AIChE The Global Home of Chemical Engineers DIERS

Review and Update on Design Institute for Emergency Relief Systems (DIERS)

Presented by: Ben Doup

Fauske & Associates

Benjamin Doup, PhD

Education

- B.S, Chemical Engineering, Ohio State University
- M.S. and PhD, Nuclear Engineering, Ohio State University
  - Studied gas-liquid two-phase flow using Boltzmann type transport equations

Work Experience

- Fauske & Associates (2014 to present)
  - Thermal hazards group

AIChE/DIERS Experience

- DIERS Program Chair (2021 to present)

DIERS Committee Members

Harold G Fisher
- Chair

Georges A Melhem
- Vice-Chair

Anil Gokhale
- AIChE Staff Liaison

Marc Levin
- Secretary/Membership Chair

Passa Piland
- Projects Chair

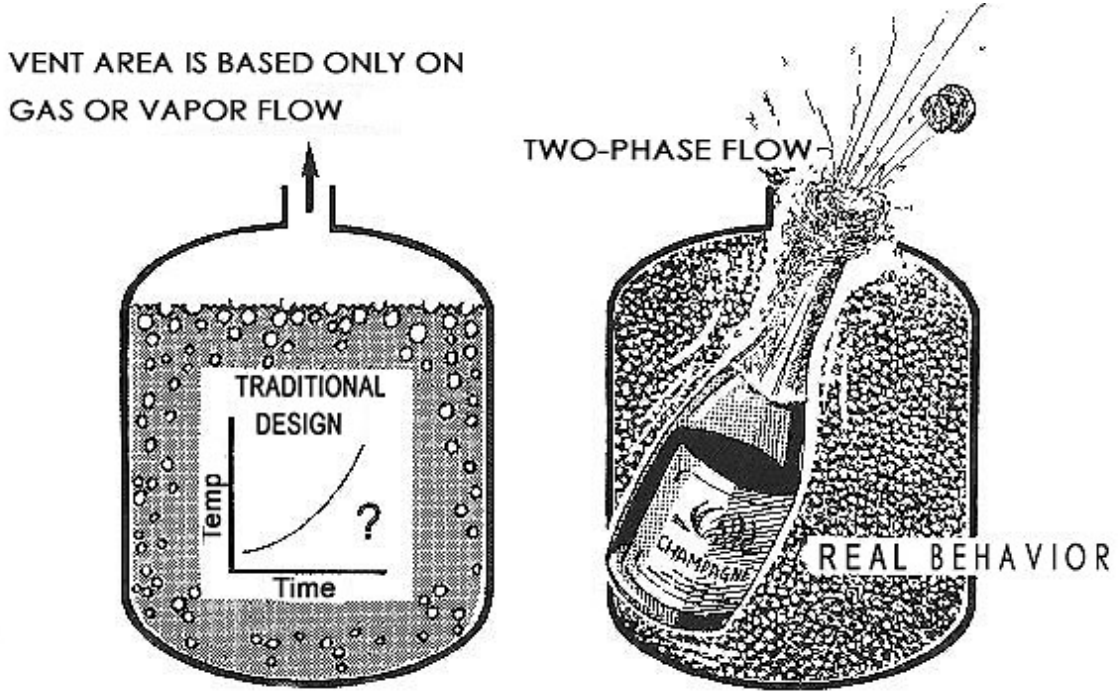
Wayne Chastain
- Meeting Arrangements Chair

Ben Doup
- Program Chair

DIERS Design Institute for Emergency Relief Systems

- Started 1976
- AIChE backing
- 29 international sponsors
- $1.6 million program
- Completed 1984
- Public release 1985-1986
- Principal contractor (~ 95%), Fauske & Associates, LLC; Dr. H. K. Fauske served as the principal investigator and leader of the DIERS research program team

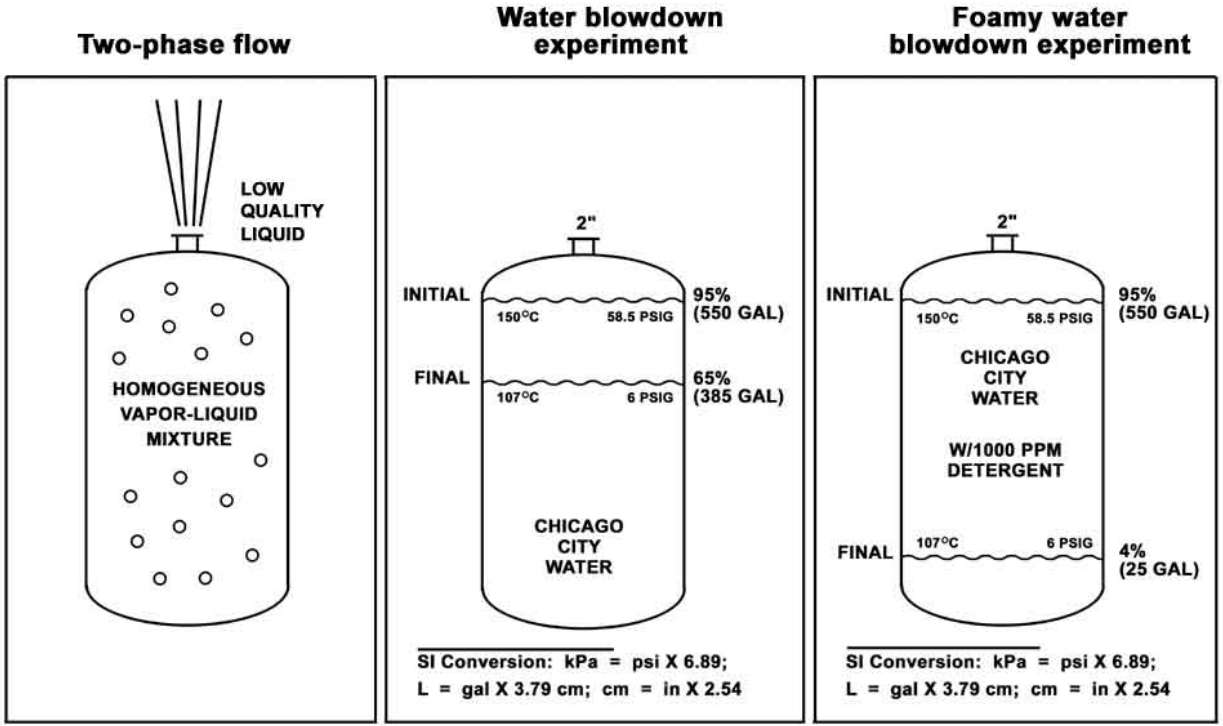
Runaway Reaction Behavior



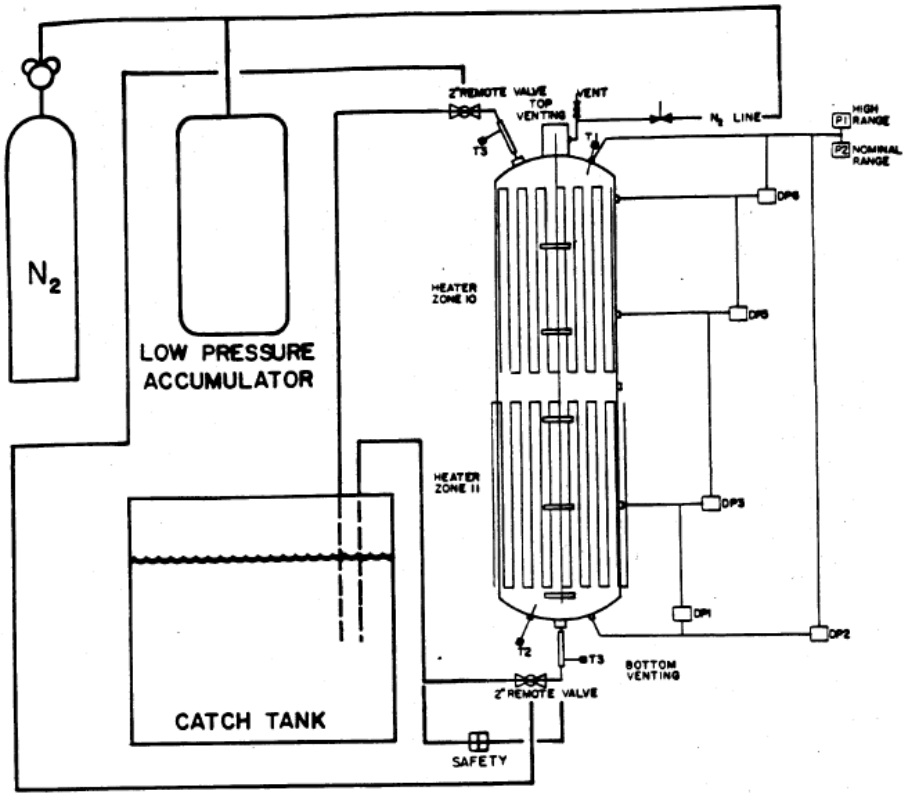
Runaway Reaction Rate at Relief is Unknown

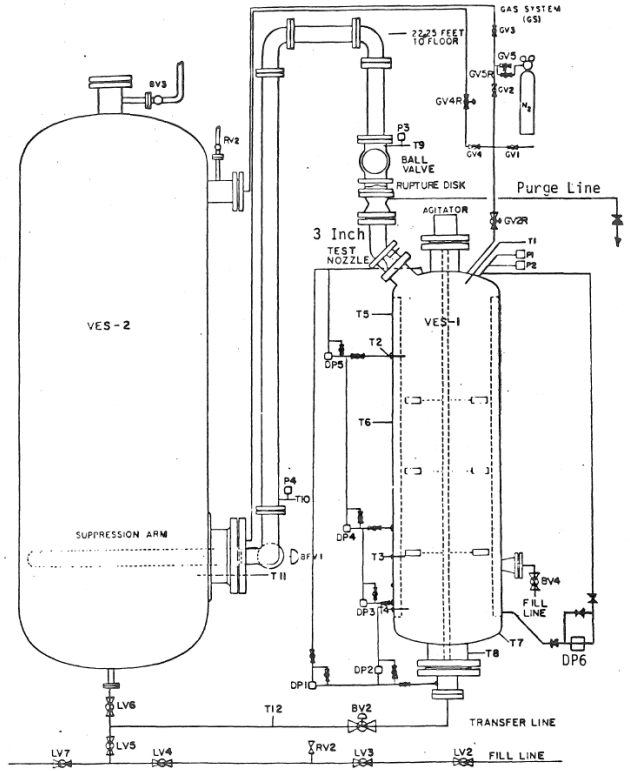
Reactor can Vent Most of Liquid Inventory Along with the Gas

Large-Scale Water Blowdown Experiments (in a 2.2 m^3 Tank)



Large-Scale Styrene Experiments





Classification of Reactive Systems

Type	Class	Source of Pressure
Vapor System	Tempered	Vapor (partial) pressure as driven by temperature effect.
Hybrid System	Tempered and Non-Tempered	Both vapor pressure and gas pressure.
Gassy System	Non-Tempered	Gas pressure due to gas accumulation within reactor.

DIERS Key Achievements

- Development of a bench-scale apparatus (VSP) capable of simulating real-time runaway behavior
- Development of vapor-liquid disengagement models
- Development of a computer program (SAFIRE) as a design tool
- Development of simplified vent sizing equations
- Verification of technology via large-scale (32-liter and 2200-liter) experimental data

AIChE DIERS

Biannual meetings

- Assimilate, implement, maintain and upgrade DIERS technology

Committees formed:

- Design/Testing Methodologies
- Venting Technology
- Mathematical Modeling of ERS
- Case History/Incident Investigations
- High Viscosity Hydrodynamics
- ERS Design for Fire Exposure
- Effluent Handling
- European DIERS Group Liaison

DIERS Resources

Reference Books

- DIERS Project Manual
  - "Emergency Relief System Design Using DIERS Technology"
- CCPS "Guidelines for Pressure Relief and Effluent Handling Systems" 2nd Edition

Conference Proceedings

- Accessible by DIERS members
- Meetings from 1989 through 2023
  - To access go to: https://www.iomosaic.com/diersweb/future.aspx
  - Select "Access DIERS 2022 Fall Meeting"

Software

- CCFlow*
- TPHEM*
- SuperChems™ for DIERS Lite*
- SuperChems™ for DIERS

*Available with purchase of "Guidelines for Pressure Relief and Effluent Handling Systems"

DIERS Resources

Active Round-Robin Test Campaigns

- Provide opportunities for companies/universities to improve their own testing capabilities by comparison with the aggregated results of other companies
- Can explore various challenging configurations

Completed Technical Projects

- Control of the Hazards Associated with reactive chemicals
- Fire exposure of vessels containing low volatility liquids
- Impact of weather conditions on the protection of low-pressure and atmospheric storage tanks
- Non-equilibrium two-phase flow

DIERS Training Courses

Courses Available

- Basics: CH172
- Advanced: CH173
- SC for DIERS training: CH174

All 3 courses are valuable training for all who practice or read ERS design and documentation. Here's where to find/register

- https://www.aiche.org/academy/courses
- Search for Basics: CH172 on-line
- Advanced: CH173 on-line
- SC for DIERS training: CH174 in person

Year	CH172 Basics	CH173 Advanced
2011		2
2012		?
2013		10
2014		25
2015		21
2016	7	18
2017	15	19
2018	32	24
2019	39	0
2020	15	0
2021	55	23
2022	54	25

Joint US and European DIERS Users Group Meeting

Dates

- September 4 – 7, 2023

Location

- Steigenberger Parkhotel, Braunschweig, Germany

DIERS Technical Projects

Current Projects	Champion	Status
Fire Exposure Relief Sizing Tutorial	Kerry McBride	In Progress: Gabe Wood had finished the reaction section. It is under internal review. Greg Hedrickson is working on the write up of 2-phase flow relief section.
Guidelines on Flame arrestors	Davide Moncalvo	In progress : First draft was completed. Under team members review.
Round-robin Reaction Calorimetry	Marc Levin	In Progress: Test results have been submitted from various companies.
Guideline for Relief Sizing of Low-Volatile Petroleum Resid During External Fire	Jacob Coleman	In Progress: Team members; Freeman Self, Dan Smith, Victor Quiroga
Chemical reactivity exchange datasheet	Wayne Chastain	Forming team: Accepting team member to review the data sheet.
Kinetic Reference Reactions for Calorimetry	Garrett Dupre	Forming team
PRV sizing for non-Newtonian flow (including solids and high viscosity)	NN	Forming team

AIChE DIERS

WEBSITE:

- www.aiche.org/diers

CONTACT:

- Harold G. Fisher
- Chair of DIERS
- Fisher Inc.
- Telephone: (775) 297-3117
- Email: fisherhg@charter.net

Questions?

Contact: doup@fauske.com

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