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**SCIENCE AND TECHNOLOGY**

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**PROBLEM OF TECHNOGENIC INFLUENCE  
ON NATURAL PROCESSES ACTIVISATION**

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Previous publications<sup>1</sup> presented data on changes in stressed state of *Gala* and *Old Gala* oilfields ("Azizbekovneft" Oil and Gas Production Department of the Azerbaijan State Oil Company in the name of Z.Tagiyev) oil and gas production division, following vibroinfluences within December 1995.

It resulted in oil production increase by absolute values by 413.7 tons, or 18.8% of November production, and 187.9 tons, or 8.5% on an average daily production basis. Pre- and post-experiment research into wells was indicative of sharp rise in the level of stratum pressure and oil and water debits in the aftermath of vibroinfluence. This was evidence of the intensification of geodynamic processes, rapid growth and redistribution of stress fields within the limits of oil fields.

A special emphasis was laid on regular specification of initial model of stressed state of environment and appropriate corrections in the related experiments.

Improperly chosen model could yield negative results, provided it ignored the time history.

The oilfields *Gala* and *Old Gala* were selected for testing in view of the fact that no secondary methods to intensify oil production have lately been applied. Thus, we could independently evaluate an effect of testing.

The said method is principally different from all well-known effect methods and has previously been developed by us as a section of focused seismicity.

The vibroinfluence was carried out in two stages: in December 1995 and February 1996, using two vibrounits placed on different points to comply with a model of stressed state of the territory.

Prior to vibroinfluence, commencing from 30 July, oil, water and stratum pressure in wells had regularly been measured. These measurements are still in progress to provide reliable information on parameter changes in the period that preceded, accompanied and followed vibroinfluence.

Previous publications provided comparative data on wells, serving various objects after the first stage of experiments.

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<sup>1</sup> 1. Weekly magazine "*Problems of Development in Azerbaijan*", N4-5, Baku, January 1996 (regretfully, a Russian version of the text appeared to be changed and semantically different from own English one).

2. Report of the research center "SIGMA" "*Energy Sector of Azerbaijan*", part 1, Baku, January 1996.

Since January 1996, the vibroinfluence had practically been discontinued, so vibrators operated for no more than 7 days. This enabled us to estimate an effect time in the medium. Drawing from results obtained, we carried out necessary corrections and determined vibrators' position on locality and mode of operations. The vibroinfluence was renewed in February.

The completion of experiments was followed by test findings, as of March 1996. Oil debits based on reiterated measurements varied as follows: it rose from 0.1 to 1.8 tn/d in 27 wells, i.e. from 5% to 180%; it dropped from 0.1 to 1.2 tn/d in 6 wells, i.e. from 9% to 25%. Debits remained unaltered in 2 wells.

Note that water debits were increased in 13 wells: from 1 to 14 cum/d. It dropped in 14 wells from 1 to 80 cum/d, i.e. from 2% to 42%. Debits remained unaltered in 8 wells.

According to reiterated measurements, stratum pressures varied as follows: rose from 0.7 to 34 kg/cm<sup>2</sup>, i.e. from 0.6% to 75.4%. Maximum rise in P(adjusted) (to 34 kg/cm<sup>2</sup>) was detected in the well N441 (over-Kermeki clayey, OKC). Maximum percentage (75.4%) of P(adjusted) increase was detected in the well N 367. Note that stratum pressures fell from 0.3 to 12.6 kg/cm<sup>2</sup>, i.e. from 1% to 18.6%. Maximum P(adjusted) reduction up to 12.6 kg/cm<sup>2</sup> was detected in the well N1513 in OKC, and maximum reduction percentage was detected in the well N886 (IVcde).

As for April 1996, measurements of oil and water of about 60% of operating wells were measured. Also, stratum pressures of about 76% of operating wells were measured.

Reiterated measurements of oil and water debits were carried out in 39 wells,

and measurements of stratum pressure - in 33 wells.

An analysis of 4-month operations, from December 1995 to April 1996, showed that the oil debit rise manifested itself in 33 wells - from 0.1 to 0.7 tn/d, i.e. from 5% to 150%. Oil debit decrease developed in 5 wells - from 0.1 to 0.2 tn/d, i.e. from 7% to 25%. Alterations in oil debits took no place in the well N 251.

Water debit increase manifested itself in 21 wells - from 1 to 80 cum/d, i.e. from 2% to 100%. Water debit decrease was characteristic of 14 wells - from 1 to 9 cum/d. Alterations in water debits took no place in 4 wells (wells N1312, N234, N355, N1466).

Rise in water debits and related percentage in the liquid recovered was due to putting electric submersible pumps into exploitation in 5 wells since November 1995.

Reiterated measurements of stratum pressure in 33 wells over the entire period showed the following.

P(adjusted) rise was characteristic of 18 wells - from 0.2 to 40.4 kg/cm<sup>2</sup>, i.e. from 1% to 75%. P(adjusted) drop was characteristic of 13 wells - from 0.3 to 15.4 kg/cm<sup>2</sup>, i.e. from 1% to 35%. Alterations in stratum pressure took no place in 2 wells (N1274 and N886).

According to our estimates, accuracy of stratum pressure measurement ranged between 0.5-1.5 kg/cm<sup>2</sup>.

The most significant changes in oil debits and stratum pressures of P(adjusted) were typical for horizons of lower section of productive depth in the 1<sup>st</sup> stage of vibroinfluence. The same changes were typical for horizons of upper section in the 2<sup>nd</sup> stage.

Changes in debits and stratum pressures resulting from vibroinfluence on the oilfields *Gala* and *Old Gala* are shown in Tables 1, 2, as of April 1996.

Table 1

Stratum pressures changes (P reduced) after vibrational influences  
 (December, 1995 - February, 1996)  
 on deposits "Gala" and "Old Gala" by April, 1996

NN of wells	Horizon	Stratum pressure changes $\Delta P$ reduced. Last measurement		Date
		kg/sq.cm	percents	
255	B	+ 6,6	+ 33,0%	I.96
250	C	- 15,4	- 35,0%	III.96
1482	C	- 10,0	- 20,8%	III.96
367	CД	+ 23,4	+ 75,4%	II.96
552	II	+ 12,9	+ 31,3%	III.96
1274	II	0	-	I.96
1435	II	- 9,5	- 19,7%	II.96
752	II	- 0,8	- 1,7%	II.96
1312	II	- 0,3	- 1,0%	XII.95
541	II	- 5,0	- 11,9%	III.96
993	III-IV	- 2,0	- 2,7%	II.96
236	IVcde	- 9,3	- 13,2%	III.96
1472	IVcde	- 6,4	- 10,3%	III.96
886	IVcde	+ 0,2	+ 0,1%	III.96
1466	IVcde	- 7,7	- 7,2%	II.96
1199	VII	+ 0,8	+ 0,7%	III.96
853	VIII	+ 4,7	+ 5,3%	I.96
853	IX	+ 17,8	+ 15,3%	XII.95
1520	HKГ	+ 13,5	+ 11,0%	III.96
1513	HKГ	- 12,6	- 11,7%	I.96
441	HKГ	+ 34,0	+ 34,6%	I.96
1485	HKГ	+ 7,7	+ 6,4%	II.96
1510	KC1-2	+ 0,7	+ 0,6%	I.96
1508	KC1-2	+ 3,2	+ 2,6%	I.96
1500	KC5-6	+ 11,6	+ 10,1%	II.96
1244	KC9-12	+ 8,5	+ 5,0%	XII.95
1492	KC9-12	- 1,7	- 1,5%	I.96
903	KC9-12	- 4,8	- 3,8%	I.96
1494	ПК	+ 12,8	+ 14,4%	XII.95
1544	ПК	+ 3,9	+ 3,8%	I.96
1545	ПК	+ 40,4	+ 35,1%	III.96
1486	KaC1	+ 11,6	+ 7,7%	II.96
1540	KaC1	+ 4,8	+ 2,8%	III.96

Table 2

Oil and water debits changes after vibrational influences  
 (December, 1995 - February, 1996)  
 on deposits "Gala" and "Old Gala" by April, 1996

NN of wells	Horizon	Debits changes			
		$\Delta Q_o$		$\Delta Q_w$	
		t	%	t	%
"Gala"					
550	C	+ 0,6	+ 150,0%	1	+ 4,5%
517	C	- 0,2	- 25,0%	-4	- 22,0%
1087	CD	+ 0,1	+ 10,0%	-1	- 2,2%
1419	CD	+ 0,2	+ 20,0%	-1	- 10,0%
541	II	- 0,1	- 9,0%	-2	- 11,8%
1312	II	+ 0,2	+ 25,0%	0	-
291	pII-III	+ 0,1	+ 10,0%	1	+ 5,2%
1130	pII-III	+ 0,6	+ 100,0%	-3	- 10,3%
125	pII-III	+ 0,3	+ 33,3%	8	+ 80,0%
234	pII-III	+ 0,1	+ 12,5%	0	-
669	pII-III	+ 0,2	+ 20,0%	5	+ 33,0%
114	pII-III	+ 0,4	+ 100,0%	1	+ 10,0%
355	pII-III	+ 0,5	+ 83,0%	0	-
747	pII-III	+ 0,1	+ 10,0%	-3	- 12,5%
993	III-IV	+ 0,3	+ 37,5%	-9	- 20,5%
995	III-IV	+ 0,5	+ 83,0%	12	+ 100,0%
554	III-IV	+ 0,2	+ 25,0%	1	+ 5,0%
1434	III-IV	+ 0,1	+ 16,6%	1	+ 9,0%
1472	IVcde	+ 0,3	+ 37,5%	1	+ 10,0%
886	IVcde	+ 0,2	+ 20,0%	2	+ 20,0%
742	IVcde	+ 0,6	+ 120,0%	-4	- 33,3%
251	IVcde	0	-	1	+ 10,0%
1466	IVcde	+ 0,2	+ 10,5%	0	-
1512	IVcde	+ 0,6	+ 120,0%	5	+ 16,0%
1532	IX	+ 0,3	+ 30,0%	3	+ 10,0%
1513	HKГ	+ 0,3	+ 37,5%	7	+ 53,8%
1413	HKГ	+ 0,4	+ 50,0%	-5	- 25,0%
441	HKГ	+ 0,2	+ 20,0%	3	+ 6,6%
1444	HKГ	+ 0,2	+ 25,0%	2	+ 10,0%
1280	HKГ	- 0,4	- 20,6%	-7	- 15,6%
1485	HKГ	- 0,2	- 20,0%	4	+ 25,0%
1413	HKГ	+ 0,1	+ 11,0%	-2	- 9,0%
1265	HKП	+ 0,3	+ 30,0%	80	+ 44,4%
1478	HKП	+ 0,1	+ 5,0%	-2	- 2,5%
1386	KC	- 0,2	- 7,5%	2	+ 5,0%
1494	ПK	+ 0,2	+ 7,5%	-5	- 5,5%
1495	ПK	+ 0,7	+ 38,9%	11	+ 28,2%
"Old Gala"					
1486	KaC1	+ 0,3	+ 15,0%	-1	- 2,3%
1543	KaC2	+ 0,3	+ 10,0%	1	+ 1,7%

Our researchers analyzed variations in stratum pressures and debits within 3 months before, during and after effects.

Before effect, stratum pressures remain unaltered or gradually being decreased.

Results of comparative analysis of changes in stratum pressures and debits before and after effects are reflected in Tables 1, 2.

After effect, variations in the level of stratum pressures are noted for some interlacing of increase and decrease depending upon seams. First, these came a considerable increase, then a continuing, insignificant though, rise. In other cases, a rise was followed by a drop. At the same time, the researchers inferred that variations in pressures in the after effect result in raising oil production. The point is that regardless of character of these changes, the level of output by all horizons appreciably increased, as shown in Table 2.

Stratum pressures were particularly high in the well N1545 in charge of the horizon *Under Kermeki* (UK, *Old Gala*).

Regretfully, no pressure measurements were performed in this well. Later on, these measurements had repeatedly been performed: 17.12.95 - 115.1 kg/cm<sup>2</sup>; 23.01.96 - 118.9 kg/cm<sup>2</sup>; 26.01.96 - 115.9 kg/cm<sup>2</sup>; 07.02.96 - 138.9 kg/cm<sup>2</sup>; 13.02.96 - 139.0 kg/cm<sup>2</sup>; 28.02.96 - 169.9 kg/cm<sup>2</sup>; 06.03.96 - 155.5 kg/cm<sup>2</sup>. Note worthy is the fact that the first 3 measurements held in December in the 1<sup>st</sup> stage, and in January when the experiments were suspended, and the stratum pressures had similar values. However, with the commencement of the 2<sup>nd</sup> stage, their level rose by more than 20 units, with the completion of experiments it rose by another 30 units! In 7 days after the completion of the 2<sup>nd</sup> stage, the stratum pressures fell by 14 units.

The probability remains that the first measurement of 17.12.96 reflected the level of stratum pressures that immeasurably exceeded the background one. The point was that the vibroinfluence had at that moment, been performed for two weeks already. The

conclusion could be verified by measurement data in the well N441 in charge of *Gala* horizon development: 11.09.95 - 98.2 kg/cm<sup>2</sup>; 20.12.95 - 131.9 kg/cm<sup>2</sup>; 24.01.96 - 132.2 kg/cm<sup>2</sup>.

In the course of analysis, we took notice of the fact that the levels of stratum pressures in the upper horizons of productive depth tended toward reduction in February as compared with previous months. In March, this tendency manifests itself rather strikingly, commencing from horizon "C" and ending with horizon "V". Note that P(adjusted) underwent no reduction in the lower horizons.

The below-quoted information makes it possible to clarify the situation, to an extent.

Methods of the work provide for studying environmental conditions though different geophysical fields. The results of the research into the variations of weak high-frequency signals and changes in gravitational field will be in the subsequent publications. Note that geodetic survey of locality - 1<sup>st</sup> class leveling was held on the area of the oilfields prior and post vibroinfluences. The survey embraced area of several tens of square kilometers. Map of datum level changes is shown in Chart 1.

It has to be kept in mind that the changes showed rise in the surface up to 6 mm as compared with the first cycle. In considering that average gradient of lowering while developing the oilfields *Gala* and *Old Gala* is about 3.3-3.5 mm a month, over the past 7 months between the cycles the datum level should have lowered by 22-25 mm. Meanwhile, we have quite the opposite: vertical motions were exposed to changes in characters and level by 25-30 mm.

To our thinking, the parameters of effect were calculated insufficiently accurate,

so a part of energy was debited into the rock deformation.

For quantitative appraisal of extra oil produced as a result of vibroinfluence, it'd be appropriate to draw from daily measurements of oil and water debits by all the wells. It was these parameters in December that found their reflection in the previous publications.

Thus, subsequent calculations, adjusting for stock of the oil and gas production division wells and number of their operations within a month, showed that growth of additionally extracted water in terms of percentage is down several times from growth in additionally extracted oil. These data once more confirm an important scientific and practical result, shown in the previous publication. This result is indicative of the possibility of "curing" the deposit - creation of stressed state area which prevents penetration of waters from external sources into the deposit.

Regretfully, the current state of measurement units makes it no possible to carry out accurate estimates. Therefore, the most rational is a calculation of average daily production on the basis of total oil production a month on the oilfields *Gala* and *Old Gala*, as shown in Table 3.

While estimating additionally extracted oil due to the vibroinfluence, the experts took into consideration an oil growth within an each month as a result of the oil and gas production division operations. These include geological and technological measures, drilling of wells, putting of idle wells into operation and

so forth. Also taken into account were losses arising from getting some wells out of order. On the average, the said measures result in production rise by 1-3%.

For example, in November the division managed to raise a monthly oil production by 83%, whereas losses made up 16 tons due to getting some wells out of order. That's why total growth of production in November aggregated to 67 tons as compared with October.

Table 3 is indicative that oil growth in December was 30.5 tons, in January - 49.5 tons (30.5 + 19.0), in February - 70.6 tons (49.5 + 21.1), in March - 120.1 tons (70.6 + 49.5).

The Table 3 data are fully consistent with monthly report of the division by the *Gala* and *Old Gala* oilfields which are indicative of considerable rise in production with respect to November both in terms of absolute values (15-25% a month) and average daily calculation.

As a result of experiments to comply with our methods, oil growth made up as follows: December - 301.2 tons (14.9%), January - 359.7 tons (17.8%), February - 335.4 tons (16.6%), March - 452.0 tons (22.3%). Thus, over the past 4 months, quantity of additionally extracted oil made up 1448.3 tons, or 71.6% of November 1995 oil production level.

Diagrams 1-2 show the dynamics in daily and monthly production changes by the oilfields *Gala* and *Old Gala* before and after the experiments on vibroinfluence to realize our new methods of oil- and gas fields exploitation.

Table 3

Analysis of the effects on "Gala" and "Old Gala" deposits  
oil production vibrational influences conducted  
since December, 1995 till February, 1996

	1995				1996		
	September	October	November	December	January	February	March
1.Extraction changes because of the works done by OGPD itself, t including:							
a) geological-technical measures;	-	+82,3	+67,0	+30,5	19,0	+21,1	47,0
b) putting into operation not being in exploitation wells	-	(+87,5)	(+41,3)	(+44,8)	(+44,0)	(+33,7)	(+84,0)
c) from the fund of temporarily not being in exploitation wells	-	(+7,6)	(+0,4)	(+0,7)	(+3,0)	(+15,8)	(+80,0)
d) going out of operation of the wells	-	(+6,2)	(+41,3)	-	-	(+0,6)	-
	-	(-19,0)	(-16,0)	(-15,0)	(-28,0)	(-29,0)	(-17,0)
b) Summary change of extraction after November as a result of OGPD work (st.1), t	-	-	-	(+30,5)	(+49,5)	(+70,6)	(+117,6)
3. Oil extraction in current month, t	1872,7	1955,0	2022,0	2420,0	2473,0	2295,5	2659,0
4. Daily extraction, t/daily	61,7	62,4	67,4	78,1	79,8	79,2	85,8
5. Additional extraction after November:							
c) daily, t	-	-	-	+10,7	+12,4	+11,8	+18,4
d) for whole month, t	-	-	-	+331,7	+384,4	+342,2	+569,6
6. Additionally extracted oil in the result of the vibration influences (st.5-b less st.2), t, %	-	-	-	+301,2 (+14,9%)	+359,7 (+17,8%)	+335,4 (+16,6%)	+452,0 (+22,3%)

### **From the editorial staff**

The given work was discussed during a session of the workshop of the *Azerbaijan State Scientific-Research Institute of Oil Industry*. The session stressed its topicality, originality and importance as recommending it to be

introduced into practice as a principally new method to provide control and reduce ecological and economic damage. The same view was reaffirmed by independent experts that underscored multiplicity of geological and geophysical parameters applied for

analyzing the environmental state and high statistical data reliability.

#### **FROM MASS MEDIA**

As informed in the administration of the foreign relations of the Ministry of education of Azerbaijan, deputy minister of foreign economic relations of Switzerland Rapor Cheler and representative of “Unitar” organization visited Azerbaijan. Guests met deputy minister of education. Akhmed Abidinov, met system of education in Azerbaijan. The purpose of meeting – to give to Azerbaijani side new proposals according to preparation of experts-management, diplomats, economists. Government of Switzerland will be financial supporter of their preparation according to line of “Unitar”. According to words of guests in order to begin the arrangement of courses in the end of May-beginning of June, Azerbaijan side must address to “Unitar” with special program. During talking guests noted, that similar activity organization “Unitar” conduct, in Moscow at the present time.

Chairman of the Permanent Parliamentary commission on ecology, energetic and natural resources Asya Manafova proposed non-budget energetical fund. According to her opinion, it must be formed at the expense of enterprises-consumers of energy and to invest the projects of creation of new technologies economizing energy. Necessity of rational relation to energy resources has been emphasized again at the meeting of commission. This principle will be the basis of being prepared draft of law of Azerbaijan Republic about the basis energetical resources utilization.

Similar laws are well-known in the World practice. For example, 7 of them were adopted since 1975 in the USA. There is Energetical charter in Europe. Adaptation of new law will allow for Azerbaijan to become its member.