HTRI®

The Exchanger

Issue 1 • 2014

READY, SET, *FLOW!*

A newly installed flow loop enables HTRI to test heat transfer and pressure drop of heat exchangers for liquid-liquid service.

HTRI
The Exchanger
Issue 1 • 2014

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Change

Claudette D. Beyer
President & CEO

Change is inevitable, continuous, and challenging.

At HTRI, as at our member companies throughout the world, change is critical for growth or sometimes a reaction to forces thrust upon us. Staff transitions occur in the workplace. Mergers and acquisitions affect the futures for all involved—sometimes for the better and sometimes not. Markets crash and markets thrive. Entire countries are impacted. Products are phased out or revamped; new products are developed.

Rapidly evolving technology affects nearly every aspect of our workplace and personal lives, at an ever-accelerating pace. Every day we must make decisions to embrace or delay change. If we hesitate, we may find ourselves falling behind in skills and capabilities that are important to commerce, communication, and quality of life.

Although a small company, far from the size of a large multi-national conglomerate—dozens of which are our customers—we at HTRI experience the same consequences if we ignore the march of technology and demands of the marketplaces. As we improve our procedures and utilize new technologies, our staff and our members also must adjust to these changes.

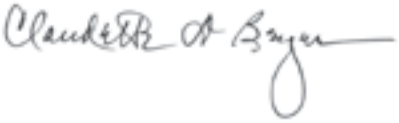
Recent changes that benefit our members:

- A new electronic distribution system for software makes product delivery more immediate and requires fewer resources.
- The newly designed website provides increased data security, customized user experiences, and more logical organization of information.
- Increased collaboration with academic researchers in important areas of investigation enhances our knowledge and allows us to provide more responsive guidance.
- A significant increase in proprietary contracts provides learning opportunities for staff that increase our capabilities.
- The recent release of HTRI *Xchanger Suite* 7.1 provides our most up-to-date methods, improved by our ongoing research program and comparative analysis with additional research we access via our alliance with Honeywell.
- Our continued streamlining of business processes, through our use of SAP and other tools, allows us to be more efficient, thus serving your needs more effectively.

To address our growing work force and research program, we are expanding our Navasota, Texas location, which will become our new global headquarters. By the time this newsletter reaches your desk, we will have held the groundbreaking for an additional office building. Our Venture Drive building in College Station is on the market; we anticipate all Texas-based staff being located at the Navasota location by spring of 2015. The Research & Technology Center also has undergone a great deal of change in the past 12 months to accommodate a significant increase in proprietary contract work as well as our new testing and certification agreement with the Air Conditioning, Heating, and Refrigeration Institute (AHRI).

Winston Churchill said, "It is always wise to look ahead, but difficult to look further than you can see."

You can count on us to continue to look forward, doing our best to "see" and take actions to help you meet the ever-evolving needs of your operations. **You should expect no less**.



Research at the RTC

James T. Schaefer, Jr.
Project Engineer,
Engineering Services

New liquid-liquid heat exhanger flow loop

A newly installed flow loop (see Figure 1) enables HTRI to test heat transfer and pressure drop of heat exchangers for liquid-liquid service. We have added this capability in response to requests that we perform certification or guarantee tests.

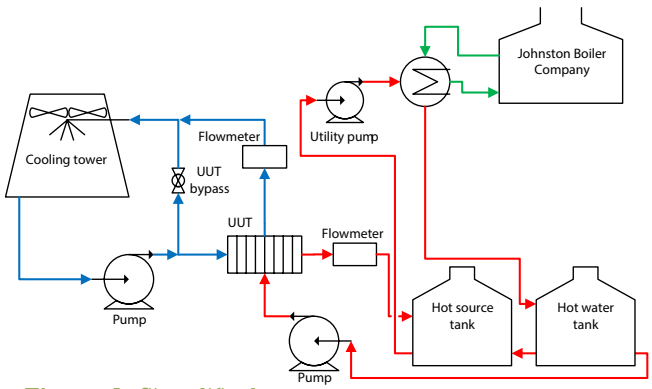


Figure 1. Simplified diagram of flow loop

The installation schedule of the flow loop itself was compressed to meet the demands of the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Performance Certification Program for Liquid-to-Liquid Heat Exchangers (LLHE). HTRI will conduct tests of exchangers to the exacting standards of AHRI Standard 400, Liquid-to-Liquid Heat Exchangers. When an exchanger has been "tested at HTRI," the purchaser can be more confident that the exchanger will perform as promised.

The flow loop was designed to allow for quick installation, testing, and removal of plate-type heat exchangers while using the full capacity of our existing 500-horsepower Johnson boiler and two-cell Marley cooling tower at the HTRI Research & Technology Center (RTC). With the installation of new pumps and tanks, the loop can facilitate tests with flow rates as high as 1000 gpm. Modifications to the boiler and the cooling tower provide for process control with minimal fluctuations, benefiting both contract and research projects.

Testing opportunities: Crude oil fouling

Thomas G. Lestina
Vice President, Research & Engineering Services

During more than 20 years of conducting crude oil fouling research, HTRI has developed high-quality fouling test methods. In our ongoing efforts to improve our techniques, we have refined our procedures to prepare, start up, test, and clean up runs, as well as modified our testing units and measurement tools.

We have logged, analyzed, and archived over 250 test runs with 20 different crude oils. Under the typical test conditions shown in Table I, we can assess the fouling propensity of a crude in comparison with the results of our library of test crudes.

With the advice from the Crude Oil Fouling Task Force (COFTF) and our other research collaborators, we expect to improve our test techniques further, making HTRI fouling tests the most rigorous and accurate in the industry.

Our current focus is on conditions in the higher temperature end of the preheat train. We are now expanding the crude oil testing program, completing the new Rotating Fouling Unit (see *The Exchanger,* Issue 2, 2013), and constructing a second High Temperature Fouling Unit. These test rigs are available for proprietary fouling tests of crude oils, blends, and other hydrocarbons.

If you would like a new "opportunity" crude tested, or if you simply want to know how your crude fouls compared to others, contact us at contracts@htri.net.

Table I. Ranges of typical test conditions

Condition	Minimum	Maximum
Bulk temperature, °C	175	290
Skin temperature, °C	200	340
Velocity, m/s	1	3

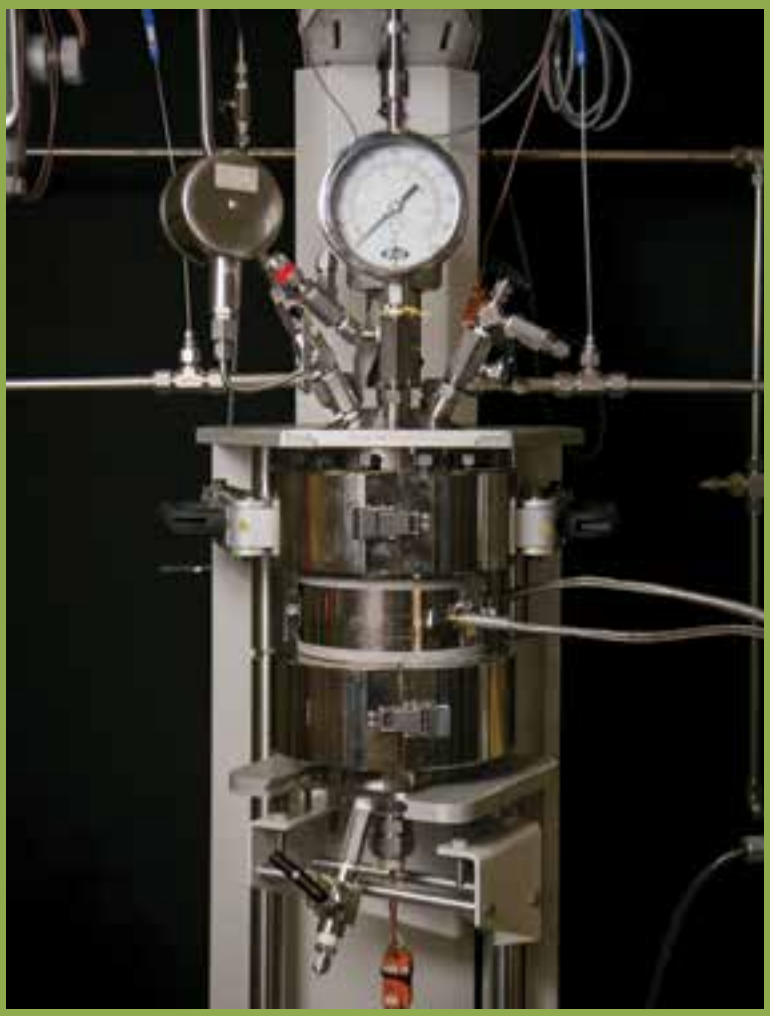


Figure 1. RFU at the Research & Technology Center

The Crude Oil Fouling Task Force (COFTF) provides advice to HTRI staff to ensure that our research results are relevant to industry. COFTF members share expertise and industrial experiences, review and comment on our fouling research plans and results, and donate samples or equipment for fouling studies. The COFTF includes representatives from HTRI member companies with expertise and interest in crude oil fouling. If you want to join the COFTF, contact us at htri@htri.net.

DISPELLING THE MYTHS ABOUT HTRI TRAINING

Have you attended one of our training events recently? Do you think our training is exclusive to HTRI members? Too expensive? Not relevant? Not accessible?

HTRI is the premier provider of training for heat exchanger technology and its application in industry. Each year, we train thousands of end-users worldwide through our best-in-class training program.

Read on to learn the truths about HTRI training.

MYTH 1:
Training is cost prohibitive.

HTRI offers several different approaches to training.

- You can attend HTRI-hosted events.
- We can provide training onsite at your facility.
- We even have free, hour-long webinars (for HTRI members).

Our training is priced in such a way to make it feasible for you to affordably learn to use HTRI software and technology. Onsite training is priced so that many people can have access to HTRI training in a cost-effective manner.

MYTH 2:
Training is for HTRI members only.

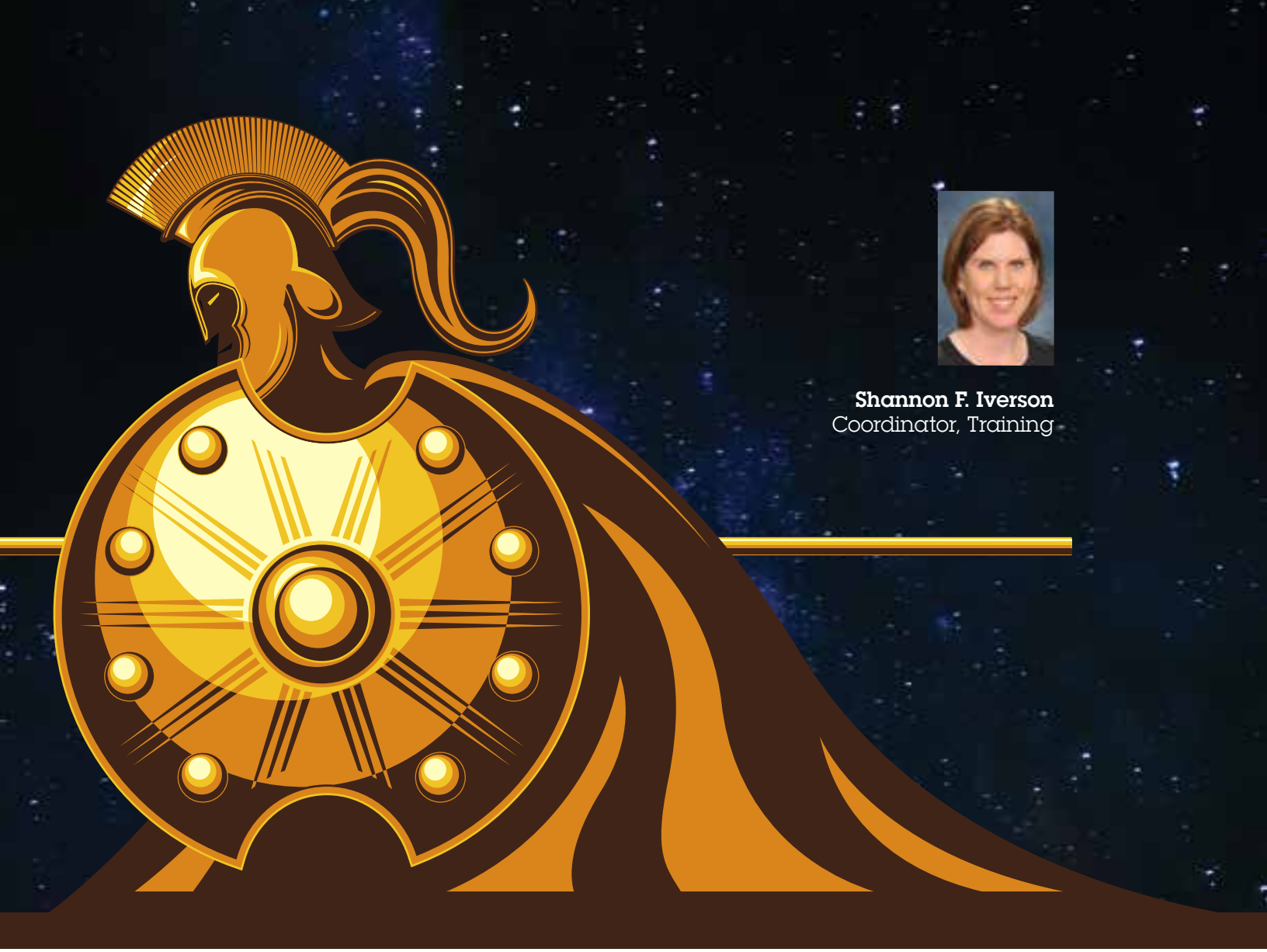
Webinars are available only to HTRI members, but all other HTRI training is open to non-members.

MYTH 3:
Examples used in training are not real.

We base our examples on real cases from industry. To bring you real value, we strive to spend as much hands-on time in ***X**changer Suite* as possible during our training sessions.

MYTH 4:
The content won't apply to you—it's one size fits all.

Do you need training on cases that are specific to applications used in your company? We can help. To make content more relevant, we often customize training, especially example cases, for onsite training. Typically, we build on existing content but emphasize specific areas that the customer requests.



Shannon F. Iverson
Coordinator, Training

MYTH 5:

If the training is not being held in your geographic area, you aren't welcome.

HTRI-hosted training events are not limited to customers in a specific region. You are welcome to register for and attend an event at any location. Before registering, though, make sure that the training is going to be conducted in a language you understand.

MYTH 6:

If you attended training a long time ago, you don't need to attend training now.

HTRI software and training is evolving. We continually revise content based on feedback, adding example cases, research updates, and concepts.

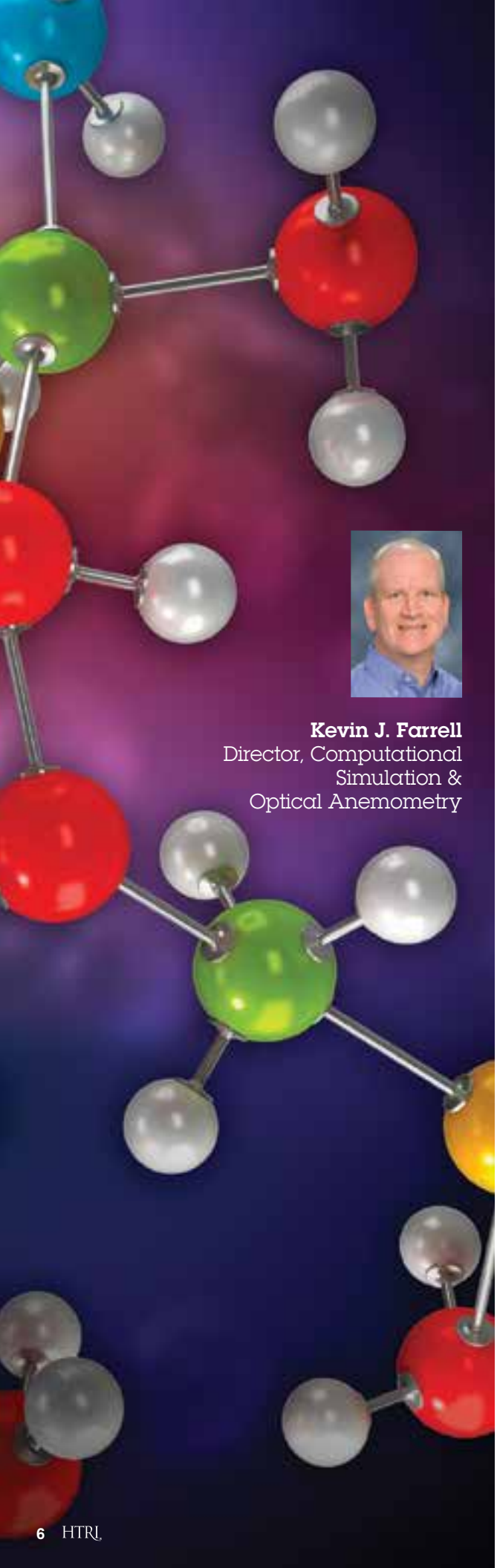
Training is conducted in the most recent released version of ***X**changer Suite*. In 2006, the ***X**ist* Workshop was taught using Version 5. Today, this session is conducted using Version 7.1. We have new information to share, and you're missing out if we haven't seen you since the last software release!

MYTH 7:

Training is only for beginners.

It's true that some courses are focused toward users new to engineering and/or HTRI. However, some are focused toward more experienced engineers and/or HTRI users. No matter what your level of engineering or HTRI experience, you will learn something new each time you attend one of our training courses.

To find out more about HTRI training, visit our website, www.htri.net, or contact us at training@htri.net.



Kevin J. Farrell
Director, Computational
Simulation &
Optical Anemometry

TROUBLESHOOTING USING MULTIPHYSICS: What's new about that?

MULTIPHYSICS IS ONE OF THOSE BUZZWORDS RECENTLY TOUTED IN THE SIMULATION COMMUNITY, BUT THE CONCEPT ISN'T A NEW REVELATION OR EVEN A NEW APPROACH. AFTER ALL, THE REAL WORLD IS MULTIPHYSICAL.

A car, for example, is a mechanical device, moving physically from point A to point B. Its parts include not only the internal combustion engine that powers it (chemical kinetics) but also the complex electric circuitry that controls it and the thermal-hydraulic systems that cool it.

And what about electronic tablets? These tools (or toys) integrate technologies related to electromagnetic waves (the antenna), mechanical touch and transduction (the touch pad and illumination), electrochemistry (the battery), integrated circuits, and electronic cooling. Their success relies on technologists with extensive interdisciplinary skills and knowledge, individuals who can perform comprehensive analyses of all these integrated effects.

Although almost every system responds to multiple physical phenomena, engineers don't always know which ones to consider *a priori*. Overlooking the most influential ones can lead to costly and tragic effects. Recall the Tacoma Narrows bridge failure in 1940, the Hyatt Regency hotel walkway collapse in 1981, the Space Shuttle Challenger accident in 1986, or the Boeing 737 rudder servo problems in the 1990s. Each of these incidents involved unexpected fluid-structure or thermal-structure interactions.

Figure 1. Modeled BJ21U NTIW gas-to-gas heat exchanger

HTRI has long recognized that designing an efficient and reliable process heat exchanger is a multiphysics problem involving many interacting phenomena concerning

- thermal hydraulics (often multiphase and phase change)
- thermodynamics
- structural strength
- flow-induced vibration (tubular or acoustic)
- materials (erosion, corrosion, fouling, embrittlement, etc.)

Fortunately, for shell-and-tube exchangers, these phenomena are ***one-way coupled.*** As long as we address each concern, we can be assured that the final design will be successful. If the flow rate is too high, tubes may vibrate violently; however, moderate vibration levels do not substantially affect the thermal hydraulic performance of the exchanger. The pressure differential across the shell wall may cause it to deform, but with the pressure loads of interest below the material yield strength, the deformation does not require us to consider any significant change in the fluid pressure.

Two-way coupling, however, requires that we analyze the phenomena *simultaneously*. Modern simulation tools running on fast computers with lots of RAM allow one to analyze many of these effects simultaneously by solving coupled systems of partial differential equations—hence the increasing buzz about *multiphysics* in the simulation world.

HTRI's research has always been multiphysical, as reflected in our published documents and our recent Technical Operating Plans. And our contract work demonstrates our abilities to improve exchanger performance using our correlational and simulation tools and experience.

For one particular exchanger, problems included multiple tube failures and a shell vibrating at 7 mm/s. The exchanger itself had a 910-mm shell ID, 30 percent baffle cut, and five intermediate support plates per baffle space. Radiated sound reached 110 dBA, even though the exchanger had an exit vapor belt, impingement rods, and very short tube spans—just 18 percent of the TEMA-specified maximum span. Our assessment indicated sympathetic tube and acoustic (cylindrical, organ pipe mode) resonance, tube fatigue failure at the center baffle, and maldistributed flow.

Using computational fluid dynamics (CFD), we simulated the velocity distribution in the exchanger (Figure 1) using porous media for the tube bundle. Contours of velocity magnitude on the symmetry plane showed very high window velocities, and the maximum crossflow velocity was computed at the central baffle beneath the vapor belt—right where the tubes had failed.

To solve this flow-induced vibration problem, we suggested installing inclined baffles in the exit window regions of the interior cross baffles. CFD computations (Figure 2) show the anticipated results: the high window flow velocities were eliminated, the crossflow velocities at the central baffle were reduced by 50 percent, the pressure drop was reduced, and the pressure gradient was smoother throughout. After inclined baffles were implemented on the actual exchanger, the vibration amplitudes were indeed reduced by 75 percent, the noise level was reduced by 10 dB, and the tube failures were eliminated.

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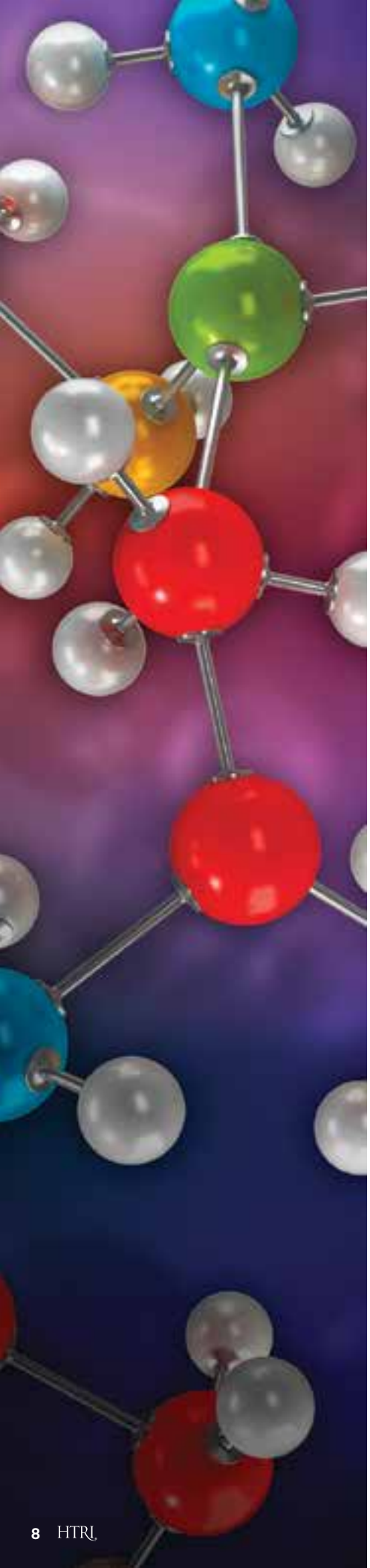

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TROUBLESHOOTING USING MULTIPHYSICS

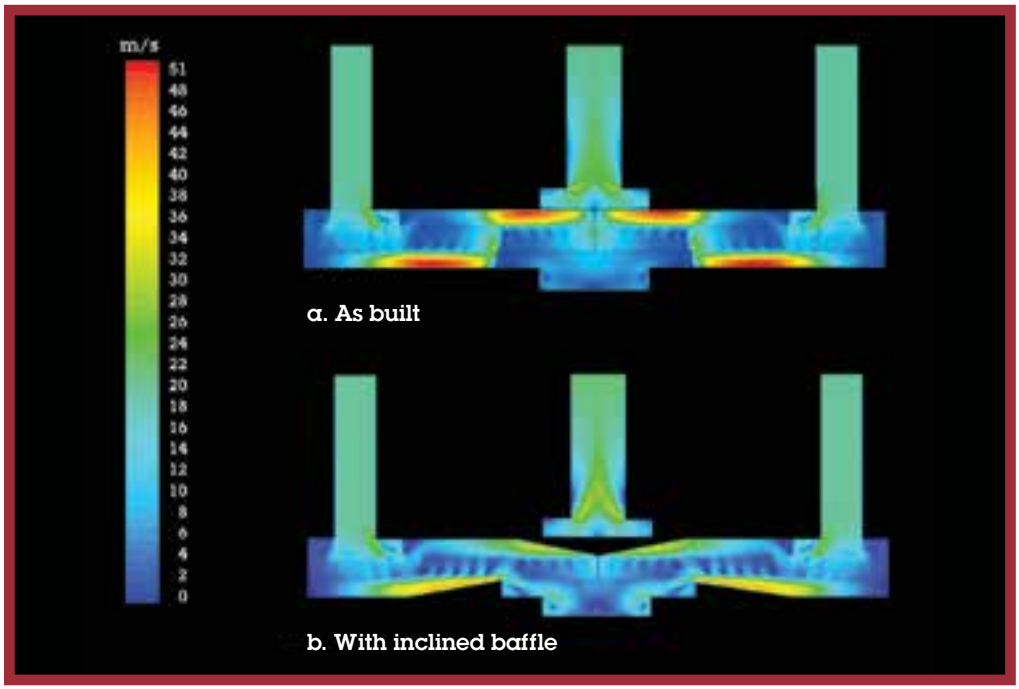


Figure 2. Superficial velocity distribution (a.) as built and (b.) with inclined baffle

Conventional, uncoupled approaches to troubleshooting process heat exchangers may not always be applicable. The growing trends for close temperature approaches and reduced footprints for exchangers mean that multiphysics will become even more important and more likely two-way coupled.

HTRI already plans to integrate a 3D finite element analysis tool with our burgeoning CFD capability to give us the ability to tackle either one-way or two-way coupled multiphysical problems, such as

- external loads on nozzle due to piping
- tube-to-tubesheet joint analysis
- tubesheet face stress analysis
- structural support analysis
- reliability and stresses in expansion joints (a previous contract inquiry)
- stresses during exchanger start-up transients, especially for plate-fin exchangers
- stresses in cryogenic services
- natural frequencies and vibration

While multiphysics itself is not a new consideration, particularly with regard to process heat exchangers, the simulation tools needed for analysis have gotten a lot better. However, the onus is still on the engineer to make sure that all of the important effects are considered in the design.

NEW RELEASE:
Process Heat Transfer

Elsevier, Ltd. announces the publication of the second edition of ***Process Heat Transfer*** in February 2014.

In this new release, Bob Serth and Tom Lestina have updated content, expanded discussion of rules-of-thumb for design, and added example cases from industry. Detailed examples using HTRI ***X****changer Suite* 7 provide instructions on how to input data, interpret results for successful thermal design, and compare results with open literature calculations. This reference is a must-have companion for new users of ***X****changer Suite*.

Visit http://store.elsevier.com/ for more information about the book or to order.

HTRI and heat transfer education

Did you know that some HTRI software is available for universities around the world to use in their engineering programs?

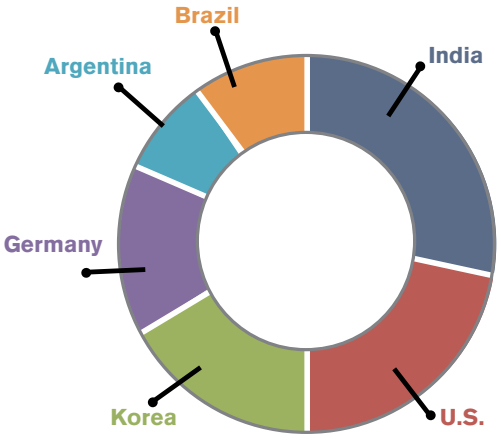
Since the mid-1990s, we've made special versions of key applications available to educational institutions for an extremely low price.

We're pleased to announce the immediate availability of three modules from HTRI ***X****changer Suite* 7 allowing students to learn about heat exchanger design and calculations with the same version being used in industry.

- ***X****ace*, for crossflow heat exchangers (air coolers and heat recovery units)
- ***X****ist*, for shell-and-tube heat exchangers (all types of applications, geometries, and process conditions)
- ***X****phe*, for plate-and-frame heat exchangers

If your company could benefit from new engineers already familiar with ***X****changer Suite,* please contact any educational institutions from which you regularly hire new engineering staff and let them know about HTRI educational licenses. Currently, institutions in 28 countries have licensed the educational version. Figure 1 highlights those countries with four or more active licensees.

Figure 1. Countries with four or more educational institutions licensing *Xchanger Suite Educational*



Additional details are available on our website at www.htri.net.

CAPE-OPEN: Helping your software work together

Joseph W. Holmes
Principal Engineer,
Research & Software Integration

Most readers are probably familiar with the acronym CAPE (**C**omputer **A**ided **P**rocess **E**ngineering) and the CAPE-OPEN standards that define its rules and interfaces connecting the different CAPE tools. The most common example is the process simulator that many process engineers use daily. Previous articles have touched on the CAPE-OPEN standards. This article provides a refresher on current capabilities, including some new features added in HTRI ***X**changer Suite* 7.

HTRI is an associate member of CO-LaN, the organization responsible for developing and maintaining the interface standards. The CO-LaN website (www.colan.org) defines a number of CAPE-OPEN standards for interfaces. The following are of primary interest to HTRI and its members:

- The **Unit Operation** interfaces allow embedding of a new unit operation in a CAPE-OPEN compliant simulator.
- The **Thermodynamic and Physical Properties** interfaces allow physical property systems in process simulators to be extended by or exposed to external programs.

HTRI software is compatible with both sets.

Unit Operation

Using the Unit Operation interfaces, HTRI allows the embedding of *Xchanger Suite* modules in a CAPE-OPEN compliant process simulator. Simulator users can create process flowsheets that, when run, invoke HTRI calculations to determine exchanger performance for the embedded unit operations.

Xchanger Suite 7.1 (Service Pack 1) added the capability for embedding *Xpfe*, *Xphe*, and *Xjpe* unit operations. Current CAPE-OPEN compliant modules in *Xchanger Suite* include

- *Xace*
- *Xhpe*
- *Xist*
- *Xjpe*
- *Xpfe*
- *Xphe*
- *Xspe*

A utility named HTRILink provides similar capability to the Unit Operation interfaces but is currently limited to *Xist* and to the UniSim® Design, Petro-Sim™, and Aspen HYSYS® process simulators. In UniSim Design, HTRILink can also be used to embed *Xace*.

Many process simulators may host *Xchanger Suite* unit operations, but Table I lists the programs that either HTRI or CO-LaN have tested.

Table I. Tested CAPE-OPEN compliant process simulators

PROCESS SIMULATOR	VENDOR
Aspen HYSYS®	Aspen Technology, Inc.
Aspen Plus®	Aspen Technology, Inc.
Petro-SIM™	KBC Advanced Technologies, Inc.
PRO/II®	Invensys Systems Inc.
UniSim® Design Suite	Honeywell International Inc.

The figure below shows a simple PRO/II flowsheet containing an embedded *Xpfe* multi-stream plate-fin exchanger as a CAPE-OPEN unit.

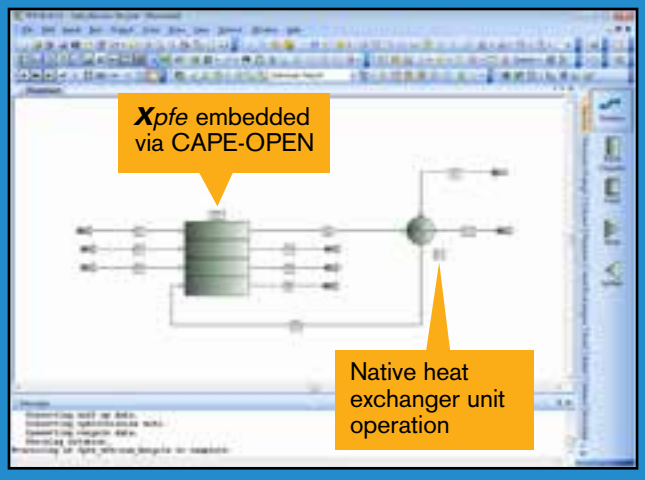


Figure 1. *Xpfe* unit (CO1) embedded in PRO/II flowsheet
Used with permission of Invensys

Thermodynamic and Physical Properties

Xchanger Suite also supports the Thermodynamic and Physical Properties interfaces that allow users to access fluid physical properties from external software in the HTRI program. In *Xchanger Suite*, the Property Generator is used to generate property grids from software tools that support CAPE-OPEN, some of which are listed in Table II.

Table II. Sample property software that supports CAPE-OPEN

PROPERTY SOFTWARE	VENDOR
Aspen HYSYS®	Aspen Technology, Inc.
Aspen Plus®	Aspen Technology, Inc.
PPDS	NEL, TÜV SÜD Ltd.
Simulis Thermodynamics	ProSim S.A.
UniSim® Design Suite	Honeywell International Inc.
VMGThermo™	Virtual Materials Group, Inc.

While not a comprehensive list, this table includes software that HTRI staff and/or members have actually used. VMGThermo is distributed with *Xchanger Suite.*

For most of the software in Table II, *Xchanger Suite* uses a built-in interface that provides an alternative to the CAPE-OPEN interfaces. For some (e.g., Aspen Plus and Simulis Thermodynamics), no native interface is included in *Xchanger Suite*, and CAPE-OPEN should be used to generate physical properties.

In *Xchanger Suite* 7.1, we added support for version 1.1 of the CAPE-OPEN Thermodynamic and Physical Properties interfaces. The most significant change in the 1.1 interface is improved support for fluids with multiple liquid phases. HTRI software does not directly support the use of multiple liquid phases; however, the new interface standard allows for improvements in the way the software handles mixing rules for such fluids.

CAPE-OPEN implementations allow the engineering software you use every day to work together and eliminate the need for manual transfer of data.

If you use the CAPE-OPEN interfaces, let us know of your experiences—both good and bad. We are also interested in any feedback you have on suggested modifications and enhancements to the CAPE-OPEN compliance of HTRI software. Just email us at support@htri.net.

Upcoming Events

TRADESHOW/EXPO	**WTT-Expo** **April 8 – 10, 2014** Karlsruhe Trade Fair Center • Karlsruhe, Germany HTRI to exhibit in Hall 3, Stand B23
TRAINING	**HTRI Training – Canada** **April 8 – 10, 2014** The Westin Calgary • Calgary, Alberta, Canada
WEBINAR	**Research Update: Mixed Convection for Shellside Flow** **April 10, 2014**
TRAINING	**HTRI Training – Middle East** **April 13 – 16, 2014** Eastern Mangroves Hotel & Spa By Anantara • Abu Dhabi, United Arab Emirates
TRAINING	**HTRI Training – Latin America** **May 13 – 16, 2014** Tivoli São Paulo – Mofarrej • São Paulo, Brasil
WEBINAR	**TechTip: Using the HTRI Parametric Study Tool** **May 15, 2014**
TRADESHOW/EXPO	**2014 Global Petroleum Show** **June 10 – 12, 2014** Stampede Park • Calgary, Alberta, Canada HTRI to exhibit in Booth 2121 in the Corral
CONFERENCE	**2014 Global Conference and Annual Meeting of Stockholders** **August 18 – 22, 2014** The Ritz-Carlton – Tysons Corner • McLean, Virginia, USA

JOIN IN!

August 18 - 22, 2014
The Ritz-Carlton
Tysons Corner
McLean, Virginia, USA

2014 Global Conference & Annual Meeting of Stockholders

5 days of face-to-face interaction provide an excellent opportunity for you to share experiences and knowledge with your fellow members and experts from HTRI.

technical presentations

staff poster sessions

roundtable discussions

Two days of presentations and poster sessions (US$425)

TECHNICAL PRESENTATIONS (August 18 & 19)

presentations subject to change

- Fouling research status and direction
- Seawater fouling
- Heat exchanger design issues
- Software update
- Heat exchanger design margins
- Condensation in inclined elliptical tubes
- Multiphysics solutions for heat exchanger performance
- Crossflow mixed convection
- Diabatic single-phase shellside flow with viscous liquids
- Condensation pressure drop in horizontal tubes
- Tubeside falling film evaporators
- PIV measurements of shellside flow
- Lessons learned from Engineering Services

STAFF POSTER SESSIONS (August 18 & 19)

- Detailed design of 5-in. air/water flow loop
- Effect of Prandtl number on plate-fin performance using CFD
- Reflux condensation in an inclined circular tube
- Shellside vacuum condensation testing
- Kettle research update
- Intube condensation of propane and propane/ethane mixtures
- Flow regime maps for shellside flow
- Crude oil fouling measurements using the Rotating Fouling Unit
- Design of the new High Temperature Fouling Unit
- New software to solve heat exchanger performance problems

Three days of training

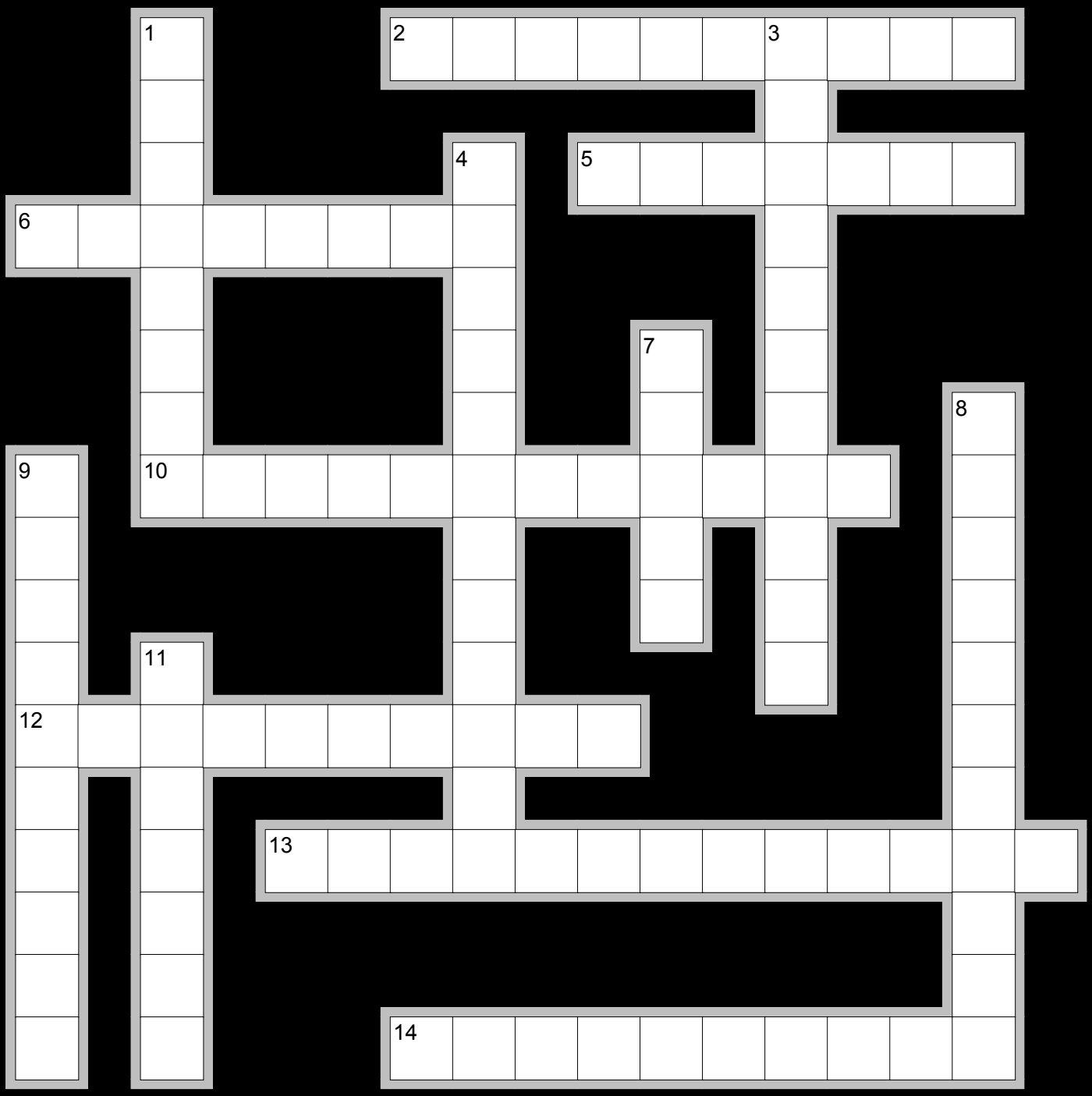
TRAINING COURSES (August 20 – 22)

training courses subject to change

- **Specifying Geometry and Tube Layout in Xist Workshop** (US$400)
  Wednesday, August 20
- **Process Heat Exchangers: Applications and Rules-of-Thumb Short Course** (US$1000)
  Thursday and Friday, August 21 and 22

Please visit our website for additional details.

www.htri.net



HOW DO YOU MEASURE UP?

ACROSS

2. Resistance-based temperature sensor
5. Inexpensive pressure gauge
6. Flow and density
10. Change between two points
12. Gas velocity instrument
13. K, J, T, E
14. Converts pressure to electricity

DOWN

1. Non-contact temperature measurement
3. Measures stretch
4. Give it a sling!
7. Stagnation pressure device
8. Measures temperature
9. Non-wetted flowmeter
11. Necks down

see solution on page 18

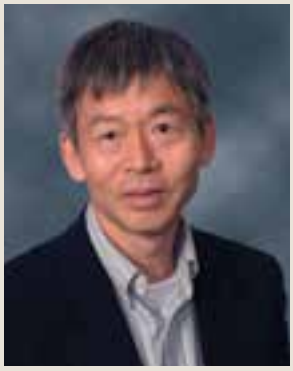
HTRI transition in Japan

After working more than thirteen (13) years at HTRI, Hirohisa Uozu has decided to retire later this year. Uozu joined HTRI in 2001 when we first established a direct presence in Japan, and he has been involved in sales, technical support, and training in the Asia-Pacific region. He is highly respected, and his contributions will be missed by members and staff as he enjoys other activities in his retirement.

To ensure a smooth transition, Hitoshi Miyamoto joined us in January 2014 and will work with Uozu through the end of the fiscal year, after which he will take responsibility for sales and contribute to technical support and training in Japan. Miyamoto joins HTRI after a long and successful career with IHI Corporation, where he held many leadership positions in project management and business development. He holds Bachelor's and Master's degrees in mechanical engineering from Aoyama-gakuin University. He has been involved with HTRI for most of his career, as a representative for IHI Corporation, as CC-Japan vice chair (1998 – 1999) and chair (1999 – 2001), and as a member of the HTRI Technical Committee (1999 – 2003). This experience will be of great help for his new role at HTRI.

We wish Uozu-san well in his retirement and welcome Miyamoto-san to the HTRI team.

Hirohisa Uozu



Hitoshi Miyamoto

Resignations from HTRI Technical Committee

HTRI recognizes the service of **Dale J. Skuldt** and **Vance T. Varner**, who recently resigned from the Technical Committee (TC). Skuldt and Varner were elected to the TC in 2011. Prior to joining the TC, both of them had long been actively involved with HTRI for many years, generously contributing and sharing their expertise.

Skuldt recently retired from his position as Senior Project Manager at Ecodyne Heat Exchangers, LLC. We thank him for his service to HTRI and wish him many happy years of retirement.

Varner resigned from the TC after accepting a new role within The Dow Chemical Company. We extend our appreciation to him for his service to HTRI and wish him continued success.

Recently published

TECHNICAL REPORTS

CT-34 Heat transfer of vacuum condensation in a vertical tube: Mixtures

CT-35 Downflow condensation heat transfer in inclined circular tubes

TECHTIP

TT-16 Selecting face velocities for API air-cooler designs

WEBINAR RECORDINGS

Beyond the Basics: Rating, Simulation, or Design?

Beyond the Basics: Understanding Fluid Property Options

Beyond the Basics: Understanding the ***X**ist* Vibration Report

Getting Started: Building Your First Case in ***X**vib*

Getting Started: Building Your First Case in ***X**ace*

Getting Started: Building Your First Case in ***X**ist*

Is My Design OK? Design Guidance for Impingement Rods

TechTip: Impact of HTRI ***X**changer Suite* 7, Service Pack 1

TechTip: Tube Layout Design and Customization

And others!

Access to information is based on your HTRI membership category. Log in to www.htri.net to access reports and webinars (in Products & Services) and TechTips (in Support).

To upgrade your membership and gain access to material not currently available to you, contact membership@htri.net.

New HTRI staff — WELCOME

Michael W. Holmes, Research Technician
David E. Oakley, Senior Project Engineer, Engineering Applications
M. Kyle Ross, Senior Project Engineer, Engineering Services
Hugh C. Docherty, Engineer, Applications Developer
Alissa B. Jones, Test Engineer
Miguel A. Orellana, Desktop Support Specialist
Jamie Schwartz, Research Technician

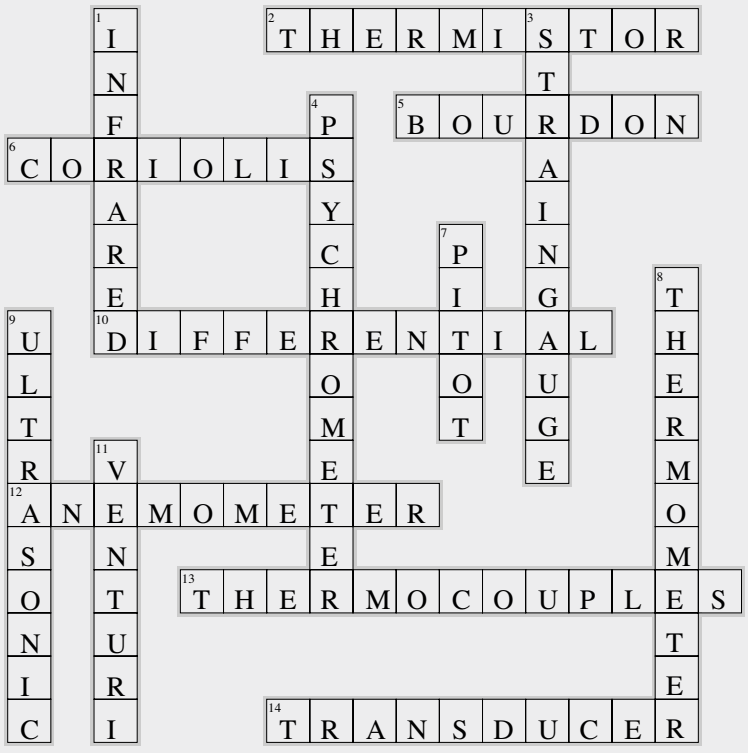
Promotions/title changes — CONGRATULATIONS

Mike Creagor, Associate Vice President, RTC & Facilities Operations
Juan Diaz, Vice President, Finance
Chalon T. Hawkins, Coordinator, Desktop Support
Timothy J. Scott, Coordinator, Software Development
Ray Toler, Vice President, Information Technology & Marketing
Hans Zettler, Vice President, Sales – EMEA

PUZZLE SOLUTION

HOW DO YOU MEASURE UP?

puzzle on page 14



Across

2. THERMISTOR—Resistance-based temperature sensor
5. BOURDON—Inexpensive pressure gauge
6. CORIOLIS—Flow and density
10. DIFFERENTIAL—Change between two points
12. ANEMOMETER—Gas velocity instrument
13. THERMOCOUPLES—K, J, T, E
14. TRANSDUCER—Converts pressure to electricity

Down

1. INFRARED—Non-contact temperature measurement
3. STRAINGAUGE—Measures stretch
4. PSYCHROMETER—Give it a sling!
7. PITOT—Stagnation pressure device
8. THERMOMETER—Measures temperature
9. ULTRASONIC—Non-wetted flowmeter
11. VENTURI—Necks down

New Members

May – December 2013

A & B Process Systems Corporation
Stratford, Wisconsin, USA

Abacus Heat Transfer Limited
New Delhi, India

Advance Boiler Services (NZ) Ltd
Hamilton, New Zealand

Air Radiators Pty Ltd
Lara, Victoria, Australia

The Alloy Engineering Company
Berea, Ohio, USA

APROVIS Energy Systems GmbH
Weidenbach, Germany

Axton Incorporated
Delta, British Columbia, Canada

Bechtel Marine Propulsion Corporation
Niskayuna, New York, USA

"BorMash" LLC
Peski, Russia

Chart Energy & Chemicals, Inc.
La Crosse, Wisconsin, USA

Chemineer, Inc.
North Andover, Massachusetts, USA

China Petroleum Engineering Co., Ltd. Southwest Branch
Chengdu, Sichuan, China

CO.ME.S s.r.l.
Poggibonsi, Siena, Italy

Connacher Oil and Gas Limited
Calgary, Alberta, Canada

DBM S.p.A.
Varallo Pombis, Novara, Italy

ECOTHERM Austria GmbH
Hartkirchen, Austria

Ellis & Watts Global Industries, LLC
Batavia, Ohio, USA

The Equity Engineering Group, Inc.
Shaker Heights, Ohio, USA

EWHA Corporation
Gimpo, Gyeonggi, Korea

Ferus Inc.
Calgary, Alberta, Canada

Fives Cryo
Golbey Cedex, France

Ford, Bacon & Davis, LLC
Baton Rouge, Louisiana, USA

GE (China) Research and Development Center Co., Ltd.
Shanghai, China

GE Gas Turbines (Greenville) L.L.C.
Greenville, South Carolina, USA

Grupa Azoty Polskie Konsorcjum Chemiczne Sp. z o.o.
Tarnów, Poland

Guangdong Chungchak Heavy Industry Co., Ltd.
Zhongshan, Guangdong, China

Heat and Control Pty Ltd
Brisbane, Queensland, Australia

Heat Transfer ABC B.V.
Leiden, The Netherlands

HOCS Projects Inc.
Calgary, Alberta, Canada

Industrial Engineering System Sdn. Bhd.
Petaling Jaya, Selangor, Malaysia

Isotherm, Inc.
Arlington, Texas, USA

Jiangsu Haolong Heat Exchanger Co., Ltd.
Suqian, Jiangsu, China

Joule Thermal, LLC
Riverside, California, USA

JSC "Giprogazoochistka"
Moscow, Russia

JSC "Oktyabrskhimmash"
Oktyabrsky, Bashkortostan, Russia

"Kurganhimmash" LLC
Kurgan, Russia

Lanpec Technologies Limited
Lanzhou, Gansu, China

Libra Perfex Precision Sdn Bhd
Shah Alam, Selangor, Malaysia

Lloyd's Register Energy Americas, Inc.
Houston, Texas, USA

Masters Process Equipment Company
Spring, Texas, USA

MEG Energy Corp.
Calgary, Alberta, Canada

MHI Engineering and Industrial Projects India Pvt. Ltd.
Gurgaon, Haryana, India

NRF B.V.
Mill, The Netherlands

OAO "Nizhnekamskneftekhim"
Nizhnekamsk, Tatarstan Republic, Russia

OJSC "Power machines"
Saint Petersburg, Russia

Petronas Chemicals Derivatives Sdn Bhd
Kerteh, Terengganu, Malaysia

The Procter & Gamble U.S. Business Services Company
West Chester, Ohio, USA

Provides Metalmeccanica S.r.l.
Latina, Italy

PT. Pertamina Hulu Energi ONWJ
Jakarta, Indonesia

PT. Synergy Engineering
Tangerang, Banten, Indonesia

PTT Maintenance and Engineering Company Limited
Muang Rayong, Rayong, Thailand

Reynold India Private Limited
Uttar Pradesh, India

Roben Manufacturing, Inc.
Lakewood, New Jersey, USA

Salamah Consulting Engineering (SaCEn)
Al-Khobar, Saudi Arabia

Shandong Sunway Petrochemical Engineering Co., Ltd.
Zibo, Shandong, China

Shanghai International Engineering Consulting Company
Shanghai, China

continued on next page »

continued from page 19

Shenyang Turbo-Machinery Corporation Reciprocating Compressor Department
Shenyang, Liaoning, China

SPIG S.p.A.
Arona, Novara, Italy

STONE Oil and Gas Inc.
Mississauga, Ontario, Canada

STRR Engineering Company Limited
Bangkok, Thailand

Tanabe Engineering Corporation
Joetsu, Niigata, Japan

Teijin Engineering Limited
Iwakuni, Yamaguchi, Japan

Teijin Limited
Chuo-ku, Osaka, Japan

Tesoro Refining and Marketing Company, LLC
Carson, California, USA

TFES Tulsa, LLC
Paola, Kansas, USA

Thermal & Mechanical Equipment Company
Houston, Texas, USA

Thermo Design Engineering Ltd.
Edmonton, Alberta, Canada

Tianhua Institute of Chemical Machinery and Automation Co., Ltd.
Lanzhou, Gansu, China

TransCanada PipeLines Limited
Calgary, Alberta, Canada

Transheat Technologies EDC
Vadodara, Gujarat, India

Tube Tech International Limited
Rayleigh, Essex, United Kingdom

VDL Groep bv
Eindhoven, The Netherlands

Vipertex Enhanced Metal Surfaces
Buffalo, New York, USA

New Participating Affiliates

May – December 2013

177461 Canada Inc.
Edmonton, Alberta, Canada

Acetex Chimie S.A.
Roussillon, Saint Maurice l'Exil Cedex, France

Acetex Intermediates S.A.S.
Roussillon, Saint Maurice l'Exil Cedex, France

Aker Clean Carbon AS
Fornebu, Norway

BP America Production Company
Houston, Texas, USA

BP Amoco Chemical Company
Texas City, Texas, USA

BP Canada Energy Group ULC
Calgary, Alberta, Canada

BP Egypt Company
Cairo, Egypt

BP Products North America Inc.
Naperville, Illinois, USA

Brembana & Rolle S.p.A.
Valbrembo, Bergamo, Italy

Catlettsburg Refining, LLC
Catlettsburg, Kentucky, USA

Celanese (Nanjing) Acetyl Derivatives Co., Ltd.
Nanjing, Jiangsu, China

Celanese (Nanjing) Acetyl Intermediates Co., Ltd.
Nanjing, Jiangsu, China

Celanese (Nanjing) Chemical Co. Ltd.
Nanjing, Jiangsu, China

Celanese (Nanjing) Diversified Chemical Co., Ltd.
Nanjing, Jiangsu, China

Celanese (Shanghai) Intermediates Co., Ltd.
Shanghai, China

Celanese Acetate Limited
Spondon, Derby, United Kingdom

Celanese Acetate LLC
Narrows, Virginia, USA

Celanese Canada Inc.
Edmonton, Alberta, Canada

Celanese Chemicals Iberica, S.L.
Tarragona, Spain

Celanese Emulsions BV
Geleen, The Netherlands

Celanese Emulsions GmbH
Frankfurt, Germany

Celanese Emulsions Norden AB
Perstorp, Sweden

Celanese EVA Performance Polymers Partnership
Edmonton, Alberta, Canada

Celanese Ltd.
Pasadena, Texas, USA

Celanese Pte. Ltd.
Singapore

Celanese S.A./N.V.
Lanaken, Belgium

Celanese Singapore VAM Pte. Ltd.
Singapore

Celstran GmbH
Kaiserslautern, Germany

Chicago Bridge & Iron Company
The Woodlands, Texas, USA

CINDA Engineering & Construction Pvt. Ltd.
Noida, Uttar Pradesh, India

Fluor Daniel South America Limited
Buenos Aires, Argentina

Grupo Celanese, S. de R.L. de C.V.
Jalisco, Mexico

HNA Acquisition ULC
Edmonton, Alberta, Canada

Ineos Chemicals Grangemouth Ltd
Grangemouth, United Kingdom

Initec Plantas Industriales, S.A.U.
Madrid, Spain

Jacobs Spain S.L.U.
Madrid, Spain

KBC Advanced Technologies Sdn Bhd
Kuala Lumpur, Malaysia

Marathon Petroleum Company LP
Findlay, Ohio, USA

MHI Technical Services Corporation
Mandaluyong City, Manila, Philippines

Mitsubishi Heavy Industries Mechatronics Systems, Ltd.
Kobe, Hyogo, Japan

NorthAm Engineering S.A. de C.V.
Monterrey, NL, Mexico

Nutrinova Nutrition Specialties & Food Ingredients GmbH
Frankfurt, Germany

Shanghai Lanbin Petrochemical Equipment Co., Ltd.
Shanghai, China

Shaw Power Inc.
Moorestown, New Jersey, USA

Shell & Tube Heat Exchangers, LLC
Stafford, Texas, USA

Shell China Exploration and Production Company Limited
Beijing, China

Shell China Limited
Beijing, China

Shell International Petroleum Co. Ltd.
London, United Kingdom

Stone & Webster, Inc.
Baton Rouge, Louisiana, USA

Technip Tianchen Chemical Engineering (Tianjin) Co. Ltd.
Shanghai, China

Ticona GmbH
Frankfurt, Germany

Ticona LLC
Grover, North Carolina, USA

Ticona Polymers Inc.
Florence, Kentucky, USA

UOP Russell LLC
Tulsa, Oklahoma, USA

VDL Delmas GmbH
Berlin (Tegel), Germany

VDL Klima Belgium NV
Zaventem, Belgium

VDL Klima BV
Eindhoven, The Netherlands

VDL Klima France SARL
Marcq en Baroeul Cedex, France

Wood Group Mustang (M) Sdn Bhd
Kuala Lumpur, Malaysia

Current Software

HTRI *Xchanger Suite*
7.1
*including **X**ace, **X**fh, **X**hpe, **X**ist, **X**jpe, **X**pfe, **X**phe, **X**spe, and **X**vib*

HTRI *Xchanger Suite Educational*
7.1

HTRI eLibrary 2
2.0.6

Software distributed by HTRI

EHT
2.2

Honeywell UniSim® Heat Exchangers
R430
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