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Development of a New Technology for Complex Utilization of Mineral Resources of the Kara-Bogaz-Gol (Turkmenistan) under Present Conditions

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92 Esgerler St., Ashgabat
Turkmenistan

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Report to contracting agency
CDR-CAR

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INTRODUCTION

The present management semi-annual report covers the period of August 2001– April 2002. During this period, the following stages of the project were carried out:

a) Collecting and statistical analysis of available data until 2001 related to chemical composition and water level of water of Kara-Bogaz-Gol were accomplished.

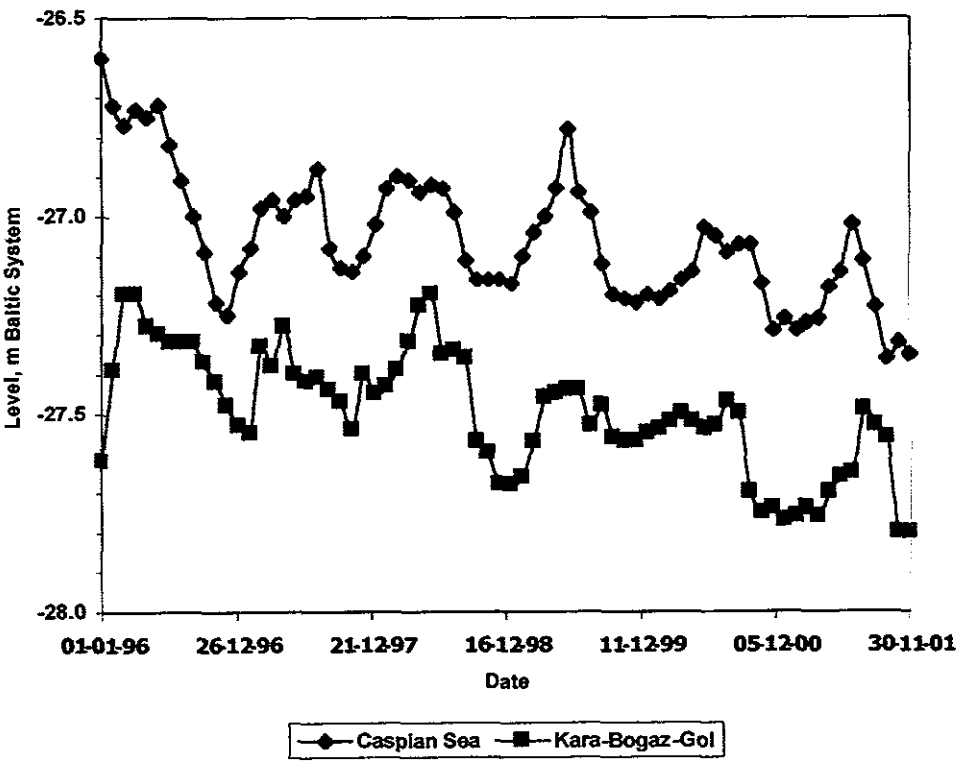
b) Comparison of chemical compositions for undersurface brines, used as raw material for the chemical industry at the present time, and surface brines that are considered to be the alternative renewable source of raw material.

SCIENTIFIC SUMMARY

1. Hydrological regime of Kara-Bogaz-Gol Gulf

The geochemical behavior of the Kara-Bogaz-Gol is related to changes in the Caspian Sea level. After destruction of the dam, the amount of seawater entering from the sea to the gulf is determined by the difference between the levels of the sea and the gulf. This difference decreased from 6.50 m in 1991 to approximately 0.49 m in 1996 and remained constant for the last six years (Fig. 1). Thus, it can be considered that the equilibrium between the levels of the sea and the gulf was reached. Natural variation of sea level for the Caspian Sea until the mid eighties was discussed by Akovetskii and Bogdanov (1988).

Levels of Caspian Sea and Kara-Bogaz-Gol



Water level changes of the Kara-Bogaz-Gol are mainly determined by annual water input from the Caspian Sea and by water evaporation from the Gulf surface. At present, the

stabilization of seawater input (18-19 km^3/year) was observed. However, the input of seawater is slightly less than the water evaporation from the gulf surface (Table 1). As a result of the negative water balance, increased mineralization of gulf brines was noted.

Table 1. Water balance of Kara-Bogaz-Gol for 1996-2001

Year	Gulf surface, km^2	Year average level (MSL), m	Seawater input, km^3/year	Rain input *, km^3/year	Water evaporation, km^3/year **	Water balance, km^3/year	Gulf volume, km^3
1995	18,400	-27.96	52.2	2.1	22.5	+32.8	90.9
1996	18,600	-27.36	25.3	2.1	22.5	+4.9	95.8
1997	18,600	-27.50	17.7	2.1	22.5	-2.7	93.1
1998	18,600	-27.40	18.0	2.1	22.5	-2.4	90.7
1999	18,600	-27.54	18.5	2.1	22.5	-1.9	88.8
2000	18,600	-27.58	18.9	2.1	22.5	-1.5	87.3
2001	18,600	-27.69	17.8	2.1	22.5	-2.6	84.7

* The yearly volume of rains was accepted as the value of equal to average for many years.

** Water evaporation from the lagoon bittern surface depends on brine mineralization and was accepted to be equal to about 1,100 mm/year (Lepeshkov et al., 1981).

2. Chemistry of the surface brines and of buried brines of Kara-Bogaz-Gol Gulf

The water sampling of surface brines was conducted in a near shore area approximately 100 m from shore. In addition, water samples were taken from two wells used at present. Brine samples were kept in glass bottles with ground glass stoppers. The contents of major ions in the brines were determined in accordance with standard techniques as follows:

Cl^- concentration was determined by volumetric argentometric titration.

SO_4^{2-} concentration was determined by gravimetric analysis by precipitation as $BaSO_4$.

CO_3^- and HCO_3^- concentrations was determined by volumetric titration using 0.05M HCl, phenolphtalein and methyl-orange as indicators.

Ca^{2+} and Mg^{2+} concentrations were determined by complexonometric analysis with murexide and chromogen black as indicators.

Boron concentration was determined by volumetric titration using 0.01 M NaOH with mannit for complexation and with methyl-rot and phenol-rot as indicators.

The physico-chemical properties and ionic compositions of the Kara-Bogaz-Gol surface brines are presented in Table 2. Existing observations for seasonal changes of chemical brine composition demonstrated that maximum mineralization was reached in September-October before the rainy season. The brines were found to be formed only due to seawater input and water evaporation from the gulf surface. It is possible that the dissolution of bottom minerals settled during the phenomenon of gulf dry-up when the gulf was separated from the Caspian Sea by a dam is completely accomplished. The analysis of the data obtained allowed us to conclude that the depth of surface brines mixing does not exceed 3 m. At present, there are no conditions for massive mineral precipitation from Kara-Bogaz-Gol waters. Only the precipitation of mirabilite during winter months (January-February) was observed.

The composition of Kara-Bogaz-Gol buried brines from two production wells used at the present for the production of mirabilite, epsomite and bischofite are also presented in Table 2. The composition of the surface brines and the buried ones are almost identical. The only difference we found is that buried brines are relatively enriched by magnesium and sulfate ions and by content of H_2S (150-280 mg/l).

REFERENCES

Akovetskii V.I. and Bogdanov I.Ya. 1988. - Kara-Bogaz-Gol yesterday, today, tomorrow. Eds. Aganbegyan A.G. and Overgeldyev O.G. 340 pp., Ashhabad, Ylym (in Russ.).

Lepeshkov I.N., Buynevich D.V. and Sedelnikov G.S. 1981. Perspectives of use of the Kara-Bogaz-Gol salt resources. M., "Nayka", 274 pp. (in Russ.).

MANAGERIAL ISSUES

The current project had a very difficult "birth". The official agreement between the CDR-CAR administration and IOLR was signed only the 25th August 2002. The complex political situation in the region of Central Asian Republics at that period of time postponed the signing the Subgrant to Grant No. TA-MOU-00-CA20-072 agreement between IOLR and Sci. Research Cooperation "GUN" (92 Esgerler St., Ashgabat, Turkmenistan) up to the middle of the November 2002.

Prof. A. Khodjamamedov and Dr. N.N. Kazantseva had numerous problems opening a new foreign currency account for this project. This account was opened only on the 17th of April with approximately an 8-month delay from the official date of the project starting date: 1.08.2001. From our experience with the previous project, we do not expect that advance payment will reach the Sci. Research Cooperation "GUN" (Turkmenistan) before the end of June, in the best case. Due to the above situation, the winter field sampling of water from the Kara-Bogaz-Gol, which was planned for September-October 2001, and the first water sampling in Kara-Bogaz-Gol, which would have been carried out during March-May 2002, could not be conducted at that time. Therefore, sampling of natural brines and their analysis has been postponed indefinitely until the Turkmenistan team will obtain advance payment.

COLLABORATION AND TRAVEL

The business trip to Israel to coordinate the program of the project and to acquaint the Turkmenistan scientific team with analytical methods applied to highly mineralized brines is planned for the end of 2002 or the beginning of 2003.

Table 2. The physical properties and ionic composition of Kara-Bogaz-Gol surface and buried brines

Place of sampling	Date of sampling	Temp., °C	Density, $g \cdot m^{-3}$	pH	Ionic concentration, mass. %								B_2O_3, g/m^3
					Na^+	K^+	Mg^{2+}	Ca^{2+}	Cl^-	HCO_3^-	SO_4^{2-}	CO_3^{2-}	
Kurguzyl Bay *, 41°33′00″N 53°02′23″E	8.04.00	13.0	1,187		6.48	0.093	1.22	0.03	11.89	0.05	3.13	0.01	91
	10.05.00	17.0	1,187		6.97	0.080	0.98	0.03	11.90	0.02	2.44	0.01	95
	20.06.00	25.0	1,208		8.11	0.083	1.00	0.03	13.08	0.02	3.31	0.01	87
	20.07.00	26.3	1,192		7.17	0.118	1.01	0.03	11.99	0.02	2.90	0.01	101
	20.08.00	28.5	1,218		8.18	0.15	1.05	0.02	13.24	0.03	3.52	0.01	95
	20.09.00	19.7	1,213		8.10	0.134	1.11	0.02	13.08	0.03	3.78	0.01	107
	15.10.00	2.3	1,197		7.50	0.186	0.96	0.02	12.01	0.03	3.44	0.01	101
	18.11.00	9.6	1,195		7.49	0.137	1.02	0.02	12.16	0.04	3.40	0.01	88
	16.12.00	6.8	1,195		7.68	0.101	0.91	0.03	12.03	0.03	3.25	0.01	96
	18.01.01	6.5	1,199		6.83	0.102	1.07	0.03	11.56	0.03	3.01	0.01	77
	20.02.01	8.6	1,187		7.05	0.135	1.01	0.02	12.50	0.03	1.99	0.01	89
	15.03.01	8.9	1,184		7.09	0.128	1.07	0.02	12.57	0.03	2.19	0.01	90
	27.04.01	27.5	1,217		8.06	0.134	1.01	0.03	12.69	0.04	3.81	0.01	101
	27.05.01	19.1	1,212		8.22	0.124	1.09	0.03	12.99	0.03	4.04	0.01	108
	25.06.01	27.1	1,215		7.90	0.101	1.21	0.03	13.01	0.03	3.81	0.01	99
	19.07.01	23.6	1,210		7.18	0.101	1.21	0.03	12.27	0.03	3.31	0.01	114
	28.08.01	27.6	1,213		7.51	0.119	1.02	0.03	12.09	0.03	3.5	0.01	102
	20.09.01	17.5	1,212		8.04	0.090	1.10	0.03	13.01	0.03	3.64	0.01	88
	16.10.01	26.2	1,201		7.44	0.090	1.05	0.02	12.40	0.02	3.03	0.01	114
	20.11.01	18.5	1,195		7.09	0.109	1.11	0.03	11.78	0.02	3.4	0.01	89
	03.12.01	5.2	1,200		7.45	0.101	1.01	0.02	12.12	0.03	3.28	0.01	96
Sartas, 41°46′26″N 52°46′51″E	14.09.96		1,174		6.46	0.09	0.85	0.04	10.45	0.04	2.87	0	
	26.09.98		1,192		7.59	0.12	0.99	0.03	12.18	0.04	3.43	0	
	9.09.99		1,208		8.09	0.13	1.02	0.03	12.86	0.04	3.74	0	
	21.09.00		1,214		9.23	0.13	0.96	0.03	11.92	0.04	3.20	0	
	30.11.01		1,206		8.13	0.12	1.06	0.03	11.98	0.04	3.31	0	

Center zone, 41°15′00″N 53°00′00″E	26.01.01	6.1											
Depth 1 m			1,183	7.34	7.54		1.10	0.027	13.09	0.044	1.70	0	
2m			1,185	7.42	7.80		1.06	0.026	13.45	0.044	1.60	0	
3m			1,187	7.43	7.82		1.05	0.025	13.47	0.044	1.60	0	
4m			1,189	7.46	8.21		1.10	0.026	13.79	0.044	2.14	0	
5m			1,190	7.47	9.03		1.12	0.026	14.85	0.044	2.49	0	
6m			1,195	7.58	10.23		1.10	0.026	16.48	0.044	2.71	0	
Well #15	24.09.00		1,220		6.87	0.13	1.51	0.03	11.06	0.03	5.51	0	
Well #23	10.10.01		1,182		6.28	0.085	0.93	0.03	10.19	0.02	2.99	0.01	

* The point for sampling was situated near the plant pipeline supply entrance.