INFLUENCE OF WOOD DENSITY ON BACKWATER RISE DUE TO LARGE WOOD ACUMULATIONS

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INTRODUCTION

Chimay Dam, Perú (2021).

Huallaga River, Perú (2005).

Congested transport in Marañón River, Perú (2008).

INTRODUCTION

Nombre científico	Familia	Nombre local
Aniba spp., *Ocotea* spp.	Lauraceae	Moena
Brunfelsia grandiflora D. Don	Solanaceae	Chiric sanango
Calophyllum brasiliensis Cambess	Clusiaceae	Alfaro, Lagarto caspi
Castilla ulei Warb	Moraceae	Caucho
Cedrela odorata L.	Meliaceae	Cedro
Ceiba pentandra (L.) Gaertn.	Bombacaceae	Lupuna
Euterpe precatoria Mart.	Arecaceae	Huasai
Ficus insipida Willd.	Moraceae	Ojé
Mauritia flexuosa l. F.	Arecaceae	Aguaje
Maytenus macrocarpa (Ruiz & Pav.) Briq.	Celastraceae	Chuchuhuasi
Minquartia guianensis Aubl.	Olacaceae	Huacapú
Phytelephas macrocarpa Ruiz & Pav.	Arecaceae	Yarina
Schelea spp.	Arecaceae	Shapaja
Smilax sp.	Smilacaceae	Zarzaparilla
Swietenia macrophylla King	Meliaceae	Aguano, Caoba
Uncaria spp.	Rubiaceae	Uña de gato
Virola spp.	Myristicaceae	Cumala, Cumala caupuri, Aguano cumala

Species in the flooded area of the Peruvian Amazon. Kvist L., Nebel G. , (2000)

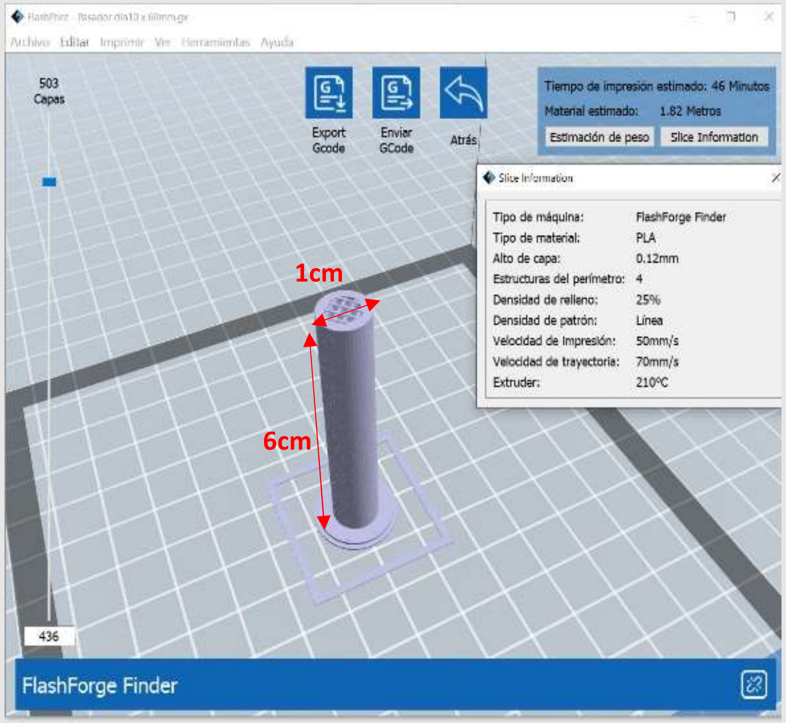
Density determines the buoyancy of the wood :

$$\rho_t = \frac{m_t}{v_t}$$

It varies according to tree **species, age, state of decomposition**, and **water content.**

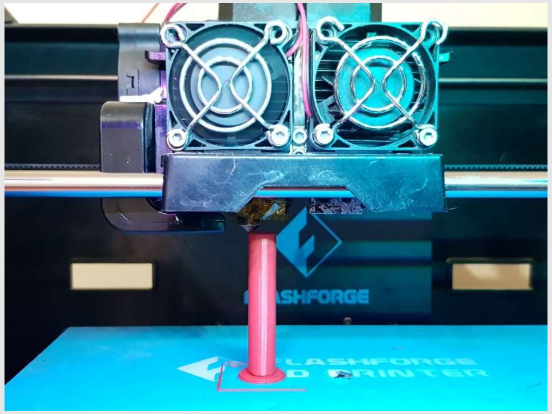
The objective was to investigate the effect of LW density on backwater rise due to LW accumulations.

MODEL DEBRIS



<u>Characteristics Printer</u>

Model: FlashForge Finder
Nozzle diameter: 0.4 mm
Filament material: PLA (Polilactic acid)
Print precision: +/- 0.2 mm
Fill density: 5%, 15%, 20%, 25%
Software: FlashPrint



GROUP	Length (cm)	Diameter (cm)	Weight (g)	Number	Density(kg/m3)
Green	6.00	1.00	1.88±0.13	700	400 ±30
Blue	6.00	1.00	2.83±0.13	700	600 ±30
Yellow	6.00	1.00	3.77±0.13	700	800 ±30
Red	6.00	1.00	4.48±0.13	700	950 ±30

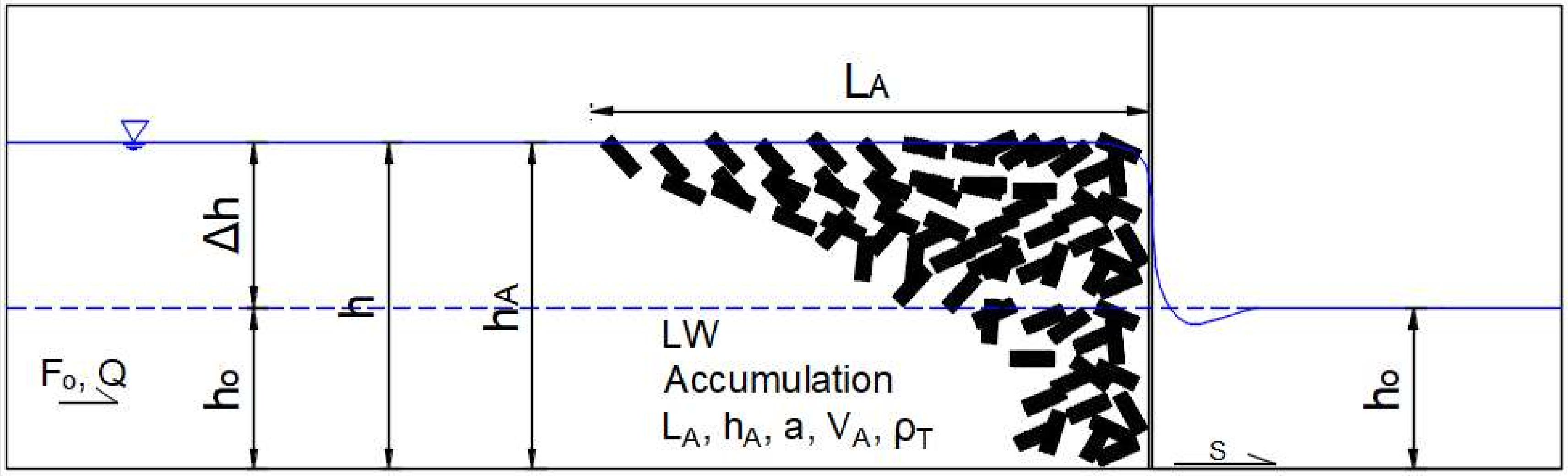
EXPERIMENTAL SETUP


Credits: Laboratorio Nacional de Hidráulica, Peru

Channel dimensions:
Length: 10.6 m
Height: 0.5 m
Width: 0.25 m
Maximum Flow: 40 l/s
Slope: 0-10%

Rack dimensions:
8 stainless steel bars
Diameter bar: 3 mm
Axial distance: 3 cm

EXPERIMENTAL SETUP



ρ_T: Density accumulation
L_A: Length accumulation
h_A: Height accumulation
a: accumulation porosity
V_A: Volume accumulation

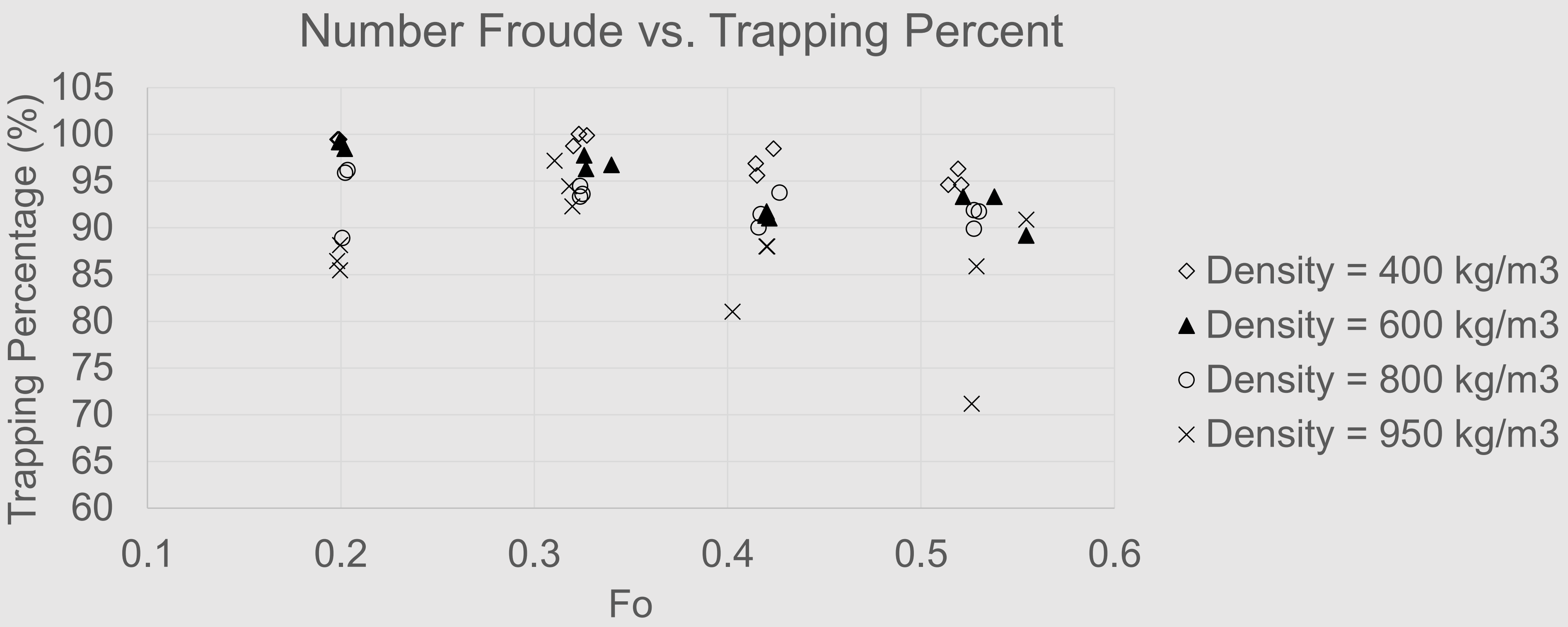
h_o: Initial height Flow
Q: Flow rate
F_o: Initial Froude number

Dimensions of logs and initial solid volume of accumulations were kept constant.

EXPERIMENTAL SETUP

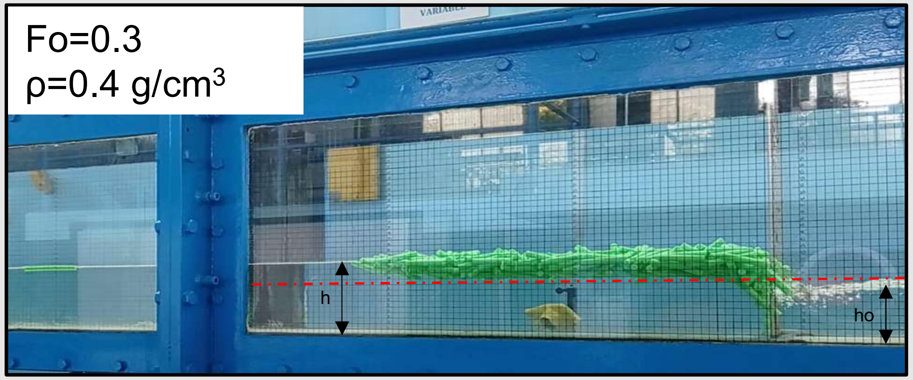
Test	Froude number (1)	Density ±30 (kg/m³) (2)	Q(l/s) (3)	S(%) (4)	ho(cm) (5)
1 2 3 4	Fo=0.2	400 600 800 950	5.0	0.015	10
5 6 7 8	Fo=0.3	400 600 800 950	3.6	0.0	6.3
9 10 11 12	Fo=0.4	400 600 800 950	10.0	0.015	10
13 14 15 16	Fo=0.5	400 600 800 950	5.5	0.2	6.3
17 18 19 20	Fo=1.3	400 600 800 950	17.20	0.8	6.3

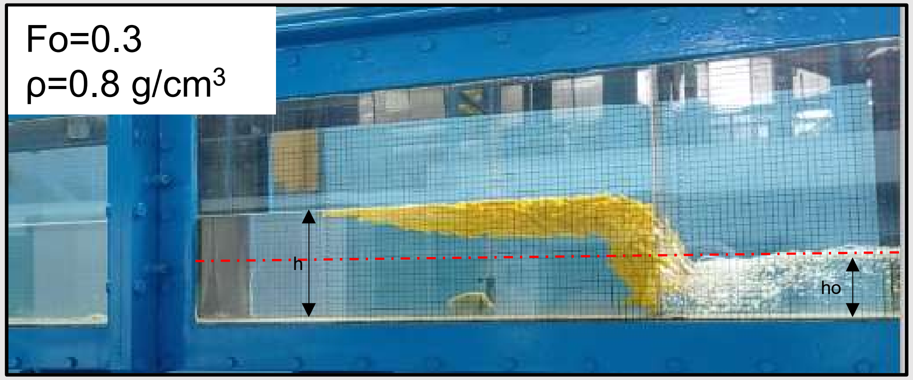
RESULTS

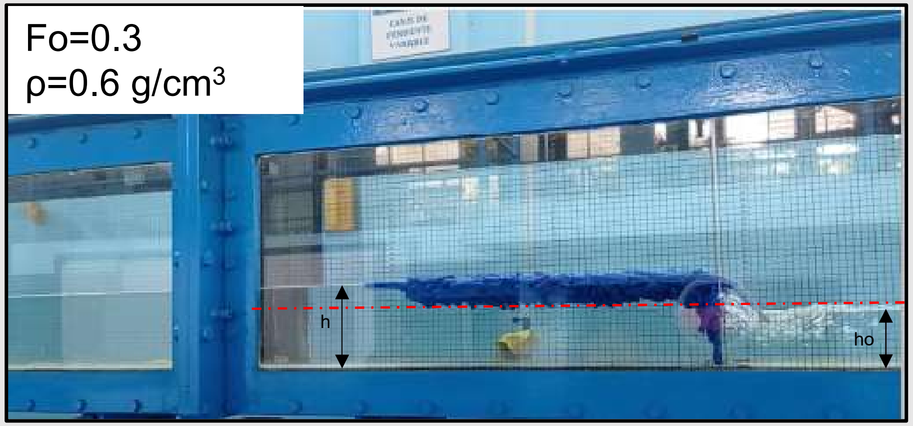


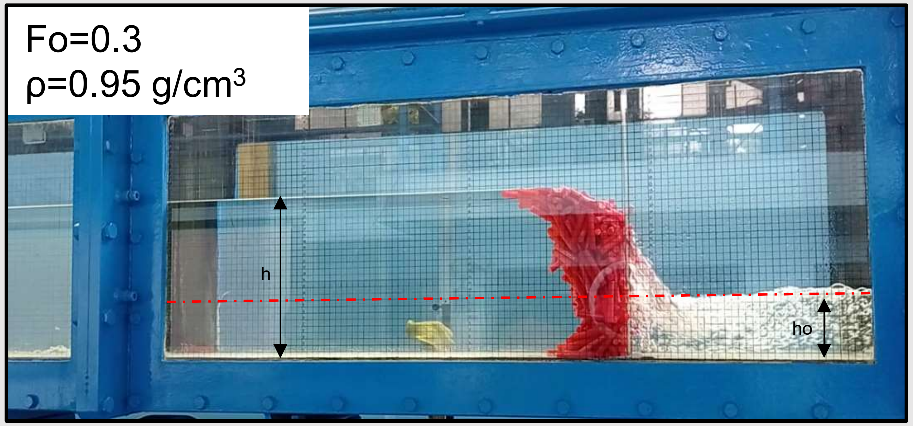
Number Froude vs. Trapping Percent
Trapping Percentage (%)
105
100
95
90
85
80
75
70
65
60
0.1
0.2
0.3
0.4
0.5
0.6
Fo
Density = 400 kg/m3
Density = 600 kg/m3
Density = 800 kg/m3
Density = 950 kg/m3

RESULTS

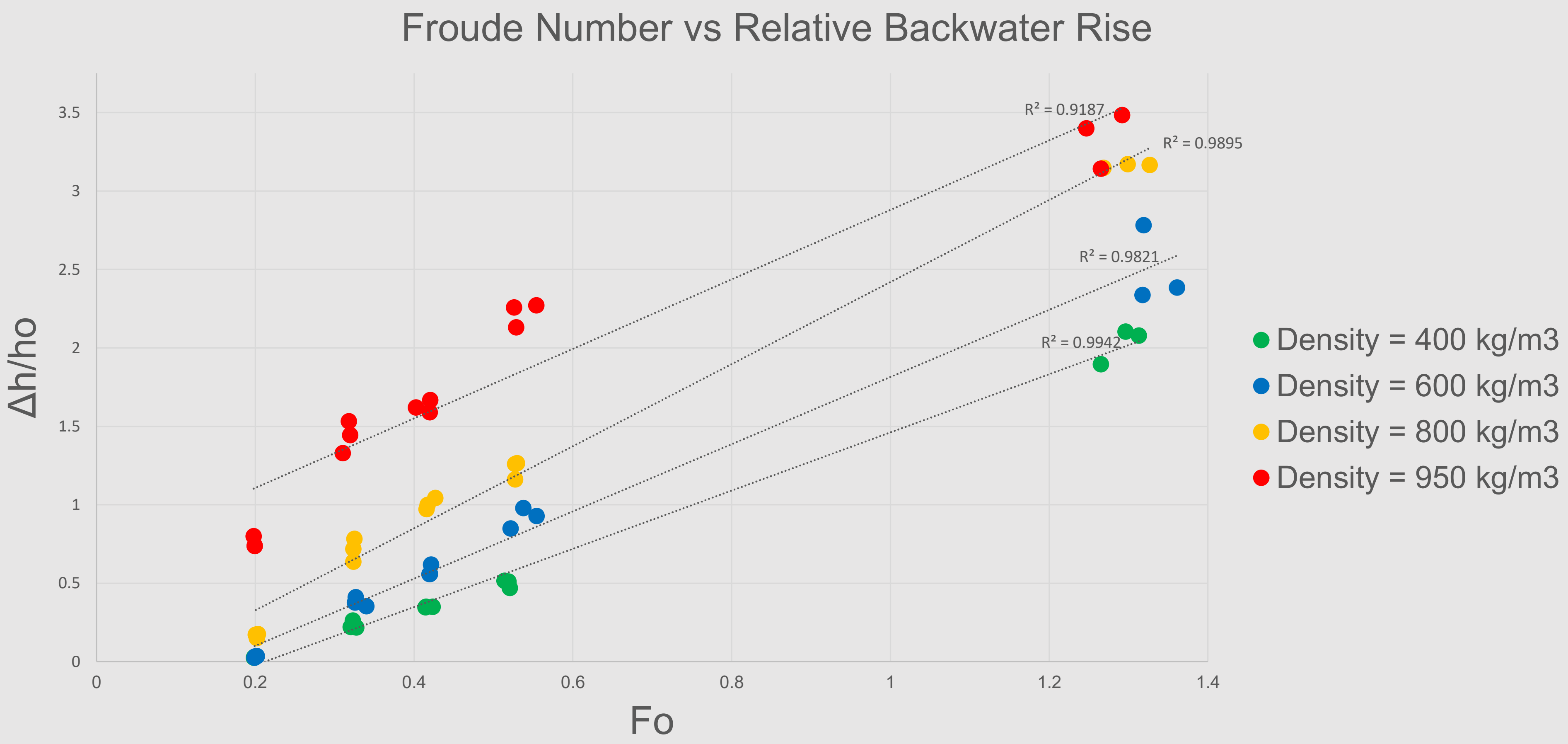

Fo=0.3
ρ=0.4 g/cm^3
h
ho


Fo=0.3
ρ=0.8 g/cm^3
h
ho


Fo=0.3
ρ=0.6 g/cm^3
h
ho


Fo=0.3
ρ=0.95 g/cm^3
h
ho

RESULTS


Froude Number vs Relative Backwater Rise
R² = 0.9187
R² = 0.9895
R² = 0.9821
R² = 0.9942
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Δh/ho
Fo
Density = 400 kg/m3
Density = 600 kg/m3
Density = 800 kg/m3
Density = 950 kg/m3

CONCLUSIONS

- Laboratory model tests were carried out to investigate the effect of LW density on backwater rise due to LW accumulations. LW density was varied to observe how the shape of LW accumulation is affected and to quantify the effect on the backwater rise.

- As a result, it was observed that accumulation length decreased slightly with the increase of LW density and the shape can be approximated box-like for accumulations with LW density of 950 kg/m^3.

- The results of the evaluation show a marked tendency in the increase of the backwater height with the increase of the density of the wood for each approach flow condition evaluated.

- Trapping percentages decrease with the increase of LW density.

Thank you very much!

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