KHAZAR UNİVERSİTY

School of Engineering and Aplied Science
Department of Petroleum Engineering
Major of Petroleum and Gas Engineering

MASTER THESİS

Title: Determinationof efficient regime of development in “NeftDashlari” and PalchigPilpilasi fields

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INTRODUCTION

Natural gases and roducts (individual hydrocarbons and gas condensate) which is used as a very valuable crude material in industry, household, fuel and chemical industry play an important role in the development of economy of our republic.

According to the information submitted by SOCAR, last year was successful for our republic in implementation of oil production plan. On the republic 13807 thousand tones oil has been produced in 1999. This figure was 11423 thousand tones in 1998. Oil production plan has been implemented for 100, 6%.

There is a definite lag in gas production. Last year 5589,5mln. m^3gas was produced. This contains 90.0% of gas production plan on the republic, i.e. it was 374,4mln. m^3 less than those of 1998. Lag is felt in implementation of drilling plan. Main reasons of decreasing of oil and gas production are fall down of oil and gas production in old fields, significant decrease of survey and exploitation drilling volume, i.e. not inclusion of oil and gas fields into engineering, very poor technical supply of oil-gas production industry and etc.

Considerable amount of gas and condensate reserves remains unextracted in old gas condensate fields. For efficient use of these reserves and increase production of hydrocarbons, first of all it is necessary to improve equipment provision of oil gas production departments, increase volume of survey and exploitation drilling, fully restore operation of explotation wells fund, and ensure increase of productivity of the wells under exploitation and accelerate application of advanced technologies.

Abovementioned can be ascribed to "NeftDashlari" field, opened in 1949 and to PalchigPilpilasi field opened in 1953 and being on the last stage of development.

"Black gold" has been extracting from ancient times in Azerbaijan which is known as oil country in a whole world. In a result of researches of historians, it has been revealed that oil had been extracted in Absheron peninsula in 7-6^{th} centuries before the Christ. Academician G.I.Gessi for the first time in the world has analyzed natural oil and gas of Azerbaijan and defined its structure in1836. Professor K.V. Kostrin shows in his works that azerbaijanians for the first time in the world have used natural gas for living and household works. According tto historical documents, first oil well drilled by mechanical method in the world has been drilled in Bibiheybat in 1847. It was proved that, first petroleum well in the sea has been drilled in Absheron peninsula -19 meters far from the sea in XVIII century. Afterwards, as the level of Caspian Sea has risen, the same oil wells remained under the water. Azerbaijan is known in the world not only as first oil-gas producer, but also as a country possessing first oil refinery enterprises. First large oil refinery plants of Dubin brothers in Baku have been presented to

service in 1859. Direct oil pipe has been laid from Baku to Batum for transportation of production and refining oil and oil products to world markets in 1897. The most important events occured in the history of Azerbaijan oil industry are noted below:

First deep well in the world has been drilled by drilling method by the effort of F.N. Semyonov in Baku mines in 1844. This event was the end of manual drilling.

In 1872-1873 years, well pump has been used 15 years earlier than US.

In 1877 "Zoroastr" first tanker with metal body, for transporation of oil products presented for usage.

In 1884 for the first time drilling by hitting method has been used. Afterwards, it became well-known as "Baku method"

Oil production in 1899-1901 in Azerbaijan has reached 11.5 million tones and Azerbaijan has become world leader in the field of oil production (at this period only 9.1 million tones oil has been extracting in USA).

In 1905 for the first time in the history of world oil industry, compressor exploitation has been applied in Balakhani.

In 1916 for the first time gaslift technology has been used in Ramana.

In 1941 for the first time in the world, inclined well in 2000 meters depth in Bayil has been drilled by the "Aga Neymatulla turbine method" and presented to the service.

In 1949 legendary "NeftDashlari" field has been discovered. This event established base of development of oil production in the sea.

Milliardth ton oil has been extracted in Azerbaijan in 1971.

In 1994 the contract entered the history as a "The Contract of the Century" about joint usage of deep parts of "Azeri", "Chirag" fields located in Azerbaijan sector of Caspian Sea and "Guneshli" field, has been signed. Thus, commencement of new era in oil industry history of Azerbaijan has been established.

113.9 thousand tones of oil has been extracted in 2011 from PalchigPilpilasi and average daily production per well has been 5.5 ton/day.

In comparison with other years, increase in number of wells has been felt, although lag in gas production has been observed. Despite, number of wells was 135 in 2010; their number was 144 in 2011. Decrease in gas production in 2009 in comparison with 2011 has been felt; it has decreased from 10.8 thousand m^3 to 9.8 thousand m^3.

These mentioned indicates that, it is important to define efficient regime of engineering in NeftDashlari and PalchigPilpilasi and implementation of measurements plan for optimization of oil giving methods. Therefore, set affairs are very actual.

CHAPTER 1.GEOLOGICAL CHARACTERISTICS OF "NEFT DASHLARI" AND PALCHIG PILPILASI FIELDS

"NeftDashlari" DQİİ currently conducts drilling works in 4 fields-NeftDashlari, PalchigPilpilasi, Gurgansea and Pirallahı northern rugosity areas. Most perspectivious of them is "NeftDashlari" field. First information about "NeftDashlari" has been given in 1863 by Q.V.Abikh, in 1945 expedition by the command of AgagurbanAliyev started to investigation of "NeftDashlari" and it was continued until 1948. "NeftDashlari" field lies in north-west, south-west of Absheron archipelago of Caspian Sea, belonging to asymmetric brachyanticline, has been complicated by a lot of in breadth and longwise breakings. NeftDaslari field is shared to 5 tectonic blocks on a base of great tectonic breakings: I, II, III, IV, V. Industrially important oil is connected with productive layer sediments. Main productive horizons are QalD, QD, FLD, QÜQ, and V, VI, VII, VIII, IX, X horizons of Balakhanı layer suit. Depth of the sea in the area where the field is located, reaches 60 meters. PalchigPilpilasi field is located in Absheron archipelago of Caspian Sea, in 110 km eastern side from Baku city and 50 km south-easter than Artyom Island. The area where the field is located varies from 10 meter to 25 meter. Belonging to asymmetric brachyanticline, the field has been complicated by a lot of in breadth and longwise breakings. According to Girmaki layer suite's ceiling, length of the field is 9 km, width is 3 km. In April, 1949 by the leading of V.M.Roshin for the first time drilling rig in the sea has been installed. By the order of Head of Damba CDW, NəsurullaBabayev, first drilling brigade has been organized and M.P.Kaverochkin has been appointed as its master. On June 24, 1949, it has been begun to the drilling of survey well No 1. In "NeftDashlari" field first well has been given to exploitation on November 7, 1949 with 100t/day yield and 6mm connecting pipe and in 1950 engineering of the field has been begun. In 1951 first tanker loaded with oil extracted from this field was sent to the shore. Depth of wells in the field varies between 550-2800 meters. "NeftDashlari" DQİİ besides "NeftDashlari" and "PalchigPilpilasi", has drilled 74 survey-searching and exploitation wells in 5 different fields in Caspian Sea aquatory: - Chilov island, HaziAslanov, Mezazoy, JanubBankasi, Gunashli areas. Once the well with the greatest inhiraf (2400 meters) in the Europe-well No 1531 with the depth of 3170 meters has been drilled by this department in 1969. DQİİ has drilled more than 2070 oil well and has presented more than 2000 wells to the exploitation since1949. The department has done drilling work more than 3060000 meters during its operation period. "NeftDashlari" DQİİ has operated from 1954 under the name of "Gurganneft" Drilling Department, from 1971 "NeftDashlari" DQİİ in composition of PU

named after XXII meeting of Soviet Union Com.Party and from 1988 under the name of "NeftDashlari" DQİİ. By the order No 51 of SOCAR dated March 12, 2007, "NeftDashlari" Marine Drilling Works Department included to "Azneft" Production Union structure, has been reorganized according to 55.1 və 55.2 articles of Civil Code of Azerbaijan Republic and given to subordination of "Complex drilling works" trust. 3 employees of the Department-KaverochkinMixailPetrovich, AbbasovQurbanAbas and HuseynovİsrafilSami have been rewarded by the highest reward of USSR state-Hero of SocialitLabour during operation of department.

First geological information about natural fuel resources of NeftDashlari has given academician Q.V.Abikh in 1863. He proved that there are hydrocarbon reserves in NeftDashlari archipelago. In 1892 N.Shegranov and in 1902 N.Lebedev have given tectonic and geological description of NeftDashlari, S.Kovalevski and M.Mirching investigated its geological structure. Academic I.M.Gubkin has set forth consideration about existance of oil reserves in current NeftDashlari area in 1930.

Expedition of USSR Academy of Sciencies under the leadership of AgagurbanAliyev started to investigation of NeftDashlari in 1945 and it continued until 1948. This expedition defined tectonics and stratigraphy of NeftDashlari area and A.G.Aliyev came to result that there is considerable oil.

"NeftDashlari"- is a cradle of world marine oil, established on the piers on native Caspian Sea, legendary city called "eighth miracle" because there is no analog in the world to it. Creation of NeftDashlari founded new era – marine oil era in the world oil history. Foundation of this marine city was a conclusion of intensive investigations, scientific researchs continuing during years and logical end of difficult and torturing way. Location of NeftDashlari in Azerbaijan area caused calling name of Azerbaijan together with this legenadary city and travelling of "Azerbaijan" word through world states.

On November 7, 1949, first oil well gushed in open Caspian Sea 110 km far from Baku city. Black Stones turned to NeftDaslari. NeftDashlari passed period equal to century during past 54 years and today became to huge production-living complex. During these years 173 million tones oil, 13 mlrd m^3 gas was extracted, more than 2000 wells have been drilled, more than 180 km piers was established, more than 170 production squares were built and hundreds of kilometers oil, gas, water lines have been laid.

Workers of NeftDashlari extracted 7, 6 mln tones oil in 1967 and written new bright page in oil industry.

In“NeftDashlari” OGPD along with NeftDashlarifieldPalchigPilpilasi field is also exploited. PalchigPilpilasi field is located in the area of OGPD No 3.

Searching survey works in PalchigPilpilasi field has begun in 1952 and daily 40 tones oil has been extracted by gusher method from the well No 261 in 1953. By expanding searching survey works, learning geological structure of field, limits of areas with oil and gas, litologic and physical features, reserve of the field has been calculated in 1968. Calculation of last reserve has been made by “Denizneftwhz” in 2001. Current extractable oil reserve is calculated as 13,8mln tones oil. Hitting last oil giving ratio to 0.229, has been reflected in engineering project compiled in 2002. Finishing of engineering will becontinued until 2030.

Engineering with industrial importance has been begun in 1963, 8,4mln tones oil, 5.7 mln m^3 gas has been extracted. Current oil giving ratio is equal to 0,126.

The largest oil production has been reached in 1977, daily production has been 964 tones. In next years production eventually decreased and in 1990 it has been 600 tones. Although working well fund is 140, it was not possible to prevent decrease of production.

In a result of strong storms happened in 1992 and next years, hydrotechnical devices and squares became hazardous and turned to separate artificial foundations (1127, 1100, 1043, 1047, 1077, 1036, 1295, 1296, 1183, 1284). Besides, separate foundations No 1127, 1157, 1126 and1145 exist in the field. Repair of hydrotechnical devices in marine foundations No 1100, 1127 and 1077 being in emergency situation is conducted and final improvement works are realized in foundations.

229 exploitation, 56 survey and 19 injection wells have been drilled in PalchigPilpilasi field during engineering period.

Currently, considerable repairing works have been conducted in 10 production wells related to emergency situation of hydrotechnical devices in the field, considerable repairing works have been conducted in wells to get them back to exploitation fund. Currently, daily oil production is 270 tones, water production is 170 m^3 and flooding is 38%. 12.7 mln m^3 water has been filled to layers, irrigation ration was close to 1.

According to engineering project of the field, construction of separate marine foundations No 1351, 1352, 1353, 1354, 1221 in the north-east side and drilling of 50 exploitation wells to remaining layer suites from the same foundations are projected. Along with this, drilling of 18 expolitation wells in the foundation No 1146, which construction has been completed and is waiting for along time for drilling and drilling of 18 exploitation wells in the foundation No 1145 and 1201 which is currently drilling process is continuing. Daily oil production of 11 new wells (1345, 1347, 1340, 1346, 1349, 1285, 1258, 1244, 1256, 1267,

1254), which adoption is completed and included to explotation is close to 145 tones. Adoption works in exploitation wells No 1323, 1322, 1355, 1251, 1206, 1339, where drilling is completed, are being continued and until the current year the surfactante wells will be included to the exploitation.

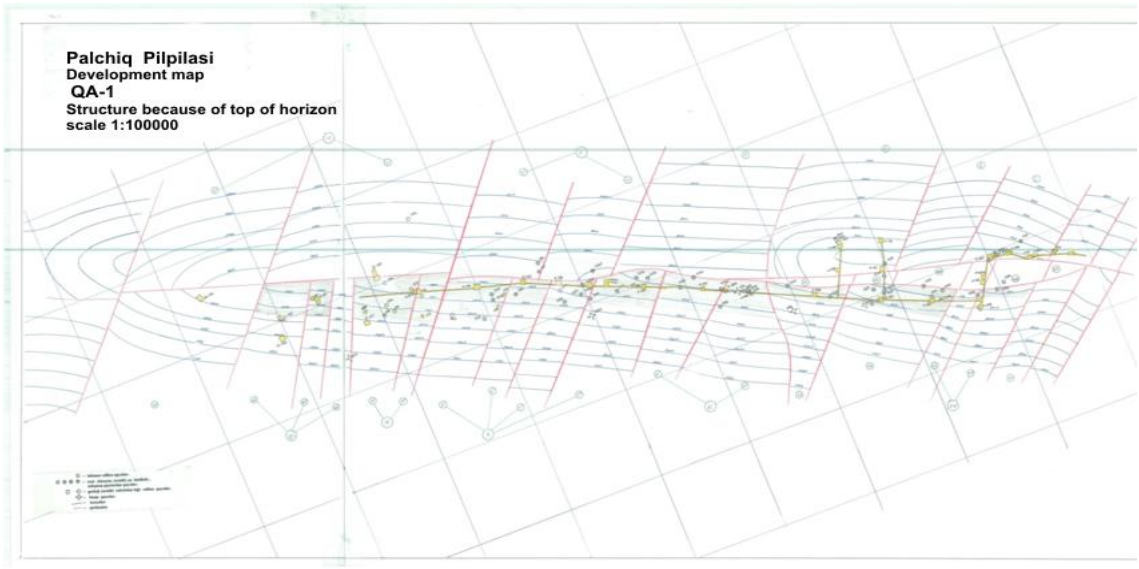
Ecological works started in 2001 və 2003 in PalchigPilpilasi field are currently being continued and materials were collected by Ecological Researches Expedition of Complex Geological Survey and Topography about "Preliminary condition of medium", reports are prepared, and got positive reference of Azerbaijan Republic Ministry of Ecological and Natural Resources, State expedition department.

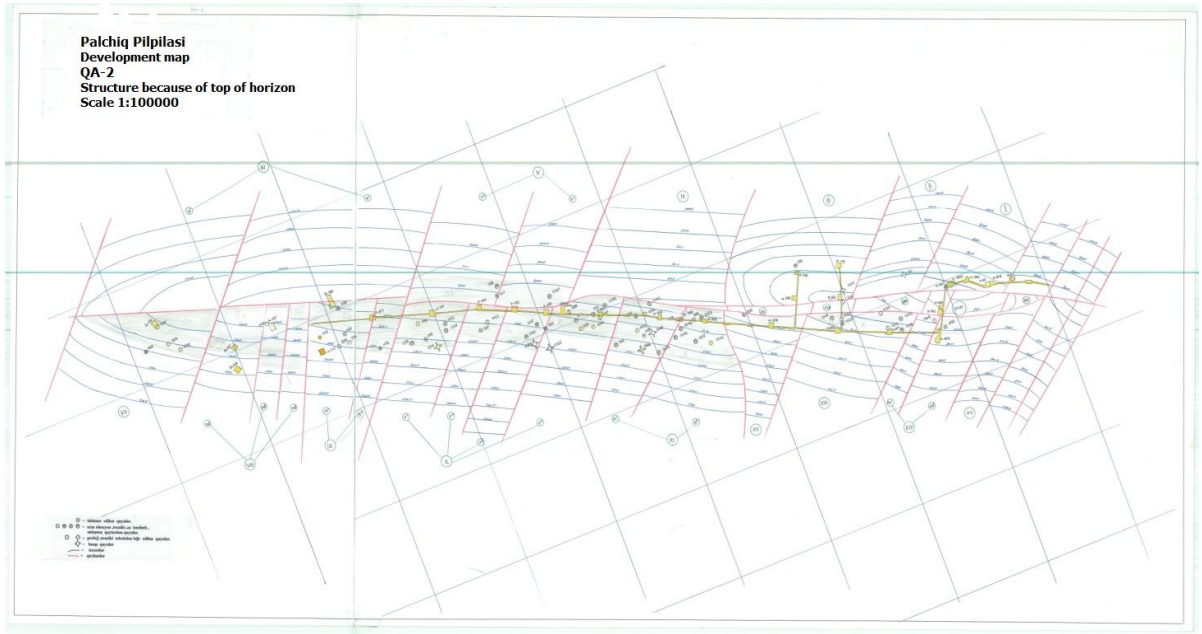
NeftDashlarifield is in IV engineering stage.

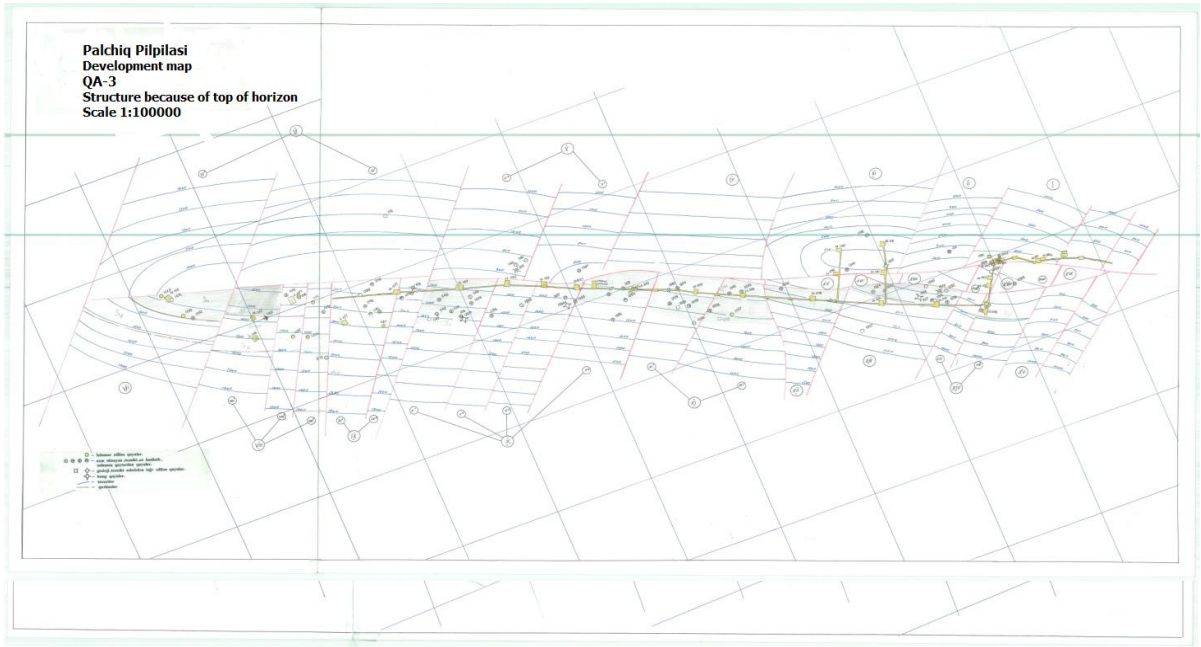
There are 22 horizons being engineered in NeftDashlarifield (IV, V, VI, VII, VIIa, VIII, IX, X, FLD, QÜG, QÜQ, BH-ü, BH-1, BH-2, WH-1ü, WH-1, WH-2ü, WH-2a, WhLD-1,WhLD-2, WhLD-3, WhLD-4) and all horizons have oil.

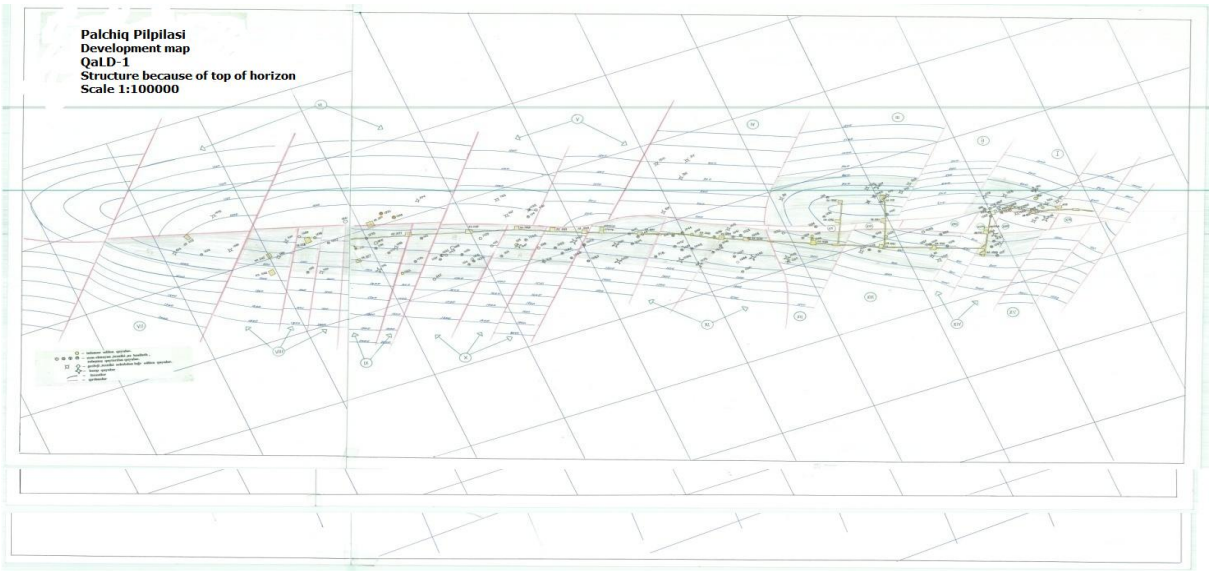
First well in PalchigPilpilasi field has been drilled in WhlD-2 horizon in 1953 and daily production has been 40/48 tone/day. PalchigPilpilasi field currently is in III engineering stage.

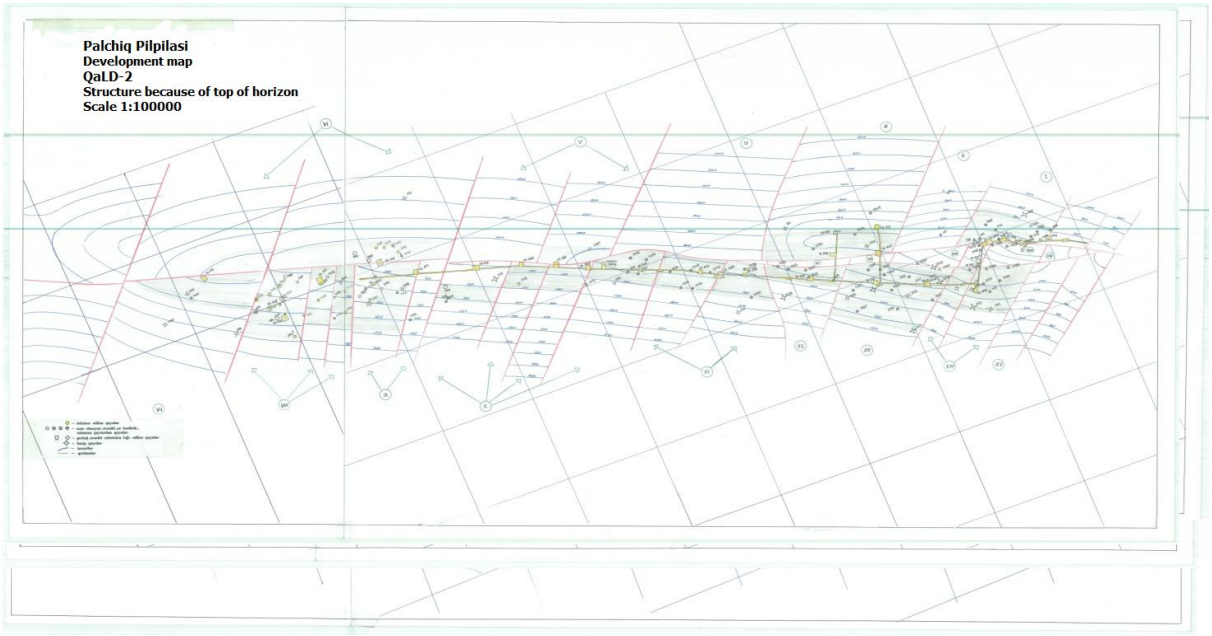
There are 14 horizons in PalchigPilpilasi field (QÜG, QÜQ, QD-1, QD-2, QD-3, QD-4, QD-5, QA-1, QA-2, QA-3, QaLD-1, QaLD-2, QaLD-3, QaLD-4) and all horizons is oil-bearing.




Palchiq Pilpilasi
Development map
QA-2
Structure because of top of horizon
Scale 1:100000


Palchiq Pilpilasi
Development map
QA-3
Structure because of top of horizon
Scale 1:100000


Palchiq Pilpilasi
Development map
QaLD-1
Structure because of top of horizon
Scale 1:100000


Palchiq Pilpilasi
Development map
QaLD-2
Structure because of top of horizon
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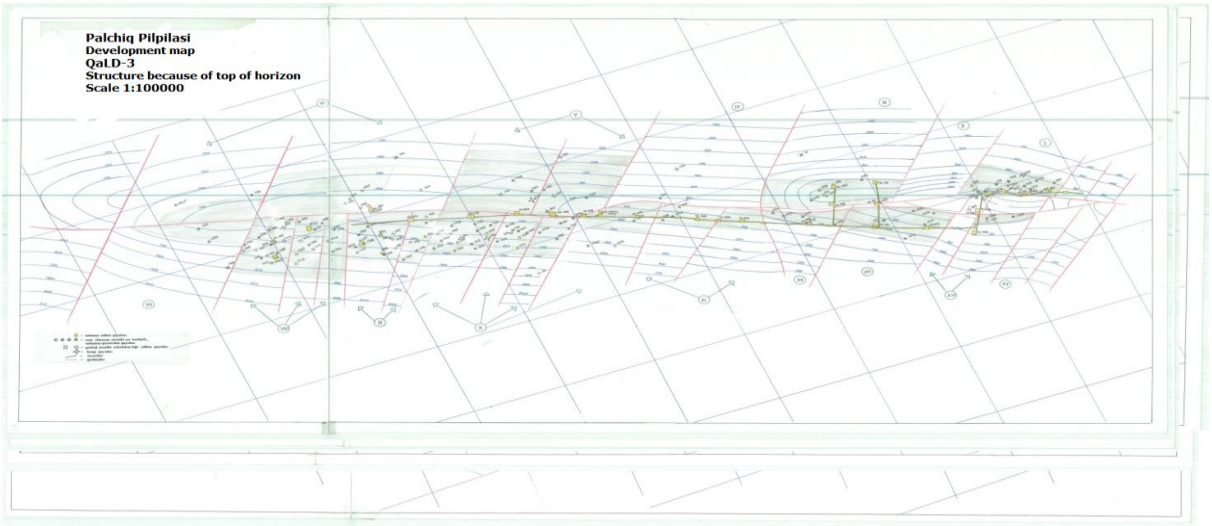
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Development map
QaLD-3
Structure because of top of horizon
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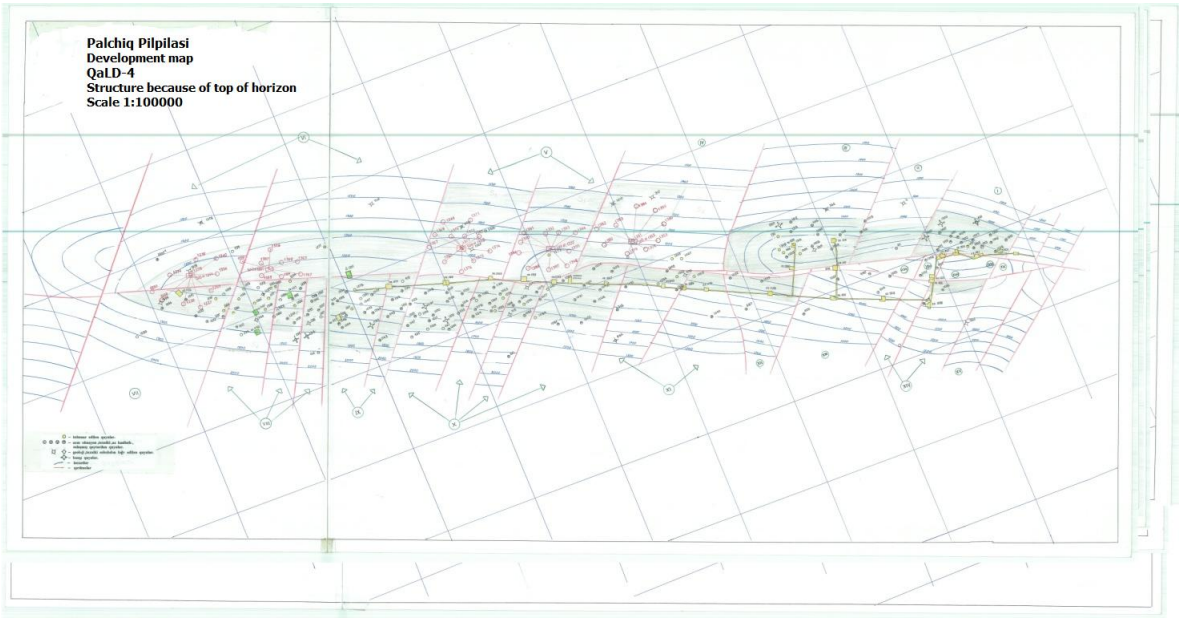
Palchiq Pilpilasi
Development map
QaLD-4
Structure because of top of horizon
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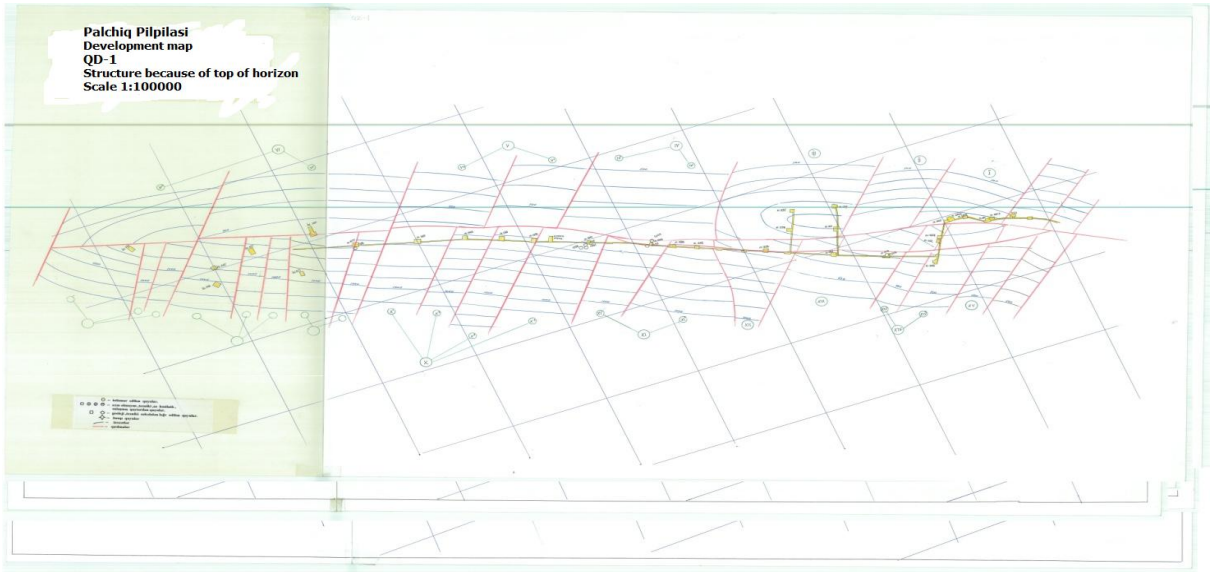
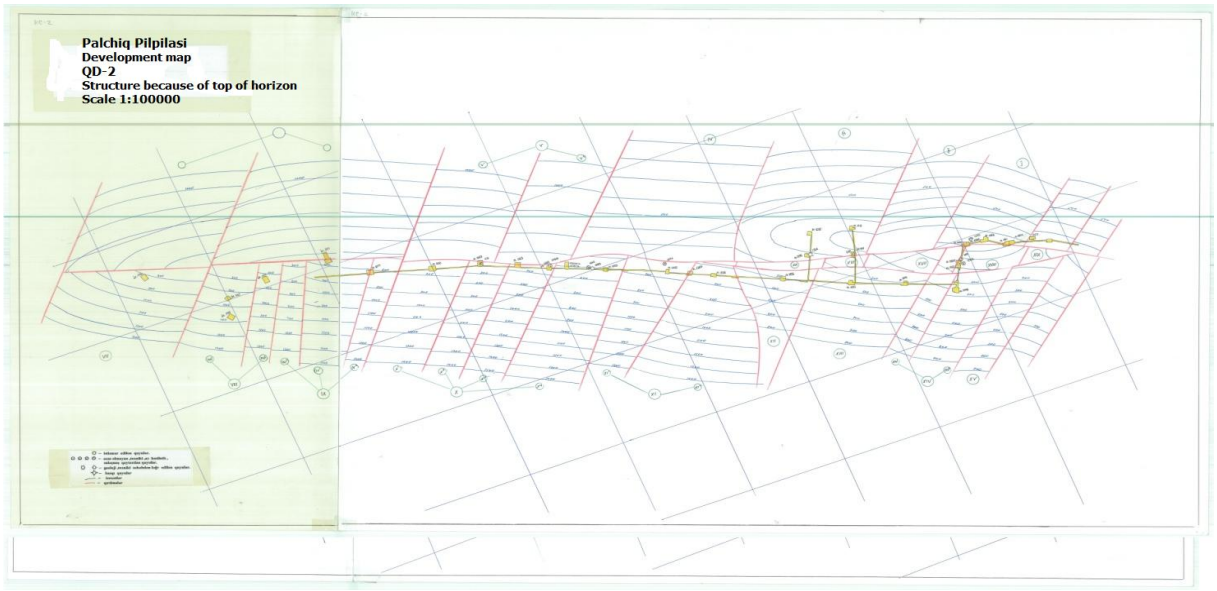

Palchiq Pilpilasi
Development map
QD-1
Structure because of top of horizon
Scale 1:100000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QD-2
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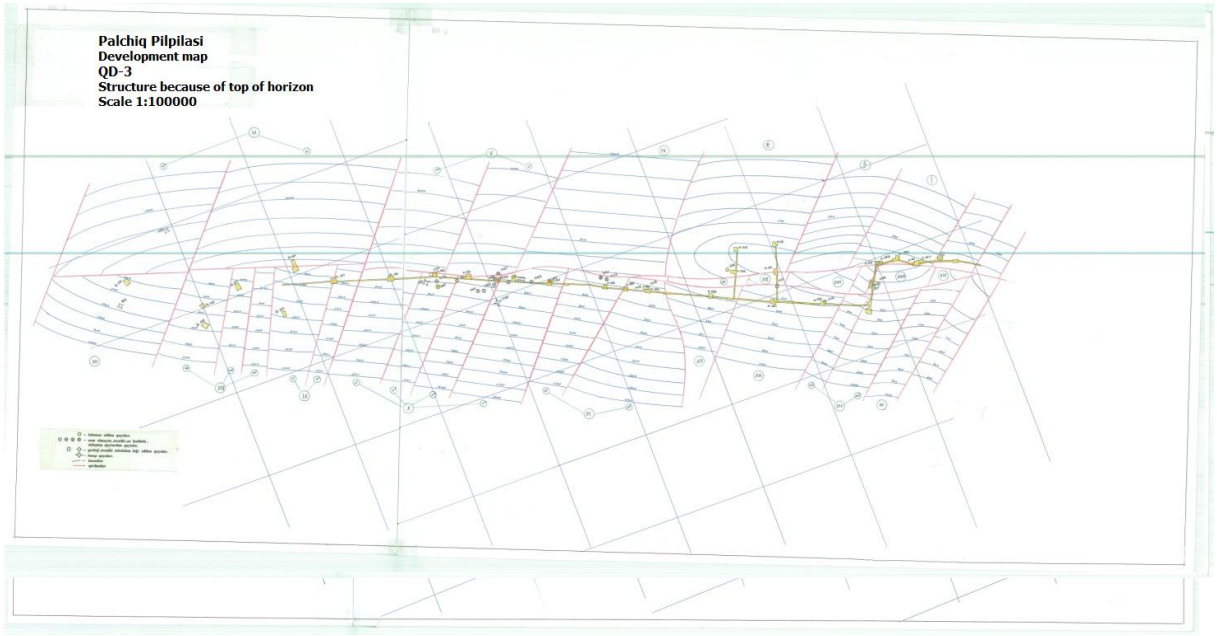
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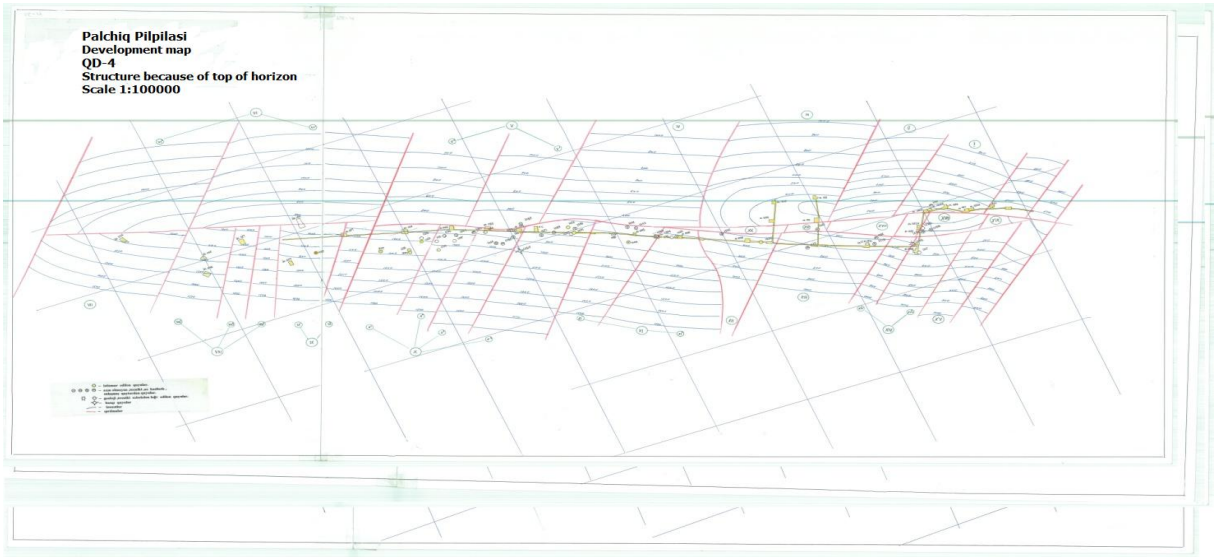
Development map
QD-3
Structure because of top of horizon
Scale 1:100000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QD-4
Structure because of top of horizon
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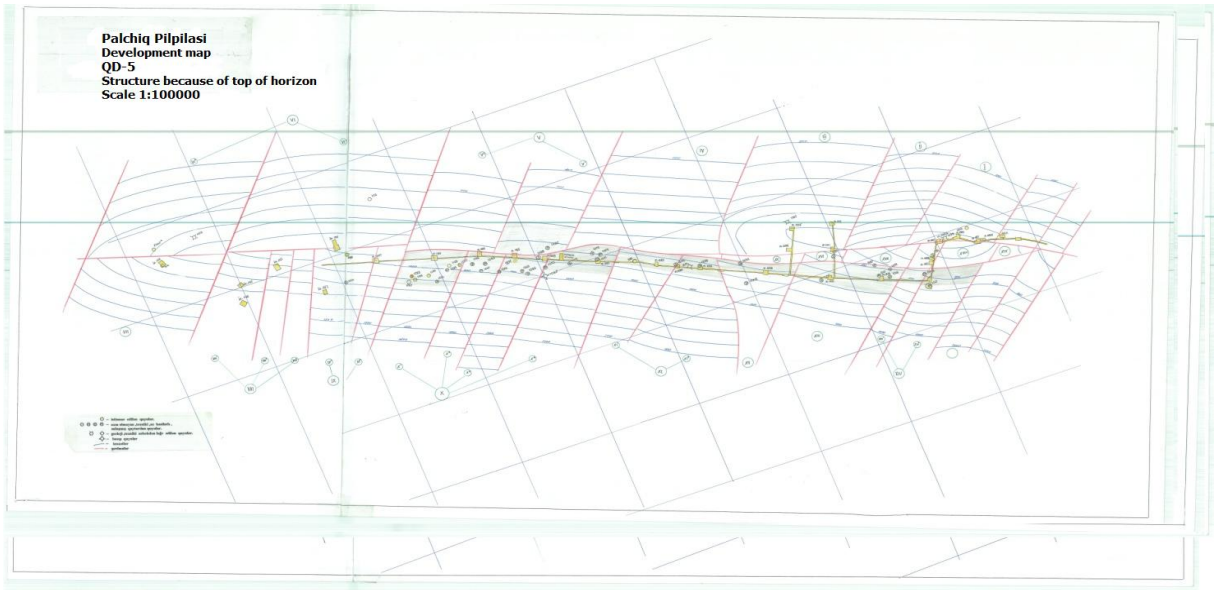
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Development map
QD-5
Structure because of top of horizon
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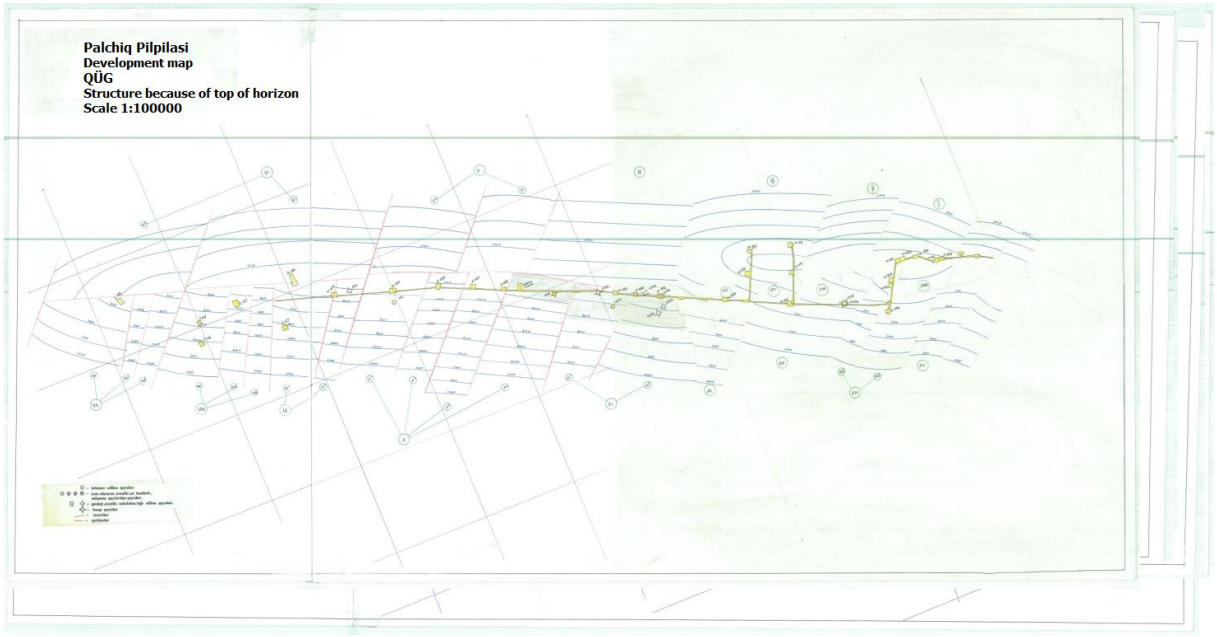
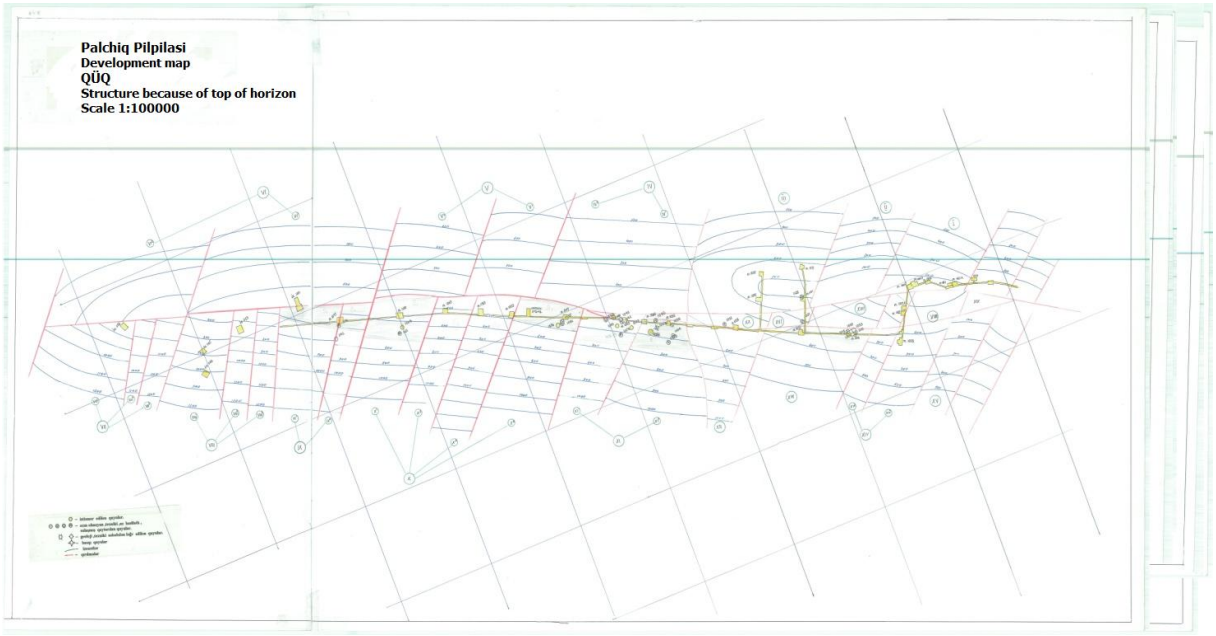

Palchiq Pilpilasi
Development map
QÜG
Structure because of top of horizon
Scale 1:100000


Palchiq Pilpilasi
Development map
QÛQ
Structure because of top of horizon
Scale 1:100000

CHAPTER 2.OIL AND GAS CONTENT OF "NEFT DASHLARI" AND PALCHIG PILPILASI FIELDS

Unprecedented event has happened 60 years before in the world oil industry. First oil well, drilled in the open sea by the industrial method far from the capital in the Caspian Sea, gushed. And from this time, history of oil extracting in the sea began. Although it passed decades from it, this day is remembered and celebrated as establishment day of marine oil industry. This heroism and bravery of Azerbaijan oil workers got well known in a whole world.

NeftDashlari" field lies in north-west, south-west of Absheron archipelago of Caspian Sea, belonging to asymmetric brachyanticline, has been complicated by a lot of in breadth and longwise breakings. NeftDaslari field is shared to 5 tectonic blocks on a base of great tectonic breakings: I, II, III, IV, V. Industrially important oil is connected with productive layer sediments. Main productive horizons are WhLD, BH, FLD, QÜQ, and V, VI, VII, VIII, IX, X horizons of Balakhanı layer suit. Depth of the sea in the area where the field is located, reaches 60 meters. PalchigPilpilasi field is located in shero archipelago of Caspian Sea, in 110 km eastern side from Baku city and 50 km south-easter than Artyom Island. The area where the field is located varies from 10 meter to 25 meter. Belonging to asymmetric brachyanticline, the field has been complicated by a lot of in breadth and longwise breakings. According to Girmaki layer suite's ceiling, length of the field is 9 km, width is 3 km. In April, 1949 by the leading of V.M.Roshin for the first time drilling rig in the sea has been installed. By the order of Head of Damba CDW, NəsurullaBabayev, first drilling brigade has been organized and M.P.Kaverochkin has been appointed as its master. On June 24, 1949, it has been begun to the drilling of survey well No 1.

In "NeftDashlari" field first well has been given to exploitation on November 7, 1949 with 100t/day yield and 6mm stutser and in 1950 engineering of the field has been begun. In 1951 first tanker loaded with oil extracted from this field was sent to the shore. Depth of wells in the field varies between 550-2800 meters.

"NeftDashlari" OGPD's mine information used for writing about oil- gaseousness of PalchigPilpilasi field.

Production, drilling and different events of PalchigPilpilasi field on 2000-2011 years are shown in the table below

years	On field		Past wells		From drilling		From inactive fund		Geological events		Technical events	
	Number of wells	Oil, ton	Number of wells	Oil, ton	Number of wells	Oil, ton	Number of wells	Oil, ton	Number of wells	Oil, ton	Number of wells	Oil, ton
2000	55	108310	47	97418	4	8404	4	2588	10	3771	117	4097
2001	46	122100	40	111708	2	5793	4	4599	11	8386,6	109	3405
2002	60	107485	44	95409	5	2489	11	9587	15	17594	112	3417
2003	62	95617	54	88589	–	–	8	7028	21	12571	126	3518
2004	68	95200	50	60546	15	32701	3	1953	11	8936,4	84	1764
2005	83	107680	65	91742	4	9485	14	6453	17	13445	143	3157
2006	95	109775	80	94202	5	4597	10	10976	18	13451	121	2508
2007	105	116680	84	97608	9	5874	12	13198	11	13517	134	2824
2008	119	115038	94	90638	11	19392	14	5008	27	16829	185	3176
2009	136	113980	118	102587	3	6746	15	4647	25	17374	154	3345
2010	135	114650	125	109259	4	1591	6	3800	20	22033	195	4551
2011	144	113955	130	105797	3	5206	11	2952	39	18622	155	3361

Firstly constructed all facilities, communication lines in NeftDashlari have been anticipated for 15-20 years of service, as by that time's calculations, exploitation of NeftDashlarifield had to be finished until that time. But afterwards, calculations conducted in different years, proved existence of extractable oil reserves in both of fields. First oil reserve of NeftDashlarifield has been calculated on a base of 20 search-survey wells drilled in 1951. Second calculation has been calculated on a base of indications of 496 wells in 1959, and the

third one in 1968. Then extractable oil reserve and extracted general oil production of the field has been in 1991 calculated. Oil-gas production has considerably decreased in the field, because of destruction of hydrotechnical devices during strong storm happened in November, 1992, irrigation works have been suspended, the field worked in natural regime. Taking into consideration abovementioned, new precised engineering project of the field has been compiled in 1997. According to the latest 2004 year calculations, extractable remainder oil reserves are 13348 thousand tones in NeftDashlarifield for 2012 and 4382 thousand tones oil (totally 17730 thousand tones) in PalchigPilpilasi field.

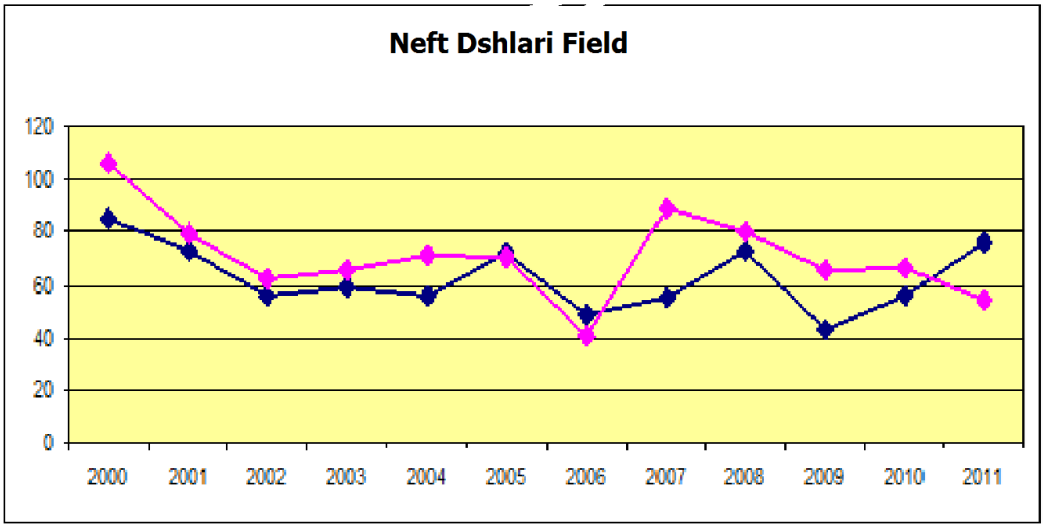
In "NeftDashlari" OGPD in 2011 oil extracting task has been implemented 100,8 % - (plan-918300 tones, fact 925915 ton). In comparison with 2010, oil production was 21177 tones (2,3 %) more. During 2010 904738 tones oil has been extracted.

From the beginning of engineering 178.1 mln tones oil, 79.9 mln m^3 water, 13.8 mld m^3 gas has been extracted.

According to the indications on "NeftDashlari" OGPD in comparison with 2000, 142290 tones (15.4%) more oil has been extracted in 2011.

65000 thousand m^3 gas has been extracted in 2010, and it is 15950 thousand m^3 more than those of 2000.

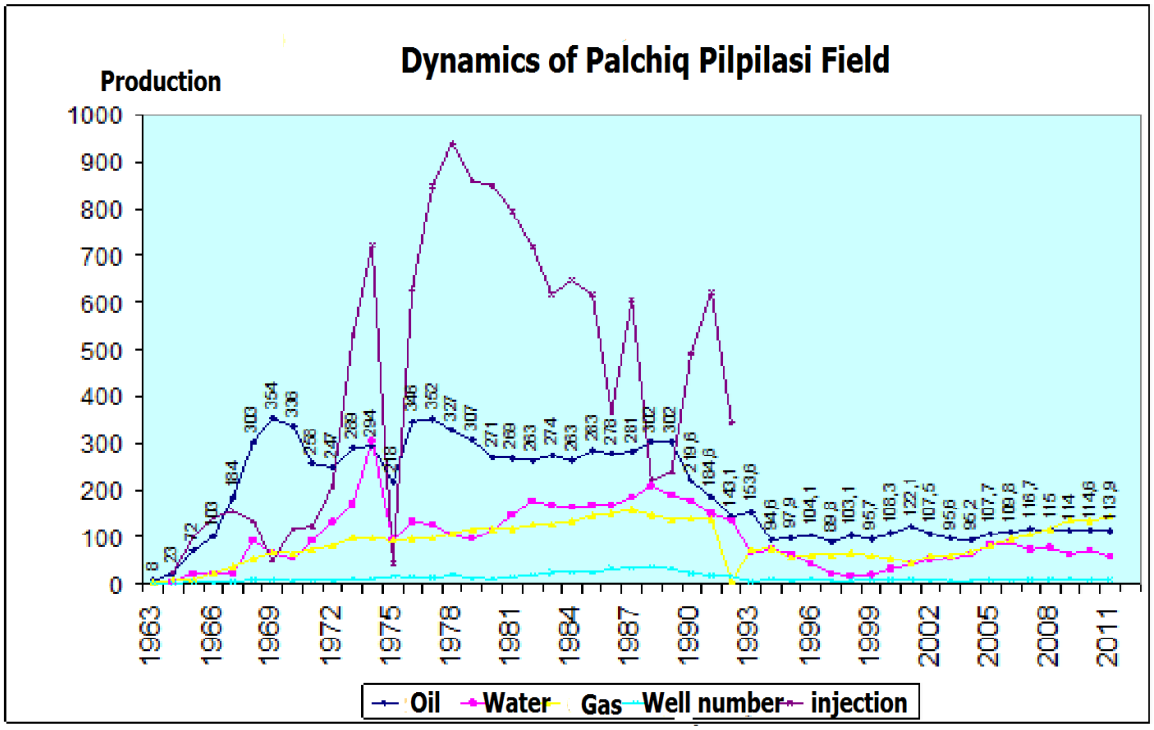
Flow chart of geological activities in NeftDashlarifield during 2000-2011



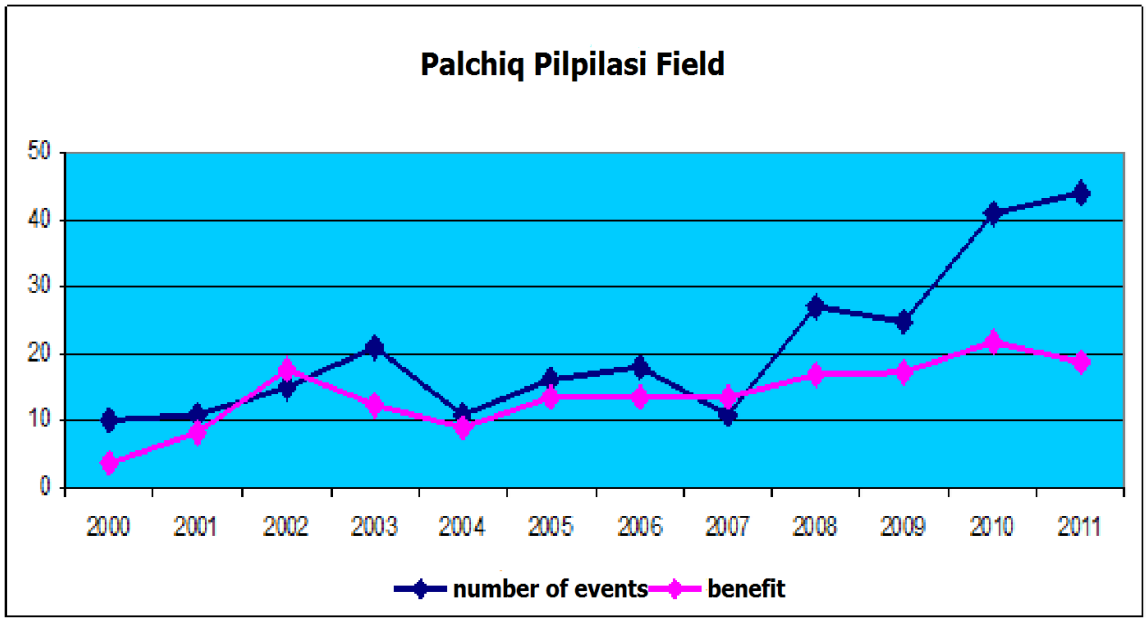
Search survey works in PalchigPilpilasi field has been started in 1952 and 40 tones daily oil has been extracted by the method of gusher from the well No 261 in 1953. By expanding searching survey works, learning geological structure of field, limits of areas with oil and gas, litologic and physical features, reserve of the field has been calculated in 1968.

Calcualtion of last reserve has been made by “Denizneftwhz” in 2001. Current extractable oil reserve has been calculated as 13,8mln tones oil. Hitting last oil giving ratio to 0.229, has been reflected in engineering project compiled in 2002. Finishing of engineering will be continued until 2030.

First well No 1 in NeftDashlarifield has been drilled to WhlD in 24.07.1949, and it has presented for exploitation in 07.11.1949, its daily production has been 100 tones.



Flow chart of geological activities in PalchiqPilpilasifield during 2000-2011



Construction of piers and squares nearby piers has been begun in NeftDashlari since 1951. During some years road-pier with more than150 km length and huge squares hasve been constructed on the waves of Caspian Sea.

Great period of NeftDashlari which founded oil production in the open sea in the world is connected with the name of great leader HeydarAliyev. As, important works have been done in the direction of expanding oil production and improvement of infrastructure for its transportation, as well as improvement of social-household conditions for oil workers in the "island of miracles" during 70-80s of last century.

Azerbaijan became fully owner of its own natural resources after gaining its independence; new oil strategy of our country has been prepared under the leadership of national Leader HeydarAliyev. At this period attention to NeftDashlari which is considered as a capital of marine oil industry of Azerbaijan has been increased, new infrastructure facilities appropriate to world standards have been created, view of the settlement has been changed. During past 60 years by the efforts of oil workers of Azerbaijan, 167 million tones oil has been extracted from NeftDashlarifield, and up to 9.2 million tones oil from PalchigPilpilasi field. Gas production during exploitation of the surfactant fields has been consequently 12,9 milliard and 640 million^3.

NeftDashlari which is considered as a leader of marine oil industry of Azerbaijan has great development prospectives. It is not accidentally that, our national leader HeydarAliyev told about it followings: « NeftDashlari which is considered as a pioneer of marine oil

extracting in our republic, has great development prospectives and during a long time will be rich fuel source». This opinion told by great leader has been confirmed. Now, new development strategy of "Island of miracles" is being successfully realized. Speaking about importance of this unique oil extracting and infrastructure facility president IlhamAliyev told: «I am sure that, NeftDashlari will serve to Azerbaijan during many years…. We all know that without NeftDashlari it is not possible any great oil or gas production project in Azerbaijan. Our all lines and projects that will be given to exploitation are joined in NeftDashlari. Therefore, importance of it never should decrease. NeftDashlari will ever live in the hearts of Azerbaijan nation».

CHAPTER 3.BRIEF INFORMATION ABOUT DEVELOPMENT AND EXPLOITATION OF PALCHIG PILPILASI FIELD

According to 2011 information, PalchigPilpilasi field is exploited by 144 wells. Most of these wells are gas compressor wells. But there are also gusher wells.

PalchigPilpilasi field is exploited by 144 exploitation wells located in separate 11 foundations in marine conditions in OGPD No 3 of NeftDashlari" OGPD. Each foundation has been named by certain number. For instance, wells No 1187 and 1153 are located in the foundation No 1077. Besides this 2 gas and gas condensate wells, there are additional 16 wells. 3 of these wells are eliminated wells, i.e. wells terminated their exploitation periods on horizons; 2 of them are wells in emergency situation, and remaining 11 wells are wells in working conditions.

Neft Dashlari Field
Characteristics of reservoir parameter

Horizon	Average depth, m	Permeability, mk m2	Porosity, %	Oil saturation thickness, m	Oil area, m2	Initial reservoir pressure,atm	Current reservoir pressure, atm	Reservoir temperature C	Specific weight of oil, q/sm3
IV	150-1550	0,12	0,24	11	200	60	25	20-60	0,9
V	153-1580	0,13	0,23	12,1	570	65	26	20-55	0,89
VI	155-1600	0,15	0,23	20	1890	73,5	50,2	20-70	0,885
VII	160-1610	0,2	0,22	16,4	3590	94,5	31,1	25-60	0,887
VIIa	164-1615	0,2	0,24	9,8	8980	77,3	27,5	25-60	0,887
VIII	166-1625	0,1	0,24	15,4	10700	93	46,1	30-65	0,886
IX	170-1630	0,158	0,24	13	12780	93	51,5	30-60	0,883
X	175-1650	0,151	0,24	17	13000	141	46,6	30-70	0,883
FLD	350-1380	0,199	0,24	27	10150	103,7	42,4	30-46	0,87
QÜG	265-1540	0,085	0,21	7,3	11940	139,5	40	30-56	0,86
QÜQ	100-1750	0,17	0,25	14,4	16420	136	36,1	23-57	0,86
QD	220-1370	0,051	0,22	27,9	27740	98,2	42,4	25-64	0,89
QA	360-1405	0,173	0,25	63,9	37470	121,8	26,1	25-65	0,886
QaLD	650-3000	0,12	0,23	64,9	18120	137,3	33,8	42-65	0,89

By clinching of first and second rows in emergency well, wells No1217 and 1163 has not been exploited. Currently, Workover Team works on the well No 1217. Already certain works have been done on this well and it is supposed that, this well will be presented to the mine for exploitation until the summer of 2013.

Palchiq Pilpilasi Field
Characteristics of reservoir parameter

Horizon	Average depth, m	Permeability, mk m2	Porosity, %	Oil saturation thickness, m	Oil area, km2	İnitial reservoir pressure, atm	Current reservoir pressure, atm	Reservoir temperature C	Specific weight of oil, q/sm3
QÜG	457	0,16	0,29	6	1230	45	45	34	0,914
QÜQ	507	0,11	0,28	7	2460	53	39	39	0,922
QD	625	0,172	0,29	51,4	12110	77	62	44	0,922
QA	794	0,236	0,23	30,7	15300	93	68	48	0,92
QaLD	1203	0,185	0,21	47	34390	203	90,2	53	0,917

The field mainly is exploited through compressor wells. Casings of these wells are 6” və 5” and first and second rows are subsequently 1,5” və 2,5”. Currently, WhlD horizon mainly is exploited in the field.

In “Mud Volcano” field wich has been presented for exploitation in 1953, industrillay important oil has been accumulated in 5 field- Gala layer suit (WhLD), under underGırmaki (WH), Gırmaki layer suit (BH), Gırmaki covered with sand - (QÖQ), Gırmakı covered with clay (QÖG). From geological point of view, mainly increasing, possessing great thickness and upper chalk sediments are prevailing. Service to exploitation and watering wells in the field is conducted mainly with pier and separate marine foundations. Recently, by the purpose of efficient operation of the field, construction of separate marine foundations and drilling of sloping production wells are planned and realized. But because of the layers are not homogenous, are in a large number, and with clays and with partition, conductivity is low, oil has a lot viscosity, pier and some technical devices are broken down and destruction of the artificial (by water) influence system to the layers make, it is difficult to realize last engineering process of the field. By the purpose of investigation and summarizing of complexities mining materials of 105 exploitation wells on “PalchigPilpilasi” field. It is obvious from analyze of mining materials that, more than 40% of working well fund works with sand obstruction and this negatively effects efficient exploitation of the wells. Investigation of underground repairs conducted during 3 years (on 2005, 2006, 2007 years) also shows that, 69 (48.6 %) of conducted 142 repairs in 105 wells are directly related to the sand. As fighting method against complexities in the wells where frequently obstructions

occur, is operation of periodic influence to the wells with marine water, direct or opposite washing. It should be noted that, 57 (83 %) of 69 repairs have been washing of sand obstructions current repair brigade.

During these repairs 8545m (155,8m3) sand obstruction has been washed and lifted to the surface.

One of complexities appeared during exploitation of PalchigPilpilasi field is related to creation of asphalt-resin-paraffin sediments inside surface of lift pipes, discharge lines in the mouth of wells, underground and surface mine equipments.

It was obvious from conducted multiply researches that, average value of density of oil on both sides of PalchigPilpilasi field is 0,907 q//sm3 on south-west wing, 0,922q/⁄sm3 on the north-east wing, changing interval is appropriately 0,898-0,934 və0,910-0,937 q ⁄sm3. Physical-chemical features of oil on horizons have been investigated and gained results are presented in Table 1.

Physical-chemical properties of oil on horizons Table 1

Horizon	Density of oil g/sm^3	Kinematic viscosity,mkm^2/san		Boiling temperature, C^0	Amount of light fractions, %				Composition of oil, mass %			
		20^0C	50^0C		100^0C	200^0C	300^0C	350^0C	Resin	Mechanical mixture	Petrol	Ligroin
South-west wing												
QÜG	0.915	90.0	23.4	121	-	5	33	44	31	0.3	-	34.0
QÜQ	0.912	67.5	21.9	111	-	9	29	49	26	0.4	5.0	15.7
BH-3	0.914	49.8	29.4	130	-	9	28	49	26	0.4	-	18.3
BH-4	0.915	86.4	22.7	120.2	-	9	24	45	33	0.4	5.6	12.8
BH-5	0.907	61.3	26.8	121	4	13	32	47	32	0.3	4.2	17.8
WhlD-1	0.917	68.8	34.1	123	-	7	29	46	26	0.5	3.5	14.7
WhlD-2	0.922	98.9	27.7	117	-	16	26	40	25	0.3	3.1	123.7
WhlD-3	0.909	70.5	22.0	129	2	10	27	42	27	0.3	6.9	15.6
WhlD-4	0.907	60.0	21.8	120	-	9	30	46	27	0.3	4.1	15.3
North-east wing												
BH-1	0.922	-	34.3	-	-	-	-	-	30	0.2	-	7.9
WhlD-2	0.913	41.5	9.7	-	-	-	-	-	32	0.3	3.2	7.9
WhlD-3	0.923	78.0	-	-	-	-	-	-	24	0.2	-	11.9
WH-1	0.925	153.0	38.5	131	2	11	27	48	28	0.3	6.9	15.2
WH-2	0.926	50.1	34.1	115	-	11	36	52	31	0.3	2.2	16.9
WH-3	0.918	68.6	37.2	-	-	-	-	-	30	0.5	2.4	98

As it is seen from the Table 1, oil of south-west wing in temperatures 200C and 500C possesses relatively lower viscosity than north-east wing. In shown temperature according to

viscosity of oil is 60,0 və21,8 mkm2⁄s. 96,4 və30,7 mkm2⁄s. Amount of light fraction (up to 3500C) is not more than 46% and varies between 34-58% , amount of benzine-ligroine varies between 4,1-15,3%. Average figure of resin amount in structure of extracted oil on the field is 28%. As it is clear, as a result man can note that, oils of PalchigPilpilasi field are heavy and possessing high viscosity. Amount of paraffin and sulphur in the structure of oil is low.

In PalchigPilpilasi field ARPS also settles to the bottom zone of the well in field and it considerably diminishes conductivity of bottom zone of the well.

But, at this time, as a result of resin settlement in bottom zone of the well, layer conductivity became fewer and absorbing ability lower, pushing the cementation solution to the layer, created difficulties. “Therefore, in such wells, pushing operation of cementation solution to layer becomes difficult and efficiency of the activity decreases in activitiesconducted for strengthening of bottom zone of the well as a method of fighting against sand in wells. During the report period, operation of fastening of bottom zone of the well has been implemented 12 times by thorough repair brigade in fighting related to sand. During this activities cement with oil base, materials changing volume and water cement solution have been used.

Many wells exploited in the“Palchig Pilpilasi” field are with resin and high viscosity, accumulation of mechanical particles-sand and clay in the bottom zone of the well, accumulation of heavy components on the surface of these particles and in porosities of layer rocks as a result of conducted investigations, are suggested 2 stage method by the purpose of fastening bottom zone of the well and enhance conductivity in bottom zone of the well in the wells.

According to this method, in the first stage bottom zone of the well is cleared from asphalt-resin paraffin (ARP) sediments or their influence is decreased to the minimum, in the next stage fastening of bottom zone of the well is realized. Effeectiveness of this method depends on positive results of both stages. As, effectiveness of fastening bottom zone of the well considerably relies on clearness of surface of rocks, i.e. used composition should be primarily adsorbed on the surface and after some period should create strong adhesion on the surface of rocks. It means that, if there is ARP sediment between phases or if they are not fully cleaned from the surface, quality of fastening process may be lower, due to this situation, after short period at the bottom zone of the well it is possible to observe complexities in a result of accumulation of sand. Currently, although, watery solutions of surfactants are used for cleaning sand particles and ARP sediments accumulated at the bottom zone of the well, conducted activites mostly do not eliminate the problem.

By the purpose of investigating effective cleaning process of ARP combinations at the bottom zone of the well, oil and ARP sediment samples are taken from 3 wells in "NeftDashlari" OGPDand have been investigated in laboratory condition. Selected wells No 1113, 1141 və2183 are exploited respectively in WhLD-3, WH-2,1vəQöQ horizons. Well No 1113 with 1466 m well bottom depth, works in a rejime of gusher, well No 1141 with 1362 m well bottom depth and well No 2183 with 1568 m well bottom depth work by gaslift method. Construction of lifting pipes is with two rows. As complexities related to sand expression in the wells are observed many pipes are pulled down until filter zone. Following physical-chemical indicators of samples taken from selected wells have been defined by standard methods: freezing temperature of neft oil samples, density in 20 C, amount of water in oil in joint form, kinematic viscosity in 20C and amount of mechanical mixtures in the composition of oil.Results are given in the Table 2

Physical-chemical indicators of "PalchigPilpilasi" field

Table 2

Number	Indicators	well number		
		1113	1141	2183
1	Freezing temperature, ^{0}C	<0	<0	+2
2	Density in 20^0 C-də, kg/m^3	900.8	938.0	845.8
3	Amount of water in product, %	izi	22.0	2.7
4	kinematic viscosity in 20^0 C, mm^2/sec	46.8	285.2	13.7
5	Amount of mechanical mixtures, %	yox	0.012	0.010

As it is seen from the Table 2, freezing temperature of researched oil samples. While the oil of the well No 2183 freezes in +20 C, oil of wells No 1113 and 1141 keep their fluidity in 0^0 C.

Density of oil samples in 20^0 C ranges from 845,8 kg/m3 to 938,0 kg/m3. Density of oil of the well No 113 is 900,8 kg/⁄m3, density of oil of the well No 2183 is 845,8 kg/⁄m3.In comparison with oil of these wells, oil of the well No 141 is harder (ρ=938,0 kq/⁄m3) and it is related to the great amount of water birləşmişhalda in its construction.

There is a track of water in the oil of well No 1113 among investigated oil samples, in other samples there are different amounts of water. While amount of water in the oil of the well No 2183 is 2,7%, there is 22,0% water in a joint form in the oil of well No 1141. By this reason, viscosity of oil of the well No 1141 in comparison with other samples is very high.

As kinematic viscosity of oil of wells No 1113 and2183 in 200 C are consequently kinematik 46,8 and13,7 mm2⁄s, kinematic viscosity of oil of well No 1141 in 200 Cis 285,2 mm2⁄s.

While in investigated wells technologic complexities related to sand expressions are observed, amount of mechanical mixtures in oil samples is maximum 0,012%.

Analyze of gained results during research of physical-chemical features of oils show that oil of these wells are resinous and by this reason probability of creation of obstructions on sand and clay particles of resins in the zone of bottom of the well is great. ARP sediment samples accumulated in the equipment of the well No 1113 have been taken for analyzing dissolve process of ARP combinations settled in the well. It should be noted that, there are 1.2 % mechanical mixtures exist in composition of ARP sediment.

Taking into consideration temperature conditions (~400C) of the well No 1113 dissolving process has been conducted in 350 C, also in more strict condition in 200 C. Gas condensate, aromatic carbohydrogens, kerosene, which is derived during processing of oil, and etc. can be used for dissolving the ARP sediments. Taking into consideration, existing realities and absence of gas-condensate wells in the field, KO-20 marked kerosene produced in oil processing plants of the country have been used for investigation of processod dissolve of ARP sediments. In researches ARP sediment and kerosene has been taken in correlation of 1:20. Solution degree of ARP sediments has been defined by gravimetric method according to change of sediment mass during certain time period.

Results have been given in the Table 3.

As it is seen from the Table 3, 60 % solution degree of ARP sediment in 30 minutes in 200 degree is observed, during the next 30 minutes ARP sediments' solution degree increases up to 85.0 %. At the beginning of the process solution degree of ARP sediments increases in linear form depending on the time. Next increase of solution degree of sediment is observed on exponential dependence. During 90 minutes period kerosene KO-20 solves 94/0% sediments in 200 C.

Addition of surfactants to kerosene to enhance its solving ability has also been investigated; as a result of researches, A-18 surfactant in amount of 1 % has been added to KO-20 kerosene. Addition of high effective surfactant to the composition of dissolvent along with enhancing its dissolving ability, increases its soaking ability too and eases penetration of reagents to the inside of sediment and microsponges of the rocks. Kerosene A-18 surfactant composition during 30 minutes in 200 C for 73,0%, during 60 minutes for92,6% and after 90 minutes fully(99,5%) solves ARP sediments.

Solution results of ARP sediments which is gotten from 1113 numbered well in solvent

Table 3

HH	Temperature ^{0}C	Solvent	Solution period, min	ARP solvent	Solution degree, %
1	20	Kerosene KO-20	15 30 45 60 90	1:20	35 64 78.3 85 94
2	20	Kerosene KO-20 +1% A-18	15 30 45 60 90	1:20	42 73 85.8 92.6 99.5
3	35	Kerosene KO-20	15 30	1:20	82.0 99.2
4	20	Solvent	15 30	1:20	83.1 99.4

Increase of temperature positively influences the speed of dissolution process. Taking into consideration temperature regime in the well dissolution of ARP sediments has been investigated in 350 degree C. Gained results show that KO-20 kerosene dissolves ARP sediments more than 99.0% during 30 minutes in 350 C.

Solvent is used for dissolution of ARP sediments by the purpose of comparison with KO-20 kerosene. As solvent mainly consists of aromatic carbohydrogens, it possesses high solving ability. As it is seen from the Table, solvent dissolves ARP sediments for 99.4 % in 30 minutes in 200 C degree. When in this condition kerosene is used, 64.0 % dissolution has been observed.

However, there are difficulties in gaining solvent possessing high dissolvent ability, usage of KO-20 marked kerosene produced in the plants of republic for cleaning accumulated ARP sediments in the bottom zone of the well is reasonable. As storage period of reagent at the bottom of the well is recommended up to 24 hours, fully solution of ARP sediments is supposed. 0,5-1% A-18 surfactant's addition to the composition of KO-20 kerosene by the purpose of expansion of influence area of reagent in the bottom zone of the well. A-18 surfactant is produced in Sumgait "Organic synthesis" plant on a base of technology elaborated by "Neftwhzlayihe" institute.

On a base of research, works conducted during a long period in the field of clearance of well equipment and bottom zone of the well from ARP sediments, it was defined that,

usage of 3,0-5,0m3 solvent for clearance of bottom zone of the well from sediments allows achievement of satisfactory indicators.

Before the fastening activity for preventing sand expression, in first stage it is necessary to process the bottom zone of the well with 3,0- 5,0m^3 kerosene KO-20 and with 0,5-1,0% A-18 surfactant, recommended to add to the compoisition to accelerate dissolution process, increase penetration ability of the solvent. It should be noted that, by the purpose of expansion of processing area of the layer solvent is pressed to the layer by water or watery solution of surfactant. In the second stage, fastening activity of bottom of the well should be conducted.

It has been written using “scientific works”articles collection of Oilgasprojetc institute about engineering and exploitation of PalchigPilpilasi field.

CHAPTER 4.SOME PROBLEMS IN PRODUCTION OF GAS-CONDENSATE WELLS AND THEIR SOLUTIONWAYS

In a result of salt deposits, many technological problems occur in lift pipes in a process of production process of water invasion oil, gas and gas-condensate wells. Settlement of solved mineral salts in composition of layer waters happens by the reason of change of thermodinamical conditions. Chemical composition of these sediments consists of carbonate-sulphate salts ($CaCO_3$, $CaCO_4$, $MgCO_3$, $BaCO_3$, $BaCO_4$) of alkali-ground metals and etc.

As salt sediments artially or fully close the width cutting of lift pipes, exploitation process of the wells is violated, occurs necessity of underground repairing. It means a lot of oil and gas loss and results with labor and asset spendings. The most efficient method in prevention of settling salts in the pipes during exploiation of oil well is usage of chemical reagents-inhibitors.

The most profitable inhibitors are inhibitors based on phosphor-organic combinations, phosphorized and oxygenized one-atom alcohols, ethers of polyphosphor acids and etc.

In general, following inhibitors are used against salt sediments in wells.

TEA AFOH-10, TEA AFOH – salts of friefauolanun of alkiletoxiphosphores and salts of acid alkilariletoxiphosphates; disovlan 4411 and 4490, Servo 5348, daufaks-1632 reagents; separol 29, 5084, 5016; diproksanin 167, p-181 and etc. are used.

Usage of reagents decreasing emulsion's viscosity and meanwhile, possessing inhibitor features against salt sediments for improving lifting process of liquid in gaslift wells and preventing salt sediments is reasonable. Among such reagents can be shown A type surfactant.

More profitably used inhibitors in Azerbaijan are heksurfactantetaphostal and tripoliphosphatnatrium.

Phosphor acids, carbonatnatrium and heksurfactantetafosfatnatrium reproductions can be shown as an example among other composition used against salt sediments. These inhibitors are added to water mediums to decrease intensity of creation of sediment.

Metal constructions, well equipments-protective belts, pump compressor pipes, pump bars, depth pumps and their parts, surface well equipments, discharge lines, collector pipes collecting and transporting it and etc. used in mines are subjected to corrosion.

Corrosion creating ability of extracted product in mines depends on amount of salts dissolved in layer waters (mainly, sodium chloride and gases: sulphur, oxygen, carbon dioxide).

Corrosion creating ability of the well product is not regular and eventually changes. The reason that causes increase of speed corrosion of well equipments is increase of layer water, carbon gas and sulphur in the composition of the product.

One of the factors sharping corrosion of mine equipments is rubbing of pump bars with pumping-compressor pipes during expoitation of wells with depth pump. In such wells average serving period of new pipes is 6 months, serving period of bars is close to 1 year. Serving period of old pump-compressor pipes and bars is too low. One of protecting methods oil-mine equipments from corrosion is protection with inhibitor.

Depending on character of corrosion process different corrosion inhibitor is applied. Application of inhibitor does not require pipes and other equipments durable to corrosion prepared from high quality, much more expensive steel.

Hydrotechnical devices in the marine fields are subjected to corrosion. Corrosion mainly happens in posts in a result of waves and motion of marine surface up and down. Special sylinder is worn to the active part of post to prevent corrosion. Part between the post and cylinder are filled with oil. Oil accumulates to the marine surface and isolates active surface of post from the atmosphere. In stormy cases, as the level of the sea changes, created oil glass moves up and down, covers the surface of the post with oil layer and thus lubricating post, protects it from corrosion.

According to classification about application of corrosion inhibitor marked as ZSMM-AzNQSETLİ, corrode during 1 year. In each well 4-12 times processing operation with inhibitor have been conducted.

Depending on corroding ability of well products inhibitor should be vurmaq to the wells periodically.

Corrosion of oil- mine equipments (pipeline, reservoirs, separators, settlers, heating changers, pumps and etc.) happen in two ways:

1. Direct destruction of metal in a result of chemical influence of medium;

2. Destruction of metal in a result of electrochemical reactions related to flow of electrical current among different areas of metal surface.

Related to aboventioned corrosion of oil-mine equipments can be divided into internal and external corrosion. Internal corrosion happens in a result of influence of moisture, hydrogen-sulphid and carbon–dioxide and salts existing in the composition of transported product. External corrosion happens from the influence of electrolyte in the composition of the soul.

Speed of corrosion process of mine equipments depends on many factors:

1. Amount of acidic components (H_2S və CO_2). When amount of acidic components increases, corrosion of metal happens with more intense speed.

2. Pressure and temperature. As temperature increases, motion speed of charged ions are increased, and it in its turn accelerates anod and catod processes. Increase of pressure eases hydrolysis process of many salts, increases solution of CO_2 gas. By increase of pressure carbon dioxide solved in the water creates carboxylic acid and this acid creates marine salt of carboxylic acid.

$$CO_2 + H_2O \rightarrow H_2CO_3$$
$$H_2CO_3 + Fe \rightarrow FeCO_3 + H_2$$

As partial pressure of carbon dioxide hydrogen indicator of medium pH dramatically falls down, corrosion of metal by carbonate acid gets intensed.

1. Speed of flow. As motion speed of oil-gas-water mixture increases, corrosion process intensifies. Dinamic influence of this flow on the metal from protection layer is explained with replacement of new and more destructive one.

2.Situation of surface of equipment. Rough surface of metal corrodes relatively much more than smooth surface.

3.Characterization of the medium. All mediums are divided to 2 parts according to hydrogen indicators: If pH<7, medium is considered as acidic, pH>7, medium is considered as alkali, if pH=7, is considered as neutral. If pH parameter is smaller than 7, corrosion speed much more increases. If pH varies in 4÷7 ranges, corrosion speed eventually stays stable.

Amount of metal $1m^2$ with spread grams during the time period (hour, month and year) or thickness of part spread from the surface of metal to its inside is called corrosion speed. Units of corrosion speed are gr/sm^2və mm/year.

Appropriation and processing of oil-gas-condensate field is normally happens in complex geological and technological condition. As, oil-gas-condensate fields are located in depth, structures often possess much more difficult structure for its tectonic point of view. When it comes to the fields in the sea, it should be taken into consideration that depth of the sea changes in great limits and technical supply and technology of appropriation of fields located in the sea fairly differs from fields in land.

Some problems occur in autumn-winter months to production and transportation of gas in OGPD named after N.Nerimanov, but the most of important of them is hydrate combinations appeared in main transport lines.

So, for ensuring production of product, their preparation and bringing to the shore in nonhydrate regime from gas-condensate wells exploited nearby Sangachal-deniz, Duvannı-dəniz, Khere-Zireisland, methanol and isoprophil alcohol reagents have been used.

It is known that, during exploitation of gas-condensate fields, thermodynamic indicators of gas: pressure, temperature, productivity, layer waters and etc., cause changes of spending norm of methanol used in technologic system.

Taking into consideration abovementioned and for intime prevention of hydrate combinations appeared in mine conditions, on a base of actual indicators in OGPD-mines, calculation of précised spending norms of methanol used in preparation process of gas to transportation in gas-condensate field.

Spending of methanol relies on temperature, pressure and moisture of gas and is implemented separately for each certain condition.

It should be noted that, it is also possible to conduct generalized calculation. Calculation of spending norm of inhibitor for similar wells group for their pressure, temperature and moisture indicators can be conducted.

Here relation should be more than 10%. Main indicators for calculation of special spending norms of methanol applied in OGPD are followings:

-amount of methanol for absorbtion of water steams in gas phase;

- amount of moisture in the structure of gas in launch and final gas results of gas pipes;

- remainder of unused alcohol injection to gas stream;

- remainder of used alcohol;

-amount of alcohol spent for absorbtion of water (free water) which is in structure of the gas

Additional inhibitor in necessary amount is injected to the system for filling place of loss occurred in the system and injected inhibitor to the gas flow for lowering hydrate generation temperature in preparation technology of gas to transportation.

Therefore, during calculation of précised spending norm of methanol losses caused by following reasons should be taken into consideration:

-loss of alcohol when it get in touché with gas (evaporation);

-dissolve of alcohol with fluid carbohydrogen;

-mechanical loss of alcohol in gas stream;

-separate technologic losses.

Methanol ensures absorbtion of water steams which area in a balance case in structure of gas. One part of methanol is dissolved with gas phase, other part is dissolved in free layer water in liquid phase coming out together with gas and carbohydrogen condensate.

Therefore, in conduction of spending norm of inhibitor, mechanical losses and etc. in specific technologic points of gas certainly we should take into considersation.

Depending on density, dependence of lowering hydrate creature temperature by different inhibitors.

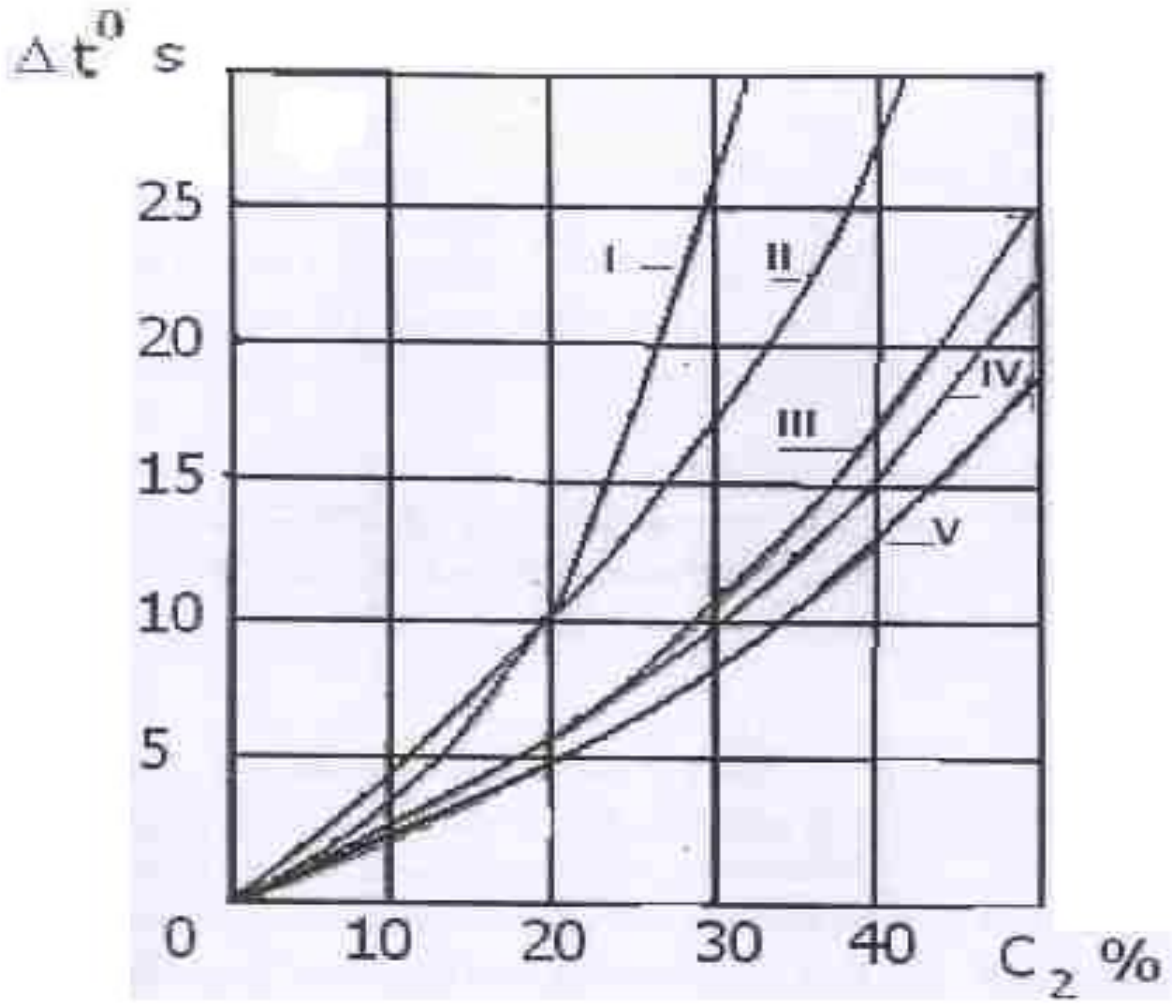


Figure 4.1

According to the results of industrial practical and mining works, it has been defined that, in a result of its dissolution with methanol condensate injected to gas stream, its lost for each 1000 m^3 gas is 10-12% of spending norm of methanol.

According to the results of scientific-research and mining works, necessary indicator for operation of précised spending norms of methanol has been gathered and methods have been selected.

Amount of general spending norm of inhibitor is calculated according to following formula:

$$S = D_m + D_q + D_k \quad (1)$$

Here: S-common spending of inhibitor, kg/1000m^3:

D_m-spending of inhibitor for water steams decomposing from gas, kg/1000m^3;

D_q-spending of inhibitor in gas phase, kg/1000m^3;

D_q- loss spending of inhibitor in carbohydrogen condensate, kg/1000m^3.

Spending of inhibitor on water steams in gas phase, mainly depends on moisture degree of gas and density of new and used inhibitor whz injected to gas stream. Calculation is conducted by the help of following formula

$$D_q = \frac{W_1 - W_2}{C_1 - C_2}$$

As $W_1, W_2 -$ is amount of water steams in gas phase until inhibitor is vurulmaq and after it, kg/1000m^3;

$C_1, C_2 -$ density of new and used inhibitor gas injected to gas stream, %mass.

It should be noted that, to find out amount of water in each m^3 of extracted gas (Figure ….) nomogram is used. According to the graphics in balace case of gas, using pressure, temperature and density, amount of water in in each m^3 gas is defined.

Results of works conducted in OGPD showed that density of gases in OGPD fields is 730-735kg/m^3.

Density of technical methanol used for preparation of natural gas for transportation in OGPD is 97% mass. Density of methanol used in technologic system depends on lowering (Δt) hydrate generation temperature of prepared gas and physical-chemical features of alcohol.

Curves of balance parameters in hidrate generation of natural gases

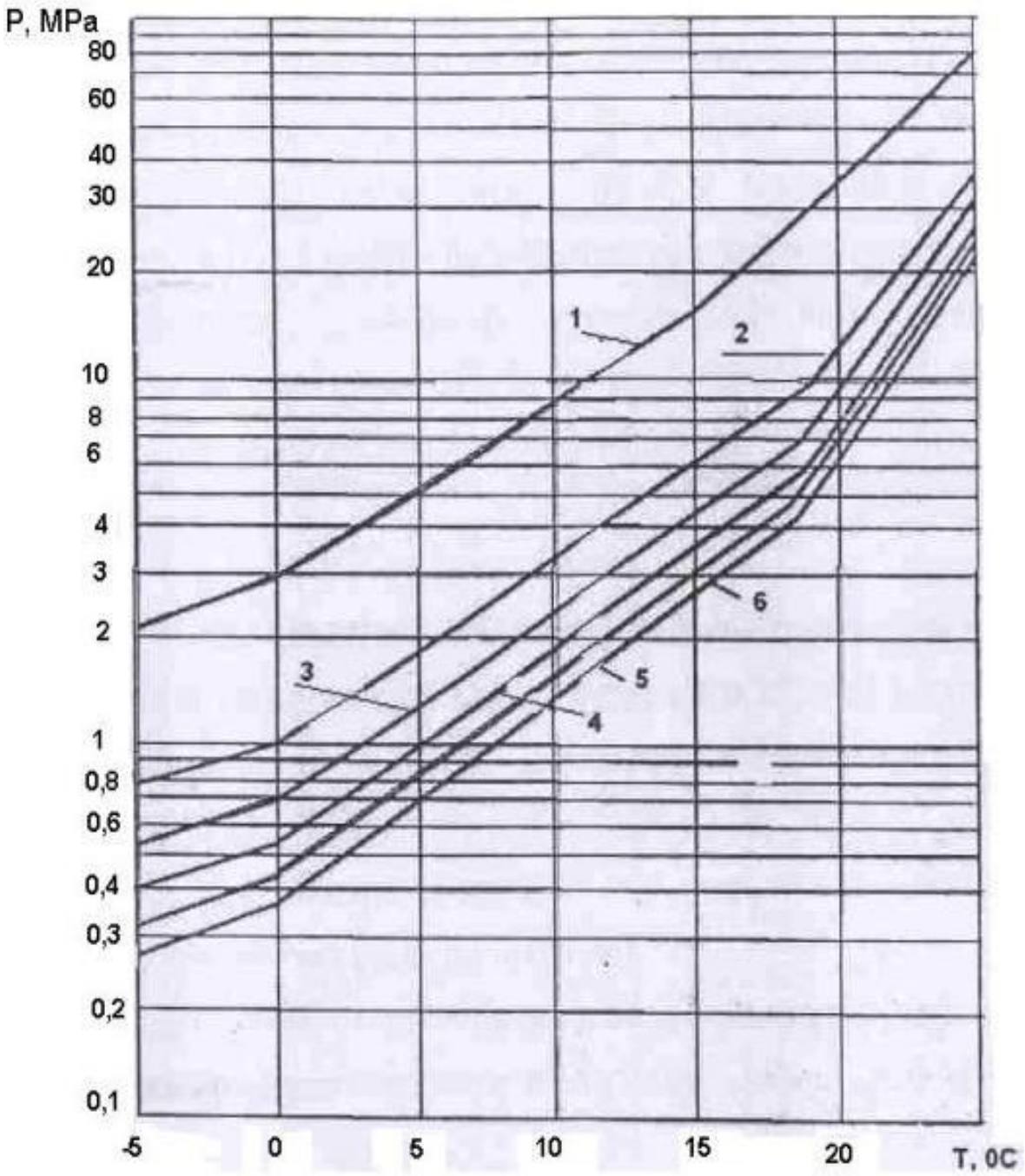


Figure 4.2

1-methan; 2-relative density of gas $\bar{\rho} = 0{,}6$; 3- relative density of gas $\bar{\rho} = 0{,}7$; 4- relative density of gas $\bar{\rho} = 0{,}8$; 5- relative density of gas $\bar{\rho} = 0{,}9$; 6- relative density of gas $\bar{\rho} = 1{,}0$;

According to known values of hidrate generation temperature of gases density of inhibitor from its saturated solution can be defined using following formula:

$$C_2 = \frac{Mx\Delta t}{K + Mx\Delta t}$$

According to scientific-research works conducted in gas condensate wells of OGPD pressure of gas, operated with gaslift and transferred to the shore, in the nouth of well is 3,0-3,3 MPa and temperature is 19-20˚C. Temperature of gas decreases in the entrance of separator for 5-7˚C.

These thermodynamic indicators of gas is appropriate to full hidrate creating condition according to known graphic (Figure 2.2).

Then hydrate creation temperature of gas is defined by following formula according to given values:

$$\Delta T_{qaz} = T_{hid} - T_{hes}$$

ΔT_{qaz}-depression of hydrate creation of gas, ˚C;

T_{hid} – hydrate creation temperature of gas in start point whzın, ˚C;

T_{hes} – temperature of gas in calculation/report point, ˚C.

In last technologic points where calculation/report operation of gas operated with gaslift in OGPD's minings, tempppperature is 5-7˚C.

According to actual indicators seen in mining condition, calculation of decrease of hudrate generation temperature of gas is conducted.

Values are put on their places and following calculation is conducted:

$$\Delta T_{gas} = 19 - 5 = 14°\text{C}$$

Then, hydrate generation temperature of gas should be lowered for 14 C degree. However, taking into consideration factors influencing process during transportation for ensuring transportation without hindrance, hydrate creature temperature should be lowered for some degrees more in the system, i.e. decreasing for 1-2˚C taking into consideration "reserve" temperature.

Water evaporation balance of natural gas with relative density 0.6, moisture keeping nomogram (nomogramma – metric units table applied in different calculation works).

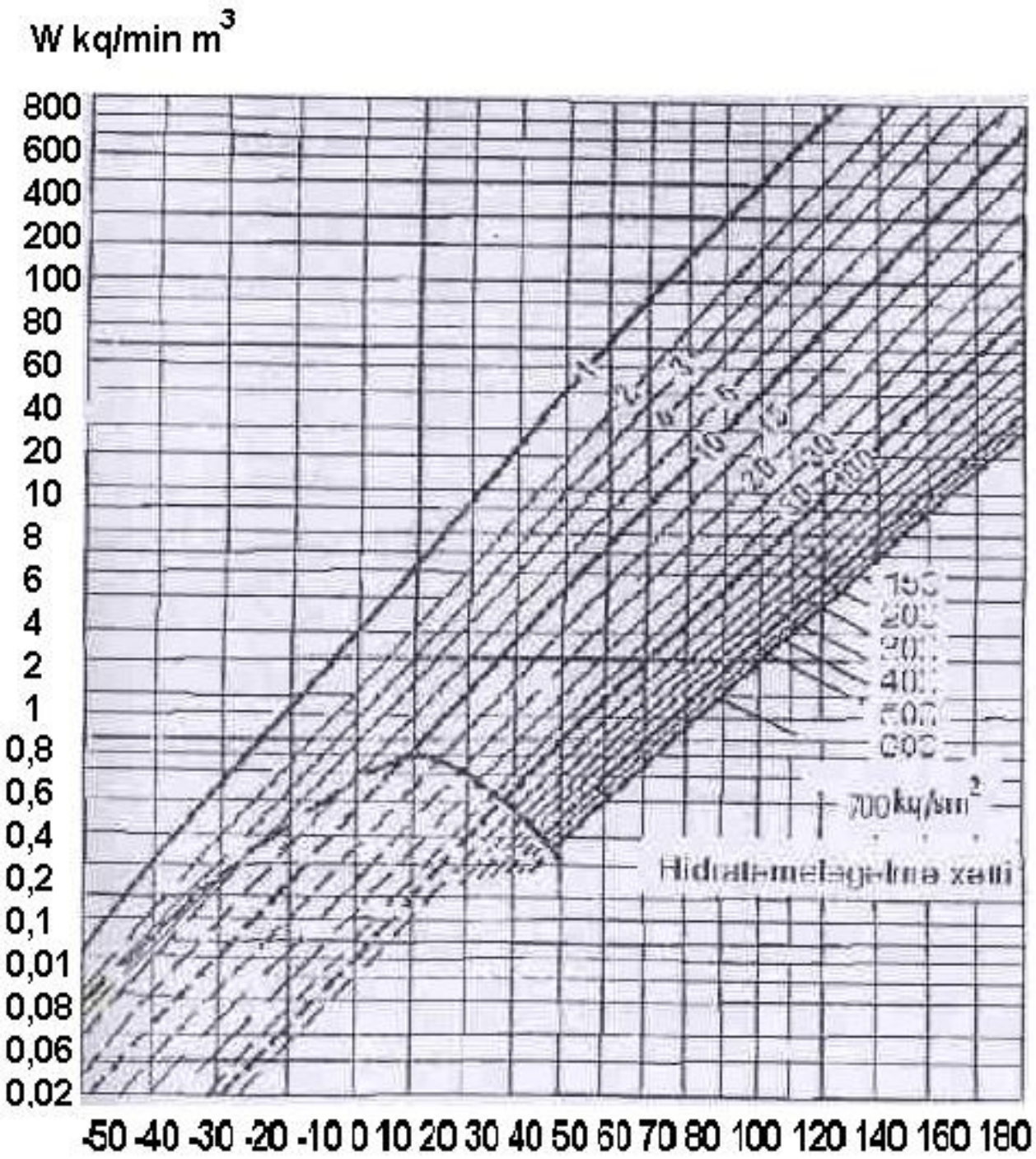


Figure 4.3

Information about faced difficulties and fighting method with them in the normal exploitation of gas condensate wells is written by citing to the information taken from the book E.B.Bukhgalter “Methanol and its useage in gas industry”

For ensuring decreasing given temperature (14-15˚C) it is necessary to define density of methanol in used solution.

By this purpose abovementioned formula is used. If we put given values in the formula to their places:

$$C_2 = \frac{32 \cdot 15}{32 \cdot 15 + 1220} \cdot 100 = 28{,}23\% \text{ mass}$$

Deməli whzın hər iki halda hidrat əmələ gətirmə temperaturunu aşağı salmaq işlədilmiş məhlulda metanolun whtılığı 28,23% kütlə olmalıdır.

Then, in both cases, it is necessary to decrease hydrate creating temperature of gas and density of methanol in used solution should be 28,23%.

According to results of conducted scientific-research works along with report, depending on density of watery solution of methanol decrease of hidrate creation temperature of gas has been defined by dependecen graphic (Figure 2.3).

It is possible to choose necessary density of inhibitor for transportation procces of gas in optimal regime in mine conditions using this graphic.

CHAPTER 5.DETERMINATION OF LIQUID ACCUMULATION TO THE BOTTOM HOLE

Wells exploited in marine conditions operate generally in complex condition. Feature of wells exploiting PalchigPilpilasi field that, these wells are located in open sea, depth of the wells is great, gas extracted from wells should be delivered to shore by its own natural pressure and finally, wells are exploited in the last stage of engineering. Listed features make exploitation conditions difficult. However, these complex conditions are considered as normal conditions of exploitation. If normal condition is violated, it is considered as technological complexities are happening in the wells.

In compiling of report part of graduate work has been cited to information in the book "Technology of production of natural gases" of Mirzajanzade and others.

Different technologic complexities –accumulation of liquid to the bottom of the well, creation of gas hydrates, creation of sand obstructions, settlemenet of the salt in the equipment, corrosion and erosion of equipment, sulashma of the wells and etc. may occur in exploitation of gas-condensate wells.

Issue of accumulation of the liquid to the bottom of the well is investigated and lifting of the waer on the surface by frothing substances is looked through in the graduate work Liquid accumulated to the bottom of the well in mine is taken out by blowing. However, it is not possible to use this method in low values of pressure in deep wellsany more and the sole efficient method remains use of frothing substances.

We calculate whether liquid is accumulated to the bottom of the well during exploitation by the method given below:

1. We calculate termperature in the depth of first row end of tubing. Adopting that T(0)=300K (27˚C), by the following formula, we calculate temperature T in H depth.

$$T = T(0) + 0{,}014829 \cdot H \text{ (K)}$$

H – depth of first row başmağı, m;

T – temperature of bashmaq in the depth of same başma q, K.

2. We calculate $P_{q.d.}$ value of pressure in the depth of first row end of tubing. In case when the well works with space behind the pipe, this pressure can be calculated by following formula:

$$P_{bh} = P_{bp} \cdot e^{S}$$

$$S = \frac{0{,}03415 \cdot \Delta \cdot H}{z_{av} \cdot T_{av}}$$

P_{bp} – pressure behind the pipe, at (when the well does not work with pressure behind the pipe).

But in most cases, because of there liquid column and paker in the well and wells are working with space behind the pipe, approximate value off pressure is calcualated as following. Average value of depression kept in the wells is $\Delta P = P_f - P_{bh} \approx 20at$

3. It can de accepted on a base of mine materials that, pseudocriticial pressure of well product is $P_{p.kr} = 47,2at$ in the well No 1187, and $P_{p.kr} = 47,4at$ in the well №-153. Pseudocritical temperature is subsequently $T_{p.kr} = 206,08K$ and $T_{p.kr} = 197,537K$

4. Pressing ratio of product z_{or} extracted in the depth of first row başmağı. by this purpose, brought pressure $\pi = \frac{P_{av}}{P_{p.kr}}$ and brought temperature $\tau = \frac{T_{av}}{T_{p.kr}}$ values are calculated and depending on these values $z_{or} = z(\pi;\tau)$ is defined.

5. Diameter of lifting pipes in the end of pipe is $d = 2^{1/2"}$.

6. $q'_{\min}$ number is calculated by following formula.

$$q'_{\min} = 115,5 \cdot \frac{d^{2,5}}{z_{av}} \cdot \sqrt{\frac{P_{bh}}{M \cdot T_{bh}}} \; ; \; \frac{10^3 \cdot m^3}{day}.$$

To bring found $q'_{\min}$ production to standard condition

$$q_{\min} = q'_{\min} \cdot \frac{T_0}{T_{bh}} \; ; \; \frac{10^3 \cdot m^3}{day}.$$

Gas production of well providing taking out the liquid from the bottom of the well is thousand m^3/day.

This production is brought to normal atmosphere pressure $P_0 = 101325Pa$ and bottom hole temperature of the well T_{bh}.

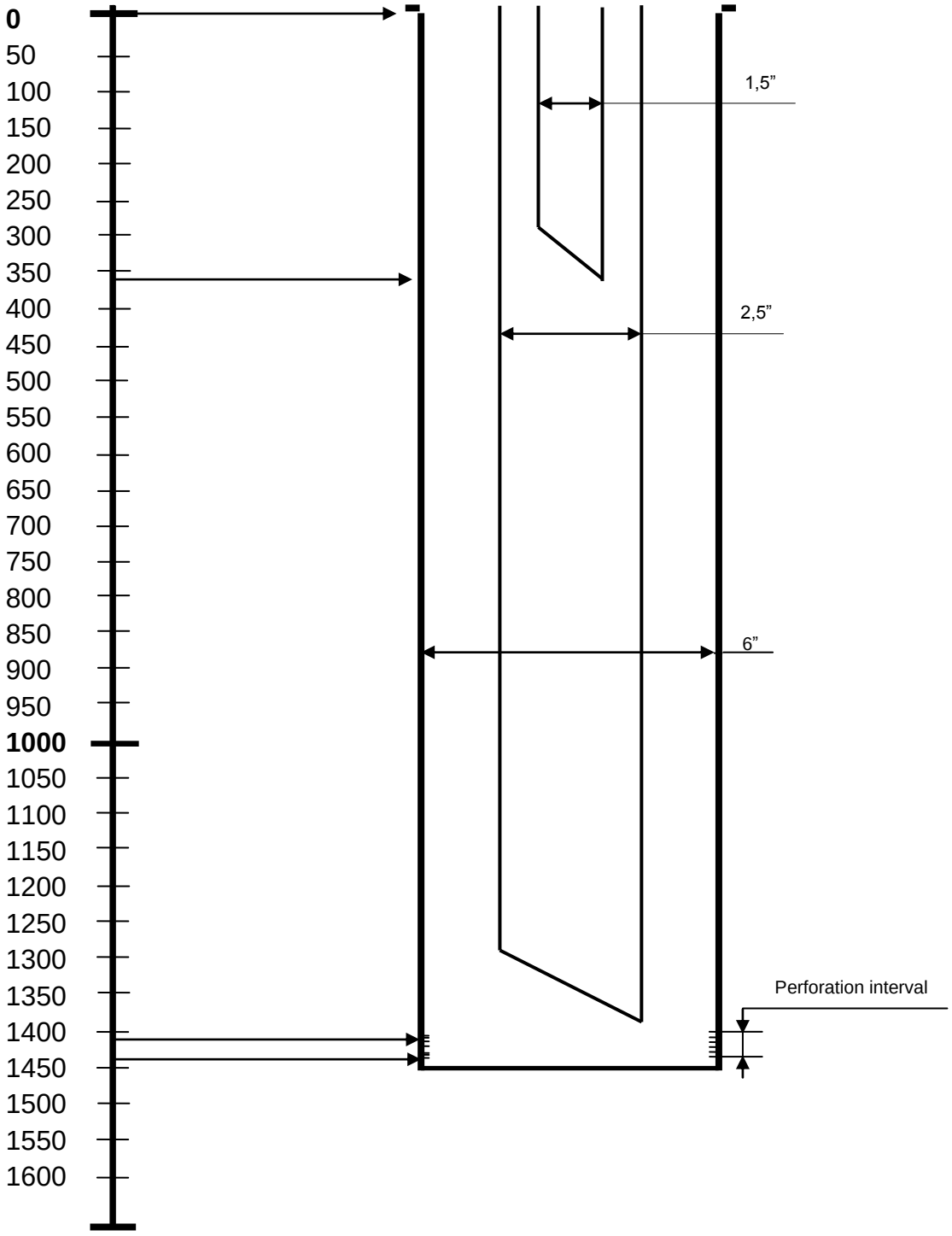
q_{min} – the same production brough to standard temperature (T=293,15K) thousand m^3/day;

M –molecular mass of well product. It is accepted in all approximate affairs as M=18,7.

7. Gas stream speed (W) is calculated according to q_{min} value of gas production in the condition of bottom of the well in lifting pipes.

Technical parameters of the 1187 numbered well

Horizon	productioncasing	H_{bh}(m)	Filter (m)	I row (2,5”)	II row (1,5”)	Q_g (m^3/day)	P_{ba} (at)	P_{wh} (at)
QalD-2	6”	1455	1440-1410	146b=1410 m	36b=358m	80	105	90



Lets watch water is accumulated to the bottom holeof 1187 numbered well or not:

$$\Delta = 0{,}652$$
$$M = 18{,}7$$
$$H = 1455m$$
$$P_{bp} = 105at$$
$$d = 2^{1/2"}$$
$$e^S = e^{0{,}132} = 1{,}141$$

$$P_{1455} = P_{bp} \cdot e^S = 105 \cdot 1{,}141 = 119.8at$$
$$T_{1455} = T_{wh} + 0{,}014829 \cdot H = 300 + 0{,}014829 \cdot 1455 = 321{,}576K$$
$$P_{p.kr} = 47{,}2at$$
$$T_{p.kr} = 206{,}08K$$
$$\pi = \frac{P_{1455}}{P_{p.kr}} = \frac{119{,}8}{47{,}2} = 2{,}538$$
$$\tau = \frac{T_{1455}}{T_{p.kr}} = \frac{321{,}576}{206{,}08} = 1{,}56$$

Lets define pressing ratio in 1455 m by formula using π and τ .

$$z_{1455} = (0{,}4 \lg \tau + 0{,}73)^{\pi} + 0{,}1\pi = (0{,}4 \lg 1{,}56 + 0{,}73)^{2{,}538} + 0{,}1 \cdot 2{,}538 =$$
$$= (0{,}4 \cdot 0{,}193 + 0{,}73)^{2{,}538} + 0{,}2538 = 0{,}81^{2{,}538} + 0{,}2538 = 0{,}586 + 0{,}2538 = 0{,}8398\,\text{V}$$
$$z_{1455} = 0{,}8398$$

Lets calculate $q'_{\min}$ using given and found numbers.

$$q'_{\min} = 115{,}5 \cdot \frac{d^{2{,}5}}{z_{av}} \cdot \sqrt{\frac{P_{bh}}{M \cdot T_{bh}}} = 115{,}5 \cdot \frac{2{,}5^{2{,}5}}{0{,}8398} \cdot \sqrt{\frac{119{,}8}{18{,}7 \cdot 321{,}576}} = 115{,}5 \cdot \frac{9{,}882}{0{,}8398} \cdot \sqrt{0{,}0199} =$$
$$= 1359{,}1 \cdot 0{,}141 = 191{,}633 \frac{10^3 \cdot m^3}{day}$$
$$q'_{\min} = 191{,}6 \frac{10^3 \cdot m^3}{day}$$

Lets use formula given below to bring found production to standard condition:

$$q_{\min} = q'_{\min} \cdot \frac{T_0}{T_{1455}} = 191{,}6 \cdot \frac{300}{321{,}576} = 178{,}74 \frac{10^3 \cdot m^3}{day}$$

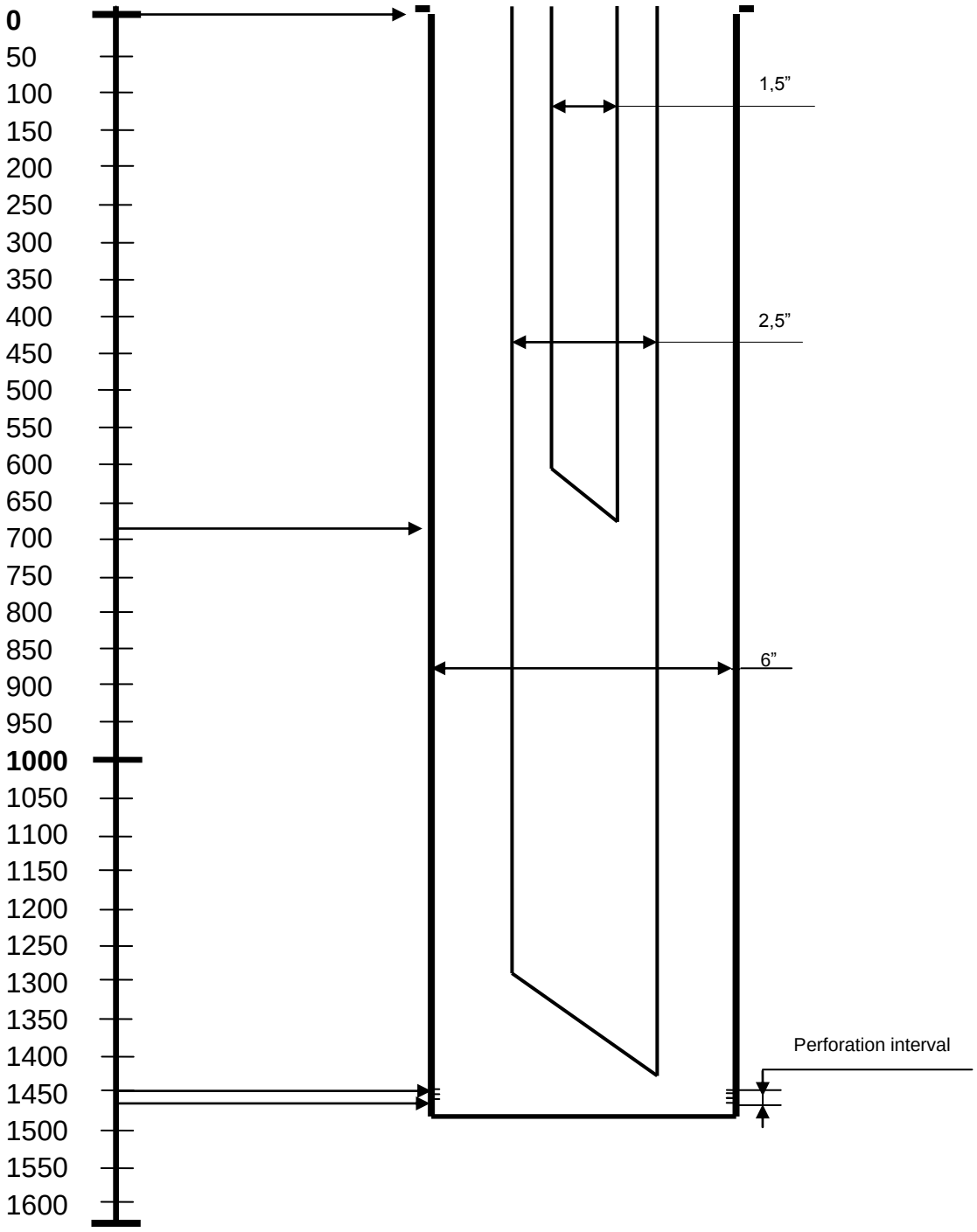
$q_{\min} > q$ i.e. as 178,74>80 is, liquid is accumulated to the bottom of the well.

Lets find speed of gas stream according to q_{min} value of gas production in conditions of bottom of the well in lifting pipes:

$$W = \frac{0{,}52 \cdot q_{\min} \cdot T_{1455} \cdot z_{1455}}{P_{1455} \cdot d^2} = \frac{0{,}52 \cdot 178{,}74 \cdot 321{,}576 \cdot 0{,}839}{119{,}8 \cdot 2{,}5^2} = \frac{25076{,}7}{119{,}8 \cdot 6{,}25} = 33{,}5 \frac{m}{\sec}$$
$$W = 33{,}5 \frac{m}{\sec}$$

Technical parameters of the 1153 numbered well

Horizon	Production casing	H_{bh}(m)	Filter (m)	I row (2,5”)	II row (1,5”)	Q_g (m^3/day)	P_{bp} (at)	P_{wh} (at)
QaLD-2	6”	1470	1460-1450	141b=1445 m	72b=697m	115	98	90



Lets watch water is accumulated to the bottom holeof 1153 numbered well or not:

$$\Delta = 0{,}602$$
$$M = 18{,}7$$
$$H = 1470m$$
$$P_{bp} = 98at$$
$$d = 2^{1/2"}$$
$$e^S = e^{0{,}114} = 1{,}12$$

$$P_{1470} = P_{bp} \cdot e^S = 98 \cdot 1{,}12 = 109{,}76at$$
$$T_{1470} = T_{wh} + 0{,}014829 \cdot H = 300 + 0{,}014829 \cdot 1470 = 321{,}798K$$
$$P_{p.kr} = 47{,}4at$$
$$T_{p.kr} = 197{,}537K$$
$$\pi = \frac{P_{1470}}{P_{p.kr}} = \frac{109{,}76}{47{,}4} = 2{,}316$$
$$\tau = \frac{T_{1470}}{T_{p.kr}} = \frac{321{,}798}{197{,}537} = 1{,}629$$

Lets define pressing ratio in 1470 m by formula using π and τ.

$$z_{1470} = 0{,}4 \lg \tau + 0{,}73^{\pi} + 0{,}1\pi = 0{,}4 \lg 1{,}629 + 0{,}73^{2{,}316} + 0{,}1 \cdot 2{,}316 =$$
$$= 0{,}4 \cdot 0{,}212 + 0{,}73^{2{,}316} + 0{,}2316 = 0{,}815^{2{,}316} + 0{,}2316 = 0{,}8546$$
$$z_{1470} = 0{,}8546$$

Lets calculate $q'_{\min}$ using given and found numbers.

$$q'_{\min} = 115{,}5 \cdot \frac{d^{2{,}5}}{z_{or}} \cdot \sqrt{\frac{P_{q.d.}}{M \cdot T_{q.d.}}} = 115{,}5 \cdot \frac{2{,}5^{2{,}5}}{0{,}8546} \cdot \sqrt{\frac{109{,}76}{18{,}7 \cdot 321{,}798}} = 115{,}5 \cdot \frac{9{,}882}{0{,}8546} \cdot \sqrt{0{,}0182} =$$
$$= 1335{,}56 \cdot 0{,}135 = 180{,}3 \frac{10^3 \cdot m^3}{day}$$
$$q'_{\min} = 180{,}3 \frac{10^3 \cdot m^3}{day}$$

Lets use formula given below to bring found production to standard condition:

$$q_{\min} = q'_{\min} \cdot \frac{T_0}{T_{1470}} = 180{,}3 \cdot \frac{300}{321{,}798} = 168{,}087 \frac{10^3 \cdot m^3}{day}$$

$q_{\min} \succ q$ i.e. as is 168,087>115, liquid is accumulated to the bottom hole.

Lets find speed of gas stream according to q_{min} value of gas production in conditions of bottom of the well in lifting pipes:

$$W = \frac{0{,}52 \cdot q_{\min} \cdot T_{1470} \cdot z_{1470}}{P_{1470} \cdot d^2} = \frac{0{,}52 \cdot 168{,}087 \cdot 321{,}798 \cdot 0{,}8546}{109{,}76 \cdot 2{,}5^2} = \frac{17075{,}44}{109{,}76 \cdot 6{,}25} = 35{,}04 \frac{m}{\sec}$$
$$W = 35{,}04 \frac{m}{\sec}$$

CHAPTER 6.CALCULATION OF STATIC AND DYNAMIC BOTTOM HOLE PRESSURE

6.1 Calculation of static bottom hole pressure in wells № 1187 and 1153

Primarily, we calculate average density of product in the report.

Calculation of average density of product

We accept that, density of extracted commodity gas in standard condition is $\rho_{gas} = 0{,}7153 kq/m^3$, molecular mass of condensate is $M_k = 150$.

Adopting product of well as assumptive gas, we calculate its density ρ_c, relative density in relation to the air (Δ).

For the well №1187

$$\rho_c = \frac{q_g \cdot \rho_g + g_k + g_w}{q_q + 24{,}055\left(\frac{g_k}{M_k} + \frac{g_w}{M_w}\right)} = \frac{80 \cdot 0{,}7153 + 6{,}6 + 1{,}4}{80 + 24{,}055 \cdot \left(\frac{6{,}6}{150} + \frac{1{,}4}{18}\right)} = 0{,}786 kq/m^3$$

Lets calculate relative density of carbohydrogen mixture:

$$\Delta = \frac{\rho_c}{\rho_{air}} = \frac{0{,}786}{1{,}205} = 0{,}652$$

1. Calculation of pseudocritical parameters of mixture:

$$P_{p.kr} = 49{,}885 - 4{,}128 \cdot \Delta = 49{,}885 - 4{,}128 \cdot 0{,}652 = 47{,}2 at$$

$$T_{p.kr} = 94{,}717 + 170{,}80 \cdot \Delta = 94{,}717 + 170{,}80 \cdot 0{,}652 = 94{,}717 + 111{,}3616 = 206{,}08 K$$

Calculation of average/Orta and brought pressures:

Lets accept depth of the well like that:

$$H = \frac{1440 + 1410}{2} = 1425 m$$

$$T_{wh} = 300 K (27°C)$$

$$t_{wh} = 27 + 0{,}014 \cdot H = 27 + 0{,}014 \cdot 1425 = 46{,}95°C$$

$$T_{bh} = 273 + 46{,}95 = 319{,}95 K$$

$$T_{av} = \frac{T_{wh+} T_{bh}}{2} = \frac{300 + 319{,}95}{2} = 309{,}975 K$$

$$\tau = \frac{T_{av}}{T_{p.kr}} = \frac{309{,}975}{206{,}08} = 1{,}504$$

2. Calculation of average and brought pressures:

$$P_{bp} = P_2 = 105at$$
$$P_{bh} = P_1 = 183at$$
$$P_{av} = \frac{2}{3}\left(P_1 + \frac{P_2^2}{P_1 + P_2}\right) = \frac{2}{3}\cdot\left(183 + \frac{105^2}{183 + 105}\right) = 147.52at$$
$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{147.52}{47,2} = 3,125$$

We define pressing ratio z from Braun-Kats curves using brought pressure and temperature values.

$$z_{av} = 0,77$$

Calculation of the pressure of the bottom of the well

Primarily, we are calculating S number:

$$S = \frac{0,03415\cdot\Delta\cdot H}{z_{av}\cdot T_{av}} = \frac{0,03415\cdot 0,652\cdot 1455}{0,77\cdot 309,975} = 0,136$$
$$e^s = e^{0,136} = 1,145$$
$$P_{1455} = P_{bp}\cdot e^s = 105\cdot e^{0,136} = 120.225at \approx 120.2at$$

As estimated values of the pressures, differ from accepted value, calculation of second approach is conducted.

$$P_{av} = \frac{2}{3}\cdot\left(120.2 + \frac{11025}{120.2 + 105}\right) = 112.77at$$
$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{112.77}{47,2} = 2,389$$
$$\tau = 1,504$$
$$z_{av} = 0,79$$
$$S = \frac{0,03415\cdot\Delta\cdot H}{z_{av}\cdot T_{av}} = \frac{0,03415\cdot 0,652\cdot 1455}{0,79\cdot 309,975} = 0,132$$
$$e^s = e^{0,132} = 1,141$$
$$P_{1455} = P_{bp}\cdot e^s = 105\cdot e^{0,132} = 119.8at$$

As estimated values of the pressures, differ from accepted value, calculation of third approach is conducted.

$$P_{av} = \frac{2}{3} \cdot \left(119.8 + \frac{105}{119.8 + 105} \right) = 112.56at$$

$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{112.56}{47,2} = 2,385$$

$$\tau = 1,504$$

$$z_{av} = 0,79$$

$$S = \frac{0,03415 \cdot \Delta \cdot H}{z_{av} \cdot T_{av}} = \frac{0,03415 \cdot 0,652 \cdot 1455}{0,79 \cdot 309,975} = 0,132$$

$$e^s = e^{0,132} = 1,141$$

$$P_{1455} = P_{bp} \cdot e^s = 105 \cdot e^{0,132} = 119.8at$$

Reiterative calculations show that value of pressure does not change any more.

Lets calculate z with the formula to check correctiveness of Z ratio:

$$\pi = 2,385$$

$$\tau = 1,504$$

$$z = 0,4 \lg \tau + 0,73^{\pi} + 0,1\pi = 0,4 \lg 1,504 + 0,73^{2,385} + 0,1 \cdot 2,385 =$$

$$0,4 \cdot 0,177 + 0,73^{2,385} + 0,2385 = 0,8^{2,385} + 0,2385 = 0,587 + 0,2385 = 0,825$$

$$z_{av} = 0,825$$

For the well No 1153

$$\rho_c = \frac{q_g \cdot \rho_g + g_k + g_w}{q_q + 24,055\left(\frac{g_k}{M_k} + \frac{g_w}{M_w} \right)} = \frac{115 \cdot 0,7153 + 1,2 + 4,7}{115 + 24,055 \cdot \left(\frac{1,2}{150} + \frac{4,7}{18} \right)} = 0,7257kq/m^3$$

Lets calculate relative density of carbohydrogen mixture:

$$\Delta = \frac{\rho_c}{\rho_{air}} = \frac{0,7257}{1,205} = 0,602$$

3. Calculation of pseudocritical parameters of mixture:

$$P_{p.kr} = 49,885 - 4,128 \cdot \Delta = 49,885 - 4,128 \cdot 0,602 = 47,4at$$

$$T_{p.kr} = 94,717 + 170,80 \cdot \Delta = 94,717 + 170,80 \cdot 0,602 = 94,717 + 102,82 = 197,537K$$

4. Calculation of average/Orta and brought temoperatures:

Lets accept depth of the well like that:

$$H = \frac{1460 + 1450}{2} = 1455$$

$$T_{wh} = 300K(27°C)$$

$$t_{wh} = 27 + 0{,}014 \cdot H = 27 + 0{,}014 \cdot 1455 = 47{,}37°C$$
$$T_{wh} = 273 + 47{,}37 = 320{,}37K$$

$$T_{av} = \frac{T_{wh+}T_{bh}}{2} = \frac{300 + 320{,}37}{2} = 310{,}185K$$
$$\tau = \frac{T_{av}}{T_{p.kr}} = \frac{310{,}185}{197{,}537} = 1{,}57$$

5. Calculation of average and brought pressures:

$$P_{bp} = P_2 = 98at$$
$$P_{bh} = P_1 = 183at$$
$$P_{av} = \frac{2}{3}\left(P_1 + \frac{P_2^2}{P_1 + P_2}\right) = \frac{2}{3} \cdot \left(183 + \frac{98^2}{183 + 98}\right) = 144.78at$$

$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{144.78}{47{,}4} = 3{,}054$$

We define pressing ratio z from Braun-Kats curves using brought pressure and temperature values.

$$z_{av} = 0{,}825$$

Calculation of pressure in the bottom of the well

Primarily, we calculate S number:

$$S = \frac{0{,}03415 \cdot \Delta \cdot H}{z_{av} \cdot T_{av}} = \frac{0{,}03415 \cdot 0{,}602 \cdot 1455}{0{,}825 \cdot 310{,}185} = 0{,}117$$

$$e^s = e^{0{,}117} = 1{,}124$$
$$P_{1470} = P_{bp} \cdot e^s = 98 \cdot e^{0{,}117} = 110.152at$$

As estimated values of the pressures, differ from accepted value, calculation of second approach is conducted.

$$P_{av} = \frac{2}{3} \cdot \left(110.152 + \frac{9604}{110.152 + 98}\right) = 104.194at$$
$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{104.194}{47{,}4} = 2.198$$
$$\tau = 1{,}57$$
$$z_{av} = 0{,}846$$

$$S = \frac{0{,}03415 \cdot \Delta \cdot H}{z_{or} \cdot T_{or}} = \frac{0{,}03415 \cdot 0{,}602 \cdot 1455}{0{,}846 \cdot 310{,}185} = 0{,}114$$

$$e^s = e^{0{,}114} = 1{,}12$$
$$P_{1470} = P_{bp} \cdot e^s = 98 \cdot e^{0{,}114} = 109.76at$$

As estimated value of pressures differs from accepted value, calculation of third approach is conducted.

$$P_{av} = \frac{2}{3} \cdot \left(109.76 + \frac{9604}{109.76 + 98} \right) = 103.99 at$$

$$\pi = \frac{P_{av}}{P_{p.kr}} = \frac{103.99}{47,4} = 2.194$$

$$\tau = 1,57$$

$$z_{av} = 0,847$$

$$S = \frac{0,03415 \cdot \Delta \cdot H}{z_{av} \cdot T_{av}} = \frac{0,03415 \cdot 0,602 \cdot 1455}{0,847 \cdot 310,185} = 0,114$$

$$e^s = e^{0,114} = 1,12$$

$$P_{1470} = P_{bp} \cdot e^s = 98 \cdot e^{0,114} = 109.76$$

Reiterated calculations show that value of pressure does not change any more.

Lets calculate with Z-formula to check correctness of Z ratio:

$$\pi = 2.194$$

$$\tau = 1,57$$

$$z = (0,4 \lg \tau + 0,73)^{\pi} + 0,1\pi = (0,4 \lg 1,57 + 0,73)^{2.194} + 0,1 \cdot 2.194 =$$

$$(0,4 \cdot 0,196 + 0,73)^{2.194} + 0.2194 = 0,81^{2.194} + 0,2194 = 0,63 + 0,2194 = 0,8494$$

$$z_{av} = 0,8494$$

6.2 Calculation of dynamic bottom hole pressure in wells № 1187 and 1153

We should define bottom hole pressure of 2.5” pipes for calculating dynamic pressure in the well No 1187.

Values of hydraulic resistance coefficient of pipes in gas wells

D_{int}, with "	$6^{5/8"}$	$5^{3/4"}$	$4^{3/4"}$	4"	3"	$2^{1/2"}$
D_{int}, mm	148	126	105	100,3	75,9	62
Λ	0,020	0,020	0,022	0,022	0,024	0,025

Let’s calculate pressure in 1455 meters depth by Adamov formula shown below using $\lambda = 0,025$ for 2,5” pipes and D_{int}=62mm=6,2cm and production of the well No 1153 $Q_{gas} = 115 \frac{10^3 \cdot m^3}{day}$:

$$P_{1455}^{-} = \sqrt{P_{wh}^2 \cdot e^{2S} + 1{,}377 \cdot \lambda \cdot \frac{Q_g^2 \cdot z_{av}^2 \cdot T_{av}^2}{D^5} \cdot \left(e^{2S} - 1\right)}$$

Lets calculate pressure in the bottom of the well in 1455 meters depth for 2,5" pipes in the well No1187. Lets define temperature at the end of 2,5" pipe using empirical formula of temperature depending on height:

$\lambda = 0{,}025$

$D_{\text{int}} = 62mm = 6{,}2cm$

$t_{bh} = 27 + 0{,}014 \cdot H = 27 + 0{,}014 \cdot 1455 = 47{,}37°C$

$T_{bh} = 273 + 47{,}37 = 320{,}37K$

$T_{wh} = 300K$

$T_{av} = \frac{T_{wh} + T_{bh}}{2} = \frac{300 + 320{,}37}{2} = 310{,}185K$

$P_{av} = 112{,}56at$ let's adopt.

$P_{p.kr} = 47{,}2at$

$T_{p.kr} = 206{,}08K$

$\pi = \frac{112{,}56}{47{,}2} = 2{,}385$

$\tau = \frac{310{,}185}{206{,}08} = 1{,}505$

$z_{av} = 0{,}795$

$S = \frac{0{,}03415 \cdot 0{,}652 \cdot 1455}{0{,}795 \cdot 310{,}185} = 0{,}13$

$$P_{1455}^{-} = \sqrt{112{,}56^2 \cdot e^{0{,}26} + 1{,}377 \cdot 0{,}025 \cdot \frac{6400 \cdot 0{,}632 \cdot 96214{,}7}{9161{,}328} \cdot \left(e^{0{,}26} - 1\right)} =$$

$$= \sqrt{12669{,}15 \cdot 1{,}296 + 432{,}858} = \sqrt{16852{,}1} = 129{,}8at \approx 130at$$

$P_{1455} = 140.3at$

As estimated value of the pressure differs from accepted value, calculation of second approach is conducted.

$$P_{av}^{2} = \frac{2}{3}\cdot\left(130 + \frac{112.56^2}{130+112.56}\right) = 121{,}49at$$

$$\pi = \frac{121{,}49}{47{,}2} = 2{,}574$$

$$\tau = 1{,}505$$

$$z_{av} = 0{,}786$$

$$S = \frac{0{,}03415\cdot 0{,}652\cdot 1455}{0{,}786\cdot 310{,}185} = 0{,}133$$

$$P_{1455}^{2} = \sqrt{121{,}49^2\cdot e^{0{,}266} + 1{,}377\cdot 0{,}025\cdot\frac{6400\cdot 0{,}618\cdot 96214{,}7}{9161{,}328}\cdot\left(e^{0{,}266}-1\right)} =$$

$$= \sqrt{14759{,}8\cdot 1{,}304 + 434{,}71} = \sqrt{19681{,}49} = 140{,}29at \approx 140.3at$$

$$P_{1455} = 140.3at$$

We should define bottom pressure of 2.5” pipes in 1470 meters for calculating dynamic pressure in the well No 1153.

Values of hydraulic resistance coefficient of pipes in gas wells

D_{int}, with "	$6^{5/8"}$	$5^{3/4"}$	$4^{3/4"}$	4"	3"	$2^{1/2"}$
D_{int}, mm	148	126	105	100,3	75,9	62
Λ	0,020	0,020	0,022	0,022	0,024	0,025

Let’s calculate pressure in 1470 meter depth by Adamov formula shown below using $\lambda = 0{,}025$ for 2,5” pipes and D_{int}=62mm=6,2cm and production of the well No 1153 $Q_{gas} = 115\frac{10^3\cdot m^3}{day}$:

$$P_{1455}^{2} = \sqrt{P_{wh}^2\cdot e^{2S} + 1{,}377\cdot\lambda\cdot\frac{Q_g^2\cdot z_{av}^2\cdot T_{av}^2}{D^5}\cdot\left(e^{2S}-1\right)}$$

Lets calculate pressure in the bottom of the well in 1470 meter depth for 2,5”pipes in the well No1153. lets define temperature at the end of 2,5” pipe using empirical formula of temperature depending on height:

$$\lambda = 0{,}025$$

$$D_{int} = 62mm = 6{,}2cm$$

$$t_{bh} = 27 + 0{,}014 \cdot H = 27 + 0{,}014 \cdot 1470 = 47{,}58°C$$

$$T_{bh} = 273 + 47{,}58 = 320{,}58K$$

$$T_{wh} = 300K$$

$$T_{av} = \frac{T_{wh} + T_{bh}}{2} = \frac{300 + 320{,}58}{2} = 310{,}3K$$

$P_{av} = 104at$ let's adopt.

$$P_{p.kr} = 47{,}4at$$

$$T_{p.kr} = 197{,}537K$$

$$\pi = \frac{104}{47{,}4} = 2{,}2$$

$$\tau = \frac{310{,}3}{197{,}537} = 1{,}57$$

$$z_{av} = 0{,}848$$

$$S = \frac{0{,}03415 \cdot 0{,}602 \cdot 1470}{0{,}848 \cdot 310{,}3} = 0{,}115$$

$$P_{1470} = \sqrt{104^2 \cdot e^{0{,}23} + 1{,}377 \cdot 0{,}025 \cdot \frac{13225 \cdot 0{,}72 \cdot 96286{,}1}{9161{,}328} \cdot \left(e^{0{,}23} - 1\right)} =$$

$$= \sqrt{10816 \cdot 1{,}257 + 885.4} = \sqrt{14481{,}1} = 120{,}3at \approx 120at$$

$$P_{1470} = 120at$$

As estimated value of the pressure differs from accepted value, calculation of second approach is conducted.

$$P_{av} = \frac{2}{3} \cdot \left(120 + \frac{104^2}{120 + 104}\right) = 112{,}2at$$

$$\pi = \frac{112{,}2}{47{,}4} = 2{,}37$$

$$\tau = 1{,}57$$

$$z_{av} = 0{,}83$$

$$S = \frac{0{,}03415 \cdot 0{,}602 \cdot 1470}{0{,}83 \cdot 310{,}3} = 0{,}117$$

$$P_{1470} = \sqrt{120^2 \cdot e^{0{,}234} + 1{,}377 \cdot 0{,}025 \cdot \frac{13225 \cdot 0{,}689 \cdot 96286{,}1}{9161{,}328} \cdot \left(e^{0{,}234} - 1\right)} =$$

$$= \sqrt{14400 \cdot 1{,}263 + 867{,}1} = \sqrt{19054{,}3} = 138at$$

$$P_{1470} = 138at$$

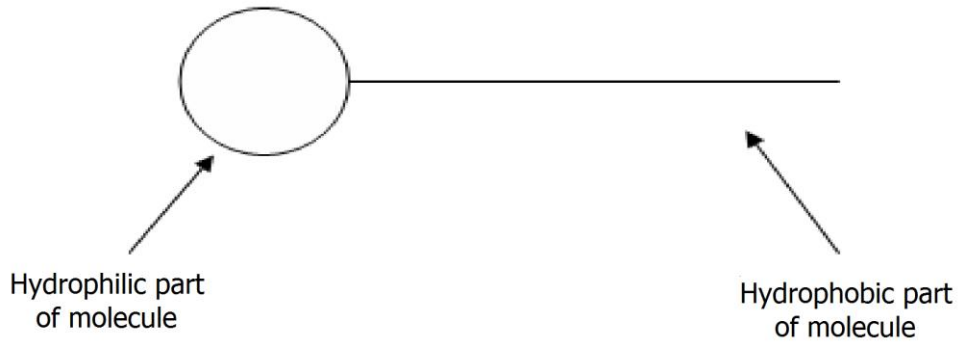
CHAPTER 7.APPLICATION OF SURFACTANTS AND FOAMING SUBSTANCES IN GAS AND GAS-CONDENSATE WELLS

If surfactants mixed to multyyphased systems, accumulating in touch point between phases, diminishes surface stretching between phases. Even slight addition of surfactants may cause to high result.

Organic combinations with diphyl (polar) structure (molecules of this combinations consists of hydrophyl and hydrofob atomic groups) are typical surfactants. Hydrophyl group of the same molecules due to their features tends to water molecules and hydrofob group is directed to the side of organic substances because they are avid of organic solvents.

Surfactant molecule is marked as R-OH. R is hydrofob group of SURFACTANT molecule called radical. Carboxyl group- COOH, sulphate group (-OSO_3-), sulphanate group (-SO_3), hydroxil group (-OH) of surfactant molecule are hydrophil part of that molecule. Hydrofob part of surfactant molecule can be organized from paraffin chain (carbohydrogenradicalı (C_HH_{2n-1}), this radical is marked with R; paraffin chain may be ramified or unramified), benzol having alkyl radical and naphthalene rings.

Surfactant molecule is expressed in diagram form as below:



When surfactant molecules are solved in multyphased system, they are directed in surfaces separatin phases as followings: hydrophil groups of surfactant molecules are directed to the water phase of system, hydrofob groups-to the gas and carbohydrogen phases. Such kind of directing dramatically change stretching between phases and man uses surfactants can be used as soakers, frothing substances, hydrofobizers, dispergators, emulgators and demilgators.

Surfactants are divided to anionactive, cationactive, non-ionogen at amphoter (ampholit) substances due to their chemical features.

Anionactive substances are solved in the water and divided into cations (ions with positive charge) and anions (ions with negative charges). Anions here are parts of

surfactantmolecule, carrying surface active features. Cations in cationactive substances are parts of molecule, carrying surface active features.

Non-ionogen substances are dissociated (divided into ions) in water molecules. Molecules of these substances take part in the process as whole units.

There are both anionactive and cationactive substances in the composition of combinations of amphoteric surfactants and their influence depend on pH indicator of the system.

surfactants are adsorbed in surface layers separating phases from each other in 2 phased systems and diminish surface stretch between phases dramatically. Even small amount of surfactant is satisfactory for it. Using this feature of surfactants, these substances are used as frothing substances and emulgators. They are also used in contrary processes to these-in eliminating froth and dismulsation (dividing emulsions).

Features of surfactants used as frothing substances depends on their chemical nature. Molecule of these surfactants increases as length of its radicals and molecular mass of non-ionogen surfactants increase. Anologic features are observed in cationactiive and atmosphere surfactants, but these surfactants have been researched in a lower degree.

Concentration of surfactant in gas-liquid system strongly influences to frothing system. Often, increase of surfactant concentration until certain degree suddenyl, surfactant causes increase of frothing ability, after certain limit on the contrary, it leads to its increase. In complex composition of surfactants, sometimes it is not felt.

As temperature of solution increases, surfactant's frothing ability decreases. When temperature of anionactive surfactant solutions decreases, foamforming ability increases until certain temperature, and then begins to decrease. After the temperature of unionogen surfactant solutions reach getting turbid temperature, foam forming ability dramatically decreases.

Fatty acids and alkali salts practically frothes in acid phase. Maximum foam forming ability of fatty acids are observed in pH=8÷9 figures, for salts of these acids in pH≥9 figures.

Foam forming ability of Alkinsulfonats is decreased in pH≥12 figures. Almost it is not dependent in pH value of foam forming ability of non-ionogen surfactants.

As surface stretching of surfactant solution decreases, its frothing ability increases. Some supplementaries (for example, phosphors, sodium-in hard phases) increases frothing ability.

The more temperature of carboxyl methyl cellulose solutions increases the more frothing ability increases, however, concentration of methyl cellulose should not be high. To

enhance foam forming ability of surfactant s, polifanolamids, solvable in the water, of mono and difanolamids, fatty acids, some fatty alcohols and ethers of glycerine are added. Compositions of surfactant s give good texhnological effect. Foam is a part of disperse system. Foam is disperce system with high concentration and its disperse form consists of gas and dispersion phase is liquid. Foam-is special gas-liquid system. Existance of third componenct is certainly important for forming of foam and this component issurfactant. surfactant is used here as a foam forming substance. Liquid without surfactant cannot create durable foamy system.

Physical features of some surfactants are shown in the Table.

Foam forming ability of surfactant s (in 20˚C temperature)

Table 8.1.

SURFACTANT	Concentration, %	Foam forming ability(with mm) of SURFACTANT during given time (with minutes)			
		0	3	5	10
Sulphonate	0,5 0,25 0,125	425 400 370	345 305 270	335 290 255	260 250 230
(Pasta)-DİS-A	0,15 0,25 0,062	212 150 188		146 100 135	146 96 135
Sulphonol	0,5 0,25 0,125	400 368 338	400 368 338	310 306 283	296 295 268
Alkalyun 2D	5*	380	290	285	285
Laurilpridniysulfat	1,25* 2,50* 5,0*	160 320 370	140 190 260	140 260 300	140 260 290
OC-20	1,25* 2,50* 5,0*	170 250 315	150 180 220	110 180 250	110 160 240
OP-7	1,25* 2,50* 5,0*	205 230 290	150 180 220	1580 150 160	40 40 60
OP-10	1,25* 2,50* 5,0*	230 290 310	180 240 260	160 180 200	60 60 60

7.1General characteristics of foam system

Structure of foam is shown in the scheme in the figure. The foam is consists of polyedric cores, its structure is like honeycomb. Insides of cores are gaseous, thin walls is liquid. Gas phase prevails than liquid phase. Gas phase and liquid phase of foam are not free phases- their motion is closely related to each other and foam acts as homogenous system during motion. This system is very light system, as most of it consists of gas. Relatively close location of phases to each other (compact) may occur only in certain relations of liquid and gas. In foamy system gas core can freely move neither vertically nor horizontal directions. Space of foamy system (construction like honeycomb) is created willfully by itself. Parts forming walls of the cores create angles equal to 120^o. Composition like that requires minimum surface energy and ensures high durability of foamy system.

As it is shown in the figure molecules of foam forming surfactant are located in the liquid phase of the system. Polar groups of these molecules are directed to the side of water phase, i.e. they are adapted in the layers separating the phases and form strong hydrat layer and this hydrat layer forms unique hull.

As we stated, foamy system has 2 phases. In most cases liquid phase is consisted of water . Let's note some features of water.

According to its chemical composition pure water consists of 11.19% hydrogen and 88.81 % oxygen and it is appropriate to H_2O formula of the water. But, water is not simple combination. Due to its composition and structure, water is a combination with complex structure. Besides neutral water molecules, there is N^+, OH^-, H_3O^+ occurred from electric dissociation in the water. Often these particles are chaoticly spread in the system, i.e. they do not distributed in a certain rule.

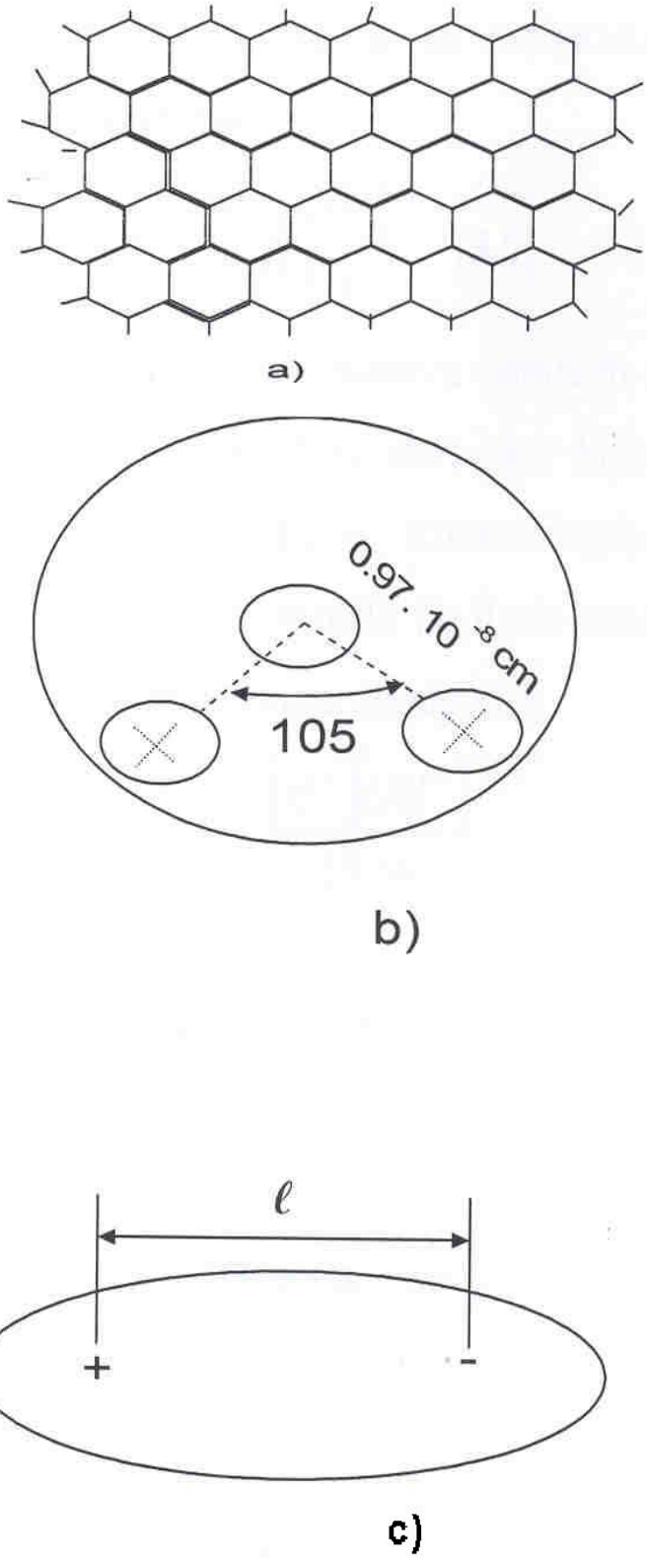
Structure of molecule is nonlinear structure. In these molecules hydrogen atoms located under 105 degree angle in relation to oxygen atoms (Figure 9.1). Thus, hydrogen ions and oxygen ion are located symmetrically in the water molecule, i.e. water molecule is dipole molecule-it has 2 molecules. Edges of water molecule have different charges: hydrogen ion edge has positive charge, oxygen ion edge has negative charge.When such molecules enters to electric field, they are directed to appropriate side. If the space between positive charge (+e) in the molecule and negative charge (-e) is ℓ olarsa, then $\mu = e \cdot \ell$ is called dipole moment of the molecule. Molecules which are constant in dipole moment are called polar, and which are not constant are called apolar (nonpolar) molecules.

Interval between positive and negative charges in water molecule, ℓ is relatively great. Therefore, dipole moment of water molecules is bigger than molecules of substances and is

equal to $\mu = 1{,}84 \cdot 10^{-18}$ electrical unit. As dipole moment is high, each substance being in contact with the water is affected by the water. For instance, most part of minerals are solved in the water in different degree if remained under the influence of the water during a long time.

In cases, when intermolecule gravitation of soluble substance is less than intermolecule gravitation of water, soluble substance is divided not only to molecules, but alson ions. Ions in their turns get in touch with molecules. In a result, new particles emerged. For instance, when mineral is solved in the water, it influences to Na^{2+}və Cl^{-1} surface ions. Directed water dipoles are located around of each ion (Figure 9.1).

Each ion surrounded with water molecules (it is called hydration of ions) pass to the solution. This kecid process continues until it reaches solving level and solution is saturated in comparision with Na^{+}vəCl^{-} ions.



Picture 9.1

Water molecule is dissociated to Hydrogen ion H^+ and hydroxyl OH^- ion:

$$H_2OH^+ \rightleftharpoons OH^-$$

According to affecting masses, this feature of water molecule is expressed with dissociation constant K:

$$K = \frac{[H^+] \cdot [OH^-]}{[H_2O]}$$

Figure of dissociation constant K in 25°C temperature of water is $K = 1{,}8 \cdot 10^{-16}$. As H^+ and OH^- ions concentrations are very small, concentration of undissociated water molecules can be considered as constant. If we express the surfactante concentration with mol/litre, it is identified from above formula that, concentrations of H^+və OH^- ions are found in

$$K = \frac{[H^+] \cdot [OH^-]}{55{,}56}$$

form.

$$55{,}56 \cdot K = [H^+] \cdot [OH^-] \text{ and}$$

$$H_2O = \frac{1000}{18} = 55{,}56$$

After putting the figure of dissociation constant is

$$55{,}56 \cdot 1{,}8 \cdot 10^{-16} = 10^{-14}$$

$$[H^+] \cdot [OH^-] = 10^{-14} = K_w \ .$$

Thus, sum of $[H^+]$ $[OH^-]$ concentrations of free ions is constant figure in constant temperature.

This figure is called ion sum of the water and is marked with K_{su}. K_{su}.figure is 55.56 times smaller than K figure.

In pure water and neutral solutions:

$$[H^+] = [OH^-] = \sqrt{K_w} = \sqrt{10^{-14}} = 10^{-7}\left(\frac{mol}{litr}\right)$$

Concentration of hydrogen ions $[H^+]$ in sour solutions is bigger than 10^{-7} figure and is smaller than 10^{-7} figure in alkali solutions.

By the purpose of not to express concentration of hydrogen ions $[H^+]$ with negative power, it is expressed with hydrogen indicator pH. The surfactante pH indicator is equal to negative decimal logariphm of concentration of hydrogen ions and is written as below:

$$-\ell g\,[H^+] = pH$$

For instance: $[H^+] = 10^{-4}$ is

will be $pH = -\ell g [H^+] = -\ell g 10^{-4} = 4$

pH indication is expressed with small figures should be:

neutral medium pH=7

in acidic medium pH<7

alkali medium pH>7

CONCLUSIONS

Decrease reasons of oil and gas production in NeftDashlari and PalchigPilpilasi fields have been identified and sone offers for optimizing of engineering regimes of fields have been put forward:

1. Liquid accumulated to the bottom of the well influence the layer contrarily, diminish depression, pressure in he bottom of the well is increased, production is decreased, pressures in the mouth of the well are diminished and normal exploitation regime of the well is destructed.

2. Accumulation or not accumulation of liquid in gas and gas-condensate wells, exploiting WhlD-2 horizon has been checked using Johns formula. Calculation is conducted for gas and gas-condensate wells № 1153 and 1187. It was clear that, liquid is accumulated to the bottom of both lines of 1153 and 1187.

3. Liquid accumulated to the bottom of well in gascondensate wells is pulled out using blowing method. However, in some cases, because of smallness of layer pressure it is not possible to use this method.

4. The most appropriate method for optimizing engineering regim in stated fields is the method of using frothing substances.

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