PREDICTION OF PRESSURE LOSSES AND LIQUID HOLDUP IN HORIZONTAL STRATIFIED AND STRATIFIED-WAVY GAS-LIQUID FLOW IN A PIPE

Calgaro B., Ambrosini W., Andreussi A.
WALL COOLING
BY MEANS OF SYNTHETIC AND CONTINUOUS JETS

Monaco G., Mongibello L., de Luca L.
PARAMETER ESTIMATION PROCEDURE FOR GEOTHERMAL APPLICATIONS

Schiavi L., Bozzoli F., Rainieri S., Pagliarini G.
HEAT TRANSFER PERFORMANCE
OF SPIRALLY ENHANCED TUBES
FOR TEMPERATURE DEPENDENT PROPERTIES FLUIDS

Rainieri S., Bozzoli F., Pagliarini G.
DROP IMPACT ON NON-WETTABLE SURFACES

Antonini C., Marengo M.
A CORRELATION BETWEEN VOID FRACTION, LIQUID SUPERFICIAL VELOCITY AND FLOW COMPLEXITY FOR TWO-PHASE FLOWS IN DUCTS WITH SINGULARITIES

Arosio S., Guilizzoni M.
A correlation between void fraction, liquid superficial velocity and flow complexity for two-phase flows in ducts with singularities

\[ \alpha - cf \]

\[ cf - (\alpha) - w_L \]

\[ \alpha - XV \]
A correlation between void fraction, liquid superficial velocity and flow complexity for two-phase flows in ducts with singularities

S. Arosio, M. Guilizzoni
EXPERIMENTAL STUDY ON THE EFFECT OF ELECTRIC FIELD ON SPRAY ATOMIZATION

Arras S., Di Marco P., Macchia L., Risimini E.
INSTABILITY OF THE BRINKMAN FLOW WITH VISCOUS HEATING IN A HORIZONTAL POROUS LAYER

Barletta A., Rossi di Schio E., Celli M.
A Porous Medium and The Brinkman Model

\[
\frac{\mu}{K} \bar{\mathbf{u}} - \mu' \nabla^2 \bar{\mathbf{u}} = -\nabla \bar{p} + \rho g \beta (\bar{T} - T_0) \mathbf{e}_z
\]

- The Brinkman model describes the momentum transfer in a fluid saturated porous medium with a high permeability \( K \).
- The Brinkman model is compatible with the no-slip boundary conditions at an impermeable boundary.
- The expression of the viscous dissipation in a Brinkman flow is still an open problem.

The purpose of this paper is to study the convective instability in a basic Brinkman flow \textbf{activated solely by the internal viscous heating}. We consider a horizontal porous layer with thickness \( L \), adiabatic lower boundary and isothermal upper boundary. We formulate a Rayleigh-Bénard problem where the thermal forcing is \textbf{not} caused by the temperature boundary conditions.
The Dissipation-Convection Instability

\[ R = Ge Pe^2, \quad \xi = 1/(2\sqrt{Da}), \quad Da = K/L^2 \]

\( Ge = \text{Gebhart number}, \quad Pe = \text{Péclet number} \)

Longitudinal rolls: plot of \( R_{cr} \) versus \( \xi \).

Longitudinal rolls: marginal stability curves, \( R \) versus the wavenumber \( a \), for different \( \xi \).

Longitudinal rolls: streamlines and isotherms with \( \xi = 1 \) (top), \( \xi = 10 \) (bottom).
DEFLUSSO BIFASE DI MISCELE ARIA-ACQUA
IN UNA GIUNZIONE A T ORIZZONTALE PER ELEVATE VELOCITÀ SUPERFICIALI DELLA FASE LIQUIDA

Bertani C., Grosso D., Malandrone M., Panella B.
The present study concerns the Politecnico di Torino- Dipartimento di Energetica research on the two-phase flow in horizontal T junctions.

The experimental investigation concerns the pressure drops and the phase separation of a two-phase air-water mixture between the branches of the junction.

The flow pattern at the inlet and outlet of the junction has also been identified.
• The tests have been carried out with air-water flow at different inlet pressure and inlet superficial velocity, and for branch extraction ratios between 0 and 1

• Intermittent flow regimes and bubble flow at higher liquid velocities have been observed

• The pressure drops test data have been compared with the results predicted by several models
PERDITE DI CARICO CONCENTRATE E RIPARTITE IN EFFLUSSO BIFASE: CONFRONTO TRA LE PREVISIONI DI CORRELAZIONI TEORICHE E DATI Sperimentali

Boccardi G., Bubbico R., Celata G.P., Di Tosto F., Trinchieri R.
L’impianto VASIB...

...la sezione di prova...

...le matrici di prova (fluido: acqua)...

<table>
<thead>
<tr>
<th>$x_{in}$ (%)</th>
<th>&lt; 1</th>
<th>1-3</th>
<th>3-6</th>
<th>6-9</th>
<th>9-12</th>
<th>&gt;12</th>
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<tr>
<td>Numero Test</td>
<td>10</td>
<td>36</td>
<td>48</td>
<td>31</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>$p_{in}$ (bar)</td>
<td>&lt; 7</td>
<td>7- 9</td>
<td>9-12</td>
<td>12-15</td>
<td>15-17</td>
<td>&gt;17</td>
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<tr>
<td>Numero Test</td>
<td>14</td>
<td>21</td>
<td>32</td>
<td>46</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>$G$ (kg/s)</td>
<td>0.08</td>
<td>0.111</td>
<td>0.139</td>
<td>0.194</td>
<td>0.208</td>
<td>0.25-0.35</td>
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<tr>
<td>Numero Test</td>
<td>25</td>
<td>23</td>
<td>46</td>
<td>16</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

G. Boccardi, R. Bubbico, G.P. Celata, F. Di Tosto, R. Trinchieri
Perdite di carico concentrate e ripartite in efflusso bifase: confronto tra le previsioni di correlazioni teoriche e dati sperimentali
Al poster...

...parliamo di...

...perdite di carico ripartite

...lunghessa equivalente bifase

...perdite di carico concentrate

...Ricerca di una correlazione globale per il calcolo delle perdite di carico in condotti attraversati da efflusso bifase...

G. Boccardi, R. Bubbico, G.P. Celata, F. Di Tosto, R. Trinchieri
Perdite di carico concentrate e ripartite in efflusso bifase: confronto tra le previsioni di correlazioni teoriche e dati sperimentali
HEAT AND MASS TRANSFER MODELLING OF WATER DROPLETS IN HOT GASEOUS ENVIRONMENT

Cossali G.E., Tonini S.
Drop evaporation modelling

Development of an evaporation model of liquid drop floating in stagnant air, based on the solution of species, momentum and energy conservation equations, taking into account the effect of thermal gradient in the vapour phase.

Non-dimensional model parameters

\[ \zeta = \frac{r_0}{r}; \tilde{T} = \frac{T}{T_\infty}; G = \ln(1 - \chi_v); \hat{m}_{ev} = \frac{\dot{m}_{ev}}{4\pi r_0 D_v \rho_\infty}; \]

\[ \tilde{U} = -\zeta^2 G_{\zeta}; \Lambda = \frac{RT_\infty r_0^2}{M_m D_v^2}; \theta = \frac{M_{m_v} - M_{m_g}}{M_{m_g}}; \hat{P}_{vs} = \frac{P_{vs} M_{m_v}}{RT_\infty \rho_\infty} \]

Approximate analytical solution of present model

\[ \hat{m}_{ev} = \frac{1 + \theta(1 - \chi_{v,\infty})}{F(1) - F(0)} \ln \left( \frac{1 + \theta(1 - \chi_{v,\infty})}{1 + \theta(1 - \chi_{v,\infty})} \right) \tilde{P}_{vs} \]

\[ F(0) = \frac{(\tilde{T}_s - 1)}{\hat{m}_{ev}/L_e \left( 1 - e^{-\hat{m}_{ev}/L_e} \right)}; F(1) = \frac{(\tilde{T}_s - e^{-\hat{m}_{ev}/L_e})}{1 - e^{-\hat{m}_{ev}/L_e}} + F(0) e^{-\hat{m}_{ev}/L_e} \]

Drop conservation equations

\[ \frac{d}{dr} \left( r^2 \rho_l U - r^2 D_i \rho \frac{d \chi_i}{dr} \right) = 0 \quad \text{with } i = v, g \]

\[ \rho U \frac{dU}{dr} = -\frac{dP_r}{dr} + \mu \left( \frac{d^2 U}{dr^2} + \frac{2}{r} \frac{dU}{dr} \right) \]

\[ \rho U \frac{dT}{dr} = k \left( \frac{d^2 T}{dr^2} + \frac{2}{r} \frac{dT}{dr} \right) \]

Temperature and velocity field distributions

G.E. Cossali and S. Tonini, Heat and mass transfer modelling of water droplets in hot gaseous environment, UIT 2010
Unsteady drop evaporation

Drop heat and mass transfer modelling

\[ \frac{dM}{dt} = -\dot{m}_{ev} \]
\[ M \frac{du}{dt} = -\dot{m}_{ev} h_{LV} + \dot{Q} \]

Comparison with Maxwell and Stefan-Fuchs models

\[ \dot{m}_{ev}^{\text{(Present)}} = \dot{m}_{ev} \left( \hat{P}_{Vs}, \chi_{V,\infty}, \hat{T}_S, Le \right) \]
\[ \dot{m}_{ev}^{\text{(Maxwell)}} = \dot{m}_{ev} \left( \hat{P}_{Vs}, \chi_{V,\infty}, \hat{T}_S \right) \]
\[ \dot{m}_{ev}^{\text{(Stefan-Fuchs)}} = \dot{m}_{ev} \left( \hat{P}_{Vs}, \chi_{V,\infty}, \hat{T}_S \right) \]

The three models yield consistent evaluation of the droplet lifetime, although the predicted plateau temperatures are different.

Accounting for the Stefan flow effect on the gas temperature affects the droplet lifetime, particularly at higher gas temperature, decreasing the vaporisation rate and increasing the lifetime up to 35%.

FILM CONDENSATION IN HORIZONTAL MINICHANNEL: APPLICATION OF THE VOF METHOD

Da Riva E., Del Col D.
MODELLING STRATEGIES AND BOUNDARY CONDITIONS

- R134a $D = 1 \text{ mm}$ 3D STEADY-STATE
- VOLUME OF FLUID METHOD TO CAPTURE LIQUID/VAPOUR INTERFACE
- GRAVITY AND SURFACE TENSION TAKEN INTO ACCOUNT
- SATURATION TEMP. (40°C) FIXED AS BOUNDARY CONDITION AT INTERFACE
- WALL TEMP. (30°C) FIXED AS BOUNDARY CONDITION
- TWO MODELLING APPROACHES:
  
  a. LAMINAR FILM:
  TURBULENT VAPOUR CORE + NULL TURBULENT VISCOSITY IN THE LIQUID FILM
  
  b. TURBULENT FILM:
  LOW-RE TURBULENCE MODEL THROUGHOUT THE DOMAIN

<table>
<thead>
<tr>
<th>Mass Flux [kg m$^{-2}$s$^{-1}$]</th>
<th>Re$_{go}$ [-]</th>
<th>Re$_{lo}$ [-]</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>8 082</td>
<td>619</td>
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<tr>
<td>200</td>
<td>16 164</td>
<td>1 239</td>
</tr>
<tr>
<td>400</td>
<td>32 328</td>
<td>2 478</td>
</tr>
<tr>
<td>800</td>
<td>64 657</td>
<td>4 955</td>
</tr>
</tbody>
</table>
LAMINAR FILM APPROACH

- FAILS TO CAPTURE THE EFFECT OF MASS FLUX
- PREDICTS EXPERIMENTAL DATA AT 100 kg m$^{-2}$ s$^{-1}$ MASS FLUX WITH 15% MAXIMUM DEVIATION

TURBULENT FILM APPROACH

- CAPTURES THE EFFECT OF MASS FLUX
- OVERPREDICTS EXPERIMENTAL DATA AT LOW MASS FLUX
- PREDICTS EXPERIMENTAL DATA AT 400 kg m$^{-2}$ s$^{-1}$ WITH 20% MAX DEVIATION, AND DATA AT 800 kg m$^{-2}$ s$^{-1}$ WITH 10% MAX DEVIATION
EXPERIMENTAL ANALYSIS OF TWO-PHASE HEAT AND MASS TRANSFER IN SMALL DIMENSIONS NATURAL-CIRCULATION LOOPS

Filippeschi S., Franco A.
In the Two-Phase Loops (TPL) devices applied to the electronic equipments cooling or to other applications, the high heat loads are limited by the wall superheat increase in the evaporator section.

The working fluid removes heat from the evaporator section, the vapour or the liquid mixture rises up to the condenser section where it exchanges heat with the ambient.

They basically consists of an evaporator, a condenser and rising and coming down connecting pipes.

Two types of two-phase closed thermosyphons can be considered.

- The first type (A) is a two-phase thermosyphon with the evaporator internal diameter much larger than that of the upward connecting pipe and of the bubble diameter.
- The second type (B) has the internal diameter equal to that of the upward connecting pipe and this is 4-5 times larger than the bubble diameter.

The first relies on a pool boiling arrangement, the second is more akin to flow boiling.
The paper experimentally analyzes the thermo-fluid dynamics of compact two-phase loops with natural circulation.

The objective is to understand if the heat transfer performances are only due to the heat transfer in the evaporator section rather than fluid-dynamic characteristics of all the loop.

The results are obtained with water and FC72 and with two different types of thermosyphons:

For both thermosyphons capillary forces are not involved in the heat and mass transfer.

It is mainly shows how **TYPE A** thermosyphon performances are influenced only by the heat transfer regime in the evaporator section, but in **TYPE B** thermosyphons, the performances are also influenced by the fluid-dynamic parameters of the whole loop.

Filippeschi S., Franco A., Experimental analysis of two-phase heat and mass transfer in small dimensions natural-circulation loops
HC-1270 (PROPYLENE) VAPORIZATION INSIDE A BRAZED PLATE HEAT EXCHANGER

Longo G.A., Storato S.
THERMAL MODELLING OF LASER ABLATION SIMULATION BY NUMERICAL SOLUTION OF A THREE PHASE STEPHAN PROBLEM

Parissenti G., Niro A.
ns Laser Ablation

How Deep Can You Go?

G. Parissenti, A. Niro - Politecnico di Milano

Thermal modelling of laser ablation simulation by numerical solution of a three phases Stephan problem
Take Multiphase Problem + Stephan Equations + Front Tracking Method + Plasma Shielding Parameter

obtain 1D Ablation Thermal Model with Effective Fluence Estimation

G. Parissenti, A. Niro - Politecnico di Milano
Thermal modelling of laser ablation simulation by numerical solution of a three phases Stephan problem
HIGH VISCOITY OIL-WATER-AIR THREE PHASE FLOWS: PRESSURE DROP AND BUBBLE DYNAMIC

Poesio P., Sotgia G., Strazza D.
THERMAL INTERACTION BETWEEN TWO DROPLETS IN SINGLE-PHASE EVAPORATION

Santangelo P.E., Corticelli M.A., Tartarini P.
SCOPE:
To investigate the thermal transient at the interface between a heated solid substrate and two gently deposited droplets (We < 30)

EXPERIMENTAL

INFRARED THERMOGRAPHY
The interface temperature has been measured from below through an IR-transparent disk

NUMERICAL

FINITE-VOLUME METHOD
The 3D energy-diffusion equation is discretized and applied to both the liquid and the solid
RESULTS:
Good agreement between experimental data and numerical simulations in terms of time and spatial temperature trends.

Center of the first droplet (C1)
Center of the second droplet (C2)
Mid point between the centers (M)

$y = y_{C1}$, time = 1.5 s from the deposition of the second droplet
$y = y_{C2}$, time = 1.5 s from the deposition of the second droplet
$y = y_{M}$, time = 1.5 s from the deposition of the second droplet
ASSESSMENT AND TUNING OF CFD CAVITATION MODEL PARAMETERS USING ADVANCED OPTIMIZATION TECHNIQUES

Morgut M., Nobile E.
Assessment and Tuning of CFD Cavitation Model Parameters Using Advanced Optimization Techniques

We present a preliminary optimization strategy to properly tune and validate different cavitation models.

Preliminary results for the cavitation flow around the Naca66(mod) hydrofoil are presented.

Results suggest that the optimization strategy is accurate and stable.
NUMERICAL STUDY OF VAPOR BUBBLE GROWING IN SUPERHEATED LIQUID

Magnini M., Pulvirenti B.