Best Practices Notice

Sulfuric Acid (H_2SO_4)

Doc no: BPN-02 Date: September 25, 2020

ASAHI/AMERICA®
Your Experts in Plastics™

VALVES • ACTUATORS • HIGH PURITY, INDUSTRIAL, ENVIRONMENTAL AND COMMERCIAL PIPING • WET PROCESS

Sulfuric acid, also known as oil of vitriol or hydrogen sulfate, is used in a wide range of applications from fertilizers to explosives. In wastewater treatment applications, it is common to use 93% to 98.3% to neutralize the waste stream.

Sulfuric acid is produced by burning sulfur to create SO2, it is then catalyzed to create 2SO3. The SO3 (sulfur trioxide), is then absorbed into water to create H2SO4. It is stable up to 98.3% concentration. Above 98.3% the SO3 comes out of solution acting as a separate chemical to consider, this mixture is called oleum. Sulfur trioxide is an extreme oxidizing agent which is known to oxidize metals and most thermoplastics.

$$S + O_2 \rightarrow SO_2 + \tfrac{1}{2}O_2 \rightarrow SO_3 + H_2O \rightarrow H_2SO_4$$

Based on Asahi/America's decades-long experience supplying single and double contained pipe systems with sulfuric acid we are pleased to make the following material compatibility recommendations. For the premier recommendation with the highest reliability Ultra Proline® ECTFE by Asahi provides 25+ year service life with up to 98.3% sulfuric acid. Other piping materials are resistant as shown below.

Concentration	H_2SO_4 (Sulfuric Acid)					
	Temperature		Material			
	°C	°F	PE	PP	PVDF	ECTFE
Waste Gasses (traces)	20	68	+	+	+	+
	40	104	+	+	+	+
	60	140	+	+	+	+
	80	176	-	+	+	+
	100	212	-	-	+	+
	120	248	-	-	-	+
85.0%	20	68	+/- (s)	+/- (s)	+/- (s)	+
	40	104	+/- (s)	+/- (s)	+/- (s)	+
	60	140	+/- (s)	+/- (s)	+/- (s)	+
	80	176	-	+/- (s)	+/- (s)	+
	100	212	-	-	+/- (s)	+
	120	248	-	-	-	+
93.0%	20	68	-	-	+/- (s)	+
	40	104	-	-	+/- (s)	+
	60	140	-	-	+/- (s)	+
	80	176	-	-	-	+
	100	212	-	-	-	+
	120	248	-	-	-	+
96.3%	20	68	-	-	+/- (s)	+
	40	104	-	-	-	+
	60	140	-	-	-	+
	80	176	-	-	-	+
	100	212	-	-	-	+
	120	248	-	-	-	+
98.3%	20	68	-	-	-	+
	40	104	-	-	-	+
	60	140	-	-	-	+
	80	176	-	-	-	+
	100	212	-	-	-	+
	120	248	-	-	-	+

- not resistant
+ chemically resistant
+/- (s) conditionally resistant[B]

Concentration	$H_2SO_4 + SO_3$ (Oleum)					
	Temperature		Material			
	°C	°F	PE	PP	PVDF	ECTFE
10% (102.25%[A] H_2SO_4)	20	68	-	-	-	+/- (s)
	40	104	-	-	-	-
	60	140	-	-	-	-
	80	176	-	-	-	-
	100	212	-	-	-	-
	120	248	-	-	-	-
30% (106.75%[A] H_2SO_4)	20	68	-	-	-	+/- (s)
	40	104	-	-	-	-
	60	140	-	-	-	-
	80	176	-	-	-	-
	100	212	-	-	-	-
	120	248	-	-	-	-

Concentration	SO_3 (Sulfur Trioxide)					
	Temperature		Material			
	°C	°F	PE	PP	PVDF	ECTFE
Waste Gasses (traces)	20	68	-	-	+/- (s)	+
	40	104	-	-	-	+
	60	140	-	-	-	+
	80	176	-	-	-	-
	100	212	-	-	-	-
	120	248	-	-	-	-
TR	20	68	-	-	-	+/- (s)
	40	104	-	-	-	-
	60	140	-	-	-	-
	80	176	-	-	-	-
	100	212	-	-	-	-
	120	248	-	-	-	

Notes: A) Equivalent sulfuric acid concentration
B) Consult Asahi/America, Inc. to discuss conditions

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In order to join ECTFE, Asahi follows DVS standards for contact and non-contact butt fusion welding. The changeover time for ECTFE is critical because ECTFE cools down rapidly creating a tight molten window when the material can be molecularly joined. Welding ECTFE should be performed by certified operators on Asahi's SP 110-S automated force-control tool. ECTFE can also be welded using several of Asahi's manually controlled welding tools.

To control flow, Asahi recommends matching the pipe system material to the valve body material. We offer ECTFE ball valves with a proprietary "F-99" litharge fluorine elastomer that offers the highest resistance to H2SO4. Our ECTFE diaphragm valves are available with EPDM backed PTFE up to 2" to weld directly into the ECTFE pipe. For larger valves we recommend Type-55 PTFE lined butterfly valves starting at 2".

Sample Specification for 98.3% H_2SO_4

Sizes	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	3"	4"
Pipe Material	Ethylene chlorotrifluoroethylene (ECTFE), ASTM D3275 Class 2							
Pipe Design Pressure	150psi at 68°F for 25 years, SDR 21							
Unions	Series 5534 ECTFE/F99			n/a				
Ball Valve	Series 1441 ECTFE/F99			n/a				
Diaphragm Valve	Type 342 ECTFE/PTFE (backed by EPDM)						n/a	
Butterfly Valve	n/a					Asahi Type 55 PTFE Lever		
Pressure Regulators/Relief	Asahi ECTFE/PTFE			Asahi PVDF[1]/PTFE/FKM				
Check Valve	PVDF[1]/FKM Flanged Ball Check Type 1233							
Gasket	AV Gasket PTFE bonded EPDM Type 3114							

Double Containment Options (if required by EPA or OSHA)

Carrier Size	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	3"	4"
Containment Size	2"	3"	3" (4")[2]	4"	4"	4" (6")[2]	6"	8"
Containment Material	ECTFE, ASTM D3275 Class 2							
Containment Wall Thickness	SDR 21						SDR 00 (10psi only)	
Containment Material	PVDF, ASTM D3222 Type II suspension grade							
Containment Wall Thickness	SDR 21	SDR 33						

Notes:
1) Replace periodically
2) Leak detection cable requires larger containment size for easiest installation

Additional Notes:

- Asahi/America's online chemical resistance guide for valves differs from our piping recommendation due to the design life requirements of the components. Piping is always considered for 25 or more years, whereas valves (due to cyclical operation and moving parts) must have more frequent maintenance, repair, or replacement.
- Discoloration of ECTFE and PVDF occurs when exposed to sulfuric acid; it is perfectly normal to see browning of the inside of the pipe over time.
- The above recommendations are based on best practices. Please consult Asahi/America, Inc. for further discussion regarding specific project conditions.

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