

水力排砂策略原則建立及實務應用

Principle establishment and practical application of sediment sluicing

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摘要

一般而言，水庫防淤以機械清淤為主，水力排砂為輔，主要原因在於機械清淤可搭配陸挖及水力抽泥的方式，在多數不下雨的時間內進行水庫清淤，然而水力排砂則須視水資源的應用情形及適當的水理時機，方能進行較為有效的水力排砂操作，且近年來由於水力抽泥技術的提升，已相對成為台灣各水庫主要施行的防淤策略，因此，針對水力排砂的原則，除了形成異重流的條件外，基於水資源運用的考量，研擬水庫執行水力排砂的條件，應分別估算水的價值(排砂致減少利用 1 立方公尺水之成本約為\$4.248/立方公尺)以及考量水力抽泥替代成本。若以現況曾文水庫抽泥成本約\$100/立方公尺(並假設淤積泥砂密度為 1500kg/立方公尺)，則基於水與砂的價值比較，可提出當壩前泥砂濃度在 6 萬 ppm 條件下，則 1000 kg 水砂含砂體積為 0.04 m³，對應的抽泥成本約\$4.00；而對應水的體積為 0.94 m³，水量移用費約\$3.99，二者相當。因此以壩前泥砂濃度 6.0 萬 ppm 作為門檻值，如水庫無須防洪運轉，但壩前濃度超過此一門檻，則開啟防淤隧道進行水力排砂仍具備效益；另為避免取水斜塔前庭淤積，當壩前泥砂濃度未達前述門檻，但仍超出 1.0 萬 ppm 時，則應開啟 PRO 排砂。

關鍵詞：水力排砂、防淤策略、水力抽泥、防淤隧道

Abstract

In general, reservoir desilting is mainly based on mechanical dredging, supplemented by hydraulic desiltation. The main reason is that mechanical dredging can be combined with land excavation and hydraulic dredging. However, hydraulic desiltation depends on the application of water resources and the appropriate timing of water management before a more effective hydraulic desilting strategy can be implemented. Therefore, the formation of density current flow and water resource utilization are both needed to be concerned for hydraulic desiltation. The requirements for implementing hydraulic desiltation in the reservoir are developed in addition to the conditions for forming density current flow. Therefore, the value of water should be estimated separately (the cost of reducing the use of 1 cubic meter of water due to hydraulic desiltation is approximate \$4.248/m³), and the replacement cost of hydraulic dredging should be considered. The current price of hydraulic dredging in Zengwen Reservoir is about \$100/m³. Based on the value comparison between water and sand, it can be suggested that when the concentration in front of the dam is 60,000 ppm, the sand volume of 1000 kg of turbid water is 0.04 m³, and the corresponding hydraulic dredging cost is about \$4.00. The related water volume is 0.94 m³, and the water transfer fee is about \$3.99, which is equivalent. Therefore, the sediment concentration in front of the dam is 60,000 ppm as the threshold value. Suppose the reservoir does not need flood control operation, but the concentration in front of the dam

exceeds this threshold. In that case, it is still beneficial to open the desilting tunnel for hydraulic desiltation. When the concentration of turbid water in front of the dam does not reach the threshold above but still exceeds 10,000 ppm, the bottom should be turned on to prevent clogging.

Keywords: Hydraulic desiltation, desilting strategy, mechanical dredging, desilting tunnel