

# Tank Talk

## Cold Weather Coatings

by Patrick Brown, E.I.

Fall is in full swing and winter is fast approaching. In the past when the winter winds blew, painters put away their brushes and owners started budgeting for tank repainting projects for next spring. With the development of cold-cured coatings, painting projects do not have to end with the onset of winter. It is still best to schedule projects during warm weather, but when the best-laid plans go awry, there are now alternatives. There are coatings on the market that boast applicability at temperatures as low as 5° F (-15° C). Inorganic and organic zinc primers, moisture-cured urethanes, and modified epoxies and mastics are some of the types of coatings that can be applied at low temperatures and continue to perform well. With this variety of coatings available, how do you know which one to use?

In cold weather conditions, ease of coating application becomes an even greater issue than normal. When the temperature drops, the viscosity of a coating will increase and it will become more difficult to spray. Thinning the coating may be necessary for ease of application. It is preferable to use a coating with a viscosity suitable for low temperatures rather than excessively thinning a standard coating. Excessive thinning can inhibit the build up of an adequate film thickness. In addition, heating and insulating spray equipment can lessen the amount of thinning needed to achieve an adequate flow of the coating for spray application.

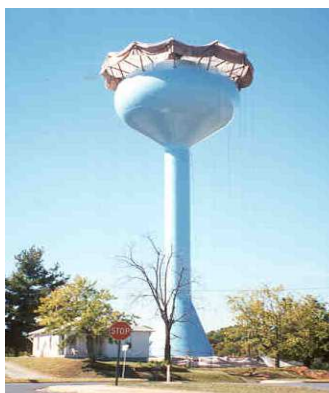
Another coating aspect that becomes more of a concern at low temperatures is cure time. The usual air-drying and thermoset coatings are slower to cure at low temperatures. Most tank painting projects are rushed as the tanks are needed in service. When selecting a coating for low-temperature application, the owner should select a coating that cures more quickly and completely. There have been advancements with high-solids coatings allowing for curing at

lower temperatures. With high-solids coatings, however, there is the issue of viscosity and ease of application. There are also epoxy mastics that have become popular for maintenance applications due to their ability to be applied over existing finish coats. Epoxy mastics perform well when applied at low temperatures, but have longer cure times meaning a longer cure time between coats, and a longer duration of the painting project.

When selecting coatings for a specific project, start by balancing the priorities of viscosity for ease of application and curing time for recoating and returning the tank to service. Both the application characteristics and long-term performance of coatings should be reviewed prior to selecting a coating.

When applying coatings in cold weather, the usual issues of meeting adequate temperature and humidity requirements and proper surface preparation are of increased concern. Ambient conditions, temperatures, and relative humidity should be continuously and carefully monitored during the coating cure time to guarantee complete curing of the coating. Coating failures are probable if

the coating is topcoated before fully cured. Applying a topcoat prior to adequate cure of the coating can lessen the cohe-



*This tank in Johnson City, TN was coated with cold weather coatings because of the marginal autumn temperatures and the fact that water for fire protection needed to remain in the tank during painting operations.*

Continued on Page 5

### Inside This Issue

- Cold Weather Coatings
- President's Corner – TIC at a Crossroads
- TIC Seminar Schedule
- Flat-Bottom Storage Tank Settlements
- Mike Carrigan – Southwest Regional Manager
- We've Been Talking About Tanks
- Industry News

## President's Corner – TIC at a Crossroads

by Steven P. Roetter, P.E., President, Tank Industry Consultants

In Tank Talk 32, I wrote my very first President's Corner about the loss of our founder and my good friend and mentor, Crone Knoy. In that article I wrote about the kind of leader Crone was and how he positioned TIC to prosper in the future without him. Eight months later, TIC has adjusted to the many transitions that needed to be made, and we found ourselves at a crossroads as we faced the future without Crone.

Let me start by saying that despite Crone's best efforts, Crone Knoy *was* TIC. Crone was known throughout the industry for his kind, witty, outgoing personality as well as his knowledge and tireless industry promotion. At times, it was difficult for him to be so well known because he did not want TIC to be so tied to him that the company could not carry on without him. When I came to work at TIC in 1984, Crone told me that he wanted TIC to be a viable operation without him. That's why he named the company Tank Industry Consultants instead of E. Crone Knoy Engineering.

Crone's knowledge, personality, and people skills made him very recognizable and popular. Yet it was these very characteristics that tied him so closely to the organization he created. I can recall times when I would attend the Indiana AWWA or National AWWA conferences, and it would take Crone two hours to get from the exhibit hall door to our booth because of all the people who would stop and talk to him. Eventually, Crone decided that it was not necessarily bad to be so closely associated with the firm he founded so long as he positioned this company to survive without him.

This is where we find ourselves now – at the crossroads. Still remembering how much he meant to this company, but looking down the road at what this company will do without him. So how did Crone plan for our future success?

First, as I indicated in my last President's Corner, he invested heavily in *intellectual capital*. Initially, TIC was composed mostly of Crone and some trusted industry associates, and the young people he hired, trained, and mentored. Crone had a vision of TIC becoming the fore-

most engineering firm in the industry, so in 1998/99 he hired Steve Meier and then John Lieb. These additions solidified TIC's technical expertise, positioned TIC to continue in Crone's absence, and allowed TIC to enter the industrial market. It was a very difficult decision for a small company like TIC to make the commitment necessary to attract two high-profile engineers the caliber of Steve and John, but Crone had a strong vision and could see past the short-term difficulties that a commitment like that entailed. I'm pleased to announce that we are continuing Crone's commitment to hiring the best people in the industry with the recent addition of Mike Carrigan. Mike has more than 29-years experience in the chemical and petroleum storage industry, and will no doubt be a tremendous asset to our clients in the industrial sector.

Probably most importantly, Crone established a strong ethical and moral attitude within the organization that stressed taking care of the client and doing the 'right' thing. When these two factors guide managers, decision-making becomes extremely simple.

TIC is at a crossroads, but there is absolutely no question of the direction we will travel. We will continue the work Crone set out for us, and we will travel the path he laid before us. TIC is, and will continue to be, the nation's leading engineering firm specializing in storage tanks. There is no doubt that there are more crossroads in our future. But we will approach each of them with the same spirit and enthusiasm.

Crone has left us with a cupboard stocked with technical expertise and a decision-making process guided by strong ethical and moral principles. With this legacy, what more could we possibly ask for?

## TIC Seminars

For the past 16 years Tank Industry Consultants has been offering storage tank seminars throughout the United States. When we attempt to analyze why the seminars have been so successful, it appears that one overriding reason is that attendees leave the two-day seminar with information that they can use in their everyday working lives. Although the seminars are conducted by some of the foremost experts in the storage tank industry, these are not "sit-behind-a-desk-and-share-textbook-information" types of seminar leaders. They are not professional "trainers" who may this week conduct a seminar on water storage tanks, and next week a seminar on coping with stress in the workplace. TIC's seminar leaders deal with the types of issues that are discussed in the seminar everyday. They are active in the regulatory and standards-making organizations that impact the storage tank industry.

In January and February, **Water Storage Tank Design, Construction, and Maintenance Seminars** will be held in Indianapolis, Indiana and Jacksonville, Florida. The following are the dates and seminar locations.

Indianapolis, IN - University Place  
Conference Center and Hotel  
January 30 & 31, 2001

Jacksonville, FL Marriott  
February 7 & 8, 2001

Water tank seminars in Richmond, Virginia and Philadelphia, Pennsylvania are currently being scheduled for the summer of 2001. In addition, one-day seminars on **Seismic Evaluation and Design** are being scheduled for California.

For additional information on these seminars, please check out our web site at

www.tankindustry.com  
or call us at  
1-800-TANKSEM

## Flat-Bottom Storage Tank Settlements

by Stephen W. Meier, P.E., S.E.

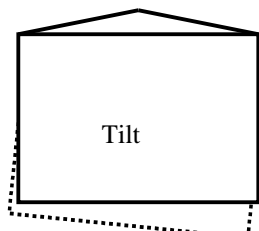
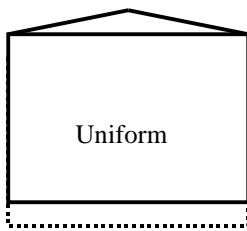
Flat-bottom ground storage tanks are generally large structures that impose significant loads on the underlying soil and are sensitive to differential settlements. The foundation, which includes the sub-grade, often influences the selection of the most practical tank configuration. Excessive settlements may cause structural failure, shell and roof deformations that interfere with proper operation, or shell and roof deformations that are aesthetically unappealing.

Settlement patterns for tanks may be complex and unpredictable, and absolute tolerances for tank settlements are difficult to establish for the following reason:

- Soil does not behave as predicted by theoretical models. Even uniform, heterogeneous sites that have had comprehensive soil investigations experience patterns of non-uniform settlements.
- The as-constructed tank characteristics vary. Tanks have a degree of distortion built in during construction from foundation levelness, weld shrinkage, construction methods, and other construction variables.
- Tank configurations vary. Height, diameter, product-stored, wind stiffeners, roof framing, shell-to-bottom connections, anchorage system, column details, and ancillary equipment all vary from tank to tank.
- Tanks are operated differently. Tanks may be cycled frequently, may be adjusted seasonally, or remain at the same level or empty for extended periods.

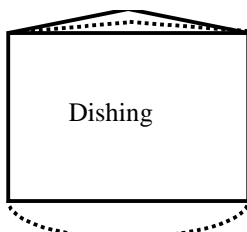
Tank settlements may be classified as:

### Planar Settlement

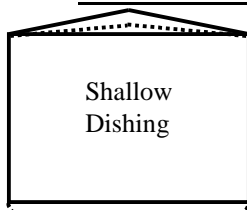


This is often referred to as "rigid body" settlement. The tank settles uniformly or tilts while the base of the tank remains essentially in the same plane. Tanks can withstand rather large planar settlements without structural distress.

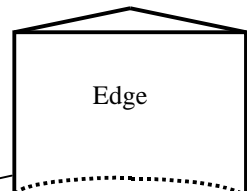
Axi-Symmetric    Out-of-Plane Settlement



**Dishing:** Tanks bottoms are flexible membranes. If the soil compresses as theoretically predicted, the bottom may "dish" into an approximate spherical shape. Most flat, welded steel tank bottoms can accommodate large dishing deformations. The limiting factor is the stress on the welds and possibly the associated settlement of the roof columns and damage to the roof. Settlements limits of 1% to 1.5% of the diameter are often used unless roof framing considerations govern. Changes in roof framing slope in excess of 0.4% may reduce the roof load capacity. Bottom slope for floating roof tanks in the "landed" position should not exceed 0.8%.



**Shallow Dishing:** The tank bottom may take a more ellipsoidal shape which has more slope in the bottom near the shell-to-bottom joint. This may be the result of inadequate compaction or a thin compressible layer under the tank bottom. The tank may tend to lift from the foundation. This condition may lead to bottom failure.



**Edge Settlements:** This type of settlement occurs when the tank shell settles more than the interior of the tank. This condition is usually caused by high shell loads or local soil bearing failure at the shell. Tolerable limits are dependent on bottom plate restraint. Near stiff areas such as an under-bottom connection, edge settlements of 1 inch may pose a problem. In regions of higher bottom plate flexibility, 3 to 4 inches may be tolerable.

## Mike Carrigan Named Regional Manager TIC's Southwest Office



Mike Carrigan, a 29-year veteran of the storage tank industry, has joined Tank Industry Consultants as the Southwest Office Regional Manager.

Mike has extensive experience in various inspection-related positions in the petroleum refining, natural gas transmission, and petrochemical industries. His industry certifications and credentials are shown at right.

As Regional Manager in TIC's Southwest Office in El Paso, Texas, Mike is responsible for managing tank rehabilitation and new tank projects for TIC's clients in Texas, Arkansas, New Mexico, Louisiana, and Oklahoma. His expertise in the industrial sector will be especially beneficial to industrial tank owners, operators, and inspectors throughout the United States.

Mike can be reached at [carrigan@tankindustry.com](mailto:carrigan@tankindustry.com) or at 1-800-560-5235 (pager).

### Mike Carrigan Professional Credentials

#### American Petroleum Institute

- API 510 Pressure Vessel Inspector
- API 653 Aboveground Storage Tank Inspector
  - API 570 Piping Inspector

#### American Welding Society

- Certified Welding Inspector

#### Previous ASNT Certifications

- Level II Dye Penetrant Examination
- Level II Magnetic Particle Examination
- Level II Radiographic Film Interpretation
  - Level II Ultrasonic Examination (UT Thickness & UT Shearwave)
  - Level II Visual Examination

## Come Visit Us At...

Indiana Section AWWA  
February 19 – 21, 2001  
Indianapolis, Indiana

American Water Works Association  
Infrastructure Conference  
March 11 – 14, 2001  
Orlando, Florida

Steel Plate Fabricators Association  
Steel Tank Seminars

February 6, 2001  
Ontario, California

March 6, 2001  
San Antonio, Texas

## What Tank Topics Would You Like to Talk About?

Please fax, phone, or e-mail to let us know what Tank Topics would be of interest to you.

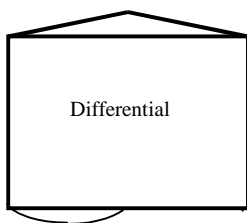
FAX: 317/271-3300

Phone: 317/271-3100

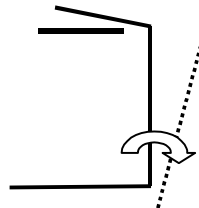
email: [snodgrass@tankindustry.com](mailto:snodgrass@tankindustry.com)

Continued from Page 3 – Tank Settlement

### Differential (Out-of-Plane) Settlement



Differential



The tank shell may not remain uniformly founded in the same plane around the entire periphery. If the base of the tank shell varies out of the plane, the shell must deform radially to redistribute the load. Small differential deformations at the bottom of the shell may be amplified by several times at the top of the shell. Many open-top or fixed-roof tanks can structurally accommodate differential settlements but may exhibit unsightly distortions. Floating roof tanks may suffer significant operational problems due to shell distortions associated with differential settlements. This settlement is usually compared to a sinusoidal curve modeling the tilt plane.

API 653 gives tolerable limits based on limiting the tensile stress in the shell to acceptable structural levels. To limit shell deformations, a limit of 0.1% (differential deviation from tilted plane/arc length) is a practical guide.

Defining tolerable settlements can be complex. Different limits may be required based on construction requirements, aesthetics, operating parameters, or structural considerations. API 653 provides guidance on assessing the structural limits for fitness for service.

[meier@tankindustry.com](mailto:meier@tankindustry.com)

**Check Out Our  
Newly Renovated  
Web Site**

**Featuring**   
Industry News  
Publications  
Seminar Schedules  
Industry Links

**[www.tankindustry.com](http://www.tankindustry.com)**

Continued from Page 1 – Cold Weather Coatings

sion between the topcoat and the underlying coating. The temperature for coating cure addressed in most product data sheets and specifications is given under the assumption that the temperature is constant for the period of time needed for curing. It is important then to not only verify that the minimum temperature and humidity requirements are met at application, but that the minimum temperature and humidity requirements are maintained for the specified minimum length of time needed for proper coating cure. Note that both minimum steel and ambient temperatures should be monitored. On some cold winter days, the temperature of the steel may not reach the temperature of the ambient air.

Surfaces to be coated should be free of dirt, oil, debris, and other surface contaminants that can lead to coating failure. Condensation is one surface contaminant that is prevalent in low temperature applications. One way of handling the issue of condensation is the use of moisture-cured urethanes. These polyurethanes are better suited to deal with condensation, since as a moisture-cured coating they can utilize the condensation during curing. Although condensation may be prevalent on the steel substrate, moisture will not be as readily available in the cold air. The lack of

moisture in the air available for the re-aging and curing of these moisture-cured urethanes again leads to slower cure times.

Along with the concern about condensation there is the issue of ice when the temperature drops below 32° F (0° C). Ice on the substrate can be difficult to detect visually. It can be even more difficult to detect on a profiled substrate such as blast-cleaned steel. Ice is a cold weather contaminant that should be removed prior to coating. If care is not taken and ice formations are coated over, when the ice melts, coating adhesion may be lost.

Coating application at low temperatures is a viable alternative and can be successful if precautions are taken. The issues are the same as with any project: select a coating to meet the project needs, verify the proper surface preparation of the substrate, and carefully monitor the conditions during coating application and curing.

#### About the Author

Patrick Brown is a 1998 graduate of Rose-Hulman Institute of Technology with a Bachelor of Science degree in Chemical Engineering. His major academic projects included the *Corning Column Distillation with Camille Controller*, *Heat Transfer in an Agitated Tank*, and *Centrifugal and Positive Placement Pumps' Characteristic Curves*. He is currently working toward a Masters Degree in Material Science.

**Tank Talk®** is published as an informational resource for the storage tank industry. For past issues of Tank Talk, or to learn more about the services offered by TIC, please contact:

Tank Industry Consultants  
7740 West New York Street, Indianapolis, Indiana 46214  
317 / 271-3100 (phone) — 317 / 271-3300 (fax)

Articles from previous issues of Tank Talk can be found on our web site  
[www.tankindustry.com](http://www.tankindustry.com)  
Email: [info@tankindustry.com](mailto:info@tankindustry.com)

#### Offices Nationwide

Copyright© 2000  
Tank Industry Consultants, Inc.  
All Rights Reserved

## We've Been Talking about Tanks

Throughout the year, representatives of Tank Industry Consultants travel across the United States to *Talk about Tanks*. In recent months, we have spoken before groups at:

#### Black & Veatch

Kansas City, Missouri  
Topics: Seismic Design • New Tank Specification • Foundations  
• Tank Failures  
Steve Meier, P.E., S.E.

#### American Water Works Association Distribution System Symposium

New Orleans, Louisiana  
"The Future of Tank Maintenance: Where Do We Go From Here?"  
Steve Roetter, P.E.

#### Alabama Rural Water

Monroeville, Alabama  
Topics: Prebid Evaluations & Lead-Based Coating Abatement  
Chip Stein, P.E.

#### SSPC: The Society for Protective Coatings Annual Conference

Nashville, Tennessee  
Gregory R. "Chip" Stein, P.E.  
General Tutorial Co-Chair  
Chip Stein and Ken Jacobi  
Tutorial T-67  
"Coating of Underground Pipelines and Storage Facilities."

#### Upcoming

#### Equilon

Tulsa, Oklahoma  
February 2001  
Equilon Tank Maintenance Mangers  
"Temporary Construction Openings for Aboveground Storage Tanks"  
John Lieb, P.E.

For copies of the technical papers relevant to the topics presented at these meetings and conferences, log on to our web site at:

[www.tankindustry.com](http://www.tankindustry.com)  
or phone, fax, or e-mail your request.

Log on to our web site for  
**Cold Weather Operation Tips**  
[www.tankindustry.com](http://www.tankindustry.com)  
*Published Papers – Cold Weather*

# Industry News

## Lieb Appointed to ANSI/ASME Committee

John Lieb, P.E., Chief Engineer-Industrial, Tank Industry Consultants, has been nominated to serve on the ANSI/ASME **Standard on Granular Storage Tanks Committee**. Initially, the scope of the standard will be limited to cylindrical steel tanks and granular loading issues.

## TIC to Perform Seismic Parametric Study

Tank Industry Consultants has been commissioned by the American Petroleum Institute, in conjunction with the Pressure Vessel Research Council, to conduct a *Parametric Study of Changes to Seismic Design of Aboveground Storage Tanks*. The study will include 59 tank sites, 5 tank configurations per tank site, each designed in accordance with 6 seismic criteria. It will include incremental design cost estimates for each seismic criteria. When completed, it will be published as a PVRC Bulletin.

It is anticipated that this landmark study will aid tank owners and engineers in seismic design selection.

## Steve Roetter Elected to SSPC Board of Governors

Steven P. Roetter, P.E., President of Tank Industry Consultants, was elected to the SSPC: The Society of Protective Coatings Board of Governors. The Board of Governors represents the various SSPC membership classifications including Facility Owners, Coating Material Suppliers, Other Product Suppliers, Coating Contractors, and Other Service Providers.

SSPC was founded in 1950 as a nonprofit professional society concerned with the use of coatings to protect industrial steel structures. Its current goals are to advance the technology and promote the use of protective coatings to preserve industrial, marine, and commercial structures, components, and substrates. SSPC develops standards and disseminates information through a variety of publications, conferences, and educational initiatives. (*Source: About SSPC: The Society for Protective Coatings.*)

For more information concerning SSPC activities, log on to their web site [www.sspc.org](http://www.sspc.org).

## API Update

At the API Fall Refining Meetings in Orlando, John Lieb, P.E., was appointed chair of the **Task Group on External Pressure**. This task group is charged with incorporating rules for evaluating external pressure on API 650 tanks. Lieb also retains his position as Secretary of the **Subgroup Design**.

Also at the Fall Meetings, Lieb volunteered (in a review capacity) to assist with an agenda item in the Subgroup Fabrication that will incorporate ultrasonic inspection alternatives to radiographic inspection in API 650. It is believed that UT inspection will replace RT Inspection as the preferred method of inspection. Such a change will have a significant impact on the tank industry.

## AWWA D102 Revision

The D102-97 Standard for Coating Steel Water-Storage Tanks Revision Task Force has sent the revised standard to the Steel Tank Committee for balloting. It is anticipated that the revised standard will be issued in 2001.

Anticipated changes include:

Systems Deleted	Systems Added
3-coat vinyl	3-coat moisture cured urethane
4-coat vinyl	3-coat DTM type acrylic emulsion system
hot-applied coal tar	zinc-rich primer/urethane/fluoro-urethane
cold-applied coal tar	organic zinc-rich primer/epoxy/epoxy
	100% solids polyurethane

Outside coating systems 1, 2, & 3 will be consolidated into one (revised OCS No. 1).

## Crone Knoy Honored as Honorary Life Member SSPC: The Society for Protective Coatings

At the SSPC 2000 Annual Meeting in Nashville, Tennessee, Crone Knoy, founder of Tank Industry Consultants, was honored posthumously as an Honorary Life Member. His wife, Cynthia, accepted the honor on his behalf.

*SSPC: The Society for Protective Coatings gratefully acknowledges the outstanding contribution of E. Crone Knoy in recognition of his long time effort advancing the technology in protective coatings and industry leadership by serving on SSPC's Board of Governors from 1992 to 2000*