sugison plastics

ECTFE
EthylenChloroTriFluoroEthylen

Material Plastic Piping for H2SO4 98 %

Introduction

Concentrated sulphuric acid is a colourless, odourless liquid. In air at room temperature, the concentrated acid gives off invisible toxic vapours. From 30°C, it gives off heavy, whitish, irritating vapours. The presence of impurities often turns the acid a yellow brown colour. H2SO4 is an aggressive oxidizer pose an additional problem as they combine with oxygen and take up electrons. **They tend to react with water and is commonly used for pH balance in water treatment and for stripping, cleaning, and etching metals**. H2SO4 embrittle many materials and cause them to stress crack. Manufactured sulphuric acid exists as an aqueous solution at various concentrations of 10% to 98%.

Sulfuric acid is produced from sulfur dioxide, which may be generated by burning sulfur, it may be a by product of a metalurgical smelting process, or it may be produced by thermal decomposition (regeneration) of spent acid. The sulphur dioxide is reacted with oxygen over a catalyst at -420° to 625° to form sulfur trioxide. The latter gas then reacts with water in the absorbing towers to form sulfuric acid.

This process is exothermic and the acid can reach temperatures as high as 180°C to 200°C. Most of this energy is recovered by a range of means to minimise energy consumption. Usually the acid is then cooled from around 100°C to close to ambient for storage.

$$S + O_2 \text{ ------> } SO_2$$

$$SO_2 + {}^1/_2\, O_2 \text{ ------> } SO_3$$

This reaction is reversible and the formation of the sulfur trioxide is exothermic

$$SO_3 + H_2O \text{ ------> } H_2SO_4$$

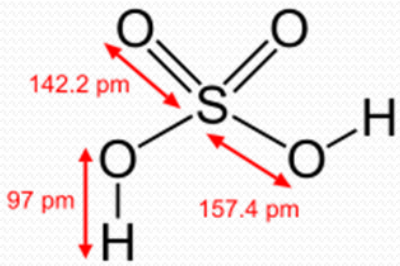
The sulfur trioxide is absorbed into 97–98% H_2SO_4 to form oleum ($H_2S_2O_7$), also known as fuming sulfuric acid. The oleum is then diluted with water to form concentrated sulfuric acid.

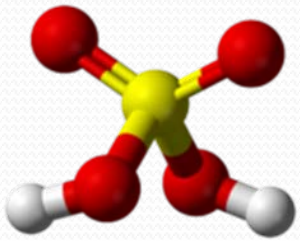
$$H_2SO_4\,(l) + SO_3 \rightarrow H_2S_2O_7\,(l)$$

$$H_2S_2O_7\,(l) + H_2O\,(l) \rightarrow 2\,H_2SO_4\,(l)$$

Note that directly **dissolving SO_3 in water is not practical due to the highly exothermic nature of the reaction between sulfur trioxide and water. The reaction forms a corrosive aerosol that is very difficult to separate, instead of a liquid.**

$$SO_3\,(g) + H_2O\,(l) \rightarrow H_2SO_4\,(l)$$





sulfuric acid (oil of vitriol)

Use

Sulphuric acid is used in the manufacture of **fertilisers (superphosphates), the synthetic textile industry, the iron and steelmaking industry to remove oxidation, rust and scale, in ore processing, the oil industry, the manufacture of dyes, for electroplating, in the explosive industry, in the paper industry**, as a dehydrating and sulphonating agent, **and in lead batteries, accumulator (accu).** It is a liquid chemical which is transported in bulk.

Properties

Molecular formula H_2SO_4
Molar mass 98.079 g/mol
Appearance : Clear, colorless, odorless liquid
Density 1.84 g/cm^3, liquid
Melting point 10 °C, 283 K, 50 °F
Boiling point 337 °C, 610 K, 639 °F
Solubility in water miscible
Acidity (pK_a) −3, 1.99
Viscosity 26.7 cP (20 °C)
Thermochemistry Std enthalpy of formation $\Delta_f H^{\ominus}_{298}$ −814 kJ·mol^{-1}[1]
Standard molar entropy $S^{\ominus}_{298}$ 157 J·mol^{-1}·K^{-1}[1]

Key Issue

In certain regions of the US, 93 % sulfuric acid has decreased in availability. However, the acid is readily available in 98 % concentrations, as this concentration is a biproduct of phosphate production. The reduction in availability of 93 %, combined with the cost savings of using the more common 98 %, caused many facilities to **switch their acid supply from 93 to 98 %. Many facilities running PVDF piping systema assumed that there would be no issue with using this acid in their pipelines.**

In various sites, failures of piping systems occurred within three to six months of changing to a higher concentration acid. **In concentration of 98.3 percent or higher, sulfuric acid has a natural contaminant, known as sulfur trioxide (SO_3). The SO_3 associated with concentrated sulfuric acid has very affinity for water, and can actually chemically dehydrate polyester or vinyl ester to yield a charred surface.**

SO_3 acts as a stress cracking agent for PVC, CPVC, PP and PVDF materials. Sulfuric acid with a concentration of 98 % is typically supplied in a concentration range from 98.1 to 98.9 %. This has led to the new common terminology of 98+ % sulfuric acid (with SO_3) attacks both PVDF pipe and steel pipe.

Many thermoplastic materials will stand up to sulfuric acid applications. However, the presence of SO_3 will create stress cracks in the pipe material. These are normally small longitudinal cracks, one to two inches, through the pipe wall.

A copolymer of ethylen chlorotrifluoroethylene ECTFE is a proven solution for these problems. This material has been succesfully tested and used in sulfuric acid and sulfur trioxide applications. The material's resistance to both sulfuric acid and the common contaminant of SO_3 makes it an ideal choice for a piping material. Its chemical resistance is superior to that of other plastics such as PVC, PP and PVDF. **Compared to carbon steel pipe it is virtually maintenance free, providing trouble free service for at least 10 years.**

THERMOPLASTICS CHEMICAL RESISTANCE COMPARATION IN SULFURIC ACID

Chemical	Formula	Conc. (%)	Temp. °C	uPVC	PE	PP	PVDF	PVC/C	ECTFE
Sulphur	**S**	100	25	1		1	1	1	1
			60	2		1	1		1
			100						1
Sulfur Dioxide	**SO2**	sat	25	1	1	1	1	1	1
			60	2					1
			100						1
Sulfur Dioxide Dry		all	25	1	1	1	1	1	1
			60	1	1	1	1		1
			100			3	1		1
Sulfur Dioxide Liq.		100	25	2	1				1
			60	3	2				1
			100						1
Sulfur Trioxide	**SO3**	100	25	2	3	3	3	2	1
			60	2	3	3	3	2	1
			100						
Sulphuric Acid	**H2SO4**	≤ 10	25	1	1	1	1	1	1
			60	1	1	1	1	1	1
			100			1	1	1	1
		≤ 75	25	1	1	1	1	1	1
			60	2	2	2	1		1
			100			2	1	2	1
		≤ 90	25	1	2	1	1	1	1
			60	2	2	2	1		1
			100			3	1	3	1
		≤ 96	25	2	2	3	1	1	1
			60	3	2	3	2	3	1
			100			3	3	3	1
Sulfuric Acid Fuming		all	25	2		3	3	2	1
			60	3		3	3	2	1
			100			3	3		1

Class : 1) high resistance 2) limited resistance 3) no resistance


PVDF pipe failure due to the presence of sulfur trioxide

Stainless steel

Sulfuric acid is an aggressive oxidizer. It has an affinity for water and is commonly used for pH balance in water treatment and for stripping, cleaning, and etching metals. Stainless steel can be used to contain Sulfuric Acid at very low (less than 6 %) and very high (over 90 %). Conc., but not in the middle range.

Sulfuric acid contained in metal may form an iron sulfate scum on the surface. While this provides some protection from corrosion if undisturbed. **It can pose an unacceptable contamination threat for high purity applications.**

ECTFE

Reason that user requirement for piping system :

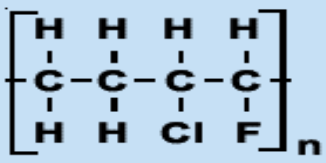
1. regulatory acceptance
2. practical installation
3. reliability
4. low maintenance
5. good cleanability
6. easy up grading
7. economical solution

ECTFE piping system save handling for the transport of highly aggressive chemicals. ECTFE provides excellent chemical resistance and high mechanical strength even at high temperatures. ECTFE shows a remarkable hardness and excellent chemical resistance to most organic and in organic chemicals (pH value 0 to 14, max 140°C) as well as solvents (max. 120°C)

- **Sulphuric acid H2SO4 98 %**
- **Hydrochloric acid HCL 37 %**
- **Hydrofluoric acid HF 90 %**
- **Sodium hydroxide NaOH 50 %**
- **Hydrogen peroxide H2O2 60 %**
- **Nitric acid HNO3 65 %**
- **Solvents**
- **Chorine and chlorine compounds**

ECTFE is distinguished from other materials by its barrier properties. The permeation of oxygen, carbon dioxide, chloric gas or hydrochloric acid is 10 to 100-times better compared to e.g PTFE or FEP.

ECTFE in comparison to PFA : cost efficient in material and installation; smoother surface; higher permeation resistance; larger dimension range (up to 110 mm/ 4inch); and lower heat expansion.



Chemical structure of ECTFE

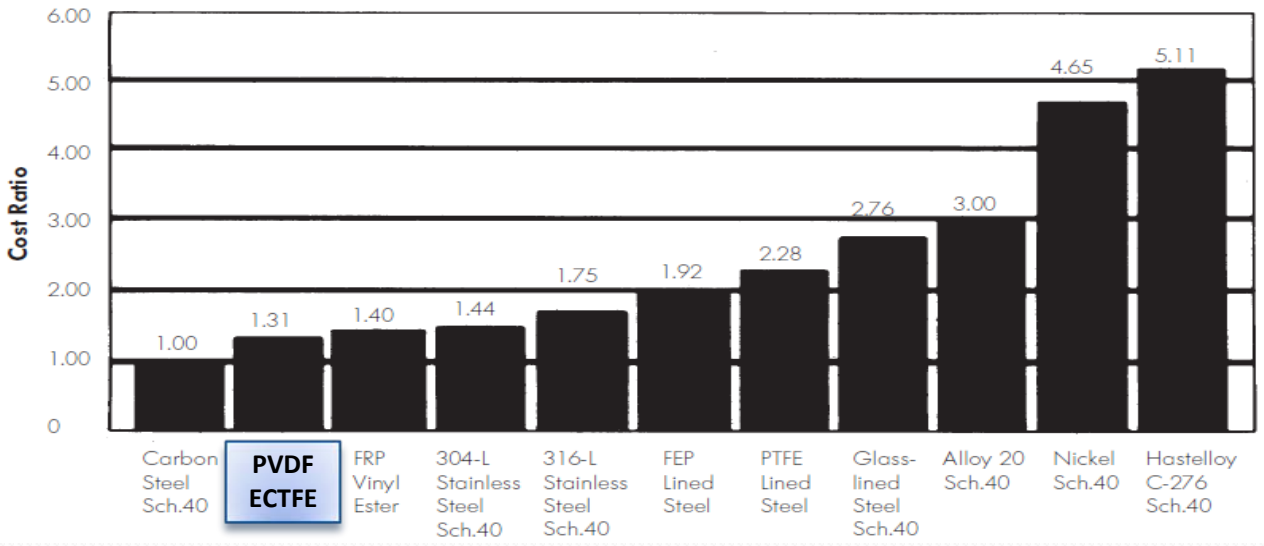
ECTFE is primarily used in the chemical, semiconductor, photovoltaic, pharmaceutical and petrochemical industries for the following application areas :

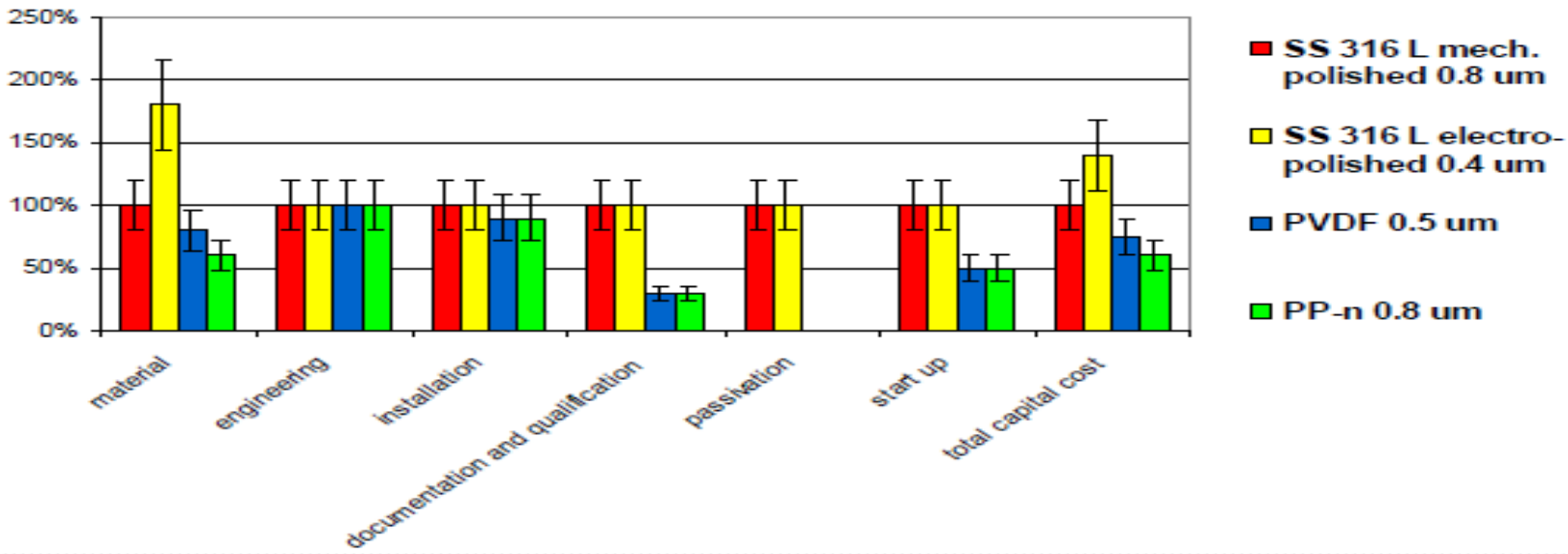
- Supply system for chemicals
- Process equipment and distribution piping systems
- Hot ultra-pure water systems
- Double containment piping systems
- **H2SO4 injection piping for sewage treatment plants**
- Ventilation piping for aggressive media and high purity media
- Lining as corrosion protection for steel, FRP and concrete tanks

Outstanding features

- Stable and highly resistant to crack growth
- Ultra pure and flame resistant (FM 4910 tested raw material; UL94-VO)
- Physiological non toxic application
- Resistant to high pressure
- Resistant to UV and gamma radiation
- Resistant to diffusion and permeation

Total Cost Ratio Piping Material





THANK YOU

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