Some examples of sediment management

In France, the methods generally considered and implemented are the **cleaning of** sediments that may be spread on the surrounding land for amendment purposes. Nevertheless, sediment quality must be proven (through relevant and robust analyses in advance) and this solution involves significant operational and transport costs.

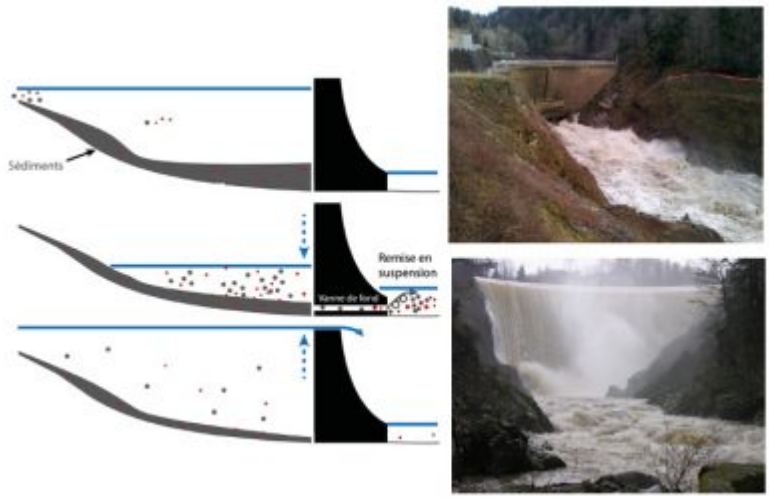

Figure 1. Schematic representation and illustrations of sediment management by hydrocarbon flushing [© adapted from Frémion]. The photo on the top right represents the stage of maximum opening of the valves [© F. Frémion], the photo on the bottom right, the clear water discharge at the end of the operation [Source: © F. Bordas]

Sediment accumulation can also be managed by means of an operation of transparency with regard to sediment transport, also known as **hydrocurage flushing**, as has been carried out for example on a large number of Alpine dams (e.g. on the Arc, the Rhône) for about thirty years. We talk about **transparency** because during these operations, the transport of sediments is no longer blocked by the dam and resumes its natural functioning for a few hours. During periods of high water - in France, during winter, when rainfall is high - the bottom gates of the dam are gradually opened to allow sediment to flow through the structure. This sedimentary material will be diluted within the watercourse thanks to the high flows **(torrential flows**) (Figure 1) [1]. The valves will then be gradually closed and the reservoir filled until the water overflows over the reservoir **(clear water discharge**), allowing the sediment dilution to be completed and the downstream stream to be cleaned. This type of operation is strictly regulated and requires continuous monitoring throughout the operation (a few hours), particularly with regard to physico-chemical parameters such as suspended load or oxygen concentration. This monitoring allows such an operation to be stopped as soon as one of the measured parameters exceeds the previously defined regulatory thresholds.

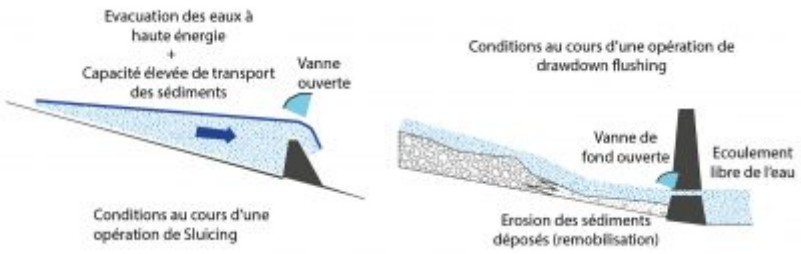

Figure 2. Schematic representation of sediment management by sluicing and drawdown flushing, the dotted lines represent water loaded with sediment. [© AGU, adapted from Kondolf]

Other alternative techniques can be implemented, including the ***sluicing*** - operation close to the transparency operations

described above and carried out when sediment volumes are large, or the ***drawdown flushing***This operation is more similar to sediment discharge discharge operations (Figure 2) [2].

During the operations of ***sluicing***, as with **flushing** operations, the tank level is lowered during high water periods, which will allow water and sediment to be conveyed to the discharge valves at high speed. The realization of operations of ***sluicing*** and **flushing** depends on the hydrological characteristics of the catchment area and the size of the reservoir concerned. Both of these operations have low impacts on aquatic ecosystems.

As for the operations of ***drawdown flushing***, the aim is to lower the water level in the reservoir completely, an operation that takes place during low water periods, often just before the flood season. This involves scouring and resuspending sediments deposited within the dam to transport them downstream. During this type of operation, only the fine sediments in the centre of the reservoir channel (the original river channel) will be eroded and transported, as lateral sediments are generally not or only slightly discharged. These operations are very effective for narrow valley and small reservoir configurations as well as for rivers with high contrast seasonal flows. They are practised in many countries, including France, on the Rhône for example, but they can nevertheless have harmful effects on aquatic ecosystems (up to 60% mortality in adult fish [3].

References and notes

Cover image. The Sanmenxia gravity dam on the Yellow River in China. [Source: CC BY-SA license, from: https://alchetron.com/Sanmenxia-Dam]

[1] Frémion, F. (2016). *Dynamics of sedimentary flows and metallic elements related to the current and exceptional operation of a hydroelectric dam.* Doctoral thesis in Environmental Sciences, University of Limoges.

[2] Kondolf, G.M., Gao, Y., Annandale, G.W., G.W., Morris, G.L., Jiang, E., Zhang, J., et al. (2014) Sustainable sediment management in reservoirs and regulated rivers: Experiences from five continents. Earth's Future, 2, 256-280

[3] Grimardias, D., Guillard, J., Cattanéo, F., (2017). Drawdown flushing of a hydroelectric reservoir on the Rhône River: Impacts on the fish community and implications for the sediment management. *Journal of Environmental Management*, **197**, 239-249