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論文名稱: 水砂運動基礎之研究及應用

英文論文名稱: Studies on the Fundamental Theory and Application of Fluid Flow

【中文摘要】

水、土為人類生存所必須的資源，為了讓水、土資源能合理經營永續利用，就有必要須掌水性；瞭解水理。觀察坡地遭豪雨打擊會發生侵蝕，經逕流搬運及水力篩選，粗顆粒的留在河床，顆粒細的隨洪水流下，得知泥砂是靠水輸送。如能明瞭水砂運作機制，將有助於泥砂治理；做好集水區保育及災害防制工作。 本研究水如何動，把所有物理參數逐一分析，同時建立合理的物理模式。對於無法推導或屬機率事件因子如碰撞、熱力波幅射則依實測或文獻等資料來率定，以減少不確定因子展現水砂之運動全貌。

第二章從流力最小單元水分子來認識水体，使用Ｖs、Ａs、Ｌs 三空間尺度以掌握水体結構動態、力場及物理性等。

第三章以三空間尺度及 Lennard-Jones 勢能函數，導出無因次內能Ｕ*，由Ｕ*和雷諾數、馬克數及空間尺度之關係，瞭解分子力、場流、流相等。此外也研析分子動量和溫度的關係，比較分析原氣体動力論得到一新運動式(P+a/V^3-c/V^5)(V-b)=kS*T ，另由焗及統計力學觀點獲知分子碰撞

熱力輻射變化情形。 第四章

從重力場來探討宏觀流態、水性及運動，整合宏、微觀結果，建立質點運動速度、應力（動量）及能量關係。並提出摻混理論說明紊動；邊界層及上舉力關係，也討論流速剖面變化、水流結構及卡門常數 κ 等。

第五章依據楊志達的單位溪功率理論，剖析了上游陡坡河道泥砂運動和啟動流況及討論 ψ1、ψ2、ψ3 三參數條件。透過學理參數間可有效轉換，節省了大量實驗工作。又由 Stockes 定律導出的沉降速度其適用範圍有限，為擴大範圍，由牛頓定律導得(5.37)公式，且和美國墾務局的經驗式相比，發現適用性比上兩者都好。 第六章探

討實務性泥砂啟動問題，以曾文水庫集水區之調查之泥砂及產量做理論性評估，獲得啟動粒徑和流量關係且經統計得到(6.1) 的經驗式，爾後祇要掌握正確的泥砂資料，即可推估河道可能之洪峰逕流。

本文以流力為中心，討論水物理特性，相關科學有量子物理、統計力學、熱力學、聲音學及輸砂力學等。從中得到許多新觀點，亦改變了分子與流体的運動模式。此外亦證明了水在慣性力作用下有不可壓縮之特性。密度隨運動狀態在變。瞭解紊流發生原因乃分子力與勢的影響。摻混運動是懸浮泥砂的原因。週期性水波、水紋、糙度、沙紋等是水運動所致，但亦是水動態傳遞之必然行為。

【英文摘要】

Water and soil essential resources for human lives. For rational management and use of resources, it is necessary to understand hydraulic and physical properties and characteristics of water flow. Observations of the surface sheet erosion on hill slopes during heavy raining reveal that both thesand and silt are moved by runoff. Through hydraulic sorting the bigger sand stay on the riverbed; and the smaller will flow down. Sediment is transportedby water. Understanding the interaction of flow fluid and sediment is useful to sediment control; watershed conservation works and disaster reduction and minimization.

This study investigates how fluid to flow. All physical parameters are analyzed. Reasonable theoretical models are built. For finding the Aspects of fluid flow and sediment transport, to usable to derive or probability events like molecular collision, thermal radiation are rated with experiment data, measured or obtainted from literature.

Chapter 2 discuses the smallest unit of flow mechanics-water molecule. Three spatial scales (Ｖs, Ａs, Ｌs) are used to the structure of dynamic fluid,force field and property behaviors.

In chapter 3 three spatial scales and lennard-jones potential energy function drive dimensionless inner energy Ｕ*, through the Ｕ* and Reynold number, Mach number and spatial scale which are utilized to derive relationship for further understanding molecular (van der Waals and Born) force; flow field; fluid phase. Relations between molecular movement and temperature are analyzed. Comparison by classical gases kinetic theory led toa new function equation (P+ a/V^3-c/V^5)(V-b)=kS*T. By entropy and statistic mechanics options suggests that molecular collision caused change of thermal radiation wave.

Chapter 4 deal with macroscopic flow fluid state, fluid behaviors and movement from gravity field integrates

macroscopic and microscopic flow fluid.It builds relationship between the unit mass of velocity, stress (momentum) and energy and promotes mixing theory to describe turbulence; boundary layer and up lift force. Velocity profile, flow fluid structure and von Karman constants are also discussed.
In chapter 5 the Yang Chih Ted unit stream power theory, analysis sedimentmovement and incipient flow on the steep river are used to discuss three parameters ψ1,ψ2,ψ3. It is able to transfore each parameter through function of theory which can save much time on experiment. The setting velocity drive from Stoke''s law is fitted with a limit physical range. From enlarging the physical use range by Newton law a new equation(5.37) form is derived. It is a better equation than original and USBR empirical equation. In Chapter 6 sediment yield of the Tsengwen watershed is used to test and assess the theoretical relations derived. A regression equation between incipient diameter and discharge was derived. It is indicated that sediment data can be useful in estimating the peak flood discharge. This study forcuses
on flow mechanics. However the physics of water and inter-science with quantum mechanics, statistic mechanics, thermodynamics, acoustic and sediment mechanics are discussed. Many new viewpoints are found to renew milecular movement and flow fliud model. It is prove that water in the inertial force is incompressible. The density will change with flow fluid movement. The turbulence occurrence process is influenced by molecular force and potential, mixing movement major support to up lift suspension load. Periodic wave, ripples, roughness, sandy ripples or dunes are results of waterflow, it is also response behaviors of fluid dynamic transform action.