ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

Д.В. Сокольский атындағы
«Жанармай, катализ және электрохимия институты» АҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
АО «Институт топлива, катализа и
электрохимии им. Д.В. Сокольского»

NEWS

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
JSC «D.V. Sokolsky institute of fuel,
catalysis and electrochemistry»

SERIES
CHEMISTRY AND TECHNOLOGY

3 (452)

JULY – SEPTEMBER 2022

PUBLISHED SINCE JANUARY 1947

PUBLISHED 4 TIMES A YEAR

ALMATY, NAS RK

«ҚР ҰҒА Хабарлары. Химия және технология сериясы»
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ66VPY00025419** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *органикалық химия, бейорганикалық химия, катализ, электрохимия және коррозия, фармацевтикалық химия және технологиялар.*

Мерзімділігі: жылына 4 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

http://chemistry-technology.kz/index.php/en/arhiv

Редакцияның мекенжайы: 050100, Алматы қ., Қонаев к-сі, 142, «Д.В. Сокольский атындағы отын, катализ және электрохимия институты» АҚ, каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

«Известия НАН РК. Серия химии и технологий».
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ66VPY00025419,** выданное 29.07.2020 г.

Тематическая направленность: *органическая химия, неорганическая химия, катализ, электрохимия и коррозия, фармацевтическая химия и технологии.*

Периодичность: 4 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

http://chemistry-technology.kz/index.php/en/arhiv

Адрес редакции: 050100, г. Алматы, ул. Кунаева, 142, АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского», каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of chemistry and technology.
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)
Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ66VPY00025419,** issued 29.07.2020.
Thematic scope: *organic chemistry, inorganic chemistry, catalysis, electrochemistry and corrosion, pharmaceutical chemistry and technology.*
Periodicity: 4 times a year.
Circulation: 300 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19
http://chemistry-technology.kz/index.php/en/arhiv

Editorial address: JSC «D.V. Sokolsky institute of fuel, catalysis and electrochemistry», 142, Kunayev str., of. 310, Almaty, 050100, tel. 291-62-80, fax 291-57-22, e-mail: orgcat@nursat.kz
Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES CHEMISTRY AND TECHNOLOGY
https://doi.org/10.32014/2518-1491.128

UDC 547.496.2+791.8
IRSTI 31.21.19

Ye.S. Sycheva[1], M.S. Mukanova[1*], G.B. Sarsenbaeva[2], O.T. Seilkhanov[3]

[1]A.B. Bekturov Institute of Chemical Sciences, Kazakhstan, Almaty;
[2]Zh. Zhiembaev Kazakh Research Institute of Plant Protection and Quarantine, Kazakhstan, Almaty;
[3]Sh. Ualikhanov Kokshetau State University, Kazakhstan, Kokshetau.
E-mail: meruyert2302@gmail.com

SYNTHESIS AND GROWTH STIMULATING ACTIVITY OF DITHIOCARBAMINE THIOANHYDRIDES BASED ON SODIUM 5-METHYL-1H-BENZOTRIAZOL-1-CARBODITHIOATE

Abstract. In this study, dithiocarbamine thioanhydrides were synthesized based on sodium 5-methyl-1H-benzo[d] triazole-1-carbodithioate, which have growth stimulating activity. The starting original sodium dithiocarbamate was synthesized with a yield of 77% by the interaction of 5-methylbenzotriazole with carbon disulfide in the presence of potassium hydroxide. Conditions for the acylation of sodium 5-methylbenzotriazolyldithiocarbamate were developed in order to synthesize new biologically active thioanhydrides, Thioanhydrides were synthesized by the acylation of sodium 5-methyl-1H-benzotriazole-1-carbodithioate with acid chlorides (benzoic, 2,4-dichlorobenzoic, 4-fluorobenzoic, and isobutyl acids) in chloroform at room temperature. The structure of the synthesized compounds was established based on elemental analysis, IR spectroscopy, and ^{1}H and ^{13}C NMR spectroscopy. Growth stimulating activity of a new synthesized thioanhydrides was tested. The germination energy and laboratory germination of wheat and soybeans seeds were studied. It was found that when wheat seeds were treated with aqueous solutions of thioanhydrides 2 – 4 at a concentration of 0.01%, the germination energy and germination of wheat seeds were 100%, which is 10% higher than in the control (90%), and 40% (20%) higher than in the standard (50%, 70%). Treatment of soybean

seeds with aqueous solutions (concentration 0.01 and 0.001%) of thioanhydrides 2-5 showed their low growth stimulating activity. The obtained results of bioscreening showed that the synthesized thioanhydrides have a high growth stimulating activity in relation to wheat and can be used in agriculture as growth stimulants when growing this grain crop.

Key words: dithiocarbamate, thioanhydrides, growth stimulating activity, wheat and soybean seeds.

Е.С. Сычева[1], М.С. Муканова[1*], Г.Б. Сарсенбаева[2], О.Т. Сейлханов[3]

[1]«А.Б. Бектұров атындағы химия ғылымдары институты» АҚ,
Қазақстан, Алматы;
[2]Ж. Жиембаев атындағы Қазақ өсімдік қорғау және карантин ғылыми зерттеу институты, Алматы, Қазақстан;
[3]Ш. Уәлиханов атындағы Көкшетау мемлекеттік университеті,
Көкшетау, Қазақстан.
E-mail: meruyert2302@gmail.com

5-МЕТИЛ-1Н-БЕНЗОТРИАЗОЛ-1-НАТРИЙ КАРБОДИТИОАТЫ НЕГІЗІНДЕ ДИТИОКАРБАМИНДІК ТИОАНГИДРИДТЕР СИНТЕЗІ ЖӘНЕ ӨСУДІ ЫНТАЛАНДЫРАТЫН БЕЛСЕНДІЛІГІ

Аннотация. Бұл жұмыста өсуді ынталандыратын белсенділігі бар 5-метил-1Н-бензо[d] триазол-1-натрий карбодитиоаты негізінде дитиокарбаминді тиоангидридтер синтезделді. 5-метилбензотриазолдың күкірт көміртегімен калий гидроксидінің қатысуымен өзара әрекеттесу реакциясы нәтижесінде 77% шығыммен бастапқы натрий дитиокарбаматы синтезделінді. Жаңа биологиялық белсенді тиоангидридтерді синтездеу мақсатында 5-метилбензотриазолилдитиокарбамат натрийін ацилдеу жағдайлары жасалынды. Тиоангидридтер бөлме температурасында хлороформда 5-метил-1Н-бензотриазол-1-натрий карбодитиоатын хлорангидридтермен (бензой, 2,4-дихлоробензой, 4-фторбензой және изобутил қышқылдар) ацилдеу арқылы синтезделді. Синтезделген қосылыстардың құрылымы элементтік талдау, ИҚ-спектроскопия және ЯМР ^{1}Н және ^{13}С спектроскопиясы мәліметтері негізінде дәлелденді. Жаңа синтезделген тиоангидридтердің өсуін ынталандыратын белсенділікке зертханалық скрининг жүргізілді. Бидай мен соя тұқымдарының өну энергиясы мен зертханалық өнуі зерттелді. Бидай тұқымдарын 2-4 тиоангидридтердің 0,01% концентрациялы сулы ерітінділерімен өңдеу кезінде бидай тұқым-

дарының өну және өну энергиясы – 100% құрады, бұл бақылауға қарағанда 10% - ға жоғары (90%) және эталонға қарағанда 40%(20%)-ға жоғары (50%, 70%). Соя тұқымын 2-5 тиоангидридтерінің сулы ерітінділерімен өңдеу (концентрациясы 0,01 және 0,001%) олардың төмен өсуін ынталандыратын белсенділігін көрсетті. Биоскринингтің нәтижелері синтезделген тиоангидридтердің бидайға қатысты жоғары өсу ынталандырушы белсенділікке ие екенін және осы дақыл өсіру кезінде өсу ынталандырғыштары ретінде ауыл шаруашылығында қолдануға болатындығын көрсетеді.

Түйін сөздер: дитиокарбамат, тиоангидридтер, өсуді ынталандыратын белсенділік, бидай және соя тұқымдары.

Е.С. Сычева[1], М.С. Муканова[1*], Г.Б. Сарсенбаева[2], О.Т. Сейлханов[3]

[1]Институт химических наук им. А.Б. Бектурова, Казахстан, Алматы;
[2]ТОО Казахский научно-исследовательский институт карантина и защиты растений им. Ж. Жиембаева, Казахстан, Алматы;
[3]Кокшетауский государственный университет им. Ш. Уалиханова, Казахстан, Кокшетау.
E-mail: meruyert2302@gmail.com

СИНТЕЗ И РОСТСТИМУЛИРУЮЩАЯ АКТИВНОСТЬ ДИТИОКАРБАМИНОВЫХ ТИОАНГИДРИДОВ НА ОСНОВЕ 5-МЕТИЛ-1Н-БЕНЗОТРИАЗОЛ-1-КАРБОДИТИОАТА НАТРИЯ

Аннотация. В данной работе синтезированы дитиокарбаминовые тиоангидриды на основе 5-метил-1Н-бензо[d] триазол-1-карбодитиоата натрия, обладающие ростстимулирующей активностью. Реакцией взаимодействия 5-метилбензотриазола с сероуглеродом в присутствии гидроксида калия синтезирован исходный дитиокарбамат натрия с выходом 77%. С целью синтеза новых биологически активных тиоангидридов разработаны условия ацилирования 5-метилбензотриазолилдитиокарбамата натрия. Тиоангидриды синтезированы ацилированием 5-метил-1Н-бензотриазол-1-карбодитиоата натрия хлорангидридами (бензойной, 2,4-дихлоробензойной, 4-фторбензойной и изо-бутиловой кислот) в хлороформе при комнатной температуре. Структура синтезированных соединений установлена на основании данных элементного анализа, ИК-спектроскопии и спектроскопии ЯМР ^{1}Н и ^{13}С. Проведен лабораторный скрининг ростостимулирующей активности новых синтезированных тиоангидридов.

Исследована энергия прорастания и лабораторная всхожесть семян пшеницы и сои. Установлено, что при обработке семян пшеницы водными растворами тиоангидридов 2 - 4 в концентрации 0,01%, энергия прорастания и всхожесть семян пшеницы составили – 100%, что на 10 % выше, чем в контроле (90%), и на 40 % (20%) выше, чем в эталоне (50%, 70%). Обработка семян сои водными растворами (концентрация 0,01 и 0,001%) тиоангидридов 2-5 показала их низкую ростостимулирующую активность. Полученные результаты биоскрининга показывают, что синтезированные тиоангидриды обладают высокой ростстимулирующей активностью по отношению к пшенице и могут найти применение в сельском хозяйстве в качестве стимуляторов роста при выращивании данной зерновой культуры.

Ключевые слова: дитиокарбамат, тиоангидриды, ростстимулирующая активность, семена пшеницы и сои.

Introduction. Dithiocarbamates have received tremendous attention for their synthesis of various sulfur-containing compounds, high reactivity and biological activities. Dithiocarbamates are analogs of carbamates, in which two oxygen atoms are replaced by sulfur atoms and can be synthesized by the reaction of primary or secondary amines with carbon disulfide in the presence of alkali. Dithiocarbamates derivatives can be easily synthesized from simple starting materials without the use of harsh conditions. Over the past years, functionalized dithiocarbamate derivatives have been synthesized by using one-pot three- or four-component reactions (Azizi et al., 2013). Dithiocarbamate derivatives possess distinguished activities, making them useful in medicine, agriculture and industry. In many studies have been successfully synthesized dithiocarbamates with cytotoxic (Yu Jia-Ying et al., 2019), anticancer (Sun Ya-Xin et al., 2022), antifungal (Singh et al., 2013), antiproliferative (Fu Dong-Jun et al., 2016), antitumor (Wang Xiao-Juan et al., 2011), anti-tubercular (Horita et al., 2011) and antimicrobial activities (Ghabraie et al., 2013). Dithiocarbamates have complexing properties, forming stable coordination complexes with metals, including the transition metals. Dithiocarbamate metal compounds show also the vast array of biological properties. Notable among these are their antioxidant (Gölcü, 2006), antileishmanial (Hayat et al., 2022), antibacterial (Ahmed, 2018), antifungal activity (Hussain Dar et al., 2021). We had previously reported about synthesis of dithiocarbamates with root-forming and growth-stimulating activity (Sycheva et al., 2018).

Thus, synthesis of dithiocarbamates and their derivatives is assessed as a promising direction in chemistry of biological active compounds and opens up wide opportunities for research.

Research materials and methods. The course of the reaction and purity

of the products were monitored by thin-layer chromatography on Silufol UV-254 plates, eluent was acetone - hexane (1:3) or water with the appearance of substances spots with iodine vapor. The melting point was determined on a Hanon MP450 apparatus. IR spectra were recorded on a Nicolet 5700 spectrometer in KBr tablets. The ^{1}H and ^{13}C NMR spectra of the compounds were recorded on a JNM-ECA 400 (Jeol) spectrometer with an operating frequency of 400 (^{1}H) and 100 MHz (^{13}C) in deuterated DMSO-D_6.

The study of growth stimulating activity was carried out at S. Zh. Zhiembaev Kazakh Research Institute of Quarantine and Plant Protection in the laboratory of biotechnology. Water-soluble N-hydrochlorides of the thioanhydrides 2-5 were prepared for bioscreening. The objects of laboratory bioscreening were wheat seeds (Steklovidnaya 24 variety) and soybean seeds (Zhansaya variety). The determination of growth stimulating activity was carried out according to the known method (Chumakov et al., 1974).

The laboratory experiment options on wheat and soybean seeds:

1. Control (water)
2. Akpinol KN-2 (standard), (0,01% и 0,001%)
3. Compound 2 (0,01% and 0,001%)
4. Compound 3 (0,01% and 0,001%)
5. Compound 4 (0,01% and 0,001%)
6. Compound 5 (0,01% and 0,001%)

Sodium 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbodithioate 1. A solution of 5.7 g (0.075 mol) of CS_2 in 5 ml of ethanol was added dropwise with stirring to a solution of 3 g (0.075 mol) sodium hydroxide dissolved in 3 ml of water and 10 g (0.075 mol) 5-methyl-1H-benzo [d] [1,2,3] triazole in 20 ml of ethanol. The reaction mixture after the addition of carbon disulfide was stirred at room temperature for 2 hours. The reaction mixture was concentrated and the residue was washed with hexane. The yield was 13.4 g (77%), m.p. 86 − 88°C, R_f = 0.71 (H_2O). Found, %: C 41.46; H 2.56; N 18.09; S 27.67. $C_8H_6N_3NaS_2$. Calculated, %: C 41.55; H 2.61; N 18.17; S 27.73. IR (KBr, ν, cm^{-1}): 1110 (C=S), 610 (C–S), 1566, 1446, 1383, 938, 797 (Ph). ^{1}H NMR (DMSO-D6, δ, ppm): 2.37 (s, 3H, CH_3), 6.84, 6.86, 7.50, 7.62, 7.63 (Ph). ^{13}C NMR (DMSO-D6, δ, ppm): 21.95 (CH_3), 115.40, 116.11, 123.29, 129.89, 143.64, 145.30 (Ph), 203.13 (C=S). HMQC NMR (DMSO-D6, cross peaks $^{1}H–^{13}C$, δ, ppm): 2.35 − 21.35, 6.81 − 123.43, 6.85 − 23.31, 6.95 − 115.44, 7.48 − 115.45.

Benzoic 5-methyl-1H-benzo [d] [1,2,3] triazole-1-carbothioic thioanhydride 2 was synthesized similarly from 2 g (0.008 mol) sodium 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbodithioate and 1.21 g (0.008 mol) of benzoic acid chloride. The yield was 2.4 g (88%), m.p. 72−73 °C, R_f = 0.5. Found, %: C 57.28; H 3.39; N 13.31; S 20.19. $C_{13}H_{11}N_3OS_2$. Calculated, %: C 57.49; H

3.54; N 13.41; S 20.46. IR (KBr, ν, cm^{-1}): 1695 (C=O), 1046 (C=S), 615 (C–S), 1602, 1446, 1378, 1249, 1173, 950 (Ph). ^{1}H NMR (DMSO-D_6, δ, ppm): 2.47 (s, 3H, CH_3), 7.15, 7.57, 7.70, 7.94, 8.03 (Ph). ^{13}C NMR (DMSO-D_6, δ, ppm): 21.71 (CH_3), 113.41, 128.78, 128.88, 131.77, 132.62, 129.67, 130.55, 133.98, 144.29, 146.22 (Ph), 166.98 (C=O), 198.77 (C= S). HMQC NMR (cross peaks $^{1}H-^{13}C$, δ, ppm): 2.46−21.44, 7.15−127.39, 7.55−113.41, 7.70−115.73, 7.96−114.20, 7.89−119.45, 7.98−119,90, 7.94−129,70, 8.02−114.28, 7.47−132.72.

2,4-Dichlorobenzoic 5-methyl-1H-benzo [d] [1,2,3] triazole-1-carbothioic thioanhydride 3. A solution of 1.8 g (0.008 mol) of 2,4-dichlorobenzoic acid chloride was added dropwise with stirring to a solution of 2 g (0.008 mol) sodium 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbodithioate in 25 ml of chloroform. The reaction mixture was stirred at room temperature for 2 hours. The solvent was evaporated, the solid residue was purified by recrystallization from hexane. The yield was 2.44 g (74%), m.p. 141−142 °C, R_f=0.64. Found, %: C 47.01; H 2.19; Cl 18.37; N 10.79; S 16.69. $C_{15}H_9Cl_2N_3OS_2$. Calculated, %: C 47.13; H 2.37; Cl 18.55; N 10.99; S 16.78. IR (KBr, ν, cm^{-1}): 1720 (C=O), 1047 (C=S), 664 (C–S), 1585, 1486, 1378, 1145, 951, 917, 812 (Ph). ^{1}H NMR (DMSO-D_6, δ, ppm): 2.42 (s, 3H, CH_3), 7.19, 7.45, 7.57, 7.65, 7.83, 7.90, 8.11 (Ph).

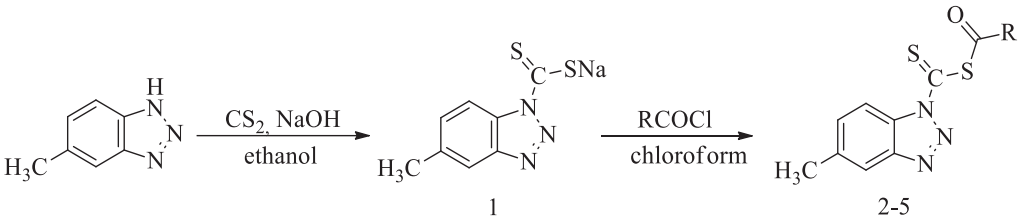
4-Fluorobenzoic 5-methyl-1H-benzo [d] [1,2,3] triazole-1-carbothioic thioanhydride 4. was synthesized similarly from 2 g (0.008 mol) sodium 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbodithioate and 1.37 g (0.008 mol) of 4-fluorobenzoic acid chloride. The yield was 2.59 g (90%), m.p. 96−98 °C, R_f= 0.52. Found, %: C 54.25; H 2.89; N 12.59; S 19.21. $C_{15}H_{10}FN_3OS_2$. Calculated, %: C 54.37; H 3.04; F 5.73; N 12.68; S 19.35. IR (KBr, ν, cm^{-1}): 1706 (C=O), 1052 (C=S), 611 (C–S), 1604, 1497, 1153, 952, 917, 811, 750 (Ph). ^{1}H NMR (DMSO-D_6, δ, ppm): 2.46 (s, 3H, CH_3), 7.32−7.40, 7.50, 7.95−7.98, 8.00−8.02; 8.12−8.15 (Ph).

Isobutyric 5-methyl-1H-benzo [d] [1,2,3] triazole-1-carbothioic thioanhydride 5. was synthesized similarly from 1.81 g (0.0078 mol) sodium 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbodithioate and 0.83 g (0.0078 mol) of isobutyric acid chloride. The yield was 1.66 g (79%), R_f = 0.76. Found, %: C 51.50; H 4.58; N 14.95; S 22.87. $C_{12}H_{13}N_3OS_2$. Calculated, %: C 51.59; H 4.69; N 15.04; S 22.95. IR (KBr, ν, cm^{-1}): 1735 (C=O), 1056 (C=S), 695 (C–S), 1606, 1457, 1308, 1125, 998, 963, 875 (Ph). ^{1}H NMR (DMSO-D_6, δ, ppm): 1.24 (d, 6H, CH_3), 2.36 (s, 3H, CH_3), 3.84−3.89 (m, 1H, CH), 7.16−7.19, 7.31−7.33, 7.71−7.75, 7.83−7.85 (Ph). ^{13}C NMR (DMSO-D_6, δ, ppm): 19.11 (t, 6H, CH_3), 21.85 (CH_3), 33.86 (CH), 113.73, 119.55, 128.29, 129.38, 131.43, 144.44 (Ph), 178.24 (C=O), 188.24 (C=S). HMQC NMR (cross peaks $^{1}H-^{13}C$, δ, ppm): 1.20−18.46, 2.34−21.32, 3.87−33.92, 8.27−113.74, 7.19−128.20, 7.32−132.40.

Results and discussion. In this study, heterocyclic dithiocarbamate thioan-

hydrides were synthesized and their growth stimulating activity was investigated.

The starting sodium dithiocarbamate was prepared by the interaction of 5-methyl-1H-benzotriazole with carbon disulfide in the presence of sodium hydroxide at room temperature in ethanol. Sodium 5-methyl-1H-benzotriazole-1-carbodithioate 1 (yield, 77%) was isolated after appropriate treatment of the reaction mixture. The scheme of the synthesis is shown in Figure 1.



R = C_6H_5 (2); 2,4-$Cl_2C_6H_3$ (3); 4-FC_6H_4 (4); i-C_4H_9 (5)

Figure 1 - Scheme of the synthesis of sodium dithiocarbamate and thioanhydrides

Conditions for acylation of sodium 5-methyl-1H-benzotriazole-1-carbodithioate 1 were developed in order to synthesize new dithiocarbamine thioanhydrides. The acylation of heterocyclic dithiocarbamates was carried out by the interaction of potassium 5-methyl-1H-benzotriazole-1-carbodithioate 1 with acid chlorides (benzoic, 2,4-dichlorobenzoic, 4-fluorobenzoic and isobutyl) at room temperature in chloroform for 2 hours (Fig. 1).

The following compounds were synthesized in appropriate yields as a result of acylation: benzoic 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbothioic thioanhydride 2 (88%), 2,4-dichlorobenzoic 5-methyl-1H-benzo[d][1,2,3] triazole-1-carbothioic thioanhydride 3 (74%), 4-fluorobenzoic 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbothioic thioanhydride 4 (90%), isobutyric 5-methyl-1H-benzo[d][1,2,3]triazole-1-carbothioic thioanhydride 5 (79%), respectively.

The structure of the synthesized compounds 1 - 5 was established based on the data of elemental analysis, IR, ^{1}H and ^{13}C NMR spectroscopy.

The IR spectrum of the compound 1 shows the absorption band of stretching vibrations of the C S group at 1005 cm^{-1}. The C─S bands appear in the region of 610 cm^{-1}. In the IR spectra of the compounds 2 – 5 bands at 1046 - 1056 cm^{-1} were attributed to the vibrations of the C=S group. The C-S bond stretching vibrations appear in the range of 611 - 704 cm^{-1}. Intense bands of the C=O group in the region of 1695 - 1735 cm^{-1} in the IR spectra indicate the formation of thioanhydrides.

Structure of the synthesized compounds was confirmed by NMR spectroscopy. The protons of the methyl group in the ^{1}H NMR spectrum of the compound 1

resonate as a singlet at δ 2.37 ppm. Chemical shifts of the aromatic protons are observed in the downfield region of δ 6.84 - 7.63 ppm. In the ^{13}C NMR spectrum, the carbon atom of the methyl group resonates in the region of δ 21.95 ppm. The signals observed in the downfield region of δ 115.40, 116.11, 123.29, 129.89, 143.64, 145.30 ppm were assigned to the aromatic carbon atoms. The carbon atom of the C=S group resonates in the downfield region of δ 203.13 ppm.

The ^{1}H NMR spectrum of the thioanhydride 3 shows signal as a singlet at δ 2.47 ppm in the upfield region due to the protons of the methyl group. The aromatic protons resonate in the downfield region of δ 7.14 - 8.07 ppm. In the ^{13}C NMR spectral analysis, chemical shift at δ 20.88 ppm was assigned to the methyl carbon atom for the thioanhydride 3. The signals of the aromatic carbon atoms are found in the downfield region of δ 113.41, 128.78, 128.88, 131.77, 132.62, 129.67, 130.55, 133.98, 144.29, 146.22 ppm. The C=O and C=S groups carbon atoms resonate in the downfield region of δ 166.98 ppm and 198.77 ppm, respectively.

Structure of the thioanhydride 3 was also confirmed by the methods of two-dimensional NMR spectroscopy COZY (^{1}H-^{1}H) and HMQC (^{1}H-^{13}C), which makes it possible to establish the spin-spin interaction of homo- and heteronuclear nature. In the ^{1}H-^{1}H COZY spectra of the compound, spin-spin correlations are observed through three bonds of protons of neighboring methine-methine groups H–H (δ 2.47, 7.53) ppm and H–H (δ 7.14, 7.73; 7.50, 8.06; 7.53, 8.03 and 7.57, 8.04) ppm Heteronuclear interactions of protons with carbon atoms through one bond were established using ^{1}H-^{13}C HMQC spectroscopy for the following pairs present in the compound: H-C (δ 2.46, 21.44), H-C (δ 7.15, 127.39), H-C (δ 7.55, 113.41), H-C (δ 7.70, 115.73), H-C (δ 7.96, 114.20), H-C (δ 7.89, 119.45), H-C (δ 7.98, 119.90), H-C (δ 7.94, 129.70), H-C (δ 8.02, 114.28), H-C (δ 7.47, 132.72) ppm.

Water-soluble N-hydrochlorides of the thioanhydrides 2-5 were tested for growth stimulating activity. It was investigated influence of the thioanhydrides 2-5 on wheat and soybean seeds germination in laboratory conditions. Wheat and soybean seed samples were moistened in the solutions of the thioanhydrides 2-5 with 0,01 % and 0,001% concentrations. The control seeds were moistened with water. Wheat and soybean seeds were placed in the test humid chambers and they placed in the thermostat at 25 ^{0}C for 7 days. About 50 pieces of seeds were used in 3-fold repetition in each variant. Germination energy and laboratory germination were determined by the number of germinated seeds on the 3-rd day and the 7-th day, respectively. Growth stimulating activity of the studied compounds 2-5 was characterized by the germination energy and laboratory germination. Results of the laboratory bioscreening are presented in the table 1.

Table 1 - Influence of the compounds 2-5 on wheat and soybean seeds germination

Variant	Germination energy, %	Laboratory germination, %	Intense seed germination	Microflora infection
Wheat seeds				
Control (water)	90	90	++	++
Akpinol KN-2 (standard), (0,01%)	50	70	-	++
Akpinol KN-2 (standard), (0,001%)	80	90	+	++
Compound 2 (0,01%)	100	100	++	++
Compound 2 (0,001%)	90	90	++	++
Compound 3 (0,01%)	100	100	+++	+++
Compound 3 (0,001%)	90	90	+++	+++
Compound 4 (0,01%)	100	100	+++	+++
Compound 4 (0,001%)	100	100	+++	+++
Compound 5 (0,01%)	90	90	++	+++
Compound 5 (0,001%)	90	100	++	++
Soybean seeds				
Control (water)	80	80	++	++
Akpinol KN-2 (standard), (0,01%)	40	20	+	-
Akpinol KN-2 (standard), (0,001%)	30	20	-	+++
Compound 2 (0,01%)	40	40	+	++
Compound 2 (0,001%)	40	40	+	++
Compound 3 (0,01%)	60	60	++	+++
Compound 3 (0,001%)	40	40	++	+++
Compound 4 (0,01%)	50	50	+	+++
Compound 4 (0,001%)	80	80	++	+++
Compound 5 (0,01%)	70	70	++	+++
Compound 5 (0,001%)	70	70	+	++

The compounds 2-4 exhibited significant growth stimulating activity on wheat seeds in comparison with the control and the KN-2 standard. Thus, the compounds 2-4 showed 100% of germination energy and laboratory germination at 0,01% concentration. Whereas, the germination energy and laboratory germination at this concentration were 90% and 50 (70) % for the control and the KN-2 standard.

It is shown that soybean seeds treated with the compounds 2-5 had low germination energy and laboratory germination. This indicates a low sensitivity of soybean seeds to the studied compounds. However, as a result, of phytoexamination was found, that wheat and soybean seeds were infected by microflora of saprophytic fungi Mucor, Penicillium and Alternaria.

Conclusion. In this study, a new heterocyclic dithiocarbamine thioanhydrides based on sodium 5-methyl-1H-benzotriazole-1-carbodithioate were synthesized and characterized using the IR, ^{1}H and ^{13}C NMR spectroscopy. Their growth

stimulating activity was studied on wheat and soybean seeds in laboratory conditions. It was established that the synthesized compounds 2-4 possess growth stimulating activity and are an effective stimulators of wheat seed germination in comparison with the control and the KN-2 standard.

Conflict of interest. All authors declare that they have no conflict of interest.

Acknowledgements. This study was supported by funds from the Committee of Science of the Ministry of Education and Science of the Republic of Kazakhstan through a research grant for young scientists "Development of bioorganic complexes with natural polysaccharides as an ecologically safe plant protection products", Number AR09057956 (2021-2023).

Information about the authors:

Sycheva Yelena Sergeevna – Candidate of Chemical Sciences, assenior researcher of the laboratory of Chemistry of Physiologically Active Compounds at the A.B. Bekturov Institute of Chemical Sciences, Almaty, Kazakhstan, e-mail: yelena-sycheva@yandex.kz, https://orcid.org/0000-0002-8409-2672;

Mukanova Meruyert Sisenbekovna – Candidate of Chemical Sciences, head of the laboratory of Chemistry of Physiologically Active Compounds at the A.B. Bekturov Institute of Chemical Sciences, Almaty, Kazakhstan, e-mail: meruyert2302@gmail.com, https://orcid.org/0000-0003-3128-1311;

Sarsenbaeva Gaziza Bazarbekovna – Candidate of Agricultural Sciences, LLP Kazakh SRI of Plant Protection and Quarantine named after Zh. Zhiembayev Ministry of Agriculture of Republic of Kazakhstan, Almaty, Kazakhstan, e-mail: aziza_niizr@mail.ru, https://orcid.org/0000-0003-0276-8569;

Seilkhanov Olzhas Tulegenovich – Master of Physics, Senior Researcher, Laboratory of NMR Spectroscopy Engineering, Kokshetau University named after Sh. Ualikhanov, Kokshetau, Kazakhstan, e-mail: seilkhanov@mail.ru, https://orcid.org/0000-0002-2322-8863.

REFERENCES

Ahmed A.J. (2018) Metal Complexes of Dithiocarbamate Derivatives and Its Biological Activity. Asian Journal of Chemistry. Chemical Publishing Co., 2595–2602. https://doi.org/10.14233/ajchem.2018.21545 (in Eng.).

Azizi N., Khajeh M., Hasani M., Dezfooli S. (2013) An Efficient Four-Component Synthesis of Dithiocarbamate Derivatives, Tetrahedron Lett., 54(39): 5407–5410. https://doi.org/10.1016/j.tetlet.2013.07.124 (in Eng.).

Chumakov A.E., Minkevich I.I., Vlasova Yu.I., Gavrilova E.A. (1974) Basic methods of phytopathological research, Moscow.

Ghabraie E., Moghimi H., Balalaie S. et al. (2013) Efficient synthesis of functionalized dithiocarbamate derivatives through one-pot three-component reaction and evaluation of their

antimicrobial activities, J Iran. Chem. Soc., 10, 725–732. https://doi.org/10.1007/s13738-012-0206-0 (in Eng.).

Gölcü A. (2006). Transition Metal Complexes of Propranolol Dithiocarbamate: Synthesis, Characterization, Analytical Properties and Biological Activity. Transition Met Chem 31, 405–412. https://doi.org/10.1007/s11243-006-0009-1 (in Eng.).

Fu Dong-Jun, Zhang Sai-Yang, Liu Ying-Chao, Zhang Li, Liu Jun-Ju, Song Jian, Zhao Ruo-Han, Li Feng, Sun Hui-Hui, Liu Hong-Min, Zhang Yan-Bing, (2016) Design, synthesis and antiproliferative activity studies of novel dithiocarbamate–chalcone derivates, Bioorganic and Medicinal Chemistry Letters, 26 (16): 3918-3922. https://doi.org/10.1016/j.bmcl.2016.07.012 (in Eng.).

Hayat F., Shah S.N.A., Rehman Z., Bélanger-Gariepy F., (2021) Antimony (III) dithiocarbamates: Crystal structures, supramolecular aggregations, DNA binding, antioxidant and antileishmanial activities, Polyhedron, 194: 114909. https://doi.org/10.1016/j.poly.2020.114909 (in Eng.).

Horita Y., Takii T., Kuroishi R., Chiba T., Ogawa K., Kremer L., Sato Y., Hasegawa T., Onozaki K. (2011) Synthesis and evaluation of anti-tubercular activity of new dithiocarbamate sugar derivatives, Bioorganic and Medicinal Chemistry Letters, 21 (3): 899-903. https://doi.org/10.1016/j.bmcl.2010.12.084 (in Eng.).

Hussain Dar S., Ansari I.A., Tabrez S., Rana M., Usman M., Ul Islam S., Rub A., Rahisuddin. (2021) Synthesis, Crystal Structures, Biological and Thermal Decomposition Evaluation of Homo and Heteroleptic Zn(II) Dithiocarbamate Complexes and Use of Zn(II) Dithiocarbamate to Prepare Zinc Sulfide Nanoparticles. Polyhedron, 208: 115424. https://doi.org/10.1016/J.POLY.2021.115424 (in Eng).

Singh M., Garg A., Sidhu A. et al. (2013) Synthesis of quarternary ammonium salts with dithiocarbamate moiety and their antifungal activities against Helminthosporium -+oryzae, J Chem Sci., 125: 567–573. https://doi.org/10.1007/s12039-013-0394-x (in Eng.).

Sun Ya-Xin, Song Jian, Kong Li-Jun, Sha Bei-Bei, Tian Xin-Yi, Liu Xiu-Juan, Hu Tao, Chen Ping, Zhang Sai-Yang (2022) Design, synthesis and evaluation of novel bis-substituted aromatic amide dithiocarbamate derivatives as colchicine site tubulin polymerization inhibitors with potent anticancer activities, Eur. J. of Med. Chem, 229: 114069. https://doi.org/10.1016/j.ejmech.2021.114069 (in Eng.).

Sycheva Ye.S., Mukanova M.S., Rakhimbekov Zh.A., Yu V.K., Mukanova G.S. (2019) Synthesis and root-forming activity of dithiocarbamates based on the 2-(methylamino)ethanol and quinoline-8-ol Chemical journal of Kazakhstan, 4: 31−36. (in Eng).

Wang Xiao-Juan, Xu Hai-Wei, Guo Lin-Lin, Zheng Jia-Xin, Xu Bo, Guo Xiao, Zheng Chen-Xin, Liu Hong-Min, (2011) Synthesis and in vitro antitumor activity of new butenolide-containing dithiocarbamates, Bioorganic and Medicinal Chemistry Letters, 21 (10): 3074-3077. https://doi.org/10.1016/j.bmcl.2011.03.029.

Wei M.X., Zhang J., Ma F.L., Li M., Yu J.Y., Luo W., Li X.Q. (2018) Synthesis and Biological Activities of Dithiocarbamates Containing 2(5H)-Furanone-Piperazine, Eur. J. Med. Chem., 155: 165–170. https://doi.org/10.1016/j.ejmech.2018.05.056 (in Eng.).

Yu Jia-Ying, Li Xue-Qiang, Wei Meng-Xue (2019) Synthesis and biological activities of artemisinin-piperazine-dithiocarbamate derivatives, Eur. J. of Med. Chem., 169: 21-28. https://doi.org/10.1016/j.ejmech.2019.02.071 (in Eng.).

МАЗМҰНЫ

С. Айт, Ж.Ж. Тілепберген, У. Сұлтанбек, М. Жұрынов, А.Ф. Мифтахова
МЕТАНОЛДАҒЫ САНТОНИННІҢ ЭЛЕКТРОХИМИЯЛЫҚ БЕЛСЕНДІЛІГІН ЗЕРТТЕУ.....5

Н. Аппазов, Б. Диярова, Б. Базарбаев, Б. Джиембаев, О. Лыгина
КҮРІШ ҚАЛДЫҒЫМЕН МҰНАЙШЛАМЫН БІРГЕ ӨҢДЕУДЕ ҰНДЫ ҚОСУ АРҚЫЛЫ ТҮЙІРШІКТЕЛГЕН БЕЛСЕНДІРІЛГЕН КӨМІР АЛУ.....17

Н.А. Бектенов, Қ.А. Садыков, М.К. Курманалиев, Л.К. Ыбраймжанова, З.Н. Бектенова
АҒЫНДЫ ӨНДІРІСТІК СУЛАРДАН ХРОМ (VI) ЖӘНЕ ҚОРҒАСЫН ИОНДАРЫН БӨЛІП АЛУҒА АРНАЛҒАН ФОСФОРҚҰРАМДЫ ИОНИТ.....26

Е.Г. Бочевская, З.С. Абишева, А.С. Шарипова, Э.А. Саргелова
МЫС ӨНДІРІСІНІҢ ШАЙЫНДЫ ҚЫШҚЫЛЫНАН РЕНИЙДІ ЭКСТРАКЦИЯЛАУ КЕЗІНДЕ ОСМИЙ ҚҰРАМДЫ ФАЗААРАЛЫҚ ӨЛШЕМДЕРДІҢ ТҮЗІЛУІ.....42

Г.Ж. Джаманбаева, Б.Р. Таусарова, Б.Н. Сүрімбаев, С.Т. Шалғымбаев
МЫРЫШ НИТРАТЫ КОНЦЕНТРАЦИЯСЫНЫҢ МЫРЫШ ОКСИДІНІҢ МИКРО ЖӘНЕ НАНОБӨЛШЕКТЕРІН АЛУҒА ӘСЕРІ.....57

С.Д. Дузелбаева, З.С. Ахатова, Б.А. Касенова, С.Р. Конуспаев
ЖҮНДІ ЖУҒАН САРҚЫНДЫ СУДАН ЖҮН МАЙЫН БӨЛІП АЛУ, ЛАНОЛИНДІ АЛУ ЖӘНЕ ОНЫ ТЕРЕҢ ӨҢДЕУ.....68

Б.Т. Ермағамбет, М.К. Қазанқапова, Ж.М. Касенова
ГУМИН ҚЫШҚЫЛЫ МЕН МИКРОСФЕРА НЕГІЗІНДЕГІ КОМПОЗИТТІК МАТЕРИАЛДЫ АЛУ ЖӘНЕ СУДЫ АУЫР МЕТАЛДАРДАН ТАЗАРТУДА ҚОЛДАНУ.....86

М.К. Ибраев, О.А. Нуркенов, Ж.Б. Рахимберлинова, З.Т. Шульгау, А.Т. Такибаева, М.Б. Исабаева, А.А. Кельмялене
ФУНКЦИОНАЛДЫ АЛМАСТЫРЫЛҒАН АЛКЕНДЕР МЕН ОЛАРДЫҢ ТУЫНДЫЛАРЫНЫҢ СИНТЕЗІ ЖӘНЕ РАДИКАЛДЫ ЕМЕС БЕЛСЕНДІЛІГІ.....97

Б.Р. Исакулов, Ю.А. Соколова, М.В. Акулова, А.Г. Соколова, Ж.Б. Тукашев
МҰНАЙ-ГАЗ САЛАСЫНЫҢ КҮКІРТ ҚАЛДЫҚТАРЫН СІҢДІРУ АРҚЫЛЫ АРБОЛИТО-БЕТОН КОМПОЗИТТЕРІНІҢ БЕРІКТІК ҚАСИЕТТЕРІН АРТТЫРУ.....111

З.М. Мулдахметов, А.М. Газалиев, А.Х. Жакина, Е.П. Василец, О.В. Арнт
СИНТЕЗ И ИЗУЧЕНИЕ СТРУКТУРЫ N-ПРОИЗВОДНОГО ГУМИНОВЫХ КИСЛОТ НА ОСНОВЕ ОТХОДОВ УГЛЕДОБЫЧИ.....123

Г.Н. Мусина, А.А. Жорабек, И.В. Кулаков, М.Ж. Кайырбаева, А. Карилхан, Б.Б. Акимбекова
АУЫР КӨМІРСУТЕК ШИКІЗАТЫ (ТАСКӨМІР ШАЙЫРЫ) МЕН ГИДРОГЕНИЗАТТАРДЫҢ ТЕРМОДИНАМИКАЛЫҚ ФУНКЦИЯЛАРЫН АНЫҚТАУДАҒЫ ӘДІС.....135

М. Нажипкызы, А. Нургайн, А. Жапарова, А. Исанбекова, Жеоффри Роберт Митчелл
«AL/DIATOMITE НЕГІЗДІ КОМПОЗИТТІК МАТЕРИАЛДАР.....146

С.Б. Рыспаева, А.Ж. Керимкулова, Ш.С. Ислам, С.З. Наурызова, М.А. Кожайсакова
АСФАЛЬТЕНДЕРДІ ТҰНДЫРУДЫҢ ЖАҢА ТЕЖЕГІШІ РЕТІНДЕГІ ТЕРЕҢ ЭВТЕКТИКАЛЫҚ ЕРІТКІШТЕР.....156

Р. Сафаров, Ж. Берденов, Р. Урлибай, Ю. Носенко, Ж. Шоманова, Ж. Бексеитова
ПАВЛОДАР АЛЮМИНИЙ ЗАУЫТЫ ТЕХНОГЕНДІК ҚАЛДЫҚТАРЫНЫҢ ҚОРШАҒАН ОРТАҒА ӘСЕРІ ЖӘНЕ ЭКОНОМИКАЛЫҚ ӘЛЕУЕТІ, ЭЛЕМЕНТТЕРІНІҢ КЕҢІСТІКТЕ БӨЛІНУІ (ҚАЗАҚСТАН, ПАВЛОДАР).....167

Е.С. Сычева, М.С. Муканова, Г.Б. Сарсенбаева, О.Т. Сейлханов
5-МЕТИЛ-1*Н*-БЕНЗОТРИАЗОЛ-1-НАТРИЙ КАРБОДИТИОАТЫ НЕГІЗІНДЕ ДИТИОКАРБАМИНДІК ТИОАНГИДРИДТЕР СИНТЕЗІ ЖӘНЕ ӨСУДІ ЫНТАЛАНДЫРАТЫН БЕЛСЕНДІЛІГІ.....190

СОДЕРЖАНИЕ

С. Айт, Ж.Ж. Тілепберген, У. Султанбек, М. Жұрынов, А.Ф. Мифтахова
ИЗУЧЕНИЕ ЭЛЕКТРОХИМИЧЕСКОЙ АКТИВНОСТИ САНТОНИНА В МЕТАНОЛЕ.....5

Н. Аппазов, Б. Диярова, Б. Базарбаев, Б. Джиембаев, О. Лыгина
ПОЛУЧЕНИЕ ГРАНУЛИРОВАННОГО АКТИВИРОВАННОГО УГЛЯ С ДОБАВЛЕНИЕМ МУКИ ПРИ СОВМЕСТНОЙ ПЕРЕРАБОТКЕ РИСОВОГО ОТХОДА С НЕФТЕШЛАМОМ.....17

Н.А. Бектенов, К.А. Садыков, М.К. Курманалиев, Л.К. Ыбраймжанова, З.Н. Бектенова
ФОСФОРСОДЕРЖАЩИЙ ИОНИТ ДЛЯ ИЗВЛЕЧЕНИЯ ИОНОВ ХРОМА (VI) И СВИНЦА ИЗ СТОЧНЫХ ПРОМЫШЛЕННЫХ ВОД.....26

Е.Г. Бочевская, З.С. Абишева, А.С. Шарипова, Э.А. Саргелова
ОБРАЗОВАНИЕ ОСМИЙСОДЕРЖАЩИХ МЕЖФАЗНЫХ ВЗВЕСЕЙ ПРИ ЭКСТРАКЦИИ РЕНИЯ ИЗ ПРОМЫВНОЙ КИСЛОТЫ МЕДНОГО ПРОИЗВОДСТВА.....42

Г.Ж. Джаманбаева, Б.Р. Таусарова, Б.Н. Суримбаев, С.Т. Шалгымбаев
ВЛИЯНИЕ КОНЦЕНТРАЦИИ НИТРАТА ЦИНКА НА ПОЛУЧЕНИЕ МИКРО- И НАНОЧАСТИЦ ОКСИДА ЦИНКА.....57

С.Д. Дузелбаева, З.С. Ахатова, Б.А. Касенова, С.Р. Конуспаев
ИЗВЛЕЧЕНИЕ ШЕРСТНОГО ЖИРА ИЗ ПРОМЫВНЫХ ВОД ШЕРСТИ, ПОЛУЧЕНИЕ ЛАНОЛИНА И ЕГО ГЛУБОКАЯ ПЕРЕРАБОТКА.....68

Б.Т. Ермагамбет, М.К. Казанкапова, Ж.М. Касенова
ПОЛУЧЕНИЕ КОМПОЗИТНОГО МАТЕРИАЛА НА ОСНОВЕ ГУМИНОВОЙ КИСЛОТЫ И МИКРОСФЕРЫ И ПРИМЕНЕНИЕ ДЛЯ ОЧИСТКИ ВОДЫ ОТ ТЯЖЕЛЫХ МЕТАЛЛОВ.....86

М.К. Ибраев, О.А. Нуркенов, Ж.Б. Рахимберлинова, З.Т. Шульгау, А.Т. Такибаева, М.Б. Исабаева, А.А. Кельмялене
СИНТЕЗ И АНТИРАДИКАЛЬНАЛЬНАЯ АКТИВНОСТЬ ФУНКЦИОНАЛЬНО ЗАМЕЩЕННЫХ ХАЛКОНОВ И ИХ ПРОИЗВОДНЫХ.....97

Б.Р. Исакулов, Ю.А. Соколова, М.В. Акулова, А.Г. Соколова, Ж.Б. Тукашев
ПОВЫШЕНИЕ ПРОЧНОСТНЫХ СВОЙСТВ АРБОЛИТОБЕТОННЫХ КОМПОЗИТОВ ПУТЕМ ПРОПИТКИ СЕРОЙ-ОТХОДОМ НЕФТЕГАЗОВОЙ ПРОМЫШЛЕННОСТИ.....111

З.М. Молдахметов, А.М. Ғазалиев, А.Х. Жакина, Е.П. Василец, О.В. Арнт
КӨМІР ӨНДІРУ ҚАЛДЫҚТАРЫ НЕГІЗІНДЕГІ ГУМИН ҚЫШҚЫЛДАРЫНЫҢ N-ТУЫНДЫСЫНЫҢ СИНТЕЗІ ЖӘНЕ ҚҰРЫЛЫМЫН ЗЕРТТЕУ.....123

Г.Н. Мусина, А.А. Жорабек, И.В. Кулаков, М.Ж. Кайырбаева, А. Карилхан, Б.Б. Акимбекова
МЕТОД ОПРЕДЕЛЕНИЯ ТЕРМОДИНАМИЧЕСКИХ ФУНКЦИЙ ТЯЖЕЛОГО УГЛЕВОДОРОДНОГО СЫРЬЯ (КАМЕННОУГОЛЬНОЙ СМОЛЫ) И ГИДРОГЕНИЗАТОВ.....135

М. Нажипқызы, А. Нұргаин, А. Жапарова, А. Исанбекова, Жеоффри Роберт Митчелл
КОМПОЗИТНЫЕ МАТЕРИАЛЫ НА ОСНОВЕ AL/DIATOMITE.....146

С.Б. Рыспаева, А.Ж. Керимкулова, Ш.С. Ислам, С.З. Наурызова, М.А. Кожайсакова
ГЛУБОКИЕ ЭВТЕКТИЧЕСКИЕ РАСТВОРИТЕЛИ В КАЧЕСТВЕ НОВЫХ ИНГИБИТОРОВ ОСАЖДЕНИЯ АСФАЛЬТЕНОВ.....156

Р. Сафаров, Ж. Берденов, Р. Урлибай, Ю.З. Носенко, Ж. Шоманова, Ж. Бексеитова
ПРОСТРАНСТВЕННОЕ РАСПРЕДЕЛЕНИЕ ЭЛЕМЕНТОВ, ВОЗДЕЙСТВИЕ НА ОКРУЖАЮЩУЮ СРЕДУ И ЭКОНОМИЧЕСКИЙ ПОТЕНЦИАЛ ТЕХНОГЕННЫХ ОТХОДОВ ПАВЛОДАРСКОГО АЛЮМИНИЕВОГО ЗАВОДА (ПАВЛОДАР, КАЗАХСТАН).....167

Е.С. Сычева, М.С. Муканова, Г.Б. Сарсенбаева, О.Т. Сейлханов
СИНТЕЗ И РОСТСТИМУЛИРУЮЩАЯ АКТИВНОСТЬ ДИТИОКАРБАМИНОВЫХ ТИОАНГИДРИДОВ НА ОСНОВЕ 5-МЕТИЛ-1*Н*-БЕНЗОТРИАЗОЛ-1-КАРБОДИТИОАТА НАТРИЯ.....190

CONTENTS

S. Ait, J.J. Tilepbergen, U. Sultanbek, M. Zhurynov, A.F. Miftakhova
STUDY OF THE ELECTROCHEMICAL ACTIVITY OF SANTONIN IN METHANOL.....5

N. Appazov, B. Diyarova, B. Bazarbaev, B. Dzhembaev, O. Lygina
PRODUCTION OF GRANULATED ACTIVATED CARBON WITH THE ADDITATION OF FLOUR DURING THE JOINT PROCESSING OF RICE WASTE WITH OIL SLUDGE.....17

N.A. Bektenov, K.A. Sadykov, M.K. Kurmanaliev , L.K.Ybraimzhanova, Z.N. Bektenova
PHOSPHORUS-CONTAINING IONITE FOR EXTRACTION OF CHROMIUM (VI) AND LEAD IONS FROM INDUSTRIAL WASTE WATER.....26

Ye.G. Bochevskaya, Z.S. Abisheva, A.S. Sharipova, E.A. Sargelova
FORMATION OF OSMIUM-CONTAINING INTERFACIAL SUSPENSIONS IN THE EXTRACTION OF RHENIUM FROM WASHING ACID OF COPPER PRODUCTION.....42

G. Jamanbayeva, B. Taussarova, B. Surimbayev, S. Shalgymbayev
EFFECT OF ZINC NITRATE CONCENTRATION ON OBTAINING ZINC OXIDE MICRO- AND NANOPARTICLES.....57

S.D. Duzelbayeva, Z.S. Akhatova, B.A. Kassenova, S.R. Konuspayev
EXTRACTION OF WOOL FAT FROM THE WOOL WASH WATER, PRODUCTION OF LANOLIN, AND ITS DEEP PROCESSING.....68

B.T. Yermagambet, M.K. Kazankapova, Zh.M. Kassenova
OBTAINING COMPOSITE MATERIAL BASED ON HUMIC ACID AND MICROSPHERE AND APPLICATION FOR WATER TREATMENT FROM HEAVY METALS.....86

M. Ibrayev, O. Nurkenov, Zh. Rakhimberlinova, Z. Shulgau, A. Takibayeva, M. Issabayeva, A. Kelmyalene
SYNTHESIS AND ANTIRADICAL ACTIVITY OF SUBSTITUTED CHALCONES AND THEIR DERIVATIVES.....97

B.R. Isakulov, Yu.A. Sokolova, M.V. Akulova, A.G. Sokolova, Zh.B. Tukashev
IMPOVEMENT OF STRENGTH PROPERTIES OF ARBOLITE CONCRETE COMPOSITES BY MEANS OF IMPREGNATION WITH SULFUR – BY-PRODUCTS OF OIL AND GAS INDUSTRY.....111

Z.M. Muldakhmetov, A.M. Gazaliev, A.Kh. Zhakina, Ye.P. Vassilets, O.V. Arnt
SYNTHESIS AND STUDY OF THE STRUCTURE OF THE N-DERIVATIVE OF HUMIC ACIDS BASED ON COAL MINING WASTE.....123

G.N. Musina, A.A. Zhorabek, I.V. Kulakov, M.Zh. Kaiyrbayeva, A. Karilkhan, B.B. Akimbekoiva
METHOD DETERMINATION OF THERMODADDITIVE METHOD DETERMINATION OF THERMODYNAMIC FUNCTIONS OF HEAVY HYDROCARBON RAW MATERIALS (COAL TAR) AND HYDROGENATES OF INAMIC FUNCTIONS OF HEAVY HYDROCARBON RAW MATERIALS (COAL TAR) AND HYDROGENATES.....135

M. Nazhipkyzy, A. Nurgain, A. Zhaparova, A. Issanbekova, Geoffrey Robert Mitchell
Al/DIATOMITE BASED COMPOSITE MATERIALS.....146

S.B. Ryspaeva, A.Zh. Kerimkulova, Sh.S. Islam, S.Z. Naurizova, M.A. Kozhaisakova
DEEP EUTECTIC SOLVENTS AS A NEW INHIBITOR OF ASPHALTENE DEPOSITION.....156

R. Safarov, Zh. Berdenov, R. Urlibay, Yu. Nossenko, Zh. Shomanova, Zh. Bexeitova
SPATIAL DISTRIBUTION OF ELEMENTS, ENVIRONMENTAL EFFECTS, AND ECONOMIC POTENTIAL OF TECHNOGENIC WASTE MATERIALS OF PAVLODAR ALUMINUM PLANT (PAVLODAR, KAZAKHSTAN)....167

Ye.S. Sycheva, M.S. Mukanova, G.B. Sarsenbaeva, O.T. Seilkhanov
SYNTHESIS AND GROWTH STIMULATING ACTIVITY OF DITHIOCARBAMINE THIOANHYDRIDES BASED ON SODIUM 5-METHYL-1*H*-BENZOTRIAZOL-1-CARBODITHIOATE.....190

Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайтах:

www:nauka-nanrk.kz
http://chemistry-technology.kz/index.php/en/arhiv
ISSN 2518-1491 (Online), ISSN 2224-5286 (Print)

Директор отдела издания научных журналов НАН РК *А. Ботанқызы*
Заместитель директор отдела издания научных журналов НАН РК *Р. Жәлиқызы*
Редакторы: *М.С. Ахметова, Д.С. Аленов*
Верстка на компьютере *Г.Д. Жадырановой*

Подписано в печать 26.09.2022.
Формат 60x88$^{1}/_{8}$. Бумага офсетная. Печать – ризограф.
13,0 п.л. Тираж 300. Заказ 3.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19