

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
НАУК РЕСПУБЛИКИ
КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF
KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

3 (453)
MAY – JUNE 2022

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

Бас редактор

ЖҰРЫНОВ Мұрат Жұрынұлы, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Қазақстан Республикасы Ұлттық Ғылым академиясының президенті, АҚ «Д.В. Сокольский атындағы отын, катализ және электрохимия институтының» бас директоры (Алматы, Қазақстан) **Н = 4**

Ғылыми хатшы

АБСАДЫКОВ Бахыт Нарикбайұлы, техника ғылымдарының докторы, профессор, ҚР ҰҒА жауапты хатшысы, А.Б. Бектұров атындағы химия ғылымдары институты (Алматы, Қазақстан) **Н = 5**

Редакциялық алқа:

ӘБСАМЕТОВ Мәліс Құдысұлы (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, «У.М. Ахмедсафина атындағы гидрогеология және геоэкология институтының» директоры (Алматы, Қазақстан) **Н = 2**

ЖОЛТАЕВ Герой Жолтайұлы (бас редактордың орынбасары), геология-минералогия ғылымдарының докторы, профессор, Қ.И. Сатпаев атындағы геология ғылымдары институтының директоры (Алматы, Қазақстан) **Н = 2**

СНОУ Дэниел, Ph.D, қауымдастырылған профессор, Небраска университетінің Су ғылымдары зертханасының директоры (Небраска штаты, АҚШ) **Н = 32**

ЗЕЛЬТМАН Реймар, Ph.D, табиғи тарих мұражайының Жер туралы ғылымдар бөлімінде петрология және пайдалы қазбалар кен орындары саласындағы зерттеулердің жетекшісі (Лондон, Англия) **Н = 37**

ПАНФИЛОВ Михаил Борисович, техника ғылымдарының докторы, Нанси университетінің профессоры (Нанси, Франция) **Н = 15**

ШЕН Пин, Ph.D, Қытай геологиялық қоғамының тау геологиясы комитеті директорының орынбасары, Американдық экономикалық геологтар қауымдастығының мүшесі (Пекин, Қытай) **Н = 25**

ФИШЕР Аксель, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) **Н = 6**

КОНТОРОВИЧ Алексей Эмильевич, геология-минералогия ғылымдарының докторы, профессор, РҒА академигі, А.А. Трофимука атындағы мұнай-газ геологиясы және геофизика институты (Новосибирск, Ресей) **Н = 19**

АГАБЕКОВ Владимир Енокович, химия ғылымдарының докторы, Беларусь ҰҒА академигі, Жаңа материалдар химиясы институтының құрметті директоры (Минск, Беларусь) **Н = 13**

КАТАЛИН Стефан, Ph.D, Дрезден техникалық университетінің қауымдастырылған профессоры (Дрезден, Берлин) **Н = 20**

СЕЙТМҰРАТОВА Элеонора Юсуповна, геология-минералогия ғылымдарының докторы, профессор, ҚР ҰҒА корреспондент-мүшесі, Қ.И. Сатпаев атындағы Геология ғылымдары институты зертханасының меңгерушісі (Алматы, Қазақстан) **Н = 11**

САҒЫНТАЕВ Жанай, Ph.D, қауымдастырылған профессор, Назарбаев университеті (Нұр-Сұлтан, Қазақстан) **Н = 11**

ФРАТТИНИ Паоло, Ph.D, Бикокк Милан университеті қауымдастырылған профессоры (Милан, Италия) **Н = 28**

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген № **KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

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

<http://www.geolog-technical.kz/index.php/en/>

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2022

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

Главный редактор

ЖУРИНОВ Мурат Журинович, доктор химических наук, профессор, академик НАН РК, президент Национальной академии наук Республики Казахстан, генеральный директор АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского» (Алматы, Казахстан) **Н = 4**

Ученый секретарь

АБСАДЫКОВ Бахыт Нарикбаевич, доктор технических наук, профессор, ответственный секретарь НАН РК, Институт химических наук им. А.Б. Бектурова (Алматы, Казахстан) **Н = 5**

Редакционная коллегия:

АБСАМЕТОВ Малис Кудысович, (заместитель главного редактора), доктор геологоминералогических наук, профессор, академик НАН РК, директор Института гидрогеологии и геоэкологии им. У.М. Ахмедсафина (Алматы, Казахстан) **Н = 2**

ЖОЛТАЕВ Герой Жолтаевич, (заместитель главного редактора), доктор геологоминералогических наук, профессор, директор Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) **Н=2**

СНОУ Дэниел, Ph.D, ассоциированный профессор, директор Лаборатории водных наук университета Небраски (штат Небраска, США) **Н = 32**

ЗЕЛЬТМАН Реймар, Ph.D, руководитель исследований в области петрологии и месторождений полезных ископаемых в Отделе наук о Земле Музея естественной истории (Лондон, Англия) **Н = 37**

ПАНФИЛОВ Михаил Борисович, доктор технических наук, профессор Университета Нанси (Нанси, Франция) **Н=15**

ШЕН Пин, Ph.D, заместитель директора Комитета по горной геологии Китайского геологического общества, член Американской ассоциации экономических геологов (Пекин, Китай) **Н = 25**

ФИШЕР Аксель, ассоциированный профессор, Ph.D, технический университет Дрезден (Дрезден, Берлин) **Н = 6**

КОНТОРОВИЧ Алексей Эмильевич, доктор геолого-минералогических наук, профессор, академик РАН, Институт нефтегазовой геологии и геофизики им. А.А. Трофимука СО РАН (Новосибирск, Россия) **Н = 19**

АГАБЕКОВ Владимир Еноквич, доктор химических наук, академик НАН Беларуси, почетный директор Института химии новых материалов (Минск, Беларусь) **Н = 13**

КАТАЛИН Стефан, Ph.D, ассоциированный профессор, Технический университет (Дрезден, Берлин) **Н = 20**

СЕЙТМУРАТОВА Элеонора Юсуповна, доктор геолого-минералогических наук, профессор, член-корреспондент НАН РК, заведующая лабораторией Института геологических наук им. К.И. Сатпаева (Алматы, Казахстан) **Н=11**

САГИНТАЕВ Жанай, Ph.D, ассоциированный профессор, Назарбаев университет (Нурсултан, Казахстан) **Н = 11**

ФРАТТИНИ Паоло, Ph.D, ассоциированный профессор, Миланский университет Бикокк (Милан, Италия) **Н = 28**

«Известия НАН РК. Серия геологии и технических наук».

ISSN 2518-170X (Online),

ISSN 2224-5278 (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 № **KZ39VPY00025420**, выданное 29.07.2020 г.

Тематическая направленность: *геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соединений.*

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

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

<http://www.geolog-technical.kz/index.php/en/>

© Национальная академия наук Республики Казахстан, 2022

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

Editorial chief

ZHURINOV Murat Zhurinovich, doctor of chemistry, professor, academician of NAS RK, president of the National Academy of Sciences of the Republic of Kazakhstan, general director of JSC “Institute of fuel, catalysis and electrochemistry named after D.V. Sokolsky» (Almaty, Kazakhstan) **H = 4**

Scientific secretary

ABSADYKOV Bakhyt Narikbaevich, doctor of technical sciences, professor, executive secretary of NAS RK, Bekturov Institute of chemical sciences (Almaty, Kazakhstan) **H = 5**

E d i t o r i a l b o a r d:

ABSAMETOV Malis Kudysovich, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, academician of NAS RK, director of the Akhmedsafin Institute of hydrogeology and hydrophysics (Almaty, Kazakhstan) **H=2**

ZHOLTAEV Geroy Zholtaevich, (deputy editor-in-chief), doctor of geological and mineralogical sciences, professor, director of the institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) **H=2**

SNOW Daniel, Ph.D, associate professor, director of the laboratory of water sciences, Nebraska University (Nebraska, USA) **H = 32**

ZELTMAN Reymar, Ph.D, head of research department in petrology and mineral deposits in the Earth sciences section of the museum of natural history (London, England) **H = 37**

PANFILOV Mikhail Borisovich, doctor of technical sciences, professor at the Nancy University (Nancy, France) **H=15**

SHEN Ping, Ph.D, deputy director of the Committee for Mining geology of the China geological Society, Fellow of the American association of economic geologists (Beijing, China) **H = 25**

FISCHER Axel, Ph.D, associate professor, Dresden University of technology (Dresden, Germany) **H=6**

KONTOROVICH Aleksey Emilievich, doctor of geological and mineralogical sciences, professor, academician of RAS, Trofimuk Institute of petroleum geology and geophysics SB RAS (Novosibirsk, Russia) **H = 19**

AGABEKOV Vladimir Enokovich, doctor of chemistry, academician of NAS of Belarus, honorary director of the Institute of chemistry of new materials (Minsk, Belarus) **H = 13**

KATALIN Stephan, Ph.D, associate professor, Technical university (Dresden, Berlin) **H = 20**

SEITMURATOVA Eleonora Yusupovna, doctor of geological and mineralogical sciences, professor, corresponding member of NAS RK, head of the laboratory of the Institute of geological sciences named after K.I. Satpayev (Almaty, Kazakhstan) **H=11**

SAGINTAYEV Zhanay, Ph.D, associate professor, Nazarbayev University (Nursultan, Kazakhstan) **H = 11**

FRATTINI Paolo, Ph.D, associate professor, university of Milano-Bicocca (Milan, Italy) **H = 28**

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),

ISSN 2224-5278 (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. KZ39VPY00025420**, issued 29.07.2020.

Thematic scope: *geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.*

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19

<http://www.geolog-technical.kz/index.php/en/>

© National Academy of Sciences of the Republic of Kazakhstan, 2022

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

N.R. Akhundova

Azerbaijan State Oil and Industry University, Baku, Azerbaijan.

E-mail: *akhundova.nargiz92@gmail.com*

**CHANGE OF HYDRODYNAMIC PRESSURES IN THE WELLBORE
OF INCLINED-HORIZONTAL WELLS DURING DRILLING MUD
CIRCULATION**

Abstract. In recent years, as you know, the volume of drilling deviated and horizontal wells has increased dramatically.

When drilling these wells there are a number of problems: lack of technical means for drilling such wells, bringing the axial load on the drill bit, bringing strings to the bottom hole, problems with borehole cleaning from the drilled rock, etc.

The data collection and analysis of field data on drilling of deviated and horizontal wells (inclinograms mode parameters) in the Baku Archipelago areas showed the changes of hydrodynamic pressure in a well, when the mode parameters, axial load, bit rotational speed and fluid consumption were the same.

Further analysis of these data revealed that these changes occur as a result of changes in the spatial curvature of deviated and horizontal wells.

Analysis of the obtained data showed that the change occurred only in the case of changes in the spatial variation of inclined-horizontal wells.

To the end, the work presented studies to determine changes in hydrodynamic pressures in the borehole of deviated-horizontal wells.

On the basis of experimental, field, as well as computer simulation studies, data were obtained, which were processed by statistical methods. As a result, dependences for determination of hydrodynamic pressure in the wellbore of slanted horizontal wells were obtained.

The studies have shown that using the traditional method of calculating the

hydrodynamic pressure in the wellbore of deviated horizontal wells differs from our calculations taking into account the zenith angles. This difference occurs in the direction of reducing these values.

Key words: deviated well, zenith angle, pumping capacity, horizontal well profile, pressure losses.

Н.Р. Ахундова

Өзірбайжан Мемлекеттік мұнай және өнеркәсіп университеті,
Баку, Өзірбайжан.

E-mail: *akhundova.nargiz92@gmail.com*

БҰРҒЫЛАУ ЕРІТІНДІСІНІҢ АЙНАЛЫМЫ КЕЗІНДЕ КӨЛБЕУ-КӨЛДЕНЕҢ ҰҢҒЫМАЛАР ОҚПАНЫНДАҒЫ ГИДРОДИНАМИКАЛЫҚ ҚЫСЫМДАРДЫҢ ӨЗГЕРУІ

Аннотация. Соңғы жылдары, көлбеу және көлденең ұңғымаларды бұрғылау көлемі күрт өсті. Ұңғымаларды бұрғылау кезінде бірқатар проблемалар туындайды. Атап айтқанда: ұңғымаларды өткізуге арналған техникалық құралдардың болмауы, кескішке осьтік жүктемені жеткізу, бағандарды кенжарға жеткізу, бұрғыланған тау жыныстарынан тазарту проблемалары және т. б.

Баку архипелагының алаңдарында көлбеу және көлденең ұңғымаларды бұрғылау бойынша кәсіптік деректерді (инклинограммалардың режимдік параметрлері) жинау және талдау режимдік параметрлердің, осьтік жүктеменің тұрақтылығы, қашаудың айналу айналымының саны, сондай-ақ сұйықтық шығыны кезінде ұңғымадағы гидродинамикалық қысымдардың өзгеруі байқалғанын көрсетті.

Осы деректерді одан әрі талдау бұл өзгерістердің көлбеу және көлденең ұңғымалардың кеңістіктік қисықтығының өзгеруі нәтижесінде пайда болатындығын анықтады. Алынған деректерді талдау, өзгеріс көлбеу-көлденең ұңғымалардың кеңістіктік өзгеруі өзгерген жағдайда ғана болатындығын көрсетті.

Бұл жұмыста көлбеу-көлденең ұңғымалар оқпанындағы гидродинамикалық қысымдардың өзгеруін анықтау бойынша зерттеулер ұсынылды. Зерттеулерді эксперименттік, коммерциялық, сондай-ақ компьютерлік модельдеу негізінде статистикалық әдістермен өңделген мәліметтер алынды. Соның нәтижесінде көлденең ұңғымалардың оқпанындағы гидродинамикалық қысымды анықтау бойынша тәуелділіктер анықталды.

Зерттеулер көрсеткендей, гидродинамикалық есептеудің дәстүрлі

әдісін қолданған кезде көлбеу-көлденең ұңғымалардағы қысым зениттік бұрыштарды ескере отырып, біз ұсынған есептеулерден өзгеше болады. Бұл айырмашылық осы шамалардың азаюына байланысты.

Түйін сөздер: көлбеу ұңғыма, зениттік бұрыш, сорғылардың өнімділігі, көлденең ұңғымалардың профилі, қысымның жоғалуы.

Н.Р. Ахундова

Азербайджанский Государственный Университет Нефти и
Промышленности. Баку, Азербайджан.
E-mail: *akhundova.nargiz92@gmail.com*

ИЗМЕНЕНИЕ ГИДРОДИНАМИЧЕСКИХ ДАВЛЕНИЙ В СТВОЛЕ НАКЛОННО-ГОРИЗОНТАЛЬНЫХ СКВАЖИН ПРИ ЦИРКУЛЯЦИИ БУРОВОГО РАСТВОРА

Аннотация. В последние годы, как известно, объем бурения наклонных и горизонтальных скважин резко увеличился.

При бурении этих скважин возникают ряд проблем: отсутствие технических средств для проводки таких скважин, доведения осевой нагрузки на долото, доведение колонн до забоя, проблемы с очисткой стволов от выбуренных пород и т.д. Проведенный сбор и анализ промысловых данных по бурению наклонных и горизонтальных скважин (режимные параметры инклинограмм) на площадях Бакинского Архипелага показало, что при постоянстве режимных параметров, осевой нагрузки, числа оборотов вращения долота, а также расхода жидкости наблюдалось изменение гидродинамических давлений в скважине.

Дальнейшим анализом этих данных было установлено, что эти изменения происходят в результате изменения пространственного искривления наклонных и горизонтальных скважин. Анализ полученных данных показал, что изменение происходило только в случае изменения пространственного изменения наклонно-горизонтальных скважин.

С этой целью в работе были представлены исследования по определению изменений гидродинамических давлений в стволе наклонно-горизонтальных скважин. На основе экспериментальных, промысловых, а также компьютерного моделирования исследований были получены данные, которые были обработаны статистическими методами. В результате чего были получены зависимости по определению гидродинамических давлений в стволе наклоны горизонтальных скважин. Исследования показали, что при использовании традиционного метода

расчёта гидродинамических давлении в стволе наклонно-горизонтальных скважин отличается от предлагаемых нами расчётов с учётом зенитных углов. Это отличие происходит в сторону уменьшения этих величин.

Ключевые слова: наклонная скважина, зенитный угол, производительность насосов, профиль горизонтальные скважины, потери давления.

Introduction. Currently, due to the increase in the volume of drilling of inclined wells with large ($>35^\circ$) zenith angles and deviations, as well as when drilling horizontal wells, it becomes necessary to investigate the movement of solid particles in the trunk of inclined horizontal wells.

As studies (Abughaban, et al, 2016) show, with an increase in the zenith angle, an increasing number of particles settle on the lower wall of the well, and in the case of a horizontal well, almost 60-70% of the drilled rock settles on the lower wall. When a solid particle settles on the lower wall, a so-called slurry layer is formed. The thickness of this layer increases as the well is flushed. This can lead, on the one hand, to the seizure of tools at the moment of lifting, and on the other hand, at certain values and the zenith angle ($35 - 60^\circ$), the sludge can slide (like an avalanche) at the bottom of the well, which will lead to a decrease in the mechanical rate of penetration.

To reduce the slurry layer, it is necessary to reduce the mechanical speed of flushing the penetration or to choose such a minimum consumption of drilling mud that to ensure the removal of these settled particles to the daytime surface. In this regard, there is a need to study the movement of solid particles deposited on the lower wall of the borehole, which will determine the minimum consumption of drilling mud, ensuring the removal of these particles to the day surface.

Research materials and methods. The movement of solid particles to the lower walls of the well occurs in the form of sliding and rolling. Sliding or rolling of particles occurs, as a rule, due to hydrodynamic forces arising in the upward flow (Agayev, et al, 2001).

The case of particle motion is considered when the lower walls of the well do not roll and slide. The solution is considered as quite general, and can be used to study and calculate the motion of solid particles regardless of the type of motion.

These studies have shown how the parameters of the curvature of an inclined well affect the formation of a slurry cushion (Albaraa, et al, 2018).

Another important factor that occurs during the drilling of inclined-horizontal wells is the change in hydrodynamic pressure during its flushing. hydrodynamic pressures are all pressures in the well, which differ from the hydrostatic pressure of the liquid column both positively and negatively

(Axundova, et al, 2021; Bulatov, et al, 1984; Cardwell 1953). As a rule, they arise due to fluid motion in the circulation system of the well. Pressure fluctuations in the well may also be of another nature, in particular due to changes in circulating fluid density, separation (segregation) of phases, setting and hardening of cement slurry, infiltration of formation fluids into the well, osmotic phenomena. However, these phenomena will not be considered here. Excess pressures in the borehole can be caused by:

- 1) friction of fluids pumped into the circulation system of the well;
- 2) local resistances in the circulation system of the well;
- 3) movement in the well of the pipe string;
- 4) local resistances in the circulation system of the well when moving the pipe string;
- 5) inertia of the fluid column in the well;
- 6) pressure fluctuations arising from abrupt start or stop of pumps, lifting or abrupt braking of the drill string or casing.
- 7) overcoming the gel strength of thixotropic viscoplastic fluids when starting pumps or at the moment of starting drill string or casing string movement in the well;
- 8) rotation of drill string or casing string;
- 9) the effect of compression or rarefaction in fluid when the drill string is moving around (especially if there is a gland on the bit).

All these phenomena may occur simultaneously in the well, and their influence cannot always be evaluated separately.

Excessive pressures that occur when fluid is injected into the well circulation system have been considered in the literature (George, et al, 2011; Juan, et al, 2002).

As is known, the pressure created by drilling pumps during the circulation of the solution is equal to the sum of losses in the entire circulation system of the well and is determined by the following relationship:

$$P_B = P_p + P_{C.S.} + P_{wdp} + P_l + P_b + P_{rb} + P_{turb}$$

where, P_p – pressure loss in drill pipes, MPa

$P_{C.S.}$ – pressure loss in the column space, MPa.

P_{wdp} – pressure loss in weighted drill pipes, MPa

P_l – pressure loss in locks, MPa.

P_b – pressure loss in the bit, MPa.

P_{rb} – pressure loss in the rig binding, MPa.

P_{turb} – pressure loss in the turbobur, MPa.

The magnitude of these losses depends on many factors (pump performance, rheology, drilling fluid density, length and diameter of drill and casing pipes, local resistances, etc.).

When considering these dependencies, according to which these hydrodynamic losses are determined, it is clear that they lack the influence of factors such as zenith and azimuth angles.

Although in the authors propose (Maurer, 1971; Movsumov, 1976, 1967; Makovey, 1986) a dependence that allows determining additional pressure losses resulting from changes in azimuthal angles.

However, as you know, in recent years, the volume of drilling of inclined and horizontal wells has increased. When drilling such wells, the zenith angles reach large values (70° - 90°). At the same time, a number of problems arise, one of which is the change in hydrodynamic pressures.

Based on the above, from a practical (experimental) point of view, the question of the influence of zenith angles on hydraulic losses during drilling of inclined-horizontal wells is interesting (Hemphill, 2010).

The fact of the influence of zenith angles on hydraulic losses during the movement of drilling mud was established experimentally and by field studies conducted by us on the areas of the Baku Archipelag.

Based on these studies, a summary table (1) was compiled and graphs (fig.1) are presented, which reflects the effect of pump performance and zenith angles with constant structural dimensions of the well (length, diameter) and rheology of the solution on pressure losses at zenith angles $\alpha = 0$ and $\alpha = 90^{\circ}$.

Table 1

№	Q $10^{-3} \text{ m}^3/\text{s}$	Vertical well $P_v (\alpha=0^{\circ}), \text{ Pa}$	Horizontal well $P_h (\alpha=90^{\circ}), \text{ Pa}$
1	0,5	17	13
2	1	27	17
3	1,5	35	20
4	2	45	25
5	2,5	55	30
6	3	65	35
7	3,5	75	40
8	4	85	45

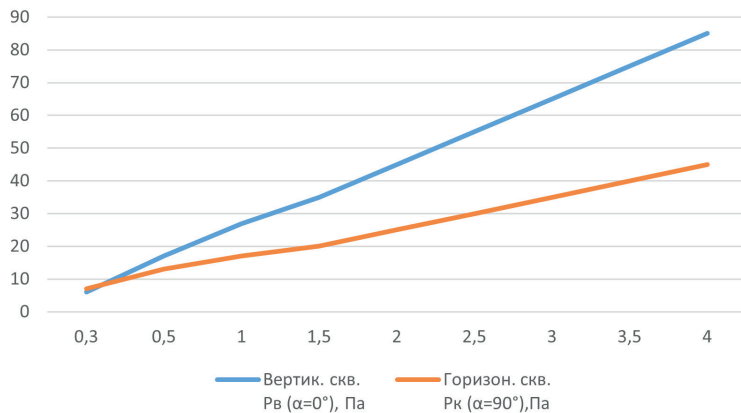


Fig.1. Dependence of pressure loss on pump performance

However, as is known, for practical calculations of pressure losses in the trunk of inclined-horizontal wells, it was necessary to have a dependence of the change in hydrodynamic losses on zenith angles.

For this purpose, the data obtained experimentally and commercially were processed.

Results. As a result of mathematical processing of these data (Qudilin, et al, 2007; Yemelyanov, et al, 1988), the dependence of the change in hydraulic losses on the zenith angles was obtained with the constancy of the technical and rheological parameters of the solution.

$$\Delta P_{i.h}^2 = \frac{\Delta P_v^1}{1 + \text{Sin}\alpha_{cp}}$$

where, ΔP_v^1 – pressure losses in a vertical well when the depth of the well and the length of the inclined horizontal part of the well are equal, MPa.

$\Delta P_{i.h}^2$ - pressure losses in an inclined-horizontal well, taking into account the average value of zenith angles, MPa.

α_{av} – the average angle of the zenith angles, degrees.

Discussion. To compare the magnitude of the change in hydrodynamic losses during drilling of inclined-horizontal wells with pressure losses in a vertical well with the same technical and technological data, a standard three-interval horizontal profile (Fig.2) with a depth of $H = 1200\text{m}$, consisting of a vertical section with a length of the tool $l = 1000\text{m}$, an inclined section of 500m was calculated. and the horizontal section $l_3 = 600\text{m}$, with the following data, the diameter of the bit $D_b = 295.3\text{mm}$, the diameter of the drill pipes $D_{dp} = 140\text{mm}$, thickness $\delta = 9\text{mm}$, length WDP = 100m , inclined length = 500m , diameter WDP = 203mm , productivity $Q = 30\text{dm}^3/\text{s}$, structural viscosity $\eta = 1 \cdot 10^{-2} \text{ N} \cdot \text{s}/\text{m}^2$, static shear stress $t = 8.16 \text{ N}/\text{m}^2$.

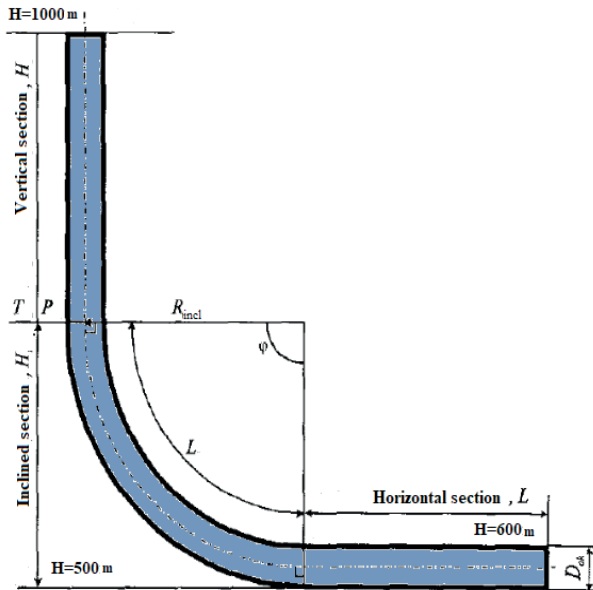


Fig. 2 Three-interval standard horizontal profile of the well.

Thus, when determining the exact value of hydraulic losses in inclined-horizontal wells, there is a need to calculate pressures at separate intervals according to the proposed method, i.e. vertical ($\alpha=0^\circ-5^\circ$), inclined ($\alpha=5^\circ-60^\circ$) and horizontal ($\alpha=60^\circ-90^\circ$) sections, as well as the calculation of these pressures when drilling a vertical well with a depth of 2100 m.az, when determining the exact value of hydraulic losses in inclined-horizontal wells, there is a need to calculate pressures at separate intervals according to the proposed method, i.e. vertical ($\alpha=0^\circ-5^\circ$), inclined ($\alpha=5^\circ-60^\circ$) and horizontal ($\alpha=60^\circ-90^\circ$) sections, as well as the calculation of these pressures when drilling a vertical well with a depth of 2100 m.

Numerical values of pressure losses in these areas obtained as a result of calculations for individual intervals are presented in table 2.

Table 2.

Interval,m	Ave- rage of zenith angle, $^\circ$	P_p , MPa	$P_{C.S.}$, MPa	P_{wp} , MPa	P_1 , MPa	P_b , MPa	P_{rb} , MPa	P_{turb} , MPa	Total losses at this interval $\alpha=0^\circ$, MPa	Total losses at this interval, taking into ac- count zenith angles, MPa
Vertical length $L_1,1000$	0	0,702	0,32	0	0,228	0	0,132	0	1,3829	1,3829

Inclined length $L_2, 500$	30	0,312	0,142	0	0,114	0	0	0	0,56865	0,3791
Length to horizontal. $L_2, 600$	90	0,39	0,178	0,239	0,137	0,45	0	2,463	3,8571	1,92855
5,80865	3,69055									

As can be seen from the calculations obtained, the hydrodynamic losses in the trunk of inclined-horizontal wells are 2.0-3.0 MPa less than in vertical wells with the same tool lengths.

Conclusion. Reduction of hydrodynamic pressures in inclined-horizontal wells contributes to the fact that:

1) Based on the analysis of the collected and systematized field and design data on the drilling of inclined and horizontal wells on the shelf of the Caspian Sea, it was found that the hydrodynamic pressures during drilling in these wells, with other parameters constant, differed from the design values by 10 - 15%.

2. To identify the reasons for the change in hydrodynamic pressures in the wellbore of inclined and horizontal wells, computer simulation of this process was carried out, as a result of which the influence of the parameters of the well curvature (in particular, the zenith angle) on the change in this value was established.

3. Statistical processing of the data obtained as a result of computer simulation made it possible to obtain the dependence of hydrodynamic pressure losses on zenith angles.

4. The results of calculations of hydrodynamic pressures during flushing of inclined and horizontal wells according to the obtained dependence confirmed their decrease by 10–15% of the design data, with other parameters remaining constant.

5. The results obtained allow, on the one hand, to reduce the load on the mud pumps, and this, in turn, will increase its productivity while maintaining power, which will improve the quality of cleaning tables of wells.

6. The dependence obtained in the article can be recommended when drawing up hydraulic programs for drilling inclined and horizontal wells.

Information about author:

Akhundova Nargiz Rovshan – PhD Student, Assistant at the Department of Transport and Storage of Oil and Gas in Azerbaijan State Oil and Industry University, *akhundova.nargiz92@gmail.com*, *https://orcid.org/0000-0001-8459-4894*; Phone: (+994)55 515-70-13.

REFERENCES

- Abughaban, Mahmoud F. (2016) et al. "Advanced Trajectory Computational Model Improves Calculated Borehole Positioning, Tortuosity and Rugosity." IADC/SPE Drilling Conference and Exhibition. Society of Petroleum Engineers.
- Agayev I.I., Rza-zade S.A., Sadikhov F.I. (2001) *Izvestiya visshix tekhnicheskix uchebnix zavedeniy Azerbajjana* №3(13), Baku p. 10 – 13.
- Albaraa, Alrushud, et. al. (2018) "Effect of the Rotary Steerable System Steering Mechanism on Wellbore Tortuosity in Horizontal Wells." SPE/IADC Middle East Drilling Technology Conference and Exhibition. Society of Petroleum Engineers. P. 145-160.
- Axundova N.R., Bahshaliyeva Sh.O., Ismaylov N.A., Mahmudova V.Z., Rza-zade S.A. (2021) *DEUTSCHE international Zeitschrift für zeitgenössische Wissenschaft* №18, p. 8 - 10.
- Bulatov A.Ī., Penkov A.Ī., Proselkov Yu.M. (1984) *Spravochnik po promivke skvajin.*, Moskva. «Nedra» p.46 – 65.
- Cardwell W.T. (1953) Pressure changes in drilling wells caused by pipe movement. In: *API Drill. Prod. Prac.* p. 97 – 112.
- George R. Gray, HCH Darley, Ryen Caenn. (2011) *Composition and Properties of Drilling and Completion Fluids.* Gulf Professional Publishing.
- Juan Carlos Rojas and Terry Hemphill. (2002) Drilling fluid sweeps: Their evaluation, timing and application. *SPE Journal*, (SPE 77448): 1–8.
- Maurer W.C. (1971) *Jetode poi de foraj.* (trad. din 1. engleza). *Висиге~Н*, Editura tehnica.
- Movsumov A.A. (1976) *Ghidrodinamicheskie osnovi sovershenstvovaniya tehnologii provodki glubokih skvajin.* Moskva, Nedra. p. 51 – 106.
- Movsumov A.A. s. a. (1967) *Opredelenie zakonomernosti izmeneniia skorosti I uskoreniia spuska burilnoi kolonni I otenka velicini gidrodinamicheskogo davleniia, voznikauscevo v skvajine.* In: *Neft. hoz.* nr. 6, p. 16 – 18.
- Nikolay Makovey. (1986) *Hidravluka bureniya.* Moskva, Nedra p. 180 – 182.
- Terry Hemphill (2010). A comparison of high-viscosity and high-density sweeps as hole cleaning tools: Separating fact from fiction. *SPE Journal*, (SPE 134514): p. 1–8.
- Qudilin N.S., Krivenko Ye.M., Maxovinov B.S., Pastyev Ī.L. (2007) *Qidravluka i qidroprovod, izdanie Moskva*, p. 520.
- Yemelyanov P.V., Mullagaliyev R.T., Sushon L.Y. (1988) *Upravleniye iskrivleniyem naklonnix skvajin v Zapadnoy Sibiri*, Moskva «Nedra».

МАЗМҰНЫ-СОДЕРЖАНИЕ-CONTENTS

R.A. Abdulvaliyev, M.N. Kvyatkovskaya, L.M. Imangalieva, A.I. Manapova KAOLINITE RAW MATERIALS OF KAZAKHSTAN AND THE METHOD OF THEIR BENEFICIATION.....	6
A.E. Abetov, Sh.B. Yessirkepova, J. Curto Ma GRAVITY FIELD TRANSFORMS AT THE EXPLORATION FOR HYDROCARBON FIELD IN THE SOUTHERN PART OF THE USTYURT REGION.....	17
E.B. Abikak, B.K. Kenzhaliev DEVELOPMENT OF AN INTEGRATED TECHNOLOGY INTENDED TO PROCESS PYRITE SLAG USING CHEMICAL PRE-ACTIVATION.....	32
R.Zh. Abuova, D.K. Suleyev, G.A. Burshukova STUDY OF DAMPING PROPERTIES OF ALLOYED STEELS WITH CERAMIC-METALLIC NANOSTRUCTURED COATING FOR CRITICAL PARTS.....	52
N.R. Akhundova CHANGE OF HYDRODYNAMIC PRESSURES IN THE WELLBORE OF INCLINED-HORIZONTAL WELLS DURING DRILLING MUD CIRCULATION.....	66
M. Bissengaliev, R. Bayamirova, A. Togasheva, A. Zholbasarova, Zh. Zaydemova ANALYSIS OF COMPLICATIONS ASSOCIATED WITH THE PARAFFINIZATION OF BOREHOLE EQUIPMENT AND MEASURES TO PREVENT THEM.....	76
T.I. Espolov, A.G. Rau, N.N. Balgabayev, E.D. Zhaparkulova, Josef Mosiej GEOLOGICAL STRUCTURE OF ALLUVIAL SEDIMENTS OF RIVER TERRACES AND ENERGY EFFICIENCY OF IRRIGATION SYSTEMS.....	89

Y.M. Kalybekova, A.K. Zauirbek, I.S. Seitasanov, U.Q. Onglassyn* INCREASING WATER PRODUCTIVITY IN IRRIGATION WITH REGARD TO GEOLOGY AND HYDROGEOLOGICAL CONDITIONS.....	101
Z.S. Kenzhetaev, T.A. Kuandykov, K.S. Togizov, M.R. Abdraimova, M.A. Nurbekova SELECTION OF RATIONAL PARAMETERS FOR OPENING AND DRILLING OF TECHNOLOGICAL WELLS UNDERGROUND URANIUM LEACHING.....	115
R.A. Kozbagarov, K.K. Shalbayev, M.S. Zhiyenkozhayev, N.S. Kamzanov, G.T. Naimanova DESIGN OF CUTTING ELEMENTS OF REUSABLE MOTOR GRADERS IN MINING.....	128
T.A. Kuandykov, T.D. Karmanov, E.I. Kuldeyev, K.K. Yelemessov, B.Z. Kaliev NEW TECHNOLOGY OF UNCOVER THE ORE HORIZON BY THE METHOD OF IN-SITU LEACHING FOR URANIUM MINING.....	142
E. Orymbetov, G.E. Orymbetova, A.E. Khussanov, T.E. Orymbetov, B.E. Orymbetov SECTIONING OF PETROLEUM GAS ADSORPTION DRYING.....	155
A.M. Serikbayeva, M.S. Kalmakhanova, H.T. Gomes, B.B.Shagraeva, N.T.Shertaeva METHODS OF PREPARATION AND PHYSICO-CHEMICAL CHARACTERISTICS OF ORGANIC MODIFIED CLAYS WITH GRAFTED ORGANOALOXIDES.....	166
Zh. Zhantayev, D. Talgarbayeva, A. Kairanbayeva, D. Panyukova, K Turekulova COMPLEX PROCESSING OF EARTH REMOTE SENSING DATA FOR PREDICTION OF LANDSLIDE PROCESSES ON ROADS IN MOUNTAIN AREA.....	181
S.A. Istekova, A.K. Issagaliyeva, M.M. Aliakbar BUILDING THE ONLINE GEOLOGICAL AND GEOPHYSICAL DATABASE MANAGEMENT SYSTEM FOR HYDROCARBON FIELDS IN KAZAKHSTAN.....	198

R.E. Lukpanov, A.S. Yenkebayeva, D.V. Tsygulyov, Y.Y. Sabitov, D.S. Dyusseminov ASSESSMENT OF ASH-STORAGE COOLECTOR STABILITY USING GEOSYNTHETIC REINFORCEMENT ELEMENTS BY TRAY TESTING AND NUMERICAL MODELING.....	212
T.K. Salikhov, D.K. Tulegenova, Zh.G. Berdenov, R.S. Sarsengaliyev, T.S. Salikhova STUDY OF THE SOIL COVER OF ECOSYSTEMS OF THE CHINGIRLAUS DISTRICT OF THE WESTERN KAZAKHSTAN REGION ON THE BASIS OF THE APPLICATION OF GIS TECHNOLOGIES.....	226
A.R. Fazylova, G. Balbayev, B. Tultayev SYSTEM OF SHORT-TERM FORECASTING OF WIND TURBINE OUTPUT POWER CONSUMPTION.....	243
O.G. Khaitov, A.A. Umirzokov, E.N. Yusupkhojaeva, S.P. Abdurakhmonova, N.G. Kholmatova ASSESSMENT OF THE DENSITY OF THE WELL GRID IN THE SOUTHEASTERN PART OF THE BUKHARA-KHIVA REGION.....	253
K.T. Sherov, S.O. Tussupova, A.V. Mazdubay, M.R. Sikhimbayev, B.N. Absadykov INCREASING DURABILITY OF THERMO-FRICTION TOOLS BY SURFACING.....	265

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://www.geolog-technical.kz/index.php/en/>
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)**

Редакторы: *М.С. Ахметова, А. Ботанқызы, Р.Жәлиқызы, Д.С. Аленов*
Верстка на компьютере *Г.Д.Жадьранова*

Подписано в печать 15.06.2022.
Формат 70x90^{1/16}. Бумага офсетная. Печать – ризограф.
17,5 п.л. Тираж 300. Заказ 3.