

選擇性引水發生下層單層流體流出之臨界條件

許少華^[1] 劉建榮^[2] 俞維昇^[3]

摘 要 颱風期間水庫集水區之降雨可造成大量泥砂沖刷進入水庫，適當條件下挾砂水流潛入庫底會形成異重流，提供大量動能將泥砂帶至壩址處形成渾水潭。渾水潭的高濁度渾水使得取水與淨水廠處理極為困難，進而影響民生用水。本研究不考慮渾水中的泥沙因素，針對鹽水進行研究，以渠槽試驗與數值模擬探討鹽水潭流出之臨界條件。透過比較垂向濃度剖面、下層流體穩定平衡厚度、出流濃度以驗證數值模式之正確性；並以驗證後之數值模式進行數值試驗，探討於不同的入流條件下（入流流量與入流濃度），出流孔口高程不同時發生僅下層流體流出之臨界條件。透過數值試驗，可模擬不同相對孔口高（ Z_0/H ）之流況進行探討，增加可供分析的數據，且減少試驗的耗時費力。研究發現不同孔口高度於不同入流條件下，由清水層與鹽水層同時流出轉變為僅下層鹽水單層流出的臨界理查生數為 0.28。此外，透過 R_i 與 q_L/q_0 之關係可評估於不同入流情況下，雙層流體同時流出時下層流體排出的多寡，即所排出的水資源量與下層流體之排渾量是否符合經濟效益。

關鍵詞：選擇性引水、渾水潭、理查生數。

Equilibrium Properties of Selective Withdrawal from a Line Sink Caused by Stratified Flow

Shaohua Marko Hsu^[1] Chien-Jung Liu^[2] Wei-Sheng Yu^[3]

ABSTRACT Large amount of sediment could be eroded from the watershed by heavy or concentrated rainfall and flow into reservoirs during typhoon days in Taiwan. High concentration sediment could form turbidity or density currents and plunge into the bottom of reservoir when certain conditions are met. If it reaches the dam site, the plunging turbidity or density current could form a muddy lake. Water withdrawn from the muddy lake could not be treated for domestic use because of its high turbidity. In this study, the lower-layer equilibrium thickness and critical withdrawal condition of stratified flow caused by density current through a line sink was investigated by both flume experiments and numerical simulations. Saline water was used as the dense fluid to analyze the flow phenomenon caused by density difference and the property of sediment was neglected. Vertical concentration profile, discharge and concentration of outflow, equilibrium thickness of lower-layer flow of experiment were measured to verify the numerical simulation. Numerical experiment was performed by a verified model to generate data for analysis instead of more

-
- [1] 逢甲大學水利工程與資源保育學系教授兼系主任
Professor, Department of Water Resources Engineering and Conservation, Feng Chia University, 100 Wen-Hua Rd, Taichung, Taiwan 407, R.O.C.
- [2] 逢甲大學 GIS 中心研究助理教授（通訊作者）(liucj@fcu.edu.tw)
Research assistant professor, GIS Reserach Center, Feng Chia University, 100 Wen-Hua Rd, Taichung, Taiwan 407, R.O.C. (Corresponding Author) (liucj@fcu.edu.tw)
- [3] 崇右技術學院數位媒體設計系教授
Department of Digital Media Design, Chungyu Institute of Technology, 40, Yi 7th Road, Keelung 201, Taiwan, R.O.C

experiments. The relation between dimensionless discharge (q_L/q_0) and Richardson number (R) could be used to evaluate if the flow withdrawn from the lower-layer was economically worthwhile. The critical Richardson number for only the lower-layer aspirated was larger than 0.28.

Key Words: Selective withdrawal, Muddy lake, Richardson number.