SALINITY CIRCULATION IN THE URMIA LAKE AFTER CONSTRUCTION OF THE CAUSEWAY

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Uremia Lake as one of the hypersaline lakes of the world is located in the Northwest of Iran with an area about 5000 km^2, mean depth of 6m and in the level of 1276.5 m above MSL of the Persian Gulf. A causeway is under construction connecting the east side of the lake -Tabriz coast - to the west side – Uremia coast - along the narrowest part of the lake. Rock filling of approximately 12 million m^3 has been carried out from both sides of the lake that 10.6 km is from Uremia coast and 3 km is from Tabriz coast, Abniro 1998. There has been no rock filling from km 10.6 to km 12.4 and this part is remained open for construction of a bridge. The constructed causeway and the remaining open part are shown in figure (1), SADRA 2004.

In a closed location such as Uremia Lake, the water resources inflowing into the lake are very important in forming ecologic and hydrodynamics processes of the lake. The rivers, while causing the water level variation of the lake, have a basic role in salinity pattern in the lake area. By increasing the human activities in the Uremia lake region and using groundwaters in recent decades, the average of total water discharge has been reduced about 40%, and the lake salinity has been increased consequently. This may affect the population of Arthemia Salina as the only bio-organism that can live in the salty water of Uremia Lake. It can live in the great range of salinity of water from 40 up to 300 gr. /litter.

Uremia Lake has a unique condition for salt high-concentration, variety of sediments, especial ecological characteristics. The salt concentration is a function of sampling place location, discharge of the rivers, seabed sources, and intensity of precipitation. The lake salinity varies from 87 to 275 g/lit; it also varies in different water level of the lake, as the salt concentration is 165 g/lit in the level of 1277m and 330 g/lit in the level of 1273 m.

After construction of the causeway, the pattern of current and water circulation in the lake has been disturbed considerably. The southern part of the lake receives almost 90% of the freshwater from rivers, while in the northern part, the evaporation is dominated. Low slope lands near the lake by the area of 1560 km^2, sever change in the surface and the water depth of the lake. High speed winds and variation of rivers discharge result in changing the water salinity of the lake.

Water level of the lake varies considerably due to morphological conditions of the lake, variations of climatic conditions, and variations of water supply to the lake. A satellite image of the lake is given in figure (1) that shows the boundary of the lake for various water levels in the years 1987, 1998, 2001, 2002. The reason for a lot of spreading in area of the lake is the low slope of southern and eastern regions of the lake.

Flow of 22 rivers discharge to Uremia Lake that the most important of them are Zarinehrud, Siminehrud, Talkhehrud, Gedarchi, Nazlochai and Mahabadchi. The annual average of rainfall in the lake is 340 mm and the annual average of evaporation is about1222 mm.

A comprehensive numerical simulation has been carried out to analyze salinity circulation and water quality of the lake after construction of the causeway and to find out solutions to minimize environmental impact of this project. Numerical simulations of related phenomena have been carried out in different conditions including lake different water level, wind with different return periods, rivers in flood and normal situations and with different geometrical conditions of the causeway. This paper presents some results of this study.

Differences in salinity content between Northern and Southern part of Uremia Lake even occur in natural condition of the lake especially in low water seasons. Due to the fact that there is no connection between the lake and free water bodies and nonexistence of tide, the self purification of the lake occurs so slowly. All these grounds show sensitivity of the lake against any changes in natural geometrical condition.

The Advection and Dispersion module of MIKE 21 software package has been used for simulation of salinity exchange in the lake. This module is able to calculate the mass transport based on advection dispersion equation. This module is prerequisite of other environmental biological models such as EU and WQ. The AD module is run using already created files as output of HD model, DHI 2003. While using AD module, definition of dispersion coefficient and Courant number is very important. Also, definition of initial and boundary conditions are necessary for hydrodynamics (HD) and Advection–Dispersion (AD) models. It has been shown that adding extra openings may reduce the maximum salinity concentration about 10% comparing to the present condition. This should be taken into consideration in decision on extra opening(s).

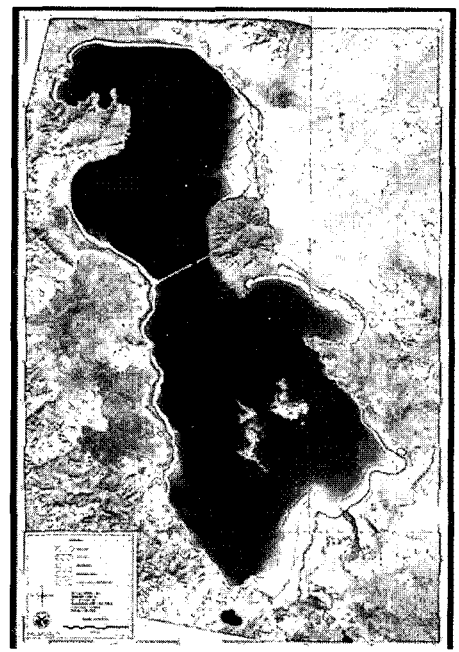

Fig. 1 Variation of the water level in Uremia Lake during 1986 to 2002