

Treatment of Acid Gases: CO₂ capture

Validation of the Use of Fluent in order to Simulate Sieve Tray Columns

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IFP's Contact: *Aude Royon-Lebeaud*

8 February 2010

Agenda

Context of our project

What is the topic of our BEI?

Why this topic?

Bibliography

Presentation of available publications

Plan of actions

What do we plan to do?

WHY

 Greenhouse gases' emissions have been increasing for a long time

CO₂: +70% since 1970

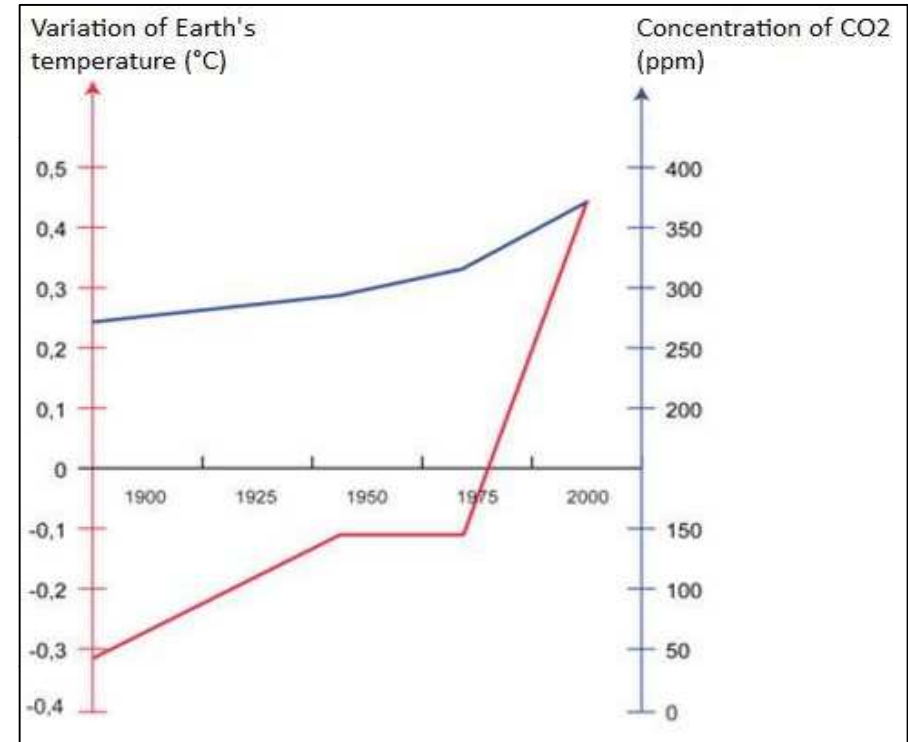
 Greenhouse effects are amplified

+0,7°C since 1900

Before 2100:


Temperature: From +1,1°C to +6,4°C

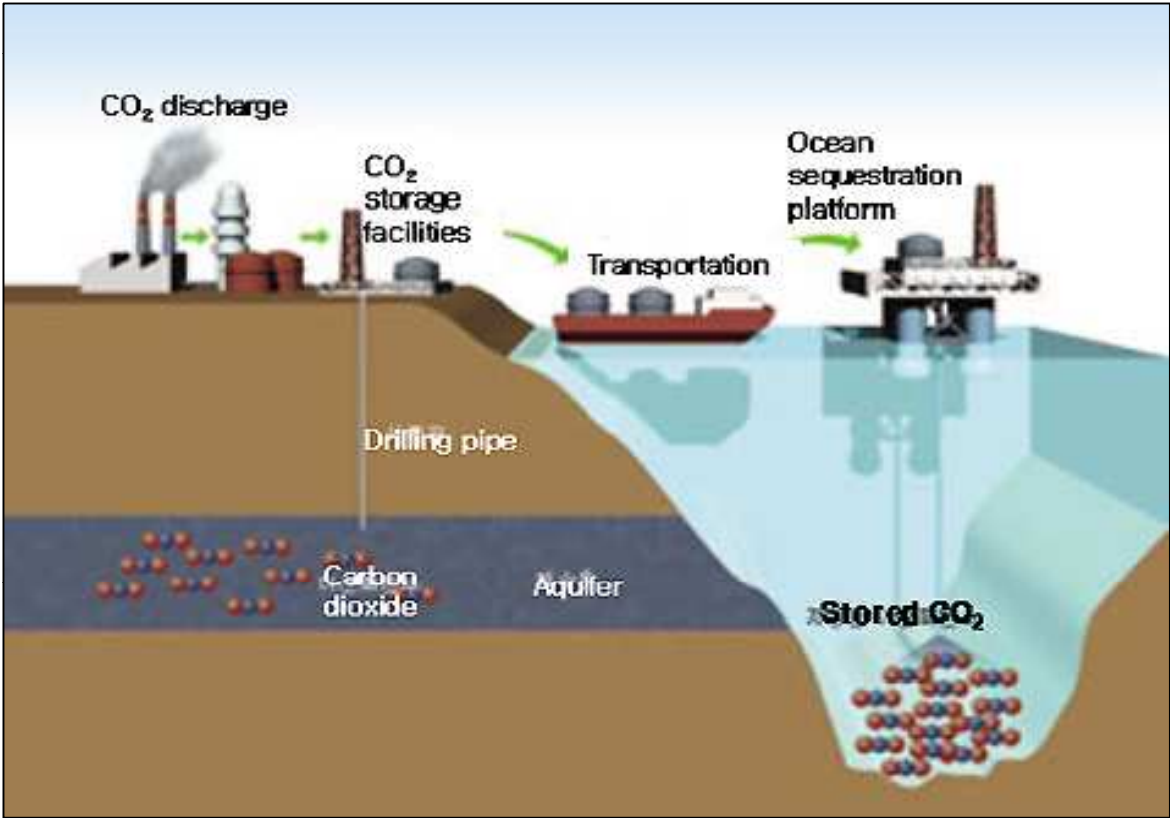
Level of Seas: From +18 cm to + 59 cm




Source: www.planete-energie.com

SOLUTION

 A solution was developed
CO₂ can be sequestered



Source: www.planete-energie.com

 Where?
Saline aquifers
Old oil fields
Other carbon sink

 Problem

CO₂ has to be captured

 Use of Sieve Tray Columns

Simulation of Sieve Tray Columns

SIEVE TRAY COLUMN

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Simulation of Sieve Tray Columns

What?

Gas/Liquid contactor

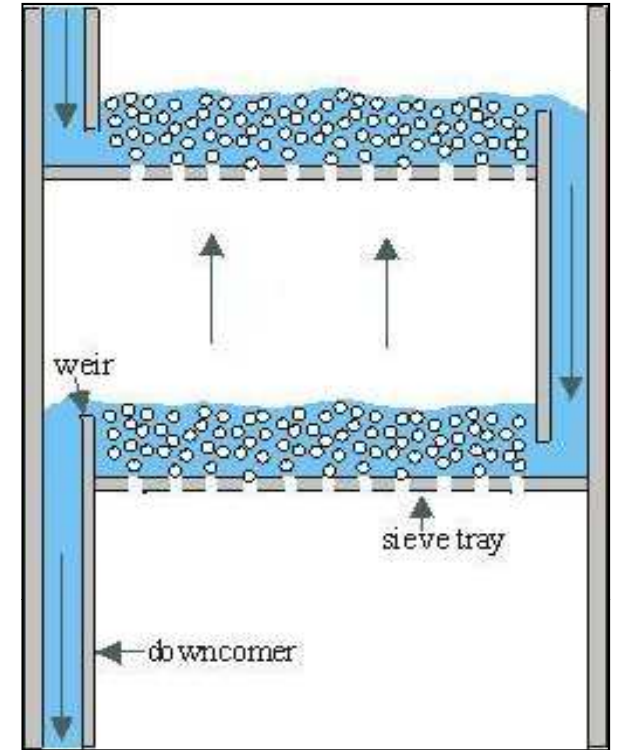
How does it work?

Liquid flows from the top to the bottom of the column

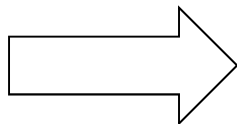
Gas flows from the bottom to the top

What's happening?

Mass exchange (CO₂) from gas phase to liquid phase



Sieve Tray Column



CO₂ is captured without other gaseous elements

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Simulation of Sieve Tray Columns

TOPIC



Simulation of Sieve Tray Columns' Hydrodynamics



Validation of the Use of Fluent

Use of Eulerian Model

Simulations including various Momentum Exchange Terms

Simulations of Mass Transfer

Context

Bibliography

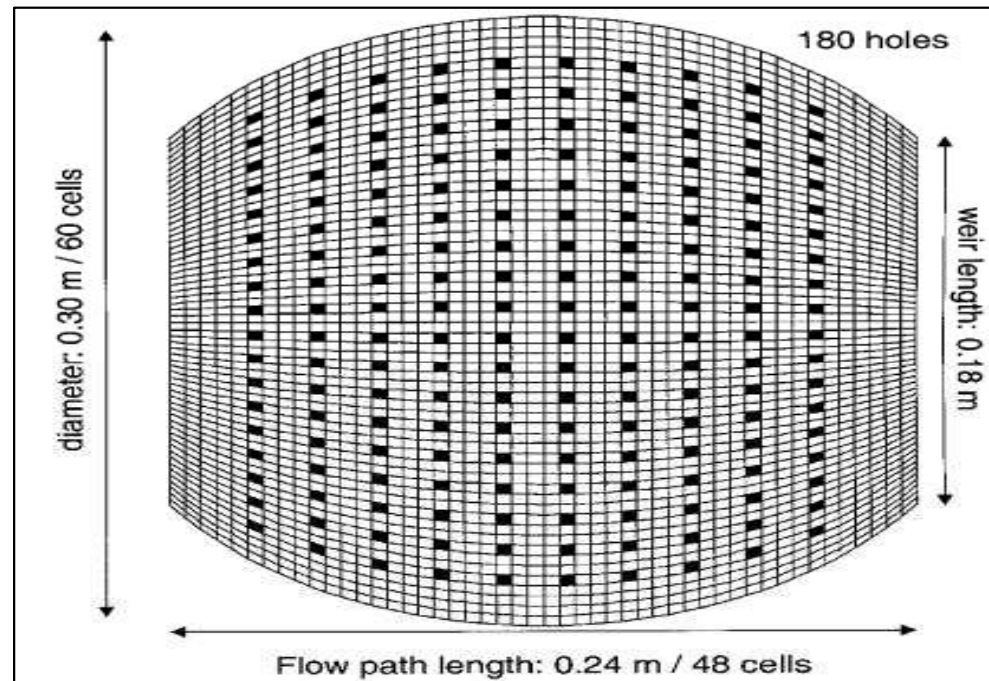
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Simulation of Sieve Tray Columns

PUBLICATIONS

 R. Krishna and J. M. Van Baten (2003)

Layout of the distributor plate



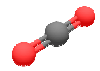
PUBLICATIONS

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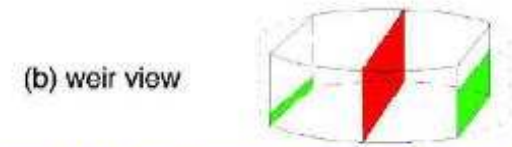
Simulation of Sieve Tray Columns



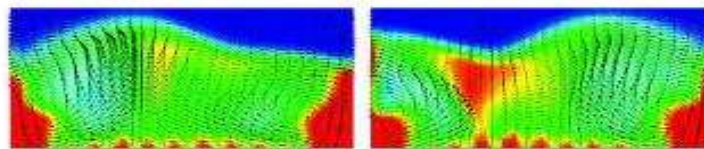
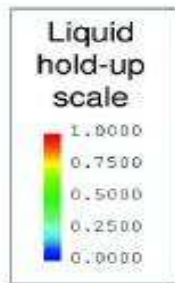
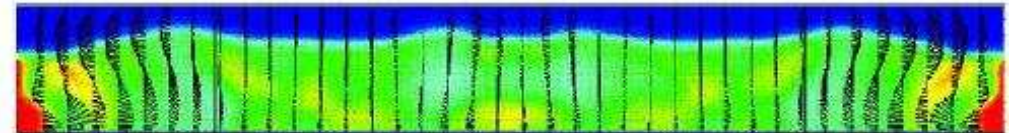
R. Krishna and J. M. Van Baten (2003)

Tracer in the liquid phase shows

Influence of the scale of parameters weir diameter :



0.9m



$\Delta t = 5 \text{ s}$

Front view



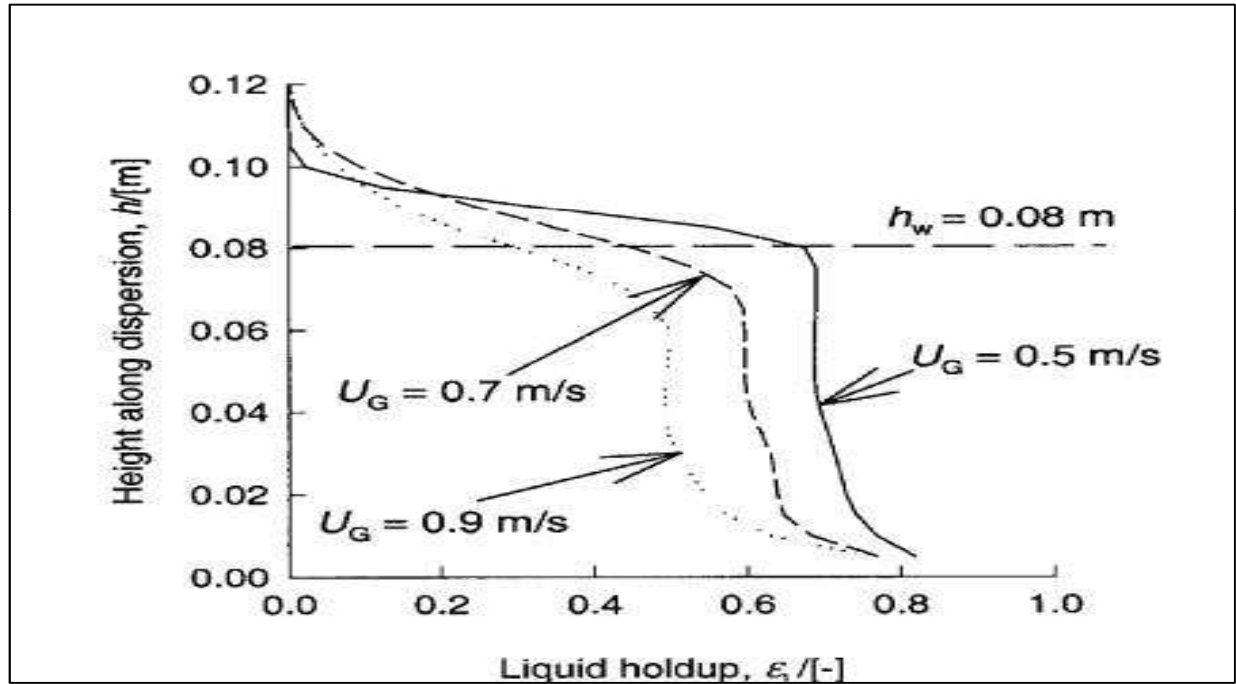
0.3m

Publications

R. Krishna and J. M. Van Baten (2003)

- Clear liquid height
 - CFD vs Correlations(Bennet 1983)
 - Dependence on gas velocity
 - on liquid velocity

➤ Liquid holdup



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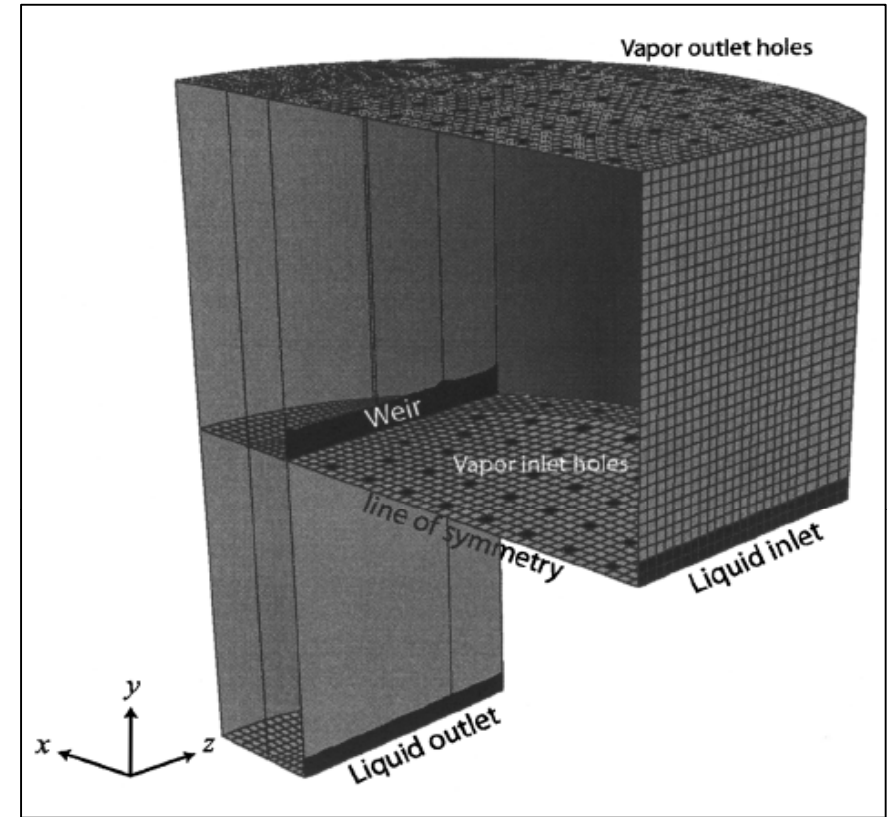
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Simulation of Sieve Tray Columns

Publications

 G. Gesit, K. Nandakumar and K. Chuang (2003)

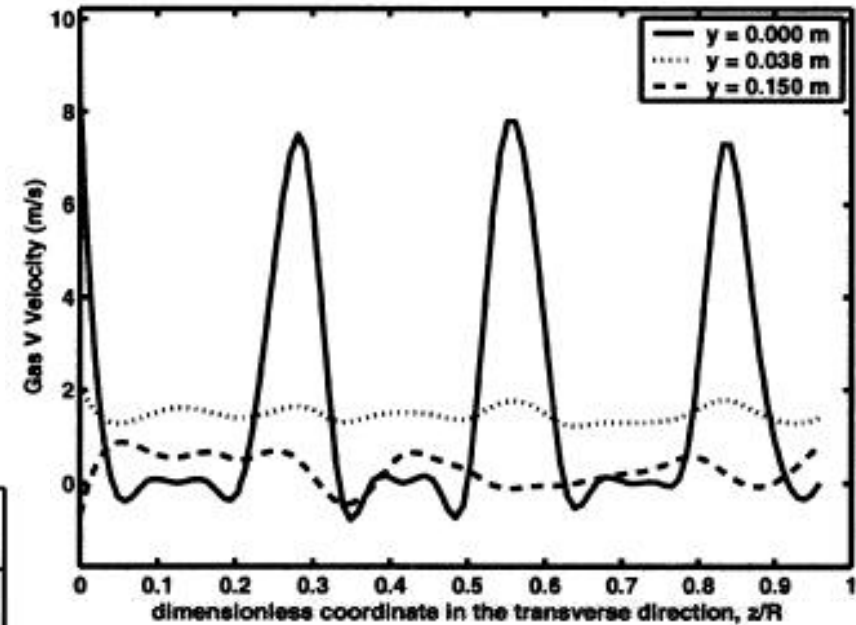
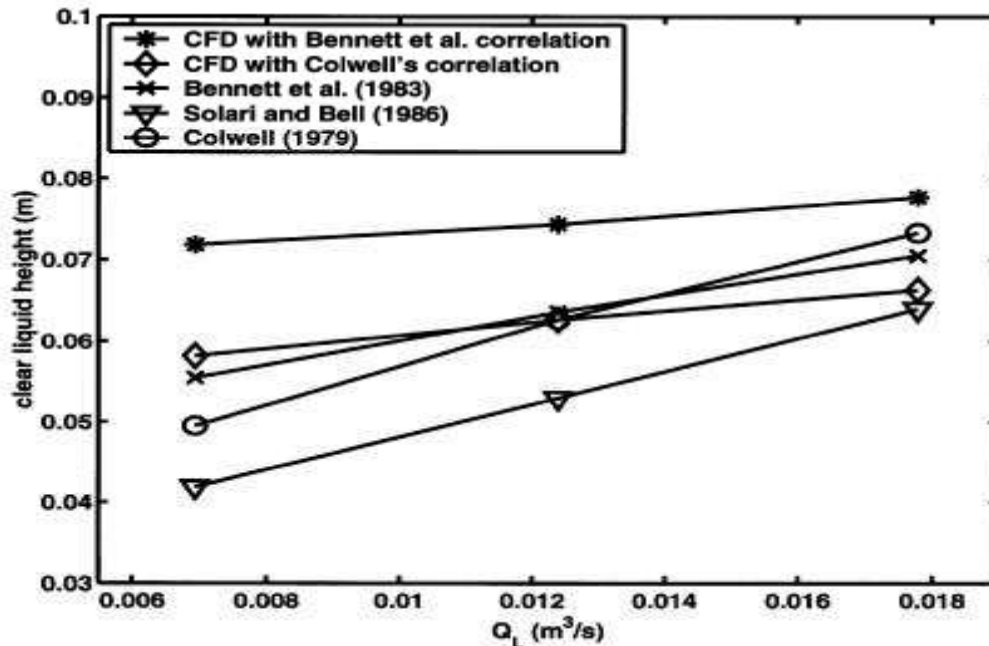
- Fluid flow patterns
- Parameters' influences



Publications

 G. Gesit, K. Nandakumar and K. Chuang (2003)

- Fluid flow patterns
 - Liquid velocity profile
 - Gaz velocity profile
 - Clear liquid height



Publications

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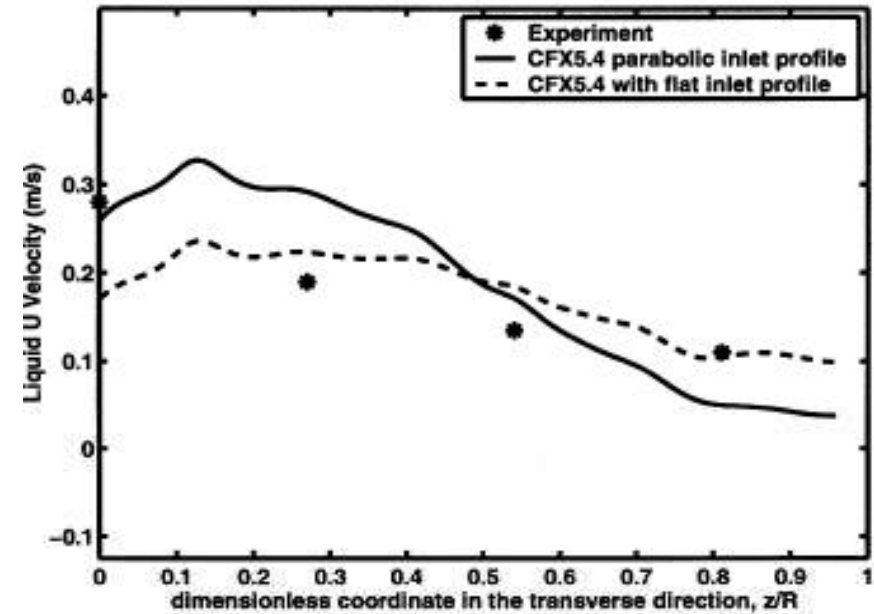
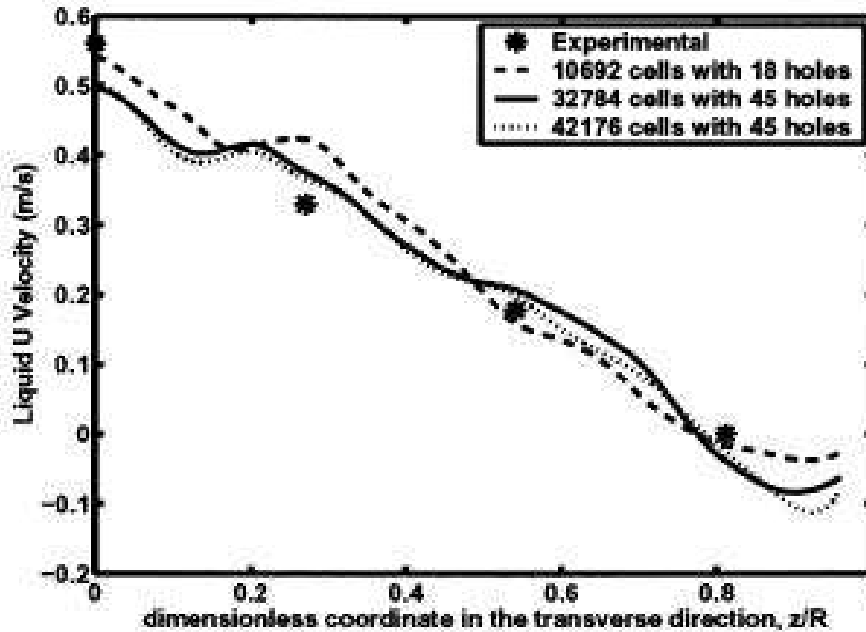
Simulation of Sieve Tray Columns

🚀 G. Gesit, K. Nandakumar and K. Chuang (2003)

Flow patterns-Parameters' influences

Boundaries & initial conditions

Grid size



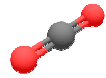
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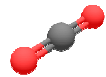
Models



Models & CFD

Euler – Euler

K- ϵ for liquid



Models & Equations

Drag coefficient

Average gaz holdup fraction

Interphase momentum transfer

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PLAN OF ACTIONS



3D simulation

Influence of gas-phase on hydraulics
Chaotic behavior



Comparative study to literature

Experimental results
CFD results form other tools


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
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Simulation of Sieve Tray Columns

 Comparing 2 geometries
 Simple geometry
 Physical geometry

 Comparing 2 models of drag
 Krishna's model
 Standard model

PLAN OF ACTIONS

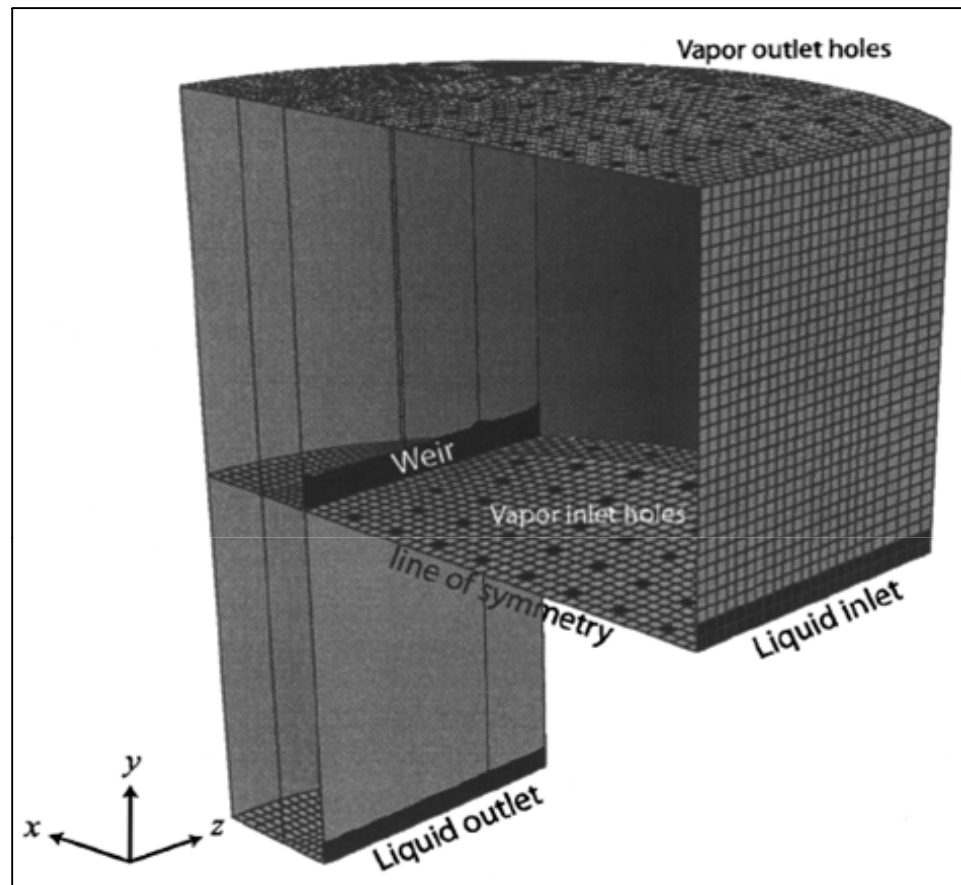
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Plan of Action

 Physical geometry

Simulation of Sieve Tray Columns



Source:

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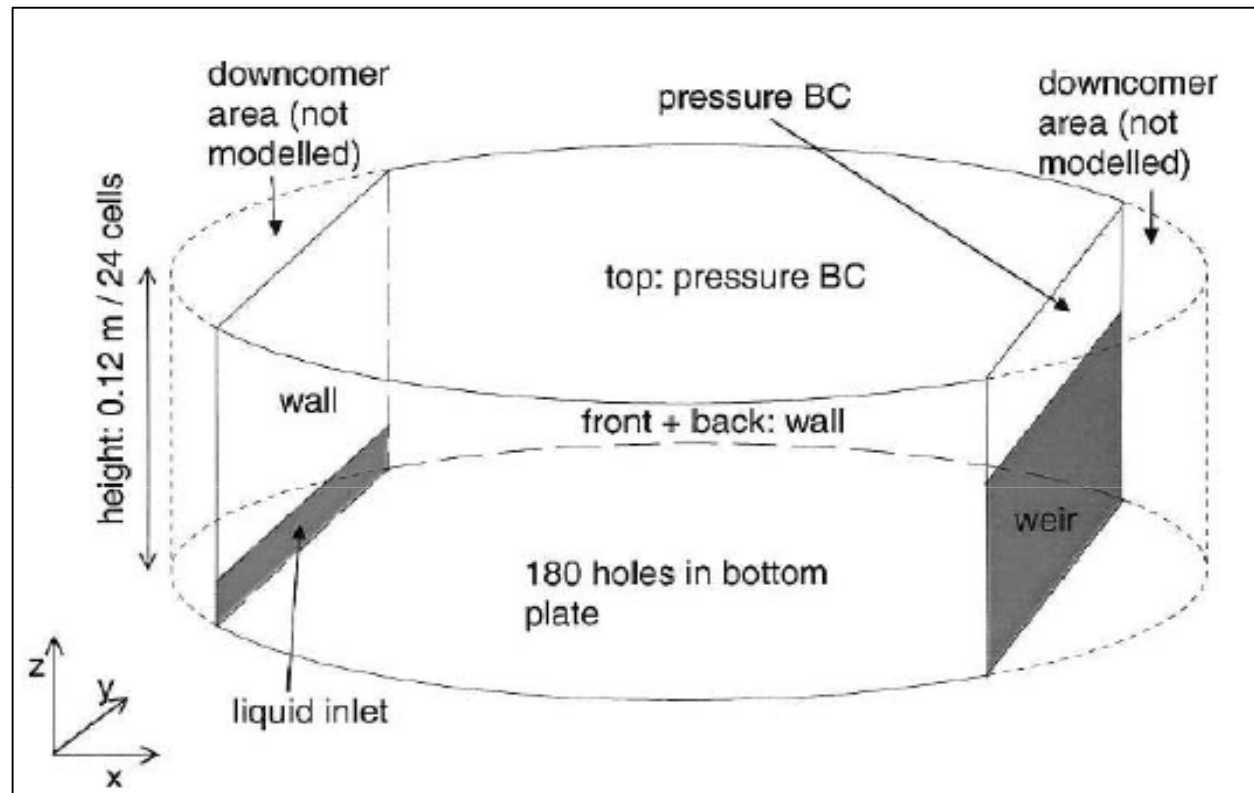
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Simple geometry

Simulation of Sieve Tray Columns



Source:

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PLAN OF ACTIONS



Krishna's model

Modeling term of momentum exchange

A drag coefficient estimated basing on correlation



Standard model given by Fluent

Drag coefficient function of flow regime

(Schiller-Naumann Law)

THANK YOU

FOR YOUR ATTENTION