun standartlashtirishdan foydalanish.

Ushbu rasmda standartlashtirish orqali optimal k ni topish grafigi keltirilgan bo‘lib, X o‘qida 40 gacha bo‘lgan qiymatlarda va Y o‘qida 1 gacha bo‘lgan qiymatlarda grafik minimum va maximum qiymat qabul qilishi keltirilgan.



8-rasm

Masalani yechish uchun normallashtirishdan foydalanish.

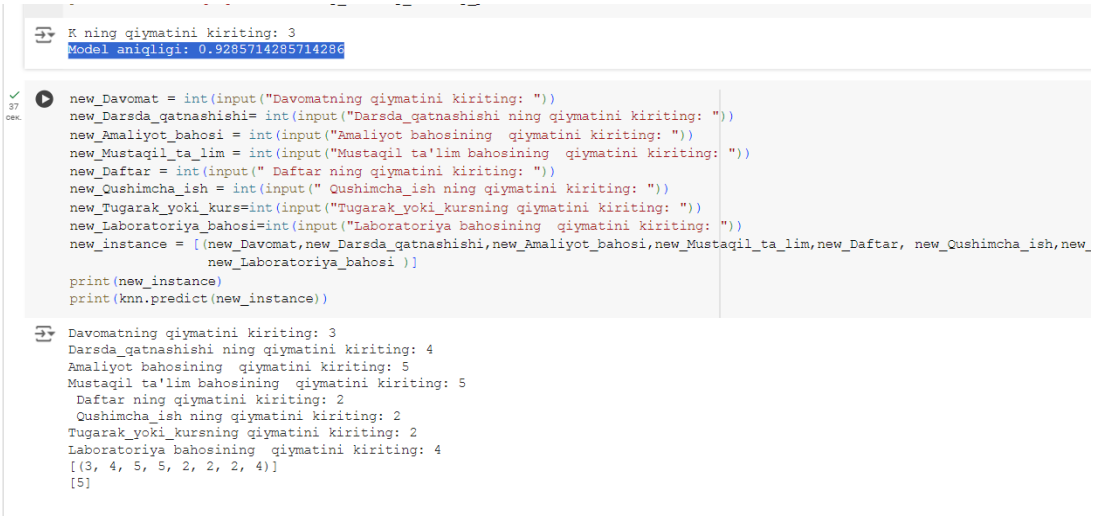


9-rasm

Ushbu rasmda esa normallashtirish orqali optimal k ni topish grafigi keltirilgan bo‘lib, X o‘qida 40 gacha bo‘lgan qiymatlarda va Y o‘qida 1 gacha bo‘lgan qiymatlarda grafik minimum va maximum qiymat qabul qilishi keltirilgan.

K ning qiymatini va testlanuvchi parametrlar qiymatlari console ekrandan kiritib oladigan qilindi. Ikkala holat uchun ham model aniqligi bir xil natija berdi , faqat optimal k qiymati farqli bo‘ldi.

Model aniqligi: 0.9285714285714286



10-rasm

K ning qiymatini va testlanuvchi parametrlar qiymatlari console ekrandan kiritib oladigan qilindi. Ikkala holat uchun ham model aniqligi bir xil natija berdi , faqat optimal k qiymati farqli bo‘ldi.

Model aniqligi: 0.9285714285714286

Yaratilgan data set hamda dasturiy ta’minot ushbu Git Hub profilga joylashtirildi:
https://github.com/RSevaraN/Magistr_dissertatsiya/blob/main/KNN_tayyor_proyekt.ipynb

XULOSA.

XXI asr axborot texnologiyalari asrida sun’iy intellekt algoritmlari , modellari rivojlanib borayotgani har bir sohaga ushbu sun’iy intellektni qo‘llashni taqozo qilmoqda . Ta’lim jarayonida ma’lumotlarning intellektual tahlili sun’iy intellekt metodlari yordamida avtomatlashtirilgan o‘qitish sohasida qo‘llanishining amaliy natijasi sanalib , ta’lim tizimlarining yangi avlodi hisoblanadi. Ushbu maqolada esa elektron ta’lim tizimida talaba bilimini baholashda ma’lumotlarni intellektual tahlil qilish algoritmi bo‘lmish KNN algoritmi keltirib o‘tilgan.

Xulosa qilib shuni aytishimiz mumkinki, aynan talaba bilimini baholashda yoki bahoni oldindan bashorat (predikt)qilishda K yaqin qo‘shni algoritmini qo‘llash data setda numeric hamda nominal attributlardan foydalana olish jihati afzallik jihati

hisoblanadi. Chunki faqat baho taraflama qarash, faqat numerik attribut bilan cheklanish yoki o‘sha numerik attributlar yig‘indisining o‘rta arifmetiki olinish muammoni to‘liq yecha olmaydi. Berilgan masalani yechishda optimal k ning qiymatini topishga ham alohida e’tibor qaratildi. Bunda standartlashtirish hamda normallashtirishdan foydalanildi.

Ushbu masalani yechishda biz bir qator sun’iy intellekt algoritmlariga murojaat qildik. Algoritmlar natijalari ham tahlil qilindi, bir – biri bilan solishtirildi. Inson hayotida yoki bo‘lmasa uni bilim olishida unga ma’naviy taraflama ham ta’sir qiladigan jihatlarga e’tibor qaratildi va ulardan eng maqbul parametrlar saralab olinib attributlar ro‘yxatida shakllantirildi.

Xulosa qilib aytadigan bo‘lsak, talaba bilimini baholashda KNN algoritmini qo‘llash jarayonida olingan natijalar tahlil qilindi. Weka dasturida olingan natijalar skrinshot qilib asos sifatida keltirildi. Bir so‘z bilan aytganda, olingan natijalarga asoslanib shuni aytishimiz mumkinki, ushbu data set uchun KNN algoritmini qo‘llash yaxshi samara beradi.

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