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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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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. Webof 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.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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MEASURES TO PREVENT AND COMBAT COMPLICATIONS IN THE OPERATION OF HIGH-VISCOSITY OILS OF WESTERN KAZAKHSTAN

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Abstract. During the operation of wells, asphalt-resinous deposits, with a decrease in reservoir temperature and oil degassing in the bottom-hole zone of the well, the filtration characteristics deteriorate. As a result, the flow rates of wells decrease, their normal operation is disrupted, and operating costs increase. To restore the productivity of producing wells, the optimal method is to treat the bottom-hole zone with a hydrocarbon composition having a high solvent capacity with respect to resins and asphaltenes. The article considers the issue of stabilization of oil production for a short period. An assessment of the technological effectiveness of the use of a salt deposition inhibitor on the ground equipment of the deposit is given. Installation of pre-discharge of water (IPDW)-1.2; Oil preparation and pumping Shop (OPPS) and Marine Pumping Station (MPS)-4 shock dosage of 200 g/ton three times a month. Weekly determination of the content of sulfate-reducing bacteria (SRB) in water. Monthly determination of hydrogen

sulfide content in gas. At the same time, it was noted that the use of pentane-hexane fraction technology gives the following effect - cleaning of underground equipment, production column and the trunk of producing wells from asphalt-resin-paraffin deposits and technologies with an emulsion of complex action and a water-hydrocarbon emulsion, which ensure the removal of deposits from the bottom-hole zone of the formation, as well as the use of a viscoelastic composition based on polyacrylamide, allow to intensify oil production, reduce sampling along the way-extracted water.

Keywords: asphalt-resin-paraffin deposits, paraffin deposits, salt deposits, bactericide, inhibitor

Acknowledgments. It is necessary to conduct pilot field testing (PFT) of new selected bactericide reagents. In order to avoid the effect of "addiction", PFT should be carried out with two types of bactericides (on a different chemical basis). In order to prevent and combat complications during the operation of wells and field facilities, such measures are recommended to prevent complications during the operation of wells and field facilities.

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БАТЫС ҚАЗАҚСТАННЫҢ ТҰТҚЫРЛЫҒЫ ЖОҒАРЫ МҰНАЙЛАРЫН ПАЙДАЛАНУ КЕЗІНДЕГІ АСҚЫНУЛАРДЫҢ АЛДЫН АЛУ ЖӘНЕ ОЛАРҒА ҚАРСЫ КҮРЕС БОЙЫНША ІС-ШАРАЛАР

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Аннотация. Ұңғымаларды, асфальт-шайырлы шөгінділерді пайдалану процесінде қабат температурасының төмендеуімен және ұңғыманың төменгі бөлігінде мұнайдың газсыздандырылуымен сүзу сипаттамаларының нашарлауы байқалады. Нәтижесінде ұңғымалардың дебиті төмендейді, олардың қалыпты жұмысы бұзылады және пайдалану шығындары артады. Өндіруші ұңғымалардың өнімділігін қалпына келтіру үшін оңтайлы әдіс-бұл шайырлар мен асфальттарға қатысты еріткіштік қабілеті жоғары көмірсутек құрамымен түп маңы аймағын өңдеу. Мақалада қысқа мерзімге мұнай өндіруді тұрақтандыру мәселесі қарастырылған. Кен орнының жер үсті жабдықтарында тұз шөгінділерінің ингибиторын қолданудың технологиялық тиімділігінің бағалауы келтірілген. Айына үш рет 200г/т - АСТҚ-1,2; МДТҚ және ТСС-4 ұрмалы дозасы 200г/тн бактерицидті ай сайын айдау, судағы СТБ құрамын апта сайын анықтау, газдағы күкіртті сутегінің құрамын ай сайын анықтау ұсынылады. Бұл ретте, пентан-гексан фракциясы (ПГФ) технологиясын қолдану мынадай нәтиже беретіні атап өтілді-жерасты жабдықтарын, өндіру ұңғымаларының пайдалану бағанасы мен оқпанын АШПТ-дан және технологиядан кешенді әсер ету эмульсиясымен (КӘЭ) және су-көмірсутек эмульсиясымен (СКСЭ) тазарту қабаттың түп аймағынан шөгінділерді жоюды, сондай-ақ полиакриламид негізінде тұтқыр серпімді құрамды (ТСҚ) қолдануды қамтамасыз ету мұнай өндіруді күшейтуге, ілеспе өндірілетін суды өндіруді азайтуға мүмкіндік береді.

Түйін сөздер: асфальтосмолопарафиновые отложения, парафиноотложения, солеотложения, бактерицид, ингибитор

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МЕРОПРИЯТИЯ ПО ПРЕДУПРЕЖДЕНИЮ И БОРЬБЕ С ОСЛОЖНЕНИЯМИ ПРИ ЭКСПЛУАТАЦИИ ВЫСОКОВЯЗКИХ НЕФТЕЙ ЗАПАДНОГО КАЗАХСТАНА

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Аннотация. В процессе эксплуатации скважин, асфальтено-смолистых отложений, при снижении пластовой температуры и разгазировании нефти в призабойной зоне скважины происходит ухудшение фильтрационных характеристик. В результате снижаются дебиты скважин, нарушается их нормальная работа, и увеличиваются эксплуатационные затраты. Для восстановления продуктивности добывающих скважин оптимальным методом является обработка призабойной зоны углеводородным составом, обладающим высокой растворяющей способностью по отношению к смолам и асфальтенам. В статье рассмотрен вопрос стабилизации добычи нефти на непродолжительный период. Приведена оценка технологической эффективности применение ингибитора солеотложений на наземном оборудовании месторождения. Рекомендовано ежемесячная закачка бактерицида с ударной дозировкой 200г/т- УПСВ-1,2; ЦППН и на НСМ-4 ударная дозировкой 200 г/тн три раза в месяц, еженедельное определение содержания СВБ в воде, ежемесячное определение содержания сероводорода в газе. При этом отмечено что, применение технологии пентана-гексановая фракция (ПГФ) дает следующий эффект — очистка подземного оборудования, эксплуатационной колонны и ствола добывающих скважин от АСПО и технологии эмульсией комплексного воздействия (ЭКВ) и водоуглеводородной эмульсией (ВУВЭ) обеспечивать удаление отложений из призабойной зоны пласта (ПЗП), а также применение вязкоупругого состава (ВУС) на основе полиакриламида позволяет интенсифицировать добычу нефти, уменьшить отбор попутно-добываемой воды.

Ключевыеслова: асфальтосмолопарафиновыеотложения, парафиноотложения, солеотложения, бактерицид, ингибитор

Introduction

The high content of paraffin in the oil fields of Western Kazakhstan causes serious complications during their extraction, due to the deposition of paraffin on underground and onshore field equipment. As a result, the cross-section of the pipes narrows, the resistance to the movement of the liquid and the movement of the column of rods increases, the load on the head of the rocking machine balancer increases (RM), its balance is disturbed, the feed coefficient decreases (Ardiansyah et al., 2019; Bayamirova et al., 2020).

The problem of asphalt-resin-paraffin deposits (ARPD) deposits on the underground equipment of wells has always been one of the most serious complications in the production of high-paraffin oil in the field of Western Kazakhstan. This problem remains extremely complex at the present time, and measures to combat these complications remain extremely costly. Therefore, there is a need to conduct research laboratory work on the selection of effective solvents and inhibitors of paraffin deposits, salt deposits.

Materials and methods

In order to restore the productivity of wells, the following well treatment technologies are used at the field (Togasheva et al., 2023):

- water–hydrocarbon emulsion (WHCE);
- complex effect emulsion (CEE);
- pentane-hexane fraction (PHF);
- hot water treatment (HWT);
- viscoelastic composition (VEC);
- acid treatment under pressure (multiple hydraulic fracturing MHF);
- acid treatment at the installation of an electric centrifugal pump (ECP).

The analysis of commercial material by types of applied technologies is carried out. The results are presented in table 1.

Table 1- Results of technology application for the analyzed period

Technologies	Years	Number of wells		Oil growth		Accumulated additional oil production, thousand tons.
		in total	with effect	t/day	%	
1	2	3	4	5	6	7
WHCE	2017	189	121	3,1	41	32,4
	2018	196	149	2,9	27	15,7
	2019	223	120	2,2	36	11,8
	2020	98	82	2,1	32	7,8
	2021	105	91	2,9	37	11,1
	Total	811	563	2,6	35	78,8
CEE	2017	259	96	1,4	28	77,0
	2018	265	192	2,35	21	47,8
	2019	277	177	2,1	23	43,1
	2020	145	94	2	37	10,3
	2021	137	102	2,3	53	9,8
	Total	1083	661	2,0	32	188,0
PHF	2017	59	15	4,7	25	23,45
	2019	101	54	3,2	22	4,07
	2020	121	37	2,6	26	2,93
	2021	86	29	2,9	28	2,35
	Total	367	135	3,4	25,3	32,8
HWT	2017	36264		inter-cleaning period - 54 days		
	2018	17655		inter-cleaning period - 32 days		
	2019	29337		inter-cleaning period - 35 days		
	2020	20466		inter-cleaning period - 49 days		
	2021	31560		inter-cleaning period - 39 days		
	Total	135282		inter-cleaning period - 42 days		
VC producing wells	2017	120	52	2,4	56	6,77
	2018	33	22	2,5	68	2,67
	2019	43	32	1,7	59	3,68
	Total	196	106	2,2	61	13,12

VC injection wells	2017	36	26	Qred, decreased - 89 m^3/day		
	2018	20	15	Qred, decreased - 108 m^3/day		
	2019	87	54	Qred, decreased - 131 m^3/day		
	Total	143	95	Qred, decreased on average - 109 m^3/day		
AT at the ECP	2018	61	30	3,1	46	13,12
	2019	26	14	4,6	77	9,24
	2020	20	14	3,3	37	17,1
	2021	49	18	4,4	48	2,98
	Total	156	76	3,9	52	42,44
MHF	2017	17	6	2,2	56	1,04
	2018	40	21	3,4	50	0,78
	2019	88	68	2,9	67	7,79
	2020	69	47	4,1	58,5	9,26
	2021	69	50	3,4	58	8,23
	Total	283	192	3,19	58	27,1
MHF injection wells	2018	19	15	Qred, increased - 113 m^3/day		
	2019	41	39	Qred, increased - 109 m^3/day		
	2020	8	6	Qred, increased - 162 m^3/day		
	2021	10	6	Qred, increased - 52 m^3/day		
	Total	78	66	Qred, increased on average - 98 m^3/day		

Well treatment technologies are used at the field in order to restore the productivity of wells.

The analysis of the applied technologies of impact on the bottom-hole zone of wells for the period 2017—2021 has been carried out. The purpose of the analysis is to determine the positive impact of the applied technologies on the increase in oil production, as well as to resolve the issue of their further use.

Water–hydrocarbon emulsion (WHCE) - the objects of application of this technology are producing wells with reduced productivity by 1,5–2 times due to asphalt-resin-paraffin deposits (ARPD) in underground equipment. The applied technology should ensure the removal of ARPD deposits from the bottom-hole zone and increase the productivity of wells.

For the period 2017–2021, 811 well operations were carried out, of which 563 with a positive result: oil growth averaged 2,6 tons/day, accumulated additional production – 78,8 thousand tons of oil.

Complex effect emulsion (CEE) is provided in producing wells, the downhole zone of which is encircled by long-term deposits of asphaltene-resin-paraffin substances (ARPD). The purpose of CEE treatment is to remove ARPD and salt deposits from underground equipment and thereby increase the productivity of the well.

For the period 2017–2021, 1083 well operations were carried out, of which 661 with a positive result: oil growth averaged 2 tons/day, accumulated additional production – 188,0 thousand tons of oil.

Pentane-hexane fraction (PHF) is the purification of underground equipment, production column and the trunk of producing wells from ARPD. The action of the reagents is based on the partial dissolution and subsequent loosening of paraffin deposits,

as a result of which the deposits become mobile and are carried out by the flow of well products (Bisengaliev et al., 2022; Ivanova et al., 2011).

For the period 2017–2021, 367 well operations were carried out, of which 135 with a positive result: oil growth averaged 3,4 tons/day, accumulated additional production – 32,8 thousand tons of oil.

Hot water treatment (HWT) is a thermal method of dewaxing wells using hot water. The process of melting, dissolving and removing ARPD by a flow of moving hot liquid. From the inner surface of the pumping and compressor pipes (PCP) it is carried out by circulation of the coolant through the channels of the borehole when it is directly injected into the PCP or through the annular space. Heated (technical) seawater with a temperature not lower than 80–90^{0}C is used for processing wells.

During the period 2017–2021, 135282 well operations were carried out, where the average ICP per well was 42 days.

Water manifestation.

Visco-elastic composition (VEC) — is provided for leveling the pickup profile in injection wells and isolation of watered intervals in producing wells, the technology of injection of visco-elastic composition (VES) based on polyacrylamide, potassium bichromate and hydrazine sulfate is used.

During the analyzed period, 196 well operations were carried out in the mining fund, 106 of which had a positive result: oil growth averaged 2,2 tons/day, accumulated additional production – 13,12 thousand tons of oil.

143 borehole operations were carried out in the injection fund, of which 95 with a positive result. The pick-up rate decreased by an average of 109 m^3/day.

Salt deposition.

Acid treatment under pressure multiple hydraulic fracturing (MHF) is carried out in order to clean the bottom – hole zone from salt deposits, increase the productivity of producing and pumping wells.

Producing wells – in 2017–2021, 283 well operations were carried out, of which 192 received a positive result: an average increase in oil – 3,2 tons/day, accumulated additional oil production – 27,1 thousand tons of oil.

Injection wells – in 2018–2021, 78 borehole operations were carried out, of which 66 borehole operations had an effect, the pick-up increased by an average of 98 m^3/day.

Acid treatment in wells with ECP is carried out in order to remove solid inorganic deposits from the working units of an electric centrifugal pump (ECP) installed in producing wells.

In 2018–2021, 156 well operations were carried out and a positive result was obtained for 76 well operations: an average increase in oil was 3,9 tons/day, the accumulated additional oil production was 42,44 thousand tons of oil.

Thus, the technologies applied at the field in order to restore the productivity of wells give reason to say that the treatments not only stabilize oil production, but also allow for an increase in oil production.

To improve the results of the treatments, it is necessary to comply with the criteria for selecting wells and the procedure for performing work according to the technological

regulations and improve the compositions of these compositions (Kayumov et al., 2006; Kuang et al., 2018), because the service market offers a large selection of chemical reagents.

Results and discussion

At the field for the chemicalization of technological processes of oil production, work was carried out to prevent deposits of inorganic salts on the field's ground equipment using a salt deposition inhibitor, to reduce the rate of corrosion in the liquid collection and transportation system using a corrosion inhibitor, to suppress the growth of sulfate-reducing bacteria (SRB) by full-scale liquid treatment in the reservoir pressure maintenance system (MRP) using bactericide (Khormali et al., 2021; Lake et al., 2006; Bisengaliev et al., 2021).

The development of the field with the maintenance of reservoir pressure is carried out using surface marine and wastewater, which lead to complications during oil production, where in the production of production wells there were simultaneously produced waters of various chemical compositions (Persiyancev et al, 2000). As a rule, surface water (seawater) is not compatible with groundwater. As a result of mixing incompatible waters, abundant sedimentation occurs. At many sites of the deposit in Western Kazakhstan, the main type of sediment by mass is barium sulfate, which falls immediately after mixing incompatible waters at measuring installations (MI). Salt deposits lead not only to high costs in the process of their removal, but also to significant losses in oil production. To prevent sedimentation, a salt deposition inhibitor of the "Ranscale-4104" brand is used at all measuring installations at the field. The inhibitor is fed to the input of the measuring unit using an electric pump dosing unit (EPD), consisting of a dosing pump and a reagent tank equipped with a level indicator and an inhibitor flow control ruler. The daily consumption of the chemical reagent is 30 g/m^3.

The amount of cleaning from inorganic deposits of switches of multi-pass wells (SMPW) and tees for all measuring installations (MI) OGPM 2 and 4 is presented.

Table 2 - The number of cleanings from inorganic deposits of SMPW and tees for all MI OGPM 2, 4 in the period 2018–2021.

№ OGPM	№ OGPW	Number of measuring units	Number of cleanings of SMPW and tees			
			2018 year	2019 year	2020 year	2021 year
1	2	3	4	5	6	7
4	4	28	34	45	34	32
	6	26	51	61	36	31
	7	27	42	32	25	30
Total OGPM—4		81	127	138	95	93
2	3	31	-	-	10	19
	12	22	-	-	8	12
	9	24	-	-	18	33
Total OGPM—2		77	-	-	36	64
Total		158	127	138	131	157

As follows from the presented data, the process of accumulation of salt deposits on the ground equipment for the deposit is different. The largest number of cleaning of

SMPW and tees for OGPM—4 falls on OGPW—6, which in 2018 is 51 times, in 2019–61 times. The smallest number of cleaning of SMPW and tees according to OGPM—2 falls on OGPW—12, which is 8 times in 2020, 12 times in 2021.

Monitoring of the effectiveness of the use of the salt deposition inhibitor on ground equipment was carried out according to OGPM—4, in 2019 and according to OGPM—2, in 2021, according to the results of the work, optimization of reagent consumption from 0 to 70 g/m^3 was recommended. After optimizing the injection of the reagent, there is a decrease in the number of cleanings of SMPW and tees at MI (comparison of the results of cleanings according to OGPM—4 before optimizing the injection of the reagent for 2019—there were 138 cleanings, after optimization it decreased to 95 cleanings for the analyzed year 2020). In the future, it is necessary to continue monitoring sediment deposition at these measuring installations. Initiate the selection of new more effective salt deposition inhibitors (SDI) and plan pilot field tests (PFT).

To determine the component composition of the sediments, after cleaning the tees, samples of inorganic sediments were taken at the measuring units. The results of the research determined that the main type of deposits are barites. As impurities, the composition of the deposits includes calcium carbonate and sulfate, iron oxides (Rashid et al., 2019; Thomas et al., 1995).

Under laboratory conditions, studies were conducted on the effectiveness of the protective effect of the salt deposition inhibitor used, the results are presented in Table 3.

Table 3 – Evaluation of the effectiveness of the salt deposition inhibitor "Ranscale—4104" on water models of the deposit of Western Kazakhstan.

№	Along the way-extracted water	Dosage, g/m^3	The effectiveness of inhibition, %		
			calcite ($CaCO_3$)	gypsum ($CaSO_4$)	barit ($BaSO_4$)
1.	Total mineralization up to 50 g/l	30	93,4	95,3	91,9
		40	95,0	97,5	94,6
		60	100,0	100,0	100,0
2.	Highly mineralized (total mineralization over 50 g/l)	30	84,0	85,9	71,8
		40	89,6	90,4	82,1
		60	95,3	96,2	92,3
		70		99,43	99,96
		80		100,0	100,0

The results of the studies show that the effectiveness of the reagent under study varies, but directly proportional to the dosage. The protective effect of inhibition for highly mineralized barium waters of the deposit (> 99%) of the reagent begins to manifest itself at 70 g/m^3.

The high corrosion aggressiveness of the extracted and transported products of the deposits of Western Kazakhstan is due to the high water content of well production up to 90%. The high corrosive aggressiveness of the aqueous phase is explained by high mineralization, the presence of a large amount of dissolved CO_2 and H_2S, and the presence of sulfate-reducing bacteria (SRB).

One of the means of controlling corrosion problems is the use of corrosion inhibitors. Inhibitory protection, as a kind of anticorrosive measures, is a method of inhibiting (reducing the speed) of corrosion of field pipelines.

To protect oilfield equipment, the injection of a corrosion inhibitor has been started since 2019. In order to achieve a safe level of corrosion rate and obtain the effectiveness of the applied corrosion inhibitor, the dosage of the reagent was increased from 30 to 70 mg/l. In the period from August to November 2020, pilot field tests (PFT) were conducted at the field using 2 types of corrosion inhibitors from different companies. Of the two types of reagent, a positive result was obtained for one reagent and recommended for industrial use at a dosage of 30 mg/l.

In April 2021, to protect oilfield equipment, the injection of a new effective corrosion inhibitor was started, according to the recommendations of the PFT for industrial use at a working dosage of 30 mg/l.

The monitoring results showed a stable decrease in the corrosion rate at the facilities where the corrosion inhibitor is injected.

The measurement results are presented in Table 4 and in Figure 1.

Table 4 – Results of measurements before and during reagent injection by group installations for 2019—2021

Reagent "Rancor—1101" dosage up to 60 mg/l					Reagent "TS—3011" dosage 30 mg/l		
Background (without reagent) corrosion rate, mm/g, April 2019	Corrosion rate with reagent, mm/g 23.08.2019-27.09.2019	Corrosion rate with reagent, mm/g 21.10.2019-08.11.2019	Corrosion rate with reagent, mm/g 03.20-18.03.2020	Corrosion rate with reagent, mm/g 12.06.2020-28.06.2020	Background (without reagent) corrosion rate, mm/g June-July 2021	Corrosion rate with reagent, m/g as of September 2021	Corrosion rate with reagent, m/g for November 2021
2,53	0,96	0,72	0,50	0,30	1,74	0,18	0,07

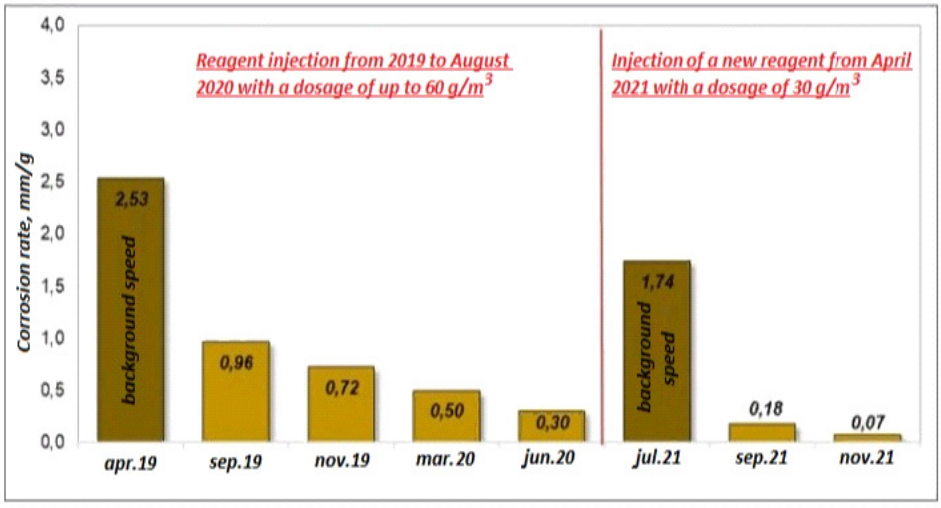

Figure 1 – Results of measurements of reagent injection efficiency

It should be noted that the monitoring results show a stable decrease in the corrosion rate at the facilities where the corrosion inhibitor is injected.

It is recommended to continue using the corrosion inhibitor in the liquid collection and transportation system, but it is necessary to search for more effective corrosion inhibitors for the field conditions (Ueng et al., 1999; Xu et al., 2020).

To track the effectiveness of the corrosion inhibitor, it is recommended to monitor the use of the corrosion inhibitor.

Currently, only 9 % of OGPM pipelines and 17 % of OPPSD pipelines operated in the fields of Western Kazakhstan are fiberglass. In comparison with metal pipes, fiberglass pipes have a number of advantages, one of which is high resistance to corrosion and chemically aggressive environments (Ratov et al., 2021).

It is recommended to increase the number of replacement of steel pipes with fiberglass/fiberglass pipes.

Application of bactericide.

Since 2018, the effectiveness of the use of bactericidal reagents has been monitored at the field of Western Kazakhstan in order to study and control the microbiological contamination of SRB in commercial environments. The bactericide is used to suppress SRB in the MRP system and oilfield equipment.

The injection of the bactericide is carried out at facilities at MPS—4 (sea water), WWTP—1, WWTP—2, OPPS (waste water). In this way, all the water used in the MRP system is treated.

The background (without the use of bactericides) content of hydrogen sulfide in the associated-extracted gas according to the samples taken from 79 group installations before the start of full-scale injection of the bactericide on 15.02.2018 averaged 353 ppm (Biletsky et al., 2018).

Full-scale injection of the bactericide has been started since March 2018. The decrease in hydrogen sulfide content during this period from March to December ranged from 353 to 135 ppm.

In 2019, the download was carried out from January to December. During the injection of the bactericide in January-April, hydrogen sulfide in the gas increases from 135 to 390 ppm. To identify the causes of the increase in hydrogen sulfide content, a laboratory study of the effectiveness of the applied bactericide was conducted. Studies have shown that the bactericide does not suppress SRB at the previous dosage of 40 mg/l (Ratov et al., 2019a; Kerimkhulle et al., 2023). For the effective use of the bactericide, the reagent injection technology program was changed. After the treatments under the new injection program, we received a decrease in hydrogen sulfide in the gas, for the month of December, the value of hydrogen sulfide was – 141 ppm.

Also in 2019, laboratory tests were carried out on the selection of new effective reagents-bactericides.

In 2020, from January to March, due to the lack of a reagent, the injection of the bactericide was completely stopped. Stopping the injection led to an increase in the content of hydrogen sulfide in the associated gas produced up to 316 pm. Since March, bactericidal treatment has resumed. The injection was already started with a new

effective reagent-a bactericide. The monitoring results showed a stable decrease in the hydrogen sulfide content in the field as a whole to 109 ppm for the month of December (Orazbayev et al., 2021; Ratov et al., 2022a).

In January 2021 the following scheme of bactericidal treatment was applied for the effective use of the bactericide:

1. "shock" treatment of MPS—4 up to 3 times a month (200mg/l);

2. "shock" treatment of WWTP—1,2 and OPPS—1 once a month (200mg / l).

The download according to this scheme was carried out from January to April. Further, due to the lack of a reagent, no injection has been carried out since April, the hydrogen sulfide content at the end of April 2021 increased to 390 ppm, for the month of October the hydrogen sulfide content is 345,8 ppm. In November, it increased to 419 ppm.

In November, according to the decision of the PTC of 08.11.2021, an inhibitor of SRB was injected to determine the technological effectiveness of the disputed batches №44, №45, №46, №47 in the conditions of the deposit of Western Kazakhstan. At the same time, the processing was resumed according to the previous program, where the "shock" treatment of MPS—4 is used up to 3 times a month (200mg/l) and the "shock" treatment of WWTP—1,2 and OPPS—1 once a month (200mg/l).

After the resumption of injection in December, the hydrogen sulfide content was up to 338,5 ppm, there was no significant decrease in hydrogen sulfide (Ratov et al, 2021).

Thus, the program of measures applied today for the injection and monitoring of the use of bactericide at the deposit of Western Kazakhstan shows its relevance and the need for its further use to combat SRB and hydrogen sulfide. To improve the quality of treatment of MPS-4 tanks, reduce the amount of SRB and suppress SRB, it is recommended to recirculate seawater in tanks with the supply of bactericide.

Conclusions

1. It is recommended to continue the use of thermal flushing, because thermal flushing is a preventive measure and allows you to restore the productivity of wells for a short period.

2. To continue the use of PHF as complicated wells are identified, since PHF contributes to the cleaning of underground equipment of the production column and the trunk of producing wells from ARPD.

3. It is recommended to continue processing CEE and WHCE and improve their results while observing the criteria for selecting wells and the procedure for performing work, according to the technological regulations. It is necessary to improve the compositions of these compositions, because the service market offers a large selection of chemical reagents.

4. It is recommended to conduct laboratory tests on the selection of the most effective removers of salt deposits from the working nodes of the ECP.

5. It is recommended to continue the use of acid treatments in producing and injection wells in order to improve the filtration characteristics of the bottom-hole zone of the well and increase the pick-up of wells.

6. It is recommended to continue the use of VEC in injection and production wells

in order to contain and reduce waterlogging, while strictly adhering to the technological regulations.

7. It is necessary to constantly monitor the effectiveness of the use of salt deposition inhibitors, to carry out periodic monitoring carried out with the help of measuring units installed on the output collector from special coils, where the presence or absence of salt deposition will be an indicator of efficiency. The injection of inhibitors should be carried out at facilities based on the chemical composition of the associated extracted waters and the determination of "incompatible" waters. Initiate the selection of new more effective SDI and plan an PFT, according to the approved rules in JSC NC "KMG".

8. A corrosion inhibitor is used to protect oilfield equipment at all fields in Western Kazakhstan. To continue using the corrosion inhibitor in the liquid collection and transportation system, since it helps to reduce the rate of corrosion at technological facilities, but it is necessary to search for more effective corrosion inhibitors for field conditions. It is recommended to increase the number of replacement of steel pipes with fiberglass/fiberglass pipes.

9. The ongoing program of measures for the injection and monitoring of the use of bactericide in the field of Western Kazakhstan shows its relevance and the need for further use to combat SRB and hydrogen sulfide.

10. A decrease in the concentration of hydrogen sulfide indicates a successful treatment: the longer the lower level of hydrogen sulfide content in the gas remains, the more effective the treatment. The positive result was made possible thanks to the system monitoring of the supplied reagents-bactericides.

11. Based on the work carried out to monitor the injection of bactericide, the subsoil user is recommended to improve the effectiveness of measures for the use of bactericide, including to avoid the effect of "habituation" of the bactericide to alternate treatments of different types of reagent-bactericide.

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