

**LA VIÑUELA DAM.
AIR EVACUATION PROBLEMS DURING THE PRESSURE
COMPENSATION PROCESS TO OPEN THE GATE BOTTOM**

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Abstract

La Viñuela is a earth and rockfill dam. The bottom outlet includes two 1600 mm diameter and 430 m length pipes. There are two Bureau (USBR) valves, in each pipe, with a by-pass and aeration pipe after the second Bureau. At the end of each pipe there is a Howell-Bunger valve to regulate the discharge. After a minor accident, the by-pass loss head device was broken since when, during the equilibration operation prior to opening the second Bureau valve of the left duct, there have been problems eliminating air between this valve and the Howell-Bunger; in consequence, a significant amount of water is ejected through the top of the 80 m. high aeration pipe, with a vertical velocity so large that water hits the ceiling of the intake tower, 15 m. above the aeration pipe exit.

After a field test, an explanation for the phenomenon was found. The velocity in the by-pass is excessive, and the impact at the outlet floor permitted the water to climb the gate covering the air exit. After this, the air inside the bottom outlet starts to be compressed because the only air that can escape is a small percentage that is mixed in the water that rises in the aeration pipe for reaching at its toe the same pressure as the air inside the duct.

The increase of pressure in the duct reduces the velocity in the by-pass. When the velocity is sufficiently low, the water curtain no longer covers the air vent but due to arrival of more water the air pressure increases more and more. Due to an imbalance between the inside pressure at the toe of the water column the air must evacuate and this is achieved in an explosive burst due to expansion of the air as it rises and is covered by less and less water.

The agreement between a mathematical model and the prototype was excellent, but a physical model was constructed better know the circumstances that accompanied the creation and destruction of the water closure of the aeration pipe and also for testing the changes that will avoid accidents in the future.

Keywords: Bottom outlet; Accidents; Air-water flows