# **Sump simulations**

150 1363 AP 1.4

Greg Cartland Glover

March 2011

Gefördert durch:



Bundesministerium für Wirtschaft und Technologie



G.Glover | Institute of Safety Research | http://www.hzdr.de

### Solver specifications

- Two-dimensional
- Eulerian multiphase with two dispersed phases
- Air bubbles and fibre agglomerates
  - Particle Size:  $d_{pa} = 3 \text{ mm } \& d_{pf} = 5 \text{ mm}$
  - Density:  $\rho_{pa} = 1.185 \text{ kg m}^{-3}$  &  $\rho_{pf} = 1027 \text{ kg m}^{-3}$
  - Liquid-fibre agglomerate mixture viscosity:  $\mu_{rf} = 1 + 2.5r_p + 7.6r_p^2$
- Transient of 100 s with timesteps of 0.01 s
- Air inlet velocity of 1.5 and 5 m s<sup>-1</sup>
- Outlet flow is drawn at the same rate as the inlet
- Air volume fraction of 0.2 given by Bin (1993)
- Fibre velocity and volume fraction given by velinleta = if(t<=5 [s], 0 [m s<sup>-1</sup>], if(t<=35 [s], 1.5 [m s<sup>-1</sup>],0) velinletb = if(t<=5 [s], 0 [m s<sup>-1</sup>], if(t<=35 [s], 5 [m s<sup>-1</sup>],0) vfin = if(t<=5 [s], 0, if(t<=35 [s], 0.05,0)</p>
- Suction chamber outlet draws the liquid volume injected out
- Strainer model of *A. Grahn* applied to the large area sieve at 4.2 m







# Contours for jet at 1.5 m $\rm s^{-1}$ and 20 s





Contours for jet at 1.5 m  $\rm s^{-1}$  and 20 s





# Contours for jet at 1.5 m $\rm s^{-1}$ and 46 s





Time = 46 [ s ]



Contours for jet at 1.5 m  $\rm s^{-1}$  and 46 s







# Contours for jet at 1.5 m $\rm s^{-1}$ and 91 s





Contours for jet at 1.5 m  $\rm s^{-1}$  and 91 s





# Contours for jet at 5 m $\rm s^{-1}$ and 18 s





# Contours for jet at 5 m $\rm s^{-1}$ and 18 s





#### Conclusions

- Two-dimensional examples of a sump with internal structures has been modelled
- Cases considered are at very high velocities
- Fibre agglomerates accumulate at the strainers resulting in a small increase of the pressure drop
- At higher velocities air penetrates the strainers



#### **Future Work**

- Run three dimensional cases at more realistic velocities
- Consider more fibre agglomerate phases
- Look at different configurations
- What features do you want to see in the simulations?
  - + jets
  - + falling films
  - + treadwells
  - + baffles
  - + weirs





#### Acknowledgments

### Project partners:

+ Institut für Prozeßtechnik, Prozeßautomatisierung und Meßtechnik Hochschule Zittau/Görlitz

S. Alt, T. Gocht, W. Kästner, A. Kratzsch, S. Renger, A. Seeliger and F. Zacharias

+ Institut für Sicherheitsforschung Helmholtz-Zentrum Dresden-Rossendorf

A. Grahn, W. Hoffmann, E. Krepper, H. Kryk, and M. Wiezorek

- German Federal Ministry of Economy and Labor Contracts No. 1501270, 1501307, 1501360 and 1501363
- This project is not part of the oversight process and does not intend to deliver safety guidelines

