12th International Riversymposium

Brisbane Australia 21 – 24 September 2009


# FLOW CHARACTERISTICS OF A NEW VORTEX CHAMBER TYPE SEDIMENT EXTRACTOR

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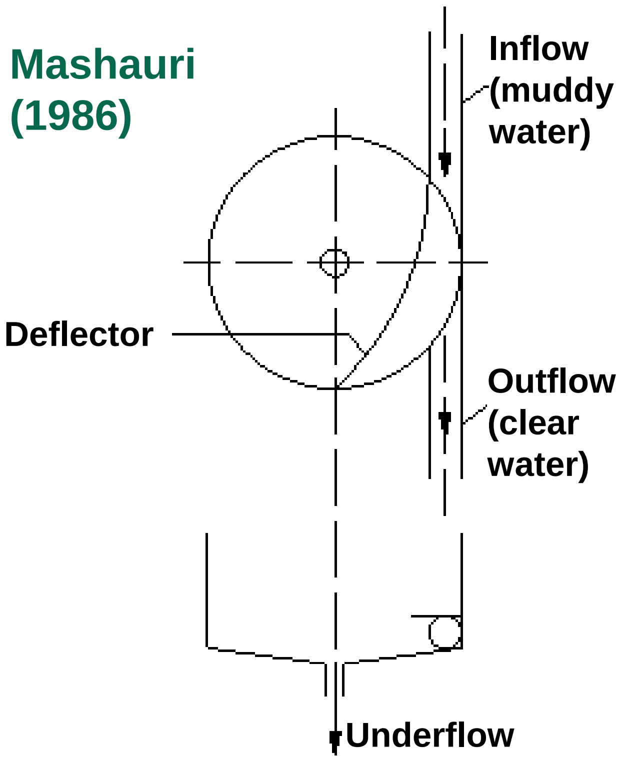
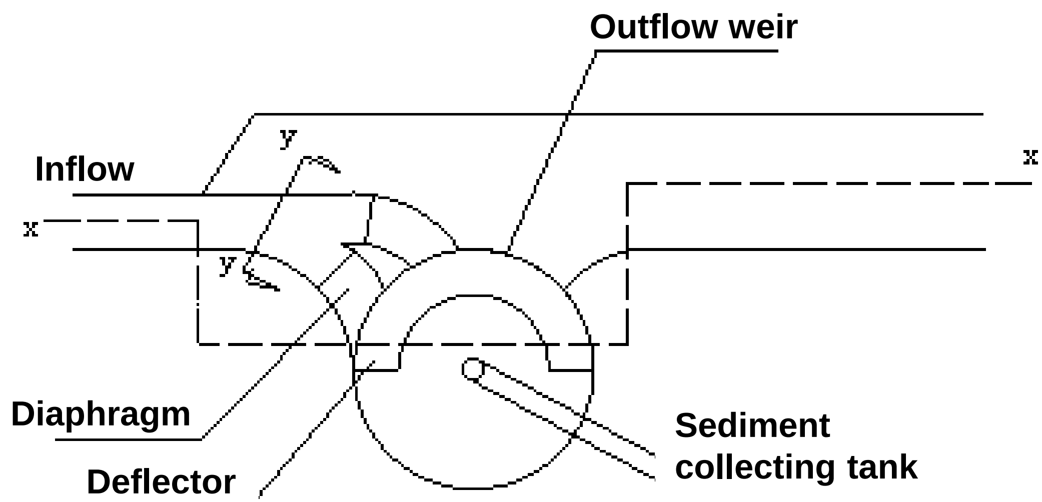
# Introduction and Earlier Models of Vortex Chamber

Vortex chamber type sediment extractor have been widely used as a device to **extract sediment from muddy water** – water with very high sediment concentration existed in natural resources such as rivers, reservoirs **naturally, efficiently and economically** under the actions of **gravity and vortex flow**.

Mashauri (1986)




Keshavarzi (2006)



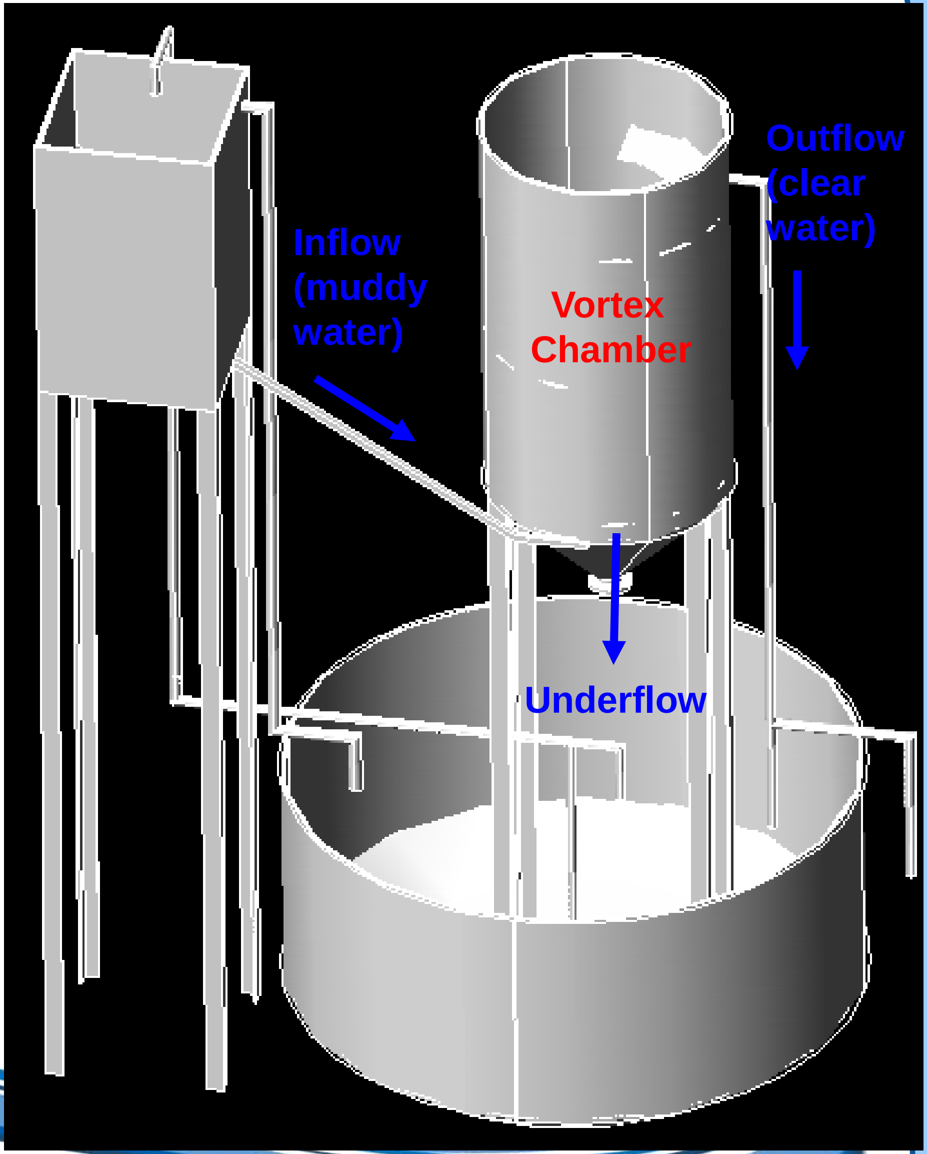
# A New Vortex Chamber Type Sediment Extractor

➢The most significant differences compared with earlier models:

❑ The ratio of height of chamber (H) to diameter of chamber (D) – **H/D > 1**.

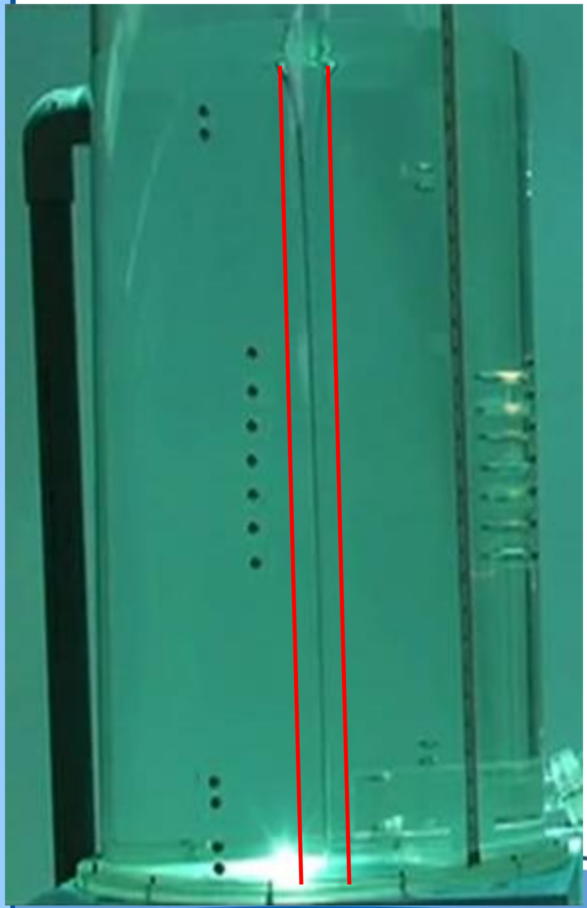
❑ Number of deflector: **3**

➢ Vortex chamber is a vertical, transparent cylindrical tank attached with a transparent cone of side slope $45^0$ at the bottom

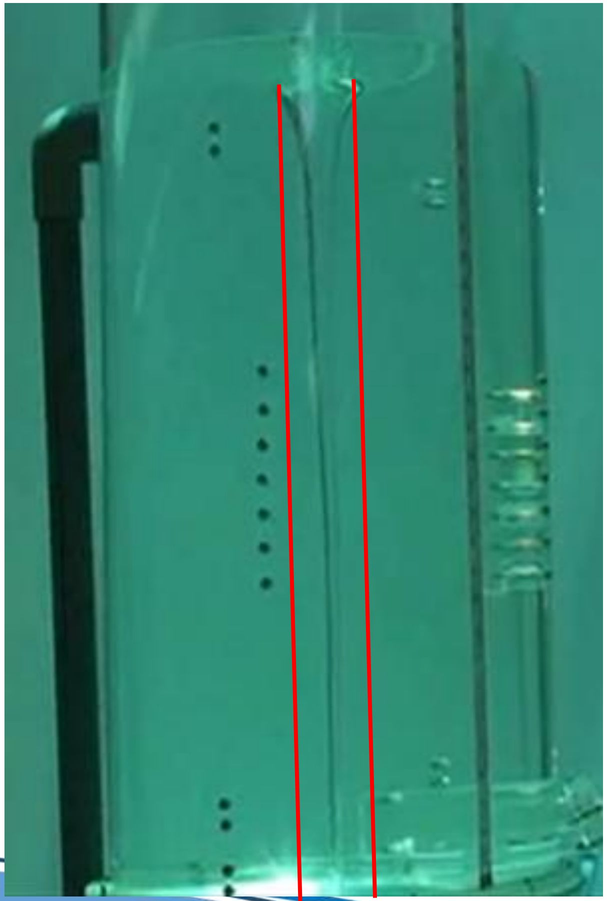


# Vortex Flow Characteristics – Air core behavior

Case 1: Without Outflow
Small and straight

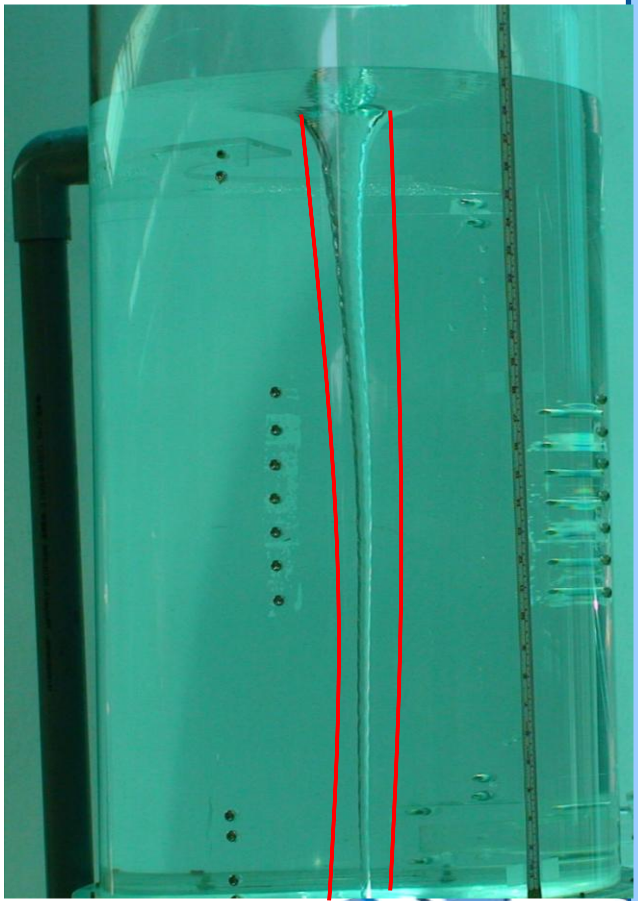


Case 2: With Outflow
Bigger and straight



Case 3: With Outflow & Deflector

Bigger and curve



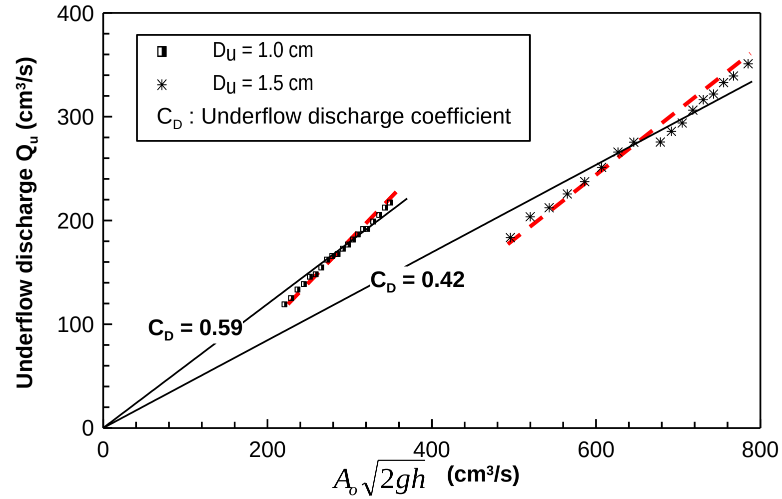
# Underflow discharge coefficient relations

$$Q_u = C_D A_o \sqrt{2gh}$$

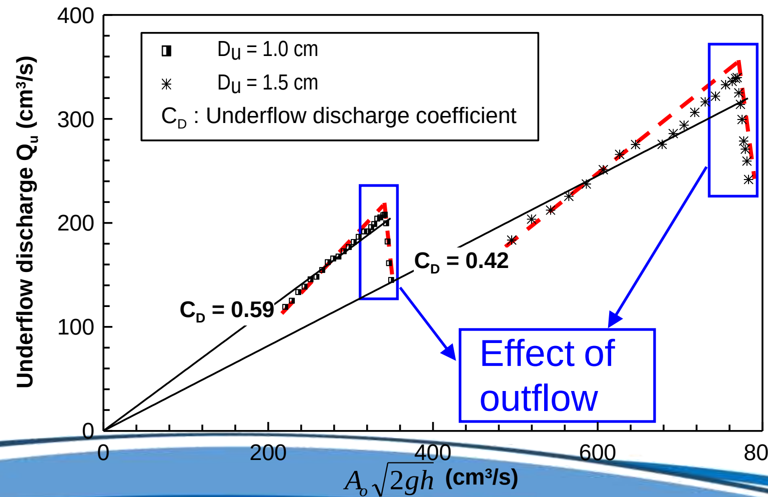
Discharge coefficient $C_D$ **is not constant**, $C_D$ **increases** with water heads h.

- Case 1: Relations are **linear** with water heads.
- Case 2 & case 3: Relations are **not linear** with water heads because of the **effect of outflow and deflector**.

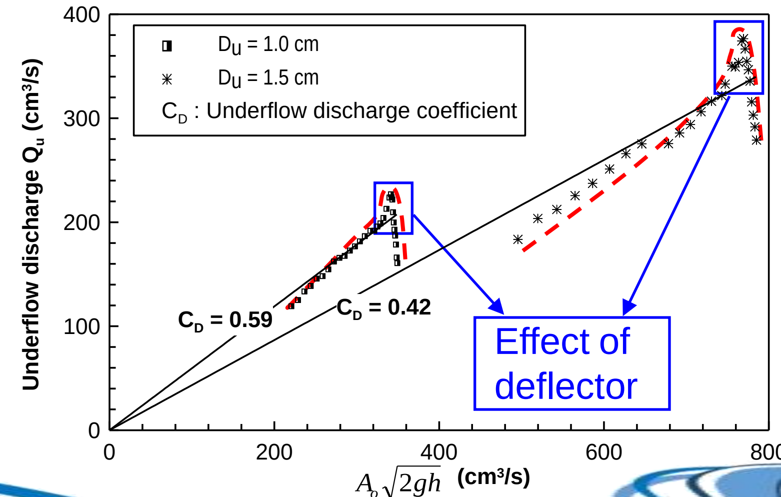
## Case 1: Without Outflow




## Case 2: With Outflow




## Case 3: With Outflow & Deflector



# Discussions & Conclusions

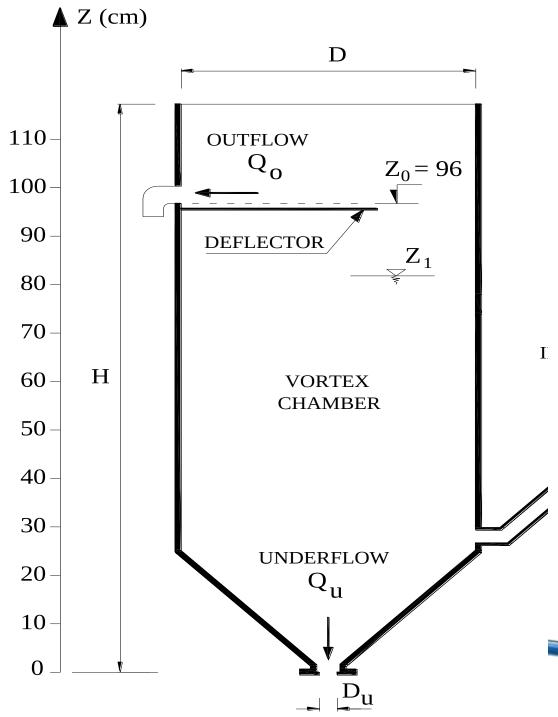
❑ Underflow discharge coefficient $C_D$ is not constant, $C_D$ increases or decreases with water heads h depending on boundary conditions.

- Case 1: $C_D$ increases with water heads h.
- Case 2 & 3: $Z_1 \leq 96$ cm, $C_D$ increases with h
  $Z_1 > 96$ cm, $C_D$ suddenly significantly decreases.

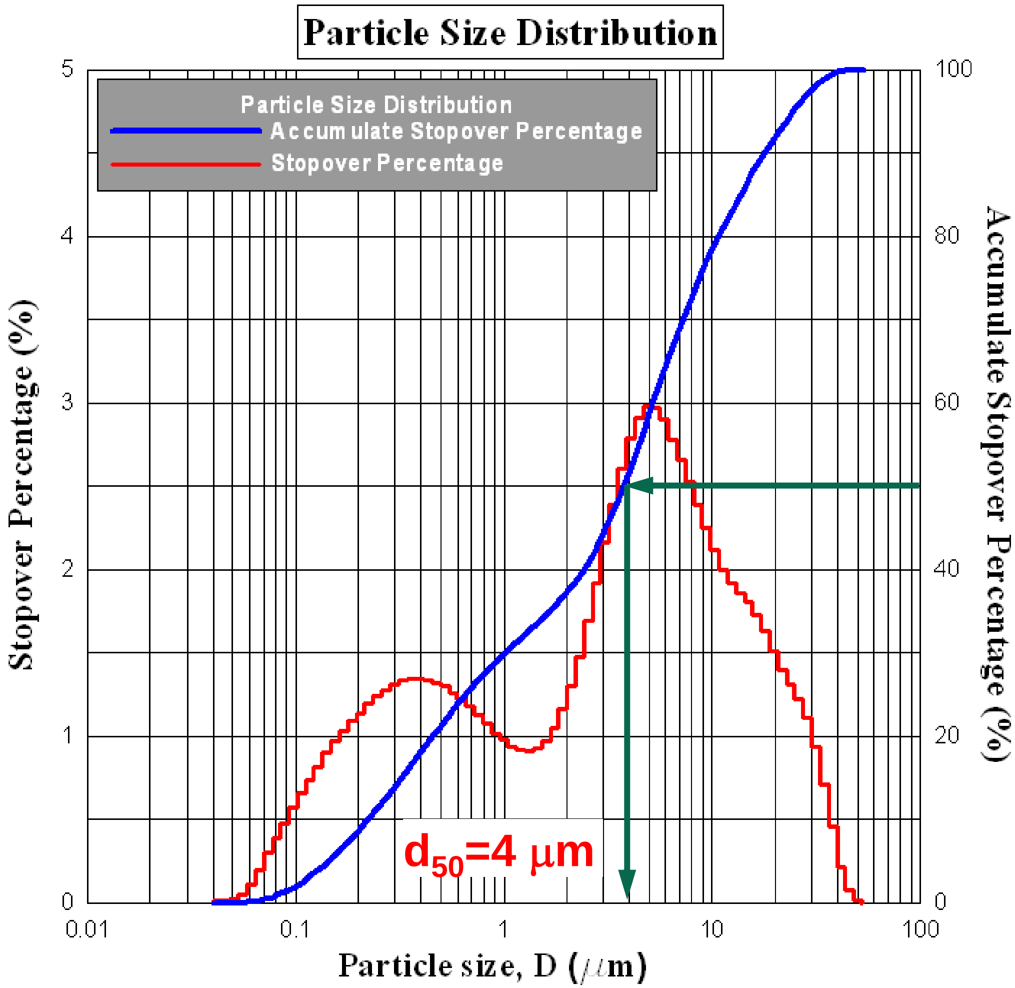
❑ Formation of vortex flow remarkably affects on underflow discharge.

❑ The diameter of air core will increase with inlet velocity.

❑ The presence of outflow $Q_o$ and deflector significantly influences on the formation of vortex flow or air core, and then $C_D$ is also affected.



# Sediment removal efficiency – Ongoing research




*Sediment Concentration*

$C_{inflow}$ = 32.65 g/L

$C_{outflow}$ = 0.11 g/L

Removal efficiency = 99.7%