Corrosion Prevention Initiative

An Update on the Liquid Products Database -
at the 2015 NTTC Tank Truck Week
Presented by…
Craig Casey of Tankstar USA
Doug Pape & Ian Haggerty of Battelle, and
John Cannon of Wabash Tank Trailers
Our Agenda

• About the LPD
• Three Pillars of the Liquid Products Database (LPD)
• A Corrosion Alert
• A Case Study: Extracting Product Information from a Shipper
• Current Affairs: Corrosion in a Heat Panel
• The New Live LPD Website
• The LPD Lounge, Here at Tank Truck Week
• Discussion
About the LPD

- $1 Billion annual industry issue, per NACE/FHWA
- $300k - $800k annual carrier hard costs
- $250k+ annual carrier soft costs?
- Prevention is tied to better data.
- Adopted as a Strategic Initiative by NTTC leaders
- Aligned with Battelle
  - Founded in science
  - Nonprofit
  - Neutral
- Volunteer steering committee
- Outreach: ACC, NACD ...
Three Pillars of the LPD

1. Compiled existing data
2. Limited annual laboratory testing of new chemical solutions
3. Carrier comment corner
Pillar 2: Laboratory Testing

Figure 1. Geometry of the two kinds of coupon. Thickness of coupons (10 ga) is not shown. Coupons were planar—not curved.
Pillar 2: Laboratory Testing

Figure 2. Image of heating bath for coupon testing.

Figure 3. View of large coupons partially immersed in aluminum sulfate.
Pillar 2: Laboratory Testing

Figure 4. Image of small coupons immersed in aluminum sulfate.

Figure 5. Image of small coupons removed for pitting-on-drying exposure.
Pillar 2: Laboratory Testing

• Coupons are at Battelle for many more tests.
• Now, carriers need to suggest ‘proprietary blends’ for future testing.
• All requests for testing will be prioritized by the Steering Committee.
• Currently, the lab testing backlog is minimal.
• The requesting carrier must arrange for the chemical solution to be shipped to Battelle.
Corrosion Alert – Caustic Soda

• Harmless?

PRODUCT NAME: CAUSTIC SODA:

<table>
<thead>
<tr>
<th>COMPONENT:</th>
<th>WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS NUMBER:</td>
<td>7732-18-5</td>
</tr>
<tr>
<td>PERCENTAGE:</td>
<td>48.5-94.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPONENT:</th>
<th>SODIUM HYDROXIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS NUMBER:</td>
<td>1310-73-2</td>
</tr>
<tr>
<td>PERCENTAGE:</td>
<td>5.5-51.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPONENT:</th>
<th>SODIUM CHLORIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS NUMBER:</td>
<td>7647-14-5</td>
</tr>
<tr>
<td>PERCENTAGE:</td>
<td>0-5.0</td>
</tr>
</tbody>
</table>

2 NaCl (aq) + 2 H₂O → Cl₂(gas) + H₂(gas) + 2NaOH (aq)

Electrical energy

• Chlorides + time + temperature = pitting
• ‘Peel the onion’!
• Determine the constituents – and concentrations.
A Case Study: Extracting Product Information from a Shipper: Email 1

- Mid May
- Hi Alex.
- *Bill* sent “*Carrier Z*” over to me as they want product information on *Proprietary Blend 1*, specifically related to chloride content. Apparently, they are looking to truck this material for us for some reason, and ended up calling me.
A Case Study: Extracting Product Information from a Shipper: Email 2

- Mid September
- Hi Charlie:
- I received a call from Carrier Z on Friday - nobody from our organization has provided them with the product information, yet. (Since May)
- Would you have any idea where I can go with this?
- Do you know who deals with this Carrier Z?
A Case Study: Extracting Product Information from a Shipper: Email 3

- Hi David:
- I pulled up the MSDS for Proprietary Blend 1. As far as I can see there is no requirement for a lined bulk trailer which would trigger the request for the chloride levels.
- Can you forward to the correct contacts?
A Case Study: Extracting Product Information from a Shipper: Email 4

- Hi Carrier Z Adm. Asst.:
- It appears you are looking for information regarding one of our products.
- Can you please provide details around the request, including your company’s relationship with our enterprise?
A Case Study: Extracting Product Information from a Shipper: Email 5

• Hi David:

• We don’t haul *Proprietary Blend 1* at this time, but a request came into our Maintenance Department for additional information. We already have your Safety Data Sheet. My boss wants to know if there are chlorides present, and if so, what is the % of chlorides by weight?

• Or, he would make do with a Technical Data Sheet if you don’t have that information available.
A Case Study: Extracting Product Information from a Shipper: Email 6

• Hi Carrier Z Adm. Asst.:
• What is the relationship between your company and mine?
A Case Study: Extracting Product Information from a Shipper: Email 7

• Hi David:
• At this time I don’t believe we have one.
• We usually don’t bid on a job without more information on the product we’re transporting.
A Case Study: Extracting Product Information from a Shipper: Email 8

- Hi Carrier Z Adm. Asst.:
- Our company does not typically provide product composition information.
- The MSDS sheet should be sufficient at this time.
- We have contracted with a 3rd Party Logistics company to arrange transportation.
- If there is an immediate or future opportunity for us to work with your firm to haul this product, that you and I are not yet aware of, we can revisit.
A Case Study: Extracting Product Information from a Shipper: Email 9

• Hi Carrier Z Boss:

• I was not able to get a Technical Data Sheet from Shipper Q. I just called their Corporate Office and spoke with Ernie in Sales. He informed me that they cannot sell us any product until we set up an account with our local Area Manager, Bill. I was referred to him from their CO a while ago, he has been unable to help per the emails, below.
A Case Study: Extracting Product Information from a Shipper:

- The names were changed to protect the “Not So Innocent”, but the story is true - and happens all too often.
- Many of you in the room have similar stories - this is not an isolated occurrence.
- Thus, we need Battelle:
  - Nonprofit,
  - Independent,
  - Disinterested (Bi-Partisan), and
  - Highly Accredited Third Party.
Current Affairs: Corrosion in a Heat Panel

• A recent episode …

• Other reports of similar situations
Current Affairs:
Corrosion in a Heat Panel

• The verdict of a metallurgist hired by the carrier:

We respectfully recommend that steam chemistry is controlled and prevent chlorine getting into the steam circuit. Chlorine typically enters from acid cleaning, disinfecting, or using chlorine contaminated water in the steam circuit. Chlorine must be kept below the ppm (part per million) range for steam temperatures to prevent stress corrosion cracking.
Corrosion in a Heat Panel (Case History)

- Recent failure occurred in an insulated tanker heat panel
  - Base plate was Type 316L stainless steel. Curved plate was Type 201 stainless steel.
  - Type 201 SS is less corrosion resistant than 316L due to differences in chemical composition (but, the heat panel is only intended to contain non-corrosive media; glycols, water and steam).
  - Cracks were found only in the heat-affected zone of the curved or Type 201 stainless steel.
SCC Susceptibility in Stainless Steel

View of cracks found on Type 201 stainless steel curved plate in the heat affected zone
Stress Corrosion Cracking vs. Sensitization in Stainless Steels

Three conditions necessary for Stress Corrosion Cracking (SCC) to occur

1. Susceptible material
2. Corrosive environment (such as the presence of chlorides in solution)
3. Tensile stresses present (either residual or external)

When chloride SCC does occur, the failure is usually sudden and without warning.
Stress Corrosion Cracking vs. Sensitization in Stainless Steels

- For sensitization to occur, chromium needs to be depleted from grain boundaries. In this case, the Type 201 SS is more susceptible to this phenomena than Type 316L due to chemical composition differences.
- As a result, Type 201 has a lower corrosion resistance.
- This can lead to intergranular attack (IGA), or along grain boundaries, in a corrosive environment.

Sensitization is typically a gradual failure mode.
Microstructure Differences

- Stress Corrosion Cracking is primarily a transgranular (through the grains) phenomenon.
- Sensitization proceeds along grain boundaries.
- Heat Affected Zone (HAZ) of weldment is often site of sensitization.

Transgranular corrosion from chloride stress corrosion cracking

Intergranular corrosion from sensitization
Microstructure Differences

The current failure is more similar to Sensitization than SCC.
Conclusions

• Cracking in heat exchanger panel was likely due to sensitization in the heat affected zone of the weldment on the Type 201 stainless steel

• The presence of chlorides likely led to the IGA in the weldment and thereby leading to perforation and leaks.
Recommendations

• It’s always a good idea to minimize the presence of chlorides in solutions when in contact with stainless steels.

• Elevated temperatures lead to corrosion (SCC or otherwise) much more quickly than at room temperature.
The LPD Website

The information in this Database was collected from a number of public and private sources. Battelle has taken care in preparing and reviewing the data, but its correctness cannot be guaranteed. Carriers accessing this Database assume all risk for using the information contained in the Database. Neither NTTC nor Battelle, nor their agents or advisors shall be held responsible for the accuracy of the Database nor the consequences of its use.

© 2015 - National Tank Truck Carriers: www.tanktruck.org
The LPD Website

Advanced Search

Corrosion Medium: sulfate
Trade Name: Trade Name...
CAS: CAS...
UN: UN...
Manufacturer: Manufacturer...

Search
Reset

Select container type: 316
show all columns

Corrosive Medium | Composition
--- | ---
2-Ethylhexyl Sodium Sulfate | 40% 2-Ethylhexyl Sodium Sulfate, Water, 3% 2-Ethyl Hexanol, 1% Formaldehyde
Aluminum Sulfate | Aluminum sulfate slurry, sulfuric acid
Aluminum Sulfate | 50% Aluminum Sulfate, 10% Sulfuric Acid, 50% Water
Aluminum Sulfate | 48.5%, balance water
Aluminum Sulfate Solution | 25.8-28.2, water 71.8-73.2
The LPD Website

No Results for the Query?

Sorry. We didn’t find anything for
Corrosion Medium - methyl deethanol : contains

Do you want to

Check Spelling  Ask Us To Find The Information  Start Over  Close
The LPD Website

No Results for the Query?

Doug Pape
pape@battelle.org
614-424-5667
methyl deathanol
Could you test this please?
Visit the LPD Lounge at Tank Truck Week
Visit the LPD Lounge at Tank Truck Week
THANK YOU!