Sulfuric Acid Today
Sulfuric Acid Workshop
Woodlands, Texas

Rick Davis

Davis & Associates Consulting

Hydrogen Safety –
Formation & Risk Mitigation

The Session will focus on issues concerning hydrogen gas incidents that have occurred in the sulfuric industry Worldwide. The session will highlight on topics such as underlying causes, suggestions for mitigation and prevention.

International Hydrogen Safety Workgroup

Mosaic
Metso Outotec
Davis & Associates Consulting
Chemetics
Elessent MECS Technologies
Eco Services
Saconix

Program

Rick Davis	Davis & Associates Consulting
Jack Harris	VIP International
Mack Jones	Mosaic
Walter Weiss	Elessent MECS Technologies
Hannes Storch	Metso Outotec
Panel Discussion	

Sulfuric Acid Process

The Process Secret

- No water No sulfuric acid
- Carbon Steel can be used
- Ductile Iron can be used

Underlying Causes

Acid concentrations out of range

- Steam systems leaks
- Cooling water leaks
- Maintenance / operational procedures

Suggestions For Mitigation

Quick acknowledgement of Acid concentrations out of range

Venting the potential accumulation of Hydrogen

Keep blower running

Maintenance / operational procedures

Instrumentation Ideas

Automatic Double Block & Bleed to ALL controlled points Water into the Strong Acid System

Measurement of dilution flow versus acid production

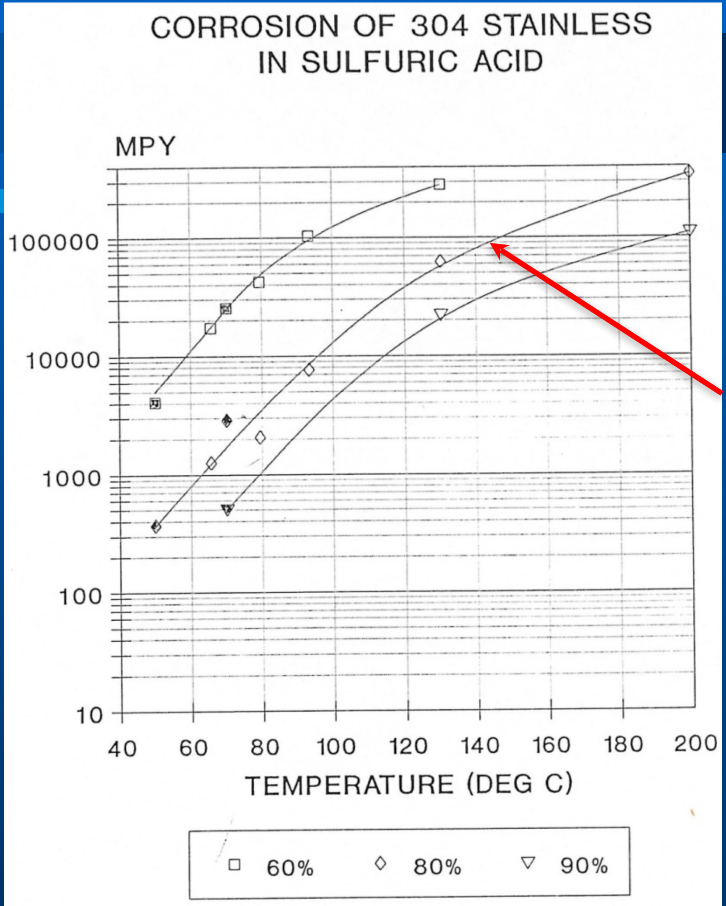
Operational Ideas

Maintain acid concentration monitoring during maintenance outages

Develop procedures for weak acid incidents

Weak Acid

Normal Acid Range	93% - 99%
Normal Temperature Range	110 – 235 F



275 mils/d (7 mm/d)
or
10 mils/hr (0.25 mm/hr)

Metal Loss

- Density of 304L SS = 8.3 g/cm^3 (0.3 lb/In^3)
- Basis: 100 M^2 (1,075 ft^2) surface area (1,000,000 cm^2 or 154,800 in^2)

<u>Metal loss:</u>

$$0.25\frac{mm}{hour}\ x\ \frac{1\ cm}{10\ mm}\ x\ 1{,}000{,}000\ cm2\ x\ 8.3\frac{g}{cm3}\ x\ \frac{kg}{1{,}000\ g} =$$

$$208\frac{kg}{hr}\ Fe\ per\ 100\ M2\ /\ \mathrm{Hr}$$

Hydrogen Generation:

$$Fe + H2SO4 \rightarrow FeSO4 + H2$$

$$208 \frac{kg\ Fe}{hr} \text{ x } \frac{kg - mole}{56\ kg} \ x\ 1 \frac{H2}{Fe} \ x\ 22.4 \frac{NM3}{kg - mole} =$$

$$83 \frac{\text{NM3}}{\text{hr} \ * \ \text{100 M2}}$$

3,000 MTPD Plant Mist Eliminator Housing

In Hanging Configuration

7.5 M diameter x 5 M high

Volume 220 M^3

Worse Case Time to Reach 4 Vol% LEL
(600 M² acid cooler)

$$\frac{220\ M3\ \times\ 0.04\ Vol\%\ x\ 60\ \frac{Min}{Hr}}{83\frac{NM3}{hr * 100\ M2}\ x\ 6\ \ 100M2} =$$

<u>38 minutes !!</u>

The potential for H_2 is always present

Conditions that accelerate H_2 formation

- High corrosion rates
  - (low acid conc and high temps caused by dilution)
- Weak acid in contact with large amounts of metal
  - Acid coolers, economizers, etc

Ever present factors contribute to reaching the explosive limit

- Time
  - Normal corrosion generates H_2 and become dangerous with time
- Stagnant gas and a place for H_2 to accumulate
  - Remember that H_2 can flow upstream to high spots, such as converters

Suggestions For Mitigation

Review SOP

Review instrumentation and interlocks

Review operation staff knowledge

Hydrogen Incident Resources

Sulfuric Acid Today

www.h2so4today.com/hydrogen-safety