COMSOL CONFERENCE ROTTERDAM2013

UNIVERSITY of OULU
OULUN YLIOPISTO

OPTIMIZATION OF AROUND-THE-END HYDRAULIC MIXER USING COMSOL MULTIPHYSICS®

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Content of presentation

- ***About 33% of Finland area is covered by peat.***

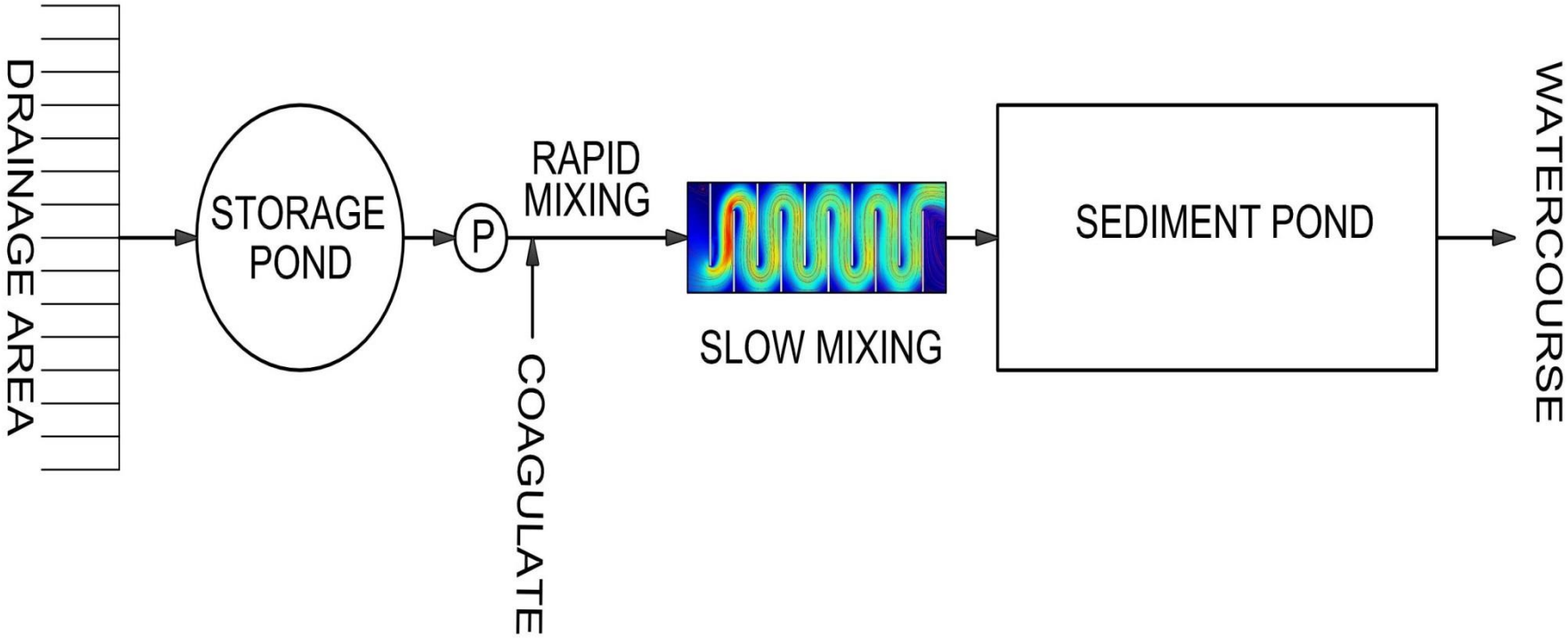
- ***Almost 51% of the Finnish peatlands have been drained for different usage such as forestry, agricultural, and peat production.***

Often pollution load of drainage water is high and treatment is needed before releasing to watercourse.

http://www.turveteollisuusliitto.fi/index.php?id=223

How Can Reduce Leaching and Impact of Diffuse Pollution to Watercourses From Peatland Drainage?

SMALL TREATMENT FACILITY



SLOW MIXING UNIT

- Mechanical Mixer

Using electrical power to move some parts, such as impeller to do mixing.

- Hydraulic Mixer

Using gravity force to move water through of some barriers to do mixing.

HYDRAULIC MIXER DESIGN AND OPTIMIZATION

- ***Design Parameters to find major dimensions***
  - ***Discharge or Volume (Q)***
  - ***Velocity Gradient (G)***
  - ***Retention time (RT)***
  - ***Operating limits***
  - ***Construction limits***
- ***Barriers optimization to achieve best efficiency***
  - ***Shape***
  - ***Size***
  - ***Number***
  - ***Arrangement***

THE OBJECTIVE OF THIS RESEARCH

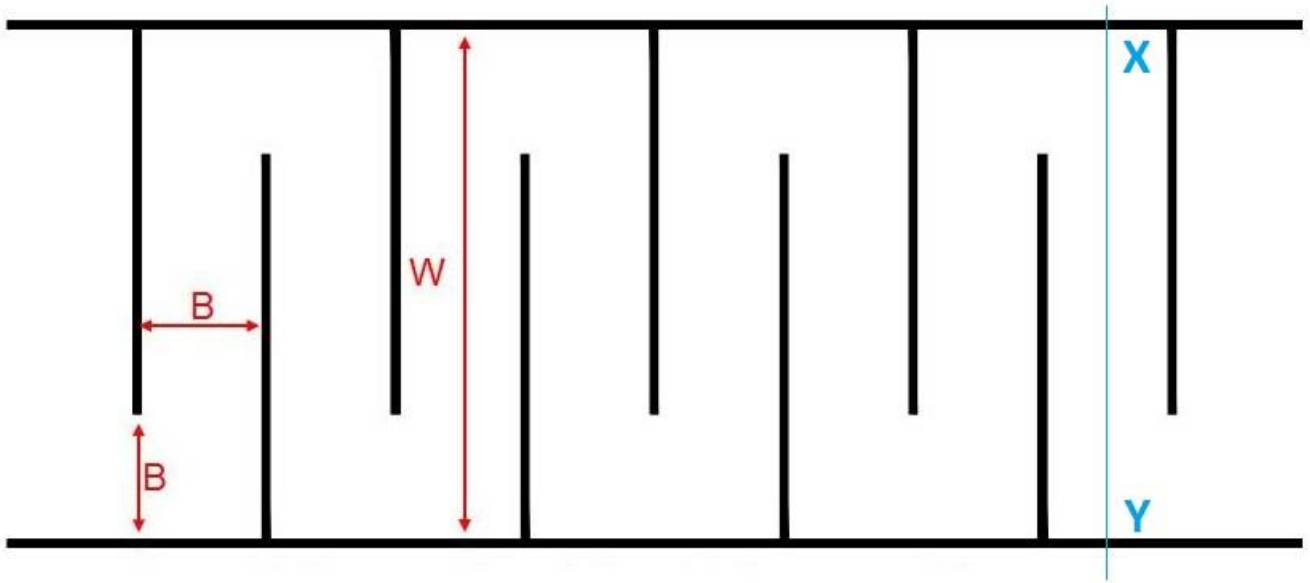
Using COMSOL Multiphysics® to find further details such as;

- ***dimensions*** **of barriers and**
- ***distance*** **between them**

to achieve the most uniform field of velocity gradient(G) is needed for efficient mixing and chemical coagulation.

METHODS

Part 1 – Simulation of different Lengths of barriers and distance between them to find the most uniform distribution of G-value.

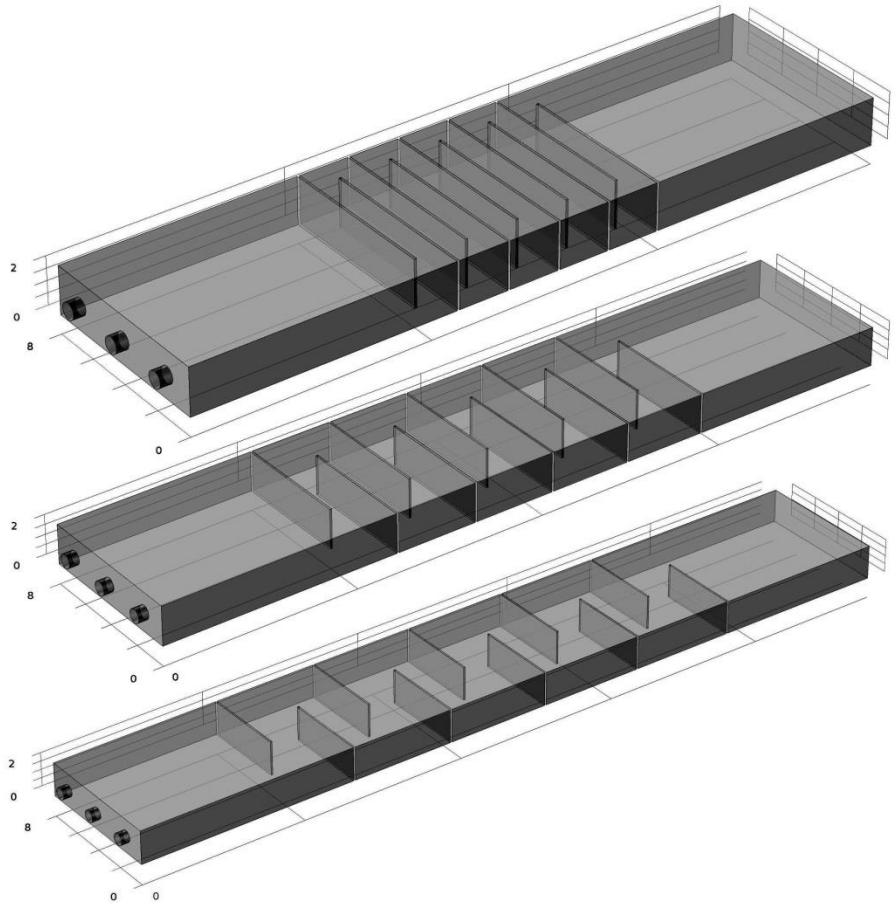


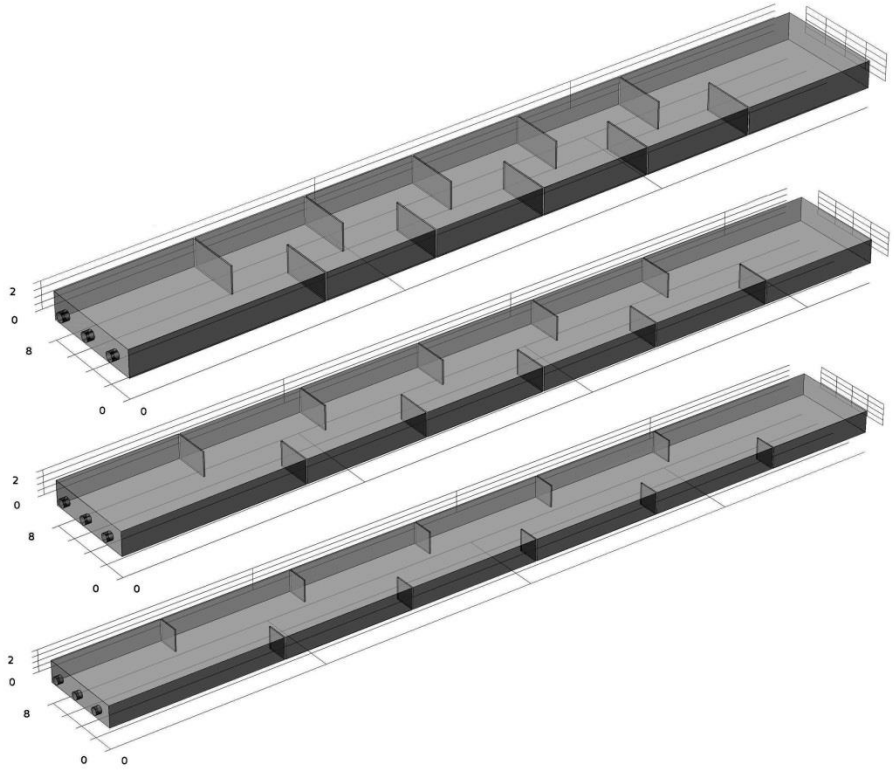
B=slots' width, W= Mixer's width

Part 2 – Simulation of different depths of water to achieve target G-value.

METHODS

Different Lengths of barriers and distance between them

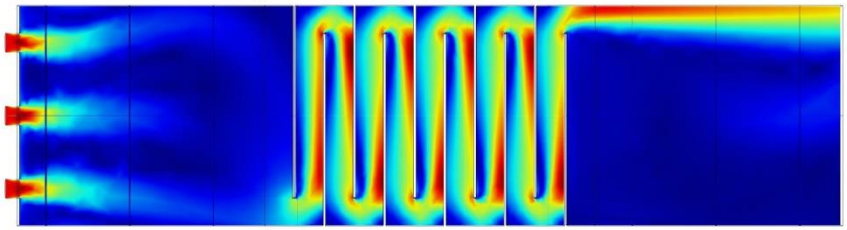




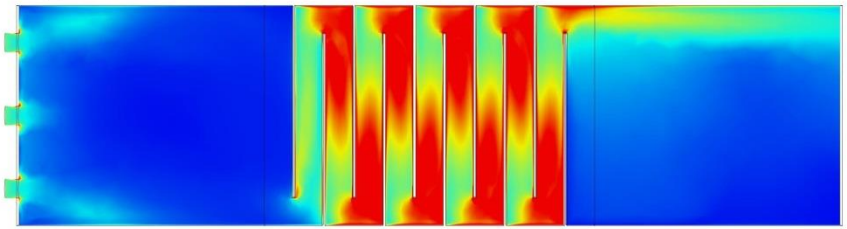
RESULTS

Flow velocity and G value distribution fields B=W/8 & B=W/4

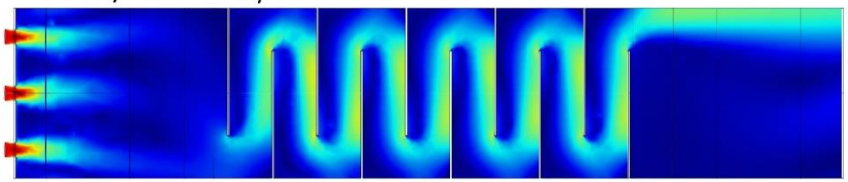
Velocity Field B=W/8



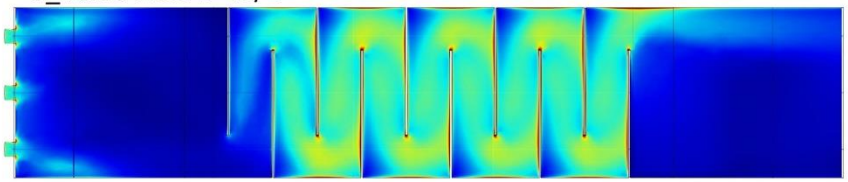
G_Value Field B=W/8

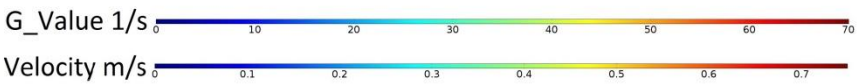


Velocity Field B=W/4



G_Value Field B=W/4

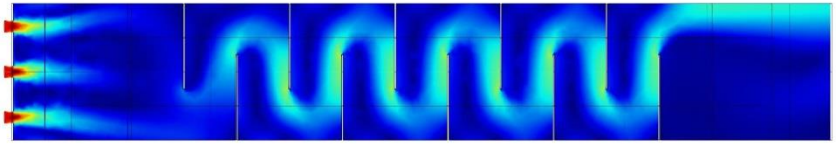




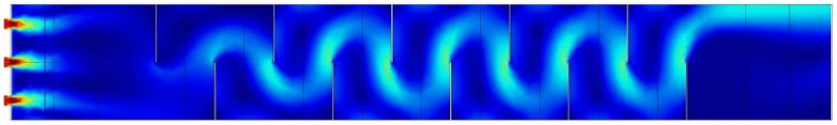
RESULTS

Flow velocity and G value distribution fields B=3W/8 & B=W/2

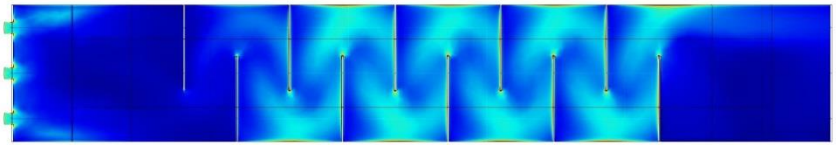
Velocity Field B=3W/8



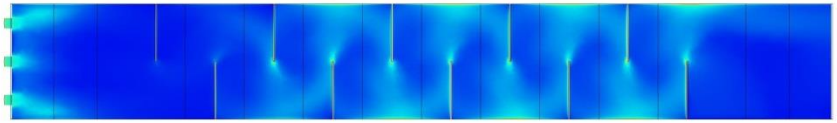
Velocity Field B=W/2

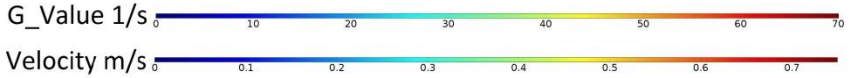


G_Value Field B=3W/8



G_Value Field B=W/2

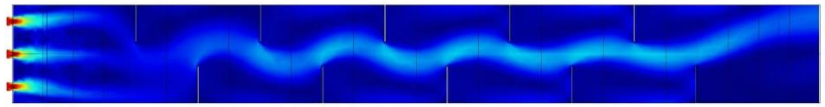




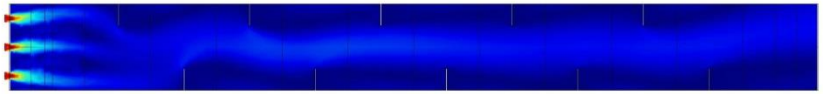
RESULTS

Flow velocity and G value distribution fields B=5W/8 & B=3W/4

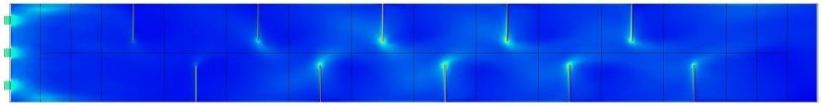
Velocity Field B=5W/8



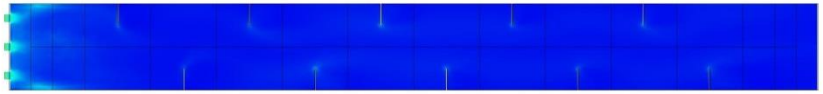
Velocity Field B=3W/4

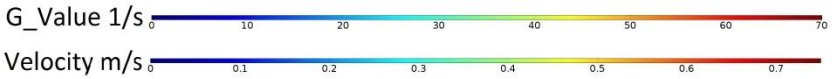


G_Value Field B=5W/8



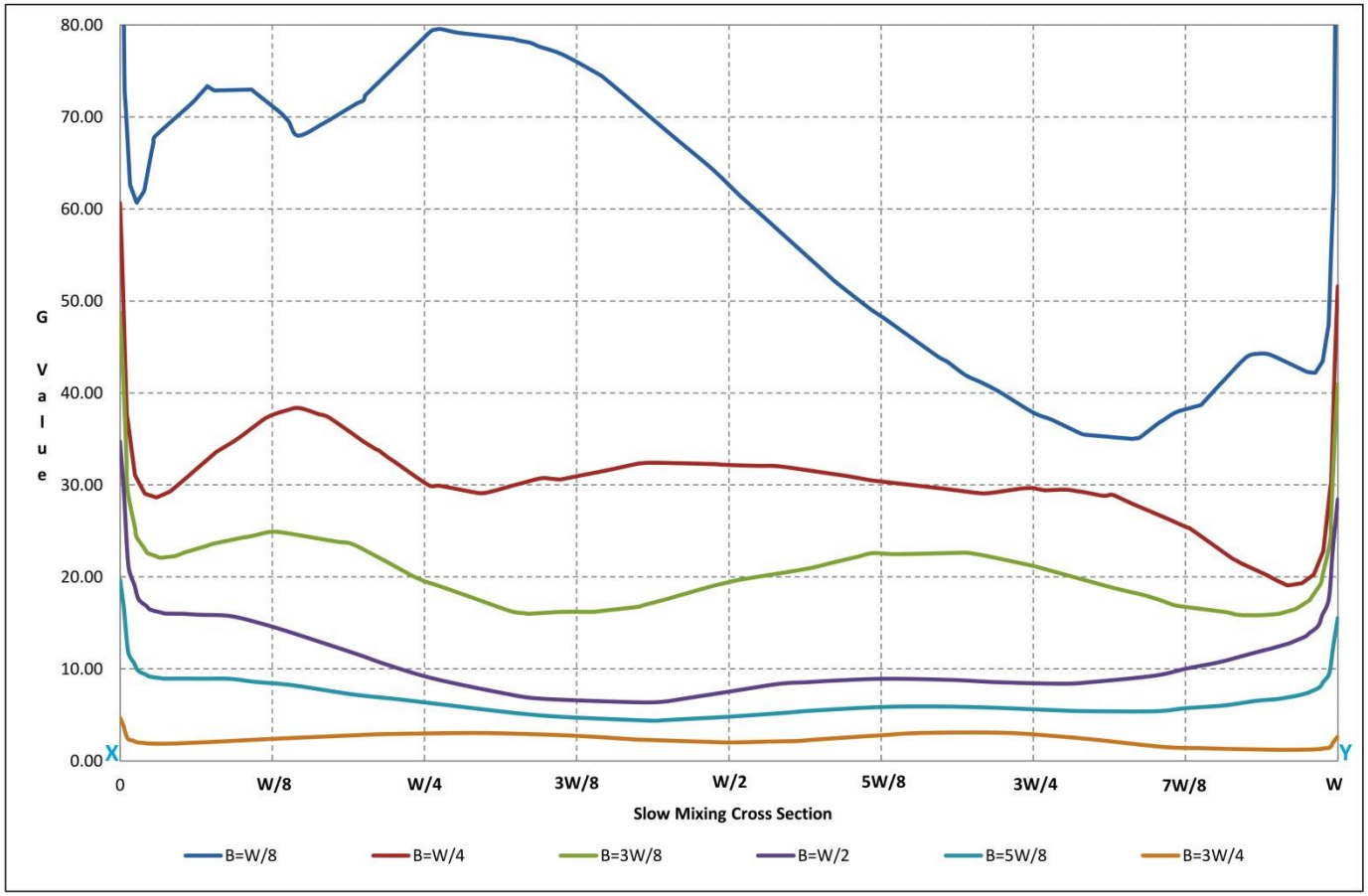
G_Value Field B=3W/4





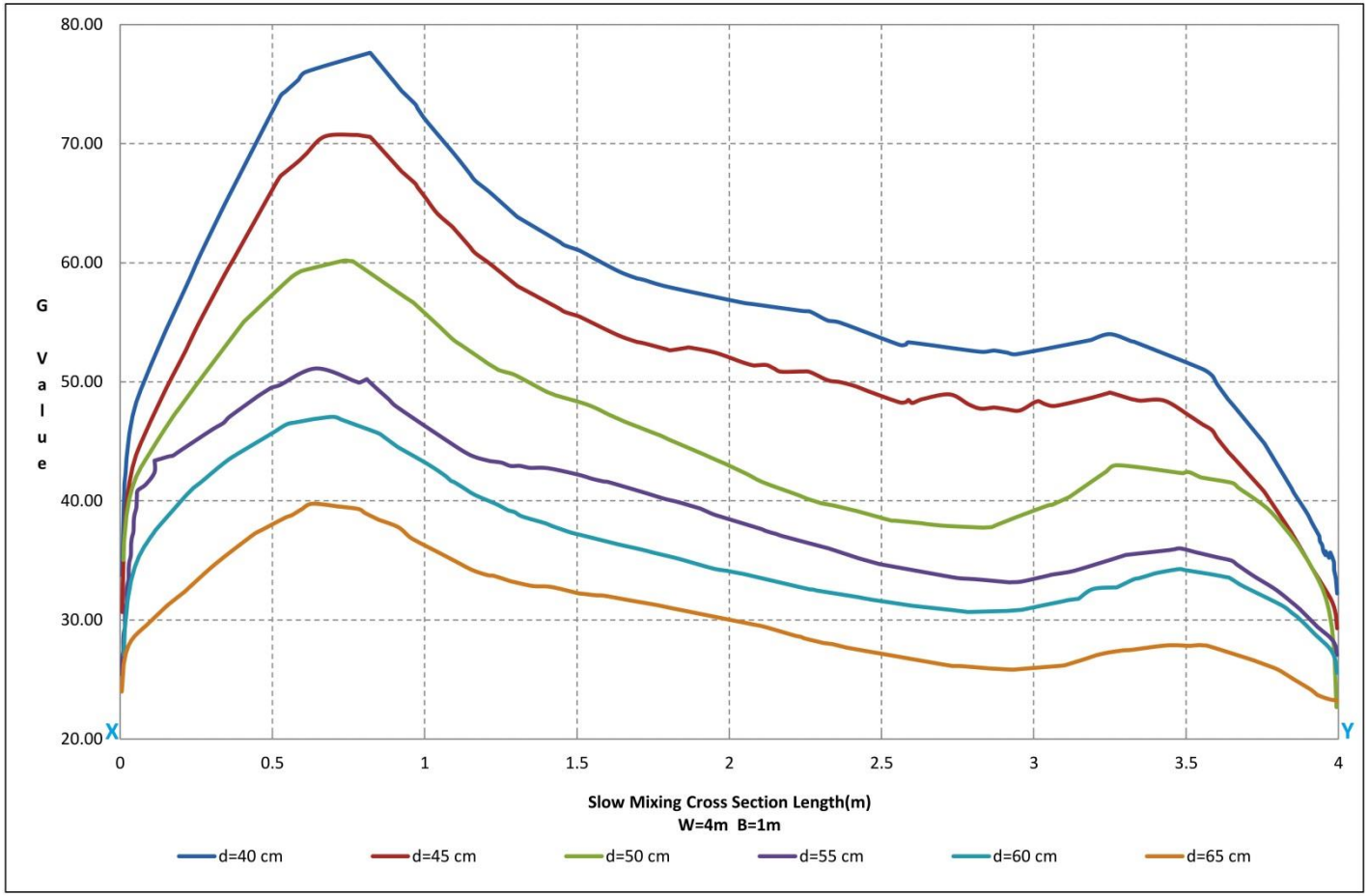
RESULTS

Variations in G value magnitude distribution through a cross section line between two barriers for different ratios between B&W



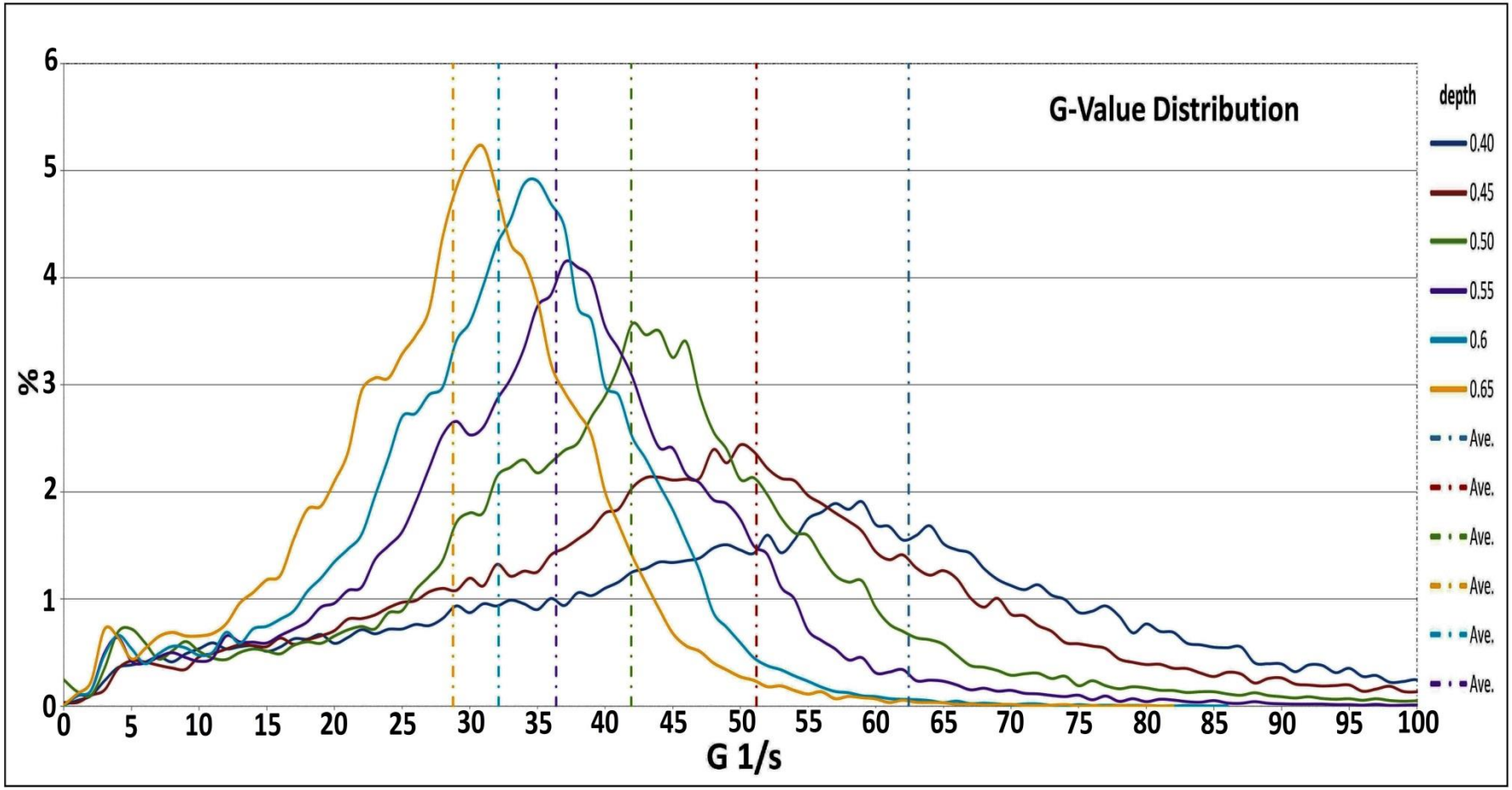
RESULTS

Variations in G values magnitude distribution through a cross section of one of the mixer channels for different flow depths (B=W/4)



RESULTS

G value magnitude distribution and average values for different flow depth (B=W/4)



CONCLUSION

The obtained results show:

- ***Optimum ratio for Around-the-End Hydraulic Mixer is B/W = ¼.***
- ***For a constant ratio between B and W, it is possible to achieve target G-value by controlling the flow depth.***

B=slots' width, W= Mixer's width


THANK YOU FOR YOUR ATTENTION!