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Water Leakages Through Banks of Hammam-Grouz Dam (Algeria)

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Abstract

The water leakages through banks and the foundations appear on the level of the whole of the dams. But in Some, the problem is much more serious, since lost volume exceeds the normal. The case of Hammam - Grouz dam (Mila) is to be raised, since the flow of the water leakages through its right bank exceeds the value of 50000 m^3/ day, whereas its initial capacity is only 45 million m^3. This article tries to show the problems and the evolution in the time of the volumes of water lost on the level of two banks of the lake by basing on hydraulic and piezometric data National Agency of the Dams (N.A.D). The couple representing the variation of the dimension and the volume of water in the lake in the course of time enabled us to say that approximately 2/3 of the total volume of the dam were lost by the water leakages through banks and more particularly right bank. In spite of the strong precipitations recorded in the area during the water resource year 2003-2004 (N.A.D), the volume of water of the lake did not reach the 1/3 of its total capacity. These water losses are likely to destabilize the dam because of the rock solid mass of right bank. Same the thermal springs being with the downstream of the dam known by their high temperature are likely to lose the effect of heat following mixing with cold water. The results obtained show that the state general of the Hammam-Grouz dam is worrying because of the progressive deterioration of materials of fillings of the rock solid mass constituting right bank by the underground flow.

Keywords: Hammam Grouz dam - Water - Escapes - Stability - Bank - Foundation.

I. Introduction

Some is the site of a dam, there' will be always water losses, not through the body of the work, but through banks and the foundations. Because of the strong hydrostatic uplift exerted by the water of the lake on the bottom and the banks of a dam, a volume of water infiltrates and is evacuated. Indeed, the annually lost average volume was evaluated to 40 million m^3 of water (Remini B., 2005). Among, 57 dams in exploitation, the leak-flow of some largely exceeds the normal, like that of Foum El Gherza dam (Biskra Algeria) (Toumi A. and Remini B., 2003 and 2004) and in particular that of Hammam Grouz dam, whose medium flow of escape borders 50000 m^3/day, is 10 times that of Foum El Gherza

dam. To recover this volume it water the services of hydraulics built basins of accumulation. This solution remains for the moment effective, but it does not represent a final solution, since the stability of the work is threatened and the thermal springs are likely to disappear.

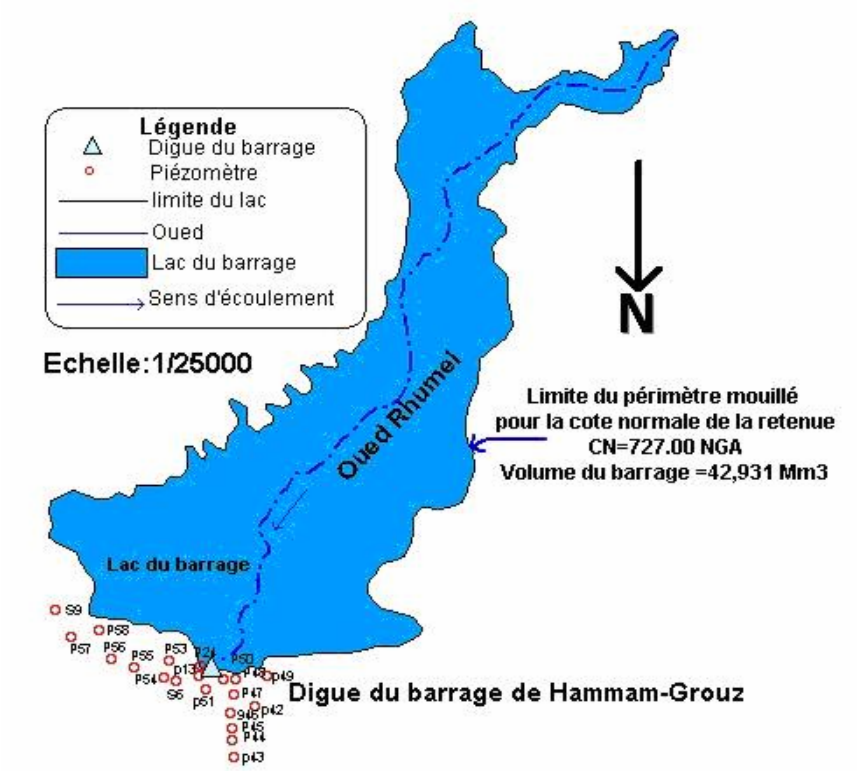
This study highlights the problems of these escapes at the level of the Hammam Grouz dam and quantified the volume lost especially through right bank of the work.

II. Data and Methods

II.1. Data Used

We used the piezometric and volumetric data carried out by the national agency of the dams during the five last years. Measurements were made on the level of the reservoir and the level of the piezometers placed in two banks. We used the data of 20 functional piezometers (fig.1).

Figure 1: Provision of the piezometers compared to the lake of the dam

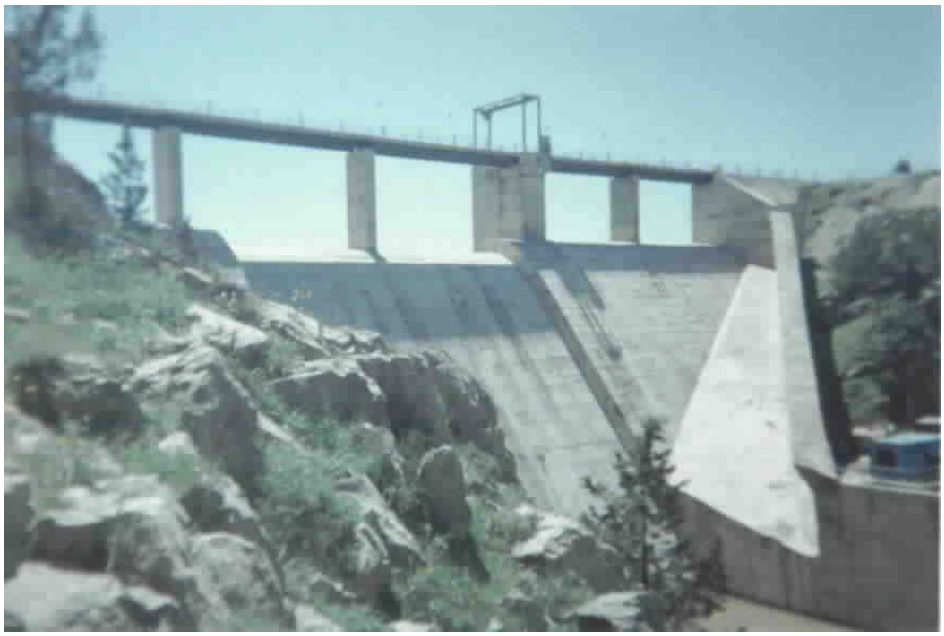


II.2. Situation and Characteristic of the Dam

Of an initial capacity of 45 million m3 and a height of 49,5 m, the Hammam Grouz dam was carried out during the period going of 1981 with 1987 on wadi Rumel. It is a dyke of the Gréager type: a concrete dam and shotcrete on the level of two banks. An argillaceous carpet on the level of the basin was produced over a length of 180m. The minimum level of the dam is at the coast 691,00 NGA, whereas that of the clay carpet is at the coast 705,00NGA. The work has two crest gates of rising; the first carried out in the middle of the dam represents the principal crest gate. Its coast is to 727,00 NGA. The second crest gate is subdivided into two and have same dimensions one, on the level of right bank and the other, on the level of left bank, and they are at the coast 728,50NGA (NAD, 2003).

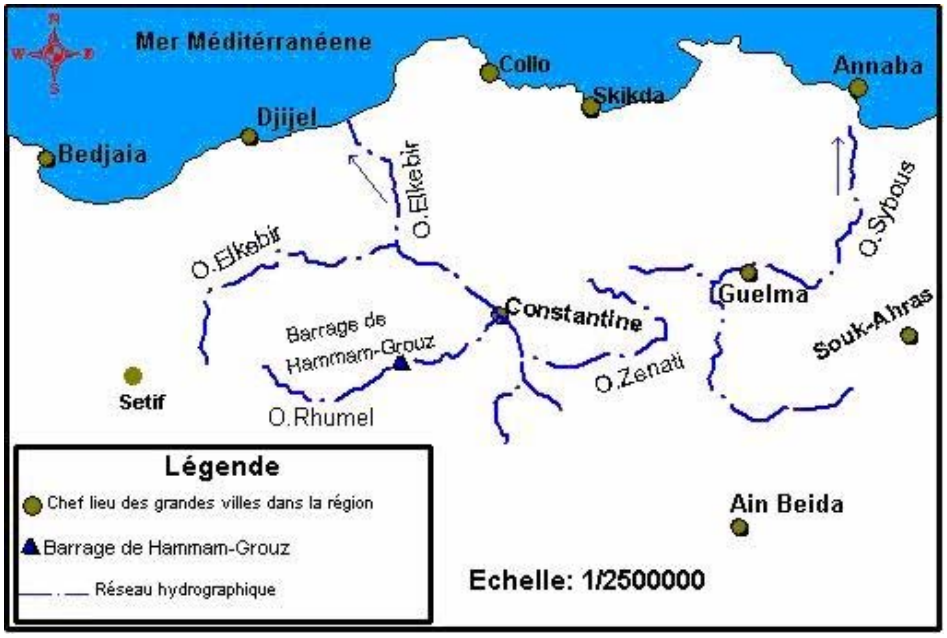
On the other hand, the coast of high waters is with 736,50 NGA. Photograph 1 illustrates the site and the type of the dam carried out.

Photograph 1: General sight of the dam of the Hammam-Grouz



The dam is intended for the food into drinkable of the town of Constantine and the protection of the town of wadi El-Othmania against the floods created by the mode of wadi Rhumel. This hydraulic infrastructure is located at 50 km in the west of the town of Constantine and at approximately 2 km in the south of the town of wadi El-Othmania (figure 2).

Figure 2: Geographical and hydrographic situation of the dam of Hammam-Grouz



II.3. The Geology of the Site

The geology of the site of the stopping has a relation closely bound with the circulation of water through the foundations and banks of the work. The study carried out by the hydraulic services on the level of the zone of the Hammam Grouz dam showed that the banks of the stopping are primarily made up of cretaceous limestone on the other hand the plate of the lake of the dam made up of the calcareous

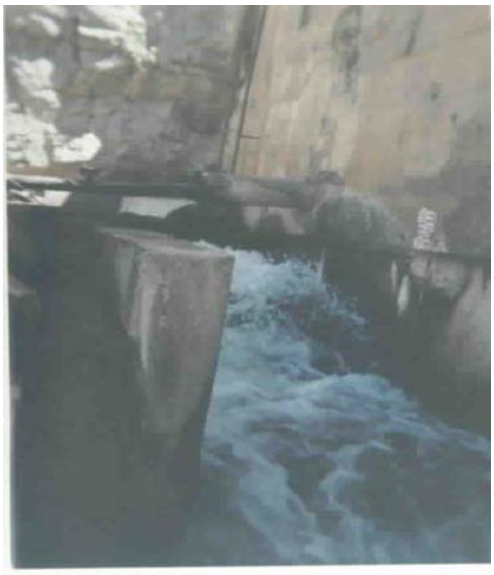
rock close to the dam is surmounted by alluvia, whereas further and just upstream from the dam one finds clay Miocene surmounted by clay Pliocene and both are surmounted by alluvia.

III. Results and Discussions

III.1. Phenomenon Observed: Water Leakages through Right Bank

The Hammam Grouz dam encounters difficulties of storage of water coming from the Rhumel wadi, since the medium flow of water leakages through right bank borders 50000 cubic meters per day (ANB, 2003). Photographs 2, and 3 show successively water which leaves the lower gallery (where the drains function like water jets) and by resurgences which we numbered from 1 to 3.

Photograph 2: Drainage which flees in the lower gallery



Photograph 3: Resurgence n°2 - Mixing of water of the thermal springs with leakage waters

Since the setting in water of the dam in 1987, the crest gate of raw functioned forever because of the small quantity of water received on the level of the dam. During the period going of June 28,

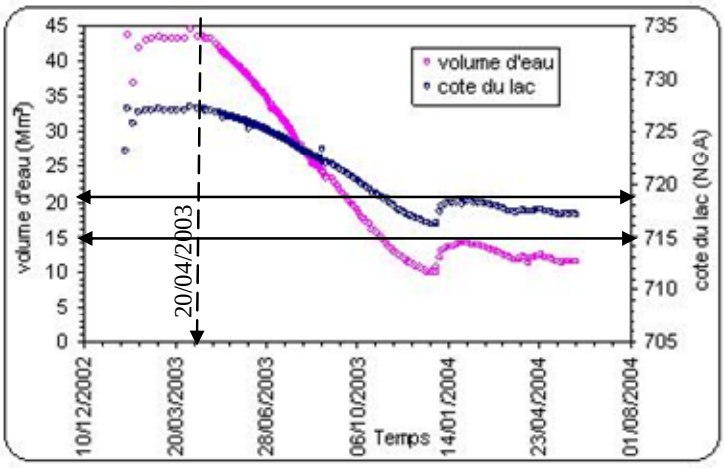
2002 until April 27, 2003, because of the strong pluviometry fallen into the area, the dimension of the lake was in a level higher than that of the principal crest gate (727.00 NGA).

This height of water of lake A creates an almost constant and permanent hydrostatic compressive force on the supports of the dam during this period. This caused the 20/04/2003 of the considerable water losses through right bank. The geology of the site primarily made up of the cretaceous limestone stuffed by argillaceous materials and the absence of work of consolidation on the level of right bank are the principal causes of this considerable water leakage. The underground flow creates by the hydrostatic pressure contributed to the drive of materials of filling by increasing the cross-sections of stream discharge.

III.2. Relation between the Water Dimension of the Lake and the Water Leakages

To put forward the relation which exists between the water dimension of the lake and the volume lost by the escapes since the appearance of the phenomenon, we represent on figure 3, the variation of the couple, the dimension and the volume of water according to time.

Figure 3: Variation of the couple dimensions and volume of water in the lake according to time dam Hammamm-Grouz-Milla-Agérie (Given ANB)



It is interesting to note that the two curves of the volume of water and the dimension of the lake are cut exactly at the date of the apparition of the water leakages of right bank (April 20, 2003). The graph also specifies that the water leakages through right bank of the Hammam-Grouz dam sufficiently took time to appear on April 20, 2003 in the form of a water jet of flow definitely higher than the normal.

The increase in time in volume in leakage water testifies to the enlarging to the corridors to circulations through right bank. The reddish color represents in fact, that a quantity of dissolved clay in water. We note that the dimension of the lake is always lower than 719NGA, i.e. volume does not exceed the 15 million m^3, which wants to say that approximately 30 million m^3 of water of the total volume of the dam were lost following the leakages through right bank.

III.3. Variation of the Piezometric Dimension According to the Dimension of the Lake

Piezometry has a great utility for the determination of the defective zones on the level of banks and the foundation of the dam. The variation of the piezometric dimension and the dimension of the lake in the course of time make it possible to deduce the anomalies which occur on the level of the zone crossed by the piezometer. On figures 4 and 5, we represent the variation of the couple dimension lake and dimension piezometric according to time for the piezometers S6 and P56 locating in right bank.

Figure 4: Piezometer S6-Variations in the time of dimensions of the lake and piezometer (Given ANB)

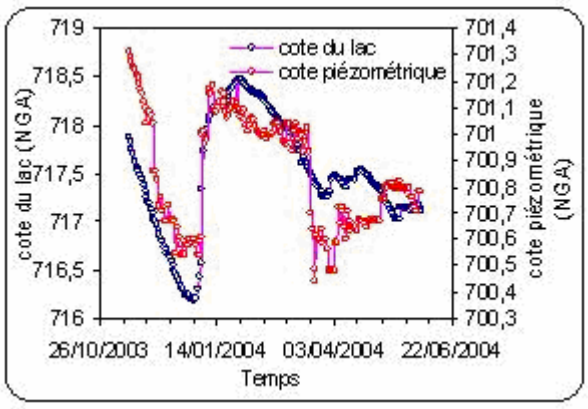
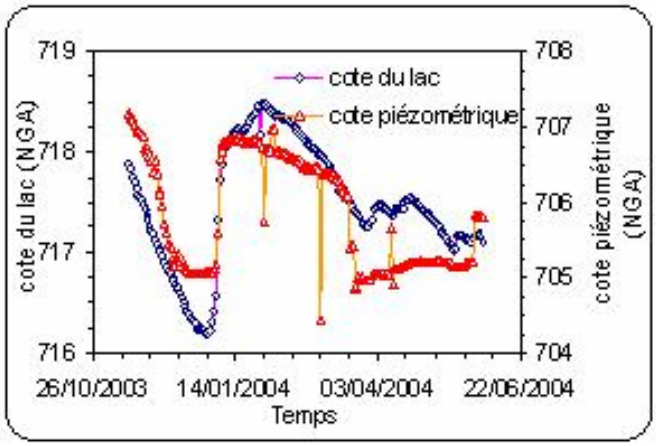


Figure 5: Piezometer p56-Variations in time of Cotes du Lac and piezometer (Data National Agency of the Dams)



We note that for the same dimension of the lake each piezometer indicates two values this confirms the existence of the anomalies on the level of the zones crossed by these piezometers. The last recorded values are lower than the first, this confirms that there is a deterioration of the zones crossed by these piezometers and consequently the water leakages increase in time.

Conclusion

As of the appearance of the water leakages (20/04/2003) on the level of the dam, several thermal springs (known by their high temperature) located meadows of the dam, lost their effectiveness and became cold following their mixing with those of the dam. The loss of such an important volume through right bank is even likely to harm the stability of the work. The search for a fast and effective solution is essential today. The reinforcement of the grout curtain and more particularly level of right bank is an option not to be drawn aside.

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