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To Questions of Renaissance Small Aral Sea in Kazakhstan

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Abstract: There are offered scientifically sound water management activities to stabilize the environmental situation in the Small Aral Sea by the cascade control and allocation of water resources and developed a scheme of water resources management and engineering activities in the Small Aral Sea, which allows to minimize the area of the drying sea bed

Key words: Aral Sea · Degradation · Small Aral Sea · Gravimetric Method of Desalination of Water · Two-Level Cascade Reservoirs

INTRODUCTION

Problem of sea reduction level in the Kazakh part of the Aral Sea ecological stabilization at an acceptable level needto consider in the complex of ecological and economic importance of water and acceptability measures introduced [1, 2]. In recent years in the lower reaches of the river activities are conducted to the reconstruction of existing hydraulic structures and construction of new projects RRSSAM 1 and 2 (ControlSyrdarya river's course and Northern Aral Sea) [3, 4].

Project RRSSAM 2 provides an extension of water management measures in the lower reaches of the Syrdarya River and the Small Aral to stabilize the environmental situation in the region. One of the activities of this project is to raise the water level of the Small Aral, the mark of which is currently at 42 abs. The project developed a two-tiered cascade of reservoirs (option 1), the first - Bay Saryshyganak with watermark 46 m abs. and the second - the Small Aral Sea with elev. 42 m are also suggested other options of this project is to create a single reservoir at 46 m abs. (option 2). It is also proposed to increase the level of a single reservoir to 50 abs. (option 3).

The variance of the project to establish a cascade of reservoirs in general correct, but his objection was to the individual decisions. Options 2 and 3 are not acceptable, since the river basin exhausted water resources for the implementation of these decisions.

On the basis of calculations previously, was substantiated the necessityof revision of some design decisions RRSSAM 2 on the complex structures in the Gulf Saryshyganak because some of its components (water level at 46 m abs., inlet channel connecting the reservoir to the city of Aral) may cause the following serious adverse environmental effects [5-8] :

- The project provides shallow water (average depth of 3-3.5 m, of which the water surface is less than 2 m depth is greater than 30 %), which enhances the process of eutrophication, where takes place the mass death of fish and increased evaporation.
- Shallow water pond also slows the process of natural desalinization in the Gulf, which resulted in the salinity of the water in the bay is always high.
- Prokop-channel connecting the bay with Aralscald locked and it plays no water role at shallow depth channel blockage occurs in the water eutrophication will quickly become dirty and be buried by sand.
- Resetfrom the Syrdarya River to the Gulf of filling up with water provided 10-12 km from the dam and the length of the bay about 40 km, while the net river water does not have time to move to the Gulf and mineralized water will be discharged into the Small Aral Sea. Under this scheme, clean river water discharged into the sea through the Big Kokaral dam arranged on dissipation 5-6 km estuary.

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Table 1: Topographic characteristics and volumes of evaporation Small Aral Sea and the Gulf of Saryshyganak

	Small Aral			Saryshyganak		
Mark,scale	W, km^3	F, thd.km^2	W_1, km^3	W, km^3	F,thd.km^2	W_1, km^3
50	56.25	4.33	3.72	4.75	0.84	0.72
48	47.4	3.86	3.32	3.17	0.77	0.66
46	41.2	3.58	3.08	1.76	0.6	0.52
44	32.9	3.5	3.01	0.74	0.422	0.36
42	27.0	3.17	2.73	0.12	0.14	0.12

Table 2: Filling time of the Small Aral to expected level

	Small Aral		
Mark	$\Delta ÄW_1=W_{50\%}-W_1$, km^3	$\Delta W=W_1-W_5$, km^3	$T = \Delta W / \Delta W_1$
50	29.25	1.776	16.47
48	20.7	2.176	9.51
46	14.2	2.416	5.88
44	5.9	2.486	2.37
42	0	2.766	

- Discharges into the Small Aral Sea through the gates of the dam, which resulted in the Small Aral, again will reset the purest water from the surface layers, as is the case in Kokaral dam.
- Fish ladder is not provided between the Small Aral Sea and the Gulf, in this embodiment, it is impossible to develop (revive) fisheries in the whole of the Kazakhstan part of the Aral Sea. The same situation leads to the death of fish in the tail bay Kokaral dam.

With limited quantities of water to fill the Small Aral Sea from the Syrdarya River which agreed with the limit in recent years in the amount of 5.85 km^3, volume and surface area is the Small Aral Sea and Gulf calculated from the current level to the historically vary within the following limits (Table 1) [9-12].

Here W-volume of the reservoir, F - water surface reservoirs, W1-the amount of annual evaporation from the water surface.

Table 2 shows that the volume of the Small Aral 12-13 times greater than the volume of the Gulf Saryshyganak area-5 times. To raise the water level in the Small Aral to 48 mabs.or up to 50 m abs. there need to score at least 20-29 km3 of water and for the Gulf Saryshyganak-no more than 3-4.5 km3. As can be seen, there is a big difference in the amount of water to raise the level of reservoirs to specified levels.

There was calculated as the time of filling up of the Small Aral expected level (Table 2). Of calculation shows to the fill the Small Aral to elevations from 44 m abs. m to 50 abs. required from 2 to 16 years. While filling the reservoir will be unequally and dependent on water availability, the individual, especially in dry years (95% probability or higher) delivery it may be less than the amount of evaporation, which will reduce the level

As a result, the data set of measures designed to desalination of water in the Gulf Saryshyganak (Fig. 1), where the basis for water desalination is the gravimetric method.

This method uses the properties of stratified flows, which is bundling it as salty. Salts lower layers are deposited over time and create an active salt concentrate, increasing the salinity of the reservoir with water-salt metabolism.

By periodic flushing of the lower most mineralized water through layers of adjustable bottom outlet structures for short-term effect can be obtained desalinization Bay (Fig. 1a). It should be noted that this rate lower flushing highly mineralized layers depends on the difference in water levels in the cascade. In general, the effect of displacing the lower layers is not inferior to the effect of desalination when mixed with fresh water, 10 years reduced the salt content of less than 10 % of the original (Fig. 1b).

One of the main effects is that Aralsk occur again around the pond on the former borders, but with fresh water (Fig. 1c). For this proposed canal route profitable option recharge Kamystybasskoy Gulf through the lake system, which flows into the bay from the city of Aral (Fig.1d). This embodiment as compared with the other embodiments has the following advantages:

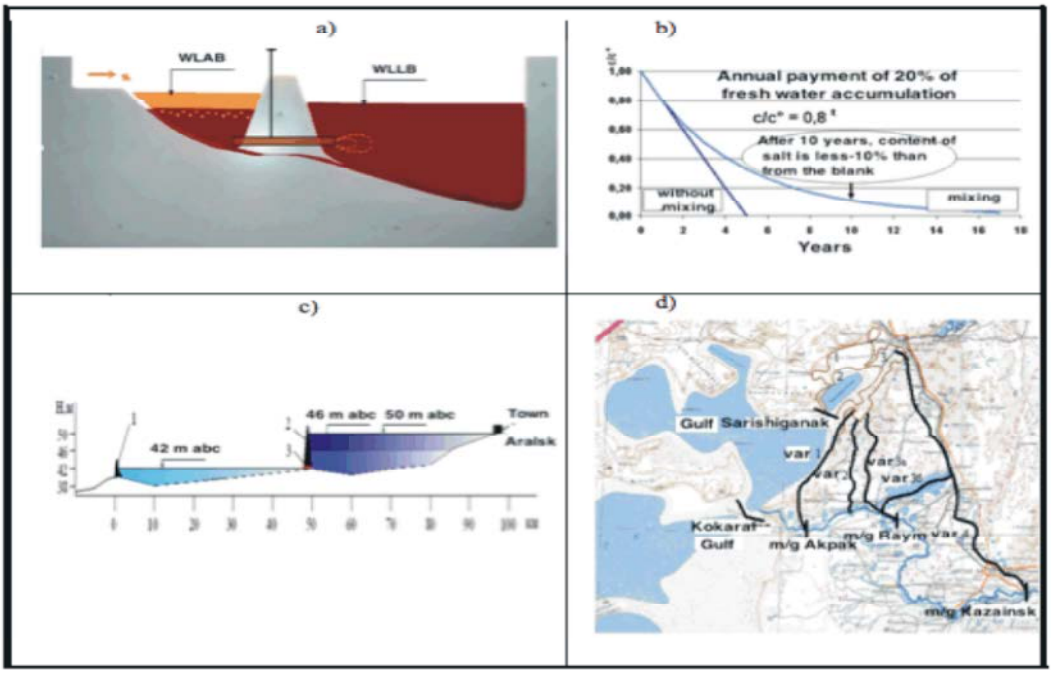

Fig. 1: Gulf Saryshyganak revival scheme. a) Washing the lower layers of the reservoir through bottom outfalls b) the duration of desalinization depending on the amount of fresh water income, c) two-level cascade reservoirs in the Small Aral, d) variants of the channels to feed the Gulf.

- Threshold of the right bank regulator Kazalinsky waterworks is 64 m abs., When the water level elevation in Saryshyganak 50 m abs. and the channel length of 144 km the average slope of the bottom of the channel is 0.0001, which allows to design a cost-effective channel section and a smaller loss in length.
- Canal flows into the bay from the city of Aral, which is beneficial, first, the total displacement of river water with the sea and secondly, to maintain recreational areas near Aralsk clean and fresh river water.
- Will be able to recharge lake systems located along the canal (9 lakes including Kamystybas, Makpalkol, Kokshekol) in case of an exception construction of water works Raim of projects RRSSAM-2.
- Will be able to transfer part of the flow in the left bank of the river through the aqueduct (4 version) for feeding the left bank of lake systems (8 lakes including Akshatau, Kotankol, Shomishkol) without building also currently projected hydroelectric Amanotkel.

To flush the reservoir had high efficiency, it is necessary to spend Systematic at maximum level difference of the upper and lower pool-loosening bottom of the reservoir using a minesweeper.

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