SENSIRION
THE SENSOR COMPANY

Chemical Resistance

Application Note for Liquid Flow Sensors

Preface

This application note provides information on the chemical compatibility of Sensirion's liquid flow sensors.

Sensirion liquid flow sensors measure the flow completely media isolated through the wall of a straight flow channel. This results in the best-in-class chemical compatibility to chemicals and aggressive liquids. For each Sensirion liquid flow sensor the list of wetted materials is provided in the respective datasheet.

Important Notice

The information provided in this document reflects the state of our current knowledge and the information available to us. However, compatibility with any liquid for any duration of exposure cannot be guaranteed and it is in the user's responsibility and best interest to test the sensor in the given application.

Contents

1 Compatibility Table

Table 1 provides a list of chemicals that have been tested on the materials or researched in the literature.

		Product Family	SLF3S	LD20	LPG10	SLI, LG16	SLS, LS32	SLQ-QT	SLG
		Wetted Materials	PPS, Stainless steel, Epoxy	PEI, LCP, Epoxy	Glass	Glass or Quartz, PEEK, (FEP)	Stainless steel, PEEK, PTFE	Quartz, PFA, (PCTFE)	Quartz, Titanium, PEEK
Type	Chemical	Concentration							
Aqueous solutions	NaCl (Sodium chloride)	0.9%	+	+	+	+	+	+	+
	NaOH (Sodium hydroxide)	1 M (=4%)	o	-	-	-	+	-	-
	HCl (Hydrochloric acid)	1 M (=3%)	o	-	o	o	-	+	o
	H2O2 (Hydrogen peroxide)	30%	-	-	+	+	o[1]	+	+
	NaClO (Sodium hypochlorite)	30%	o	o	o	o	o	o	o
	$Ca(ClO)_2$ (Calcium hypochlorite)	32%	o	o	o	o	o	o	o
Organic solvent	Ethanol IPA (Isopropyl alcohol or 2-propanol) Methanol	100%	+	+	+	+	+	+	+
	ACN (Acteonitrile)	10 - 100%[2]	o/-	-	+	+	+	+	+
	THF (Tetrahydrofuran)	10 - 100%	o/-	-	+	o	+/o	+	o
	DMSO (Dimethylsulfoxid)	10 - 100%	o/-	-	+	o	+/o	+	o
	Acetone	100%	+	-	+	+	+	+	+
	Toluene	100%	o	-	+	o	o	+	o
	Heptane	100%	+	+	+	+	+	+	+
	Gasoline Diesel fuel Kerosene (Jet fuel)	100%	+	o	+	+	+	+	+
Other	Mineral oil, Vegetable oil	100%	+	+	+	+	+	+	+
	Silicone oil	100%	+	+	+	+	+	+	+
	Engine oil, Lubricant oil	100%	+	o	+	+	+	+	+

\+ : most likely suitable for long term usage
o : possibly suitable for short/medium duration usage
\- : likely not suitable

Table 1: Tested and/or researched compatibilities

[1] stainless steel acts as a catalyst which dissociates H_2O_2 at high concentrations
[2] Disolved in water

2 Product Families

2.1 SLF3x Series

The wetted materials of the SLF3x sensor series (including the SLF3S-1300F and SLF3S-0600F) are PPS (Polyphenylene sulfide), stainless steel 316L and an epoxy-based adhesive.

2.2 LD20 Series

The wetted materials of the LD20 sensor series (including the LD20-2600B and LD20-0600L) are PEI (polyetherimide), LCP (liquid-crystal polymer) and an epoxy-based adhesive. The LD20 is a single-use sensor addressing applications in the medical market. No guarantee can be given for compatibility with any liquid or drug formulation. The user is responsible to test the compatibility of the sensor's wetted materials for his application.

To the best of our knowledge, we expect good compatibility with the following liquids:

- Water
- Saline solution
- Glucose solution
- Typical buffer solutions

Liquids that are known to be incompatible are:

- Strong acids and bases
- Acids and bases at high temperatures
- Acetone, THF, DMSO, Toluene

2.3 LPG10-1000

Owing to its design, the only wetted material of the LPG10-1000 is Borosilicate glass. No wetted adhesive is used in the final product. Chemical compatibility of the installed sensor is therefore usually limited by the customer's manifold material and by the sealing (e.g. O-ring) to this manifold.

2.4 Glass Capillary Based Sensors (SLI and LG16 series)

Glass capillary-based sensors house a straight capillary made from borosilicate glass or fused silica, fitted to the fluidic ports made from PEEK. The internal seal is either direct (PEEK on glass) or based on the fluoropolymer FEP.

Refer to the datasheet for the type of glass that is used and whether a direct or FEP seal is used.

Solvents that soften PEEK (i.e. THF) can potentially reduce the integrity of the seal between the capillary and the fluidic fittings, adversely affecting pressure ratings.

2.5 Stainless Steel Capillary Based Sensors (SLS-1500, LS32-1500)

Steel capillary-based sensors house a straight capillary made from stainless steel, fitted to the fluidic ports made from PEEK. The internal seal between the fluidic ports and the capillary uses the fluoropolymer PTFE.

2.6 High Purity Flow Sensors (SLQ-QTxxx)

The flow sensors of the high purity SLQ-QT family use quartz glass and fluoropolymers as the only wetted materials. Refer to the datasheet for the specific types of fluoropolymers used.

2.7 High Pressure Sensors (SLG-xxxx)

The sensors of the SLG series are designed for ultra-high pressure applications. The flow channel is made from fused silica and it is fitted to the titanium ports with a PEEK seal.

3 Material Details

3.1 Stainless Steel

Stainless steel is inert to almost all solvents, alcohols, fuels and oils.

Grade 316 L stainless steel is a variant with good corrosion resistance to weak acids and many bases.

Grade 904 L stainless steel has a particularly good corrosion resistance to sulphuric and other acids as well as warm salt water and other high chloride environments.

It is not possible to state precise compatibilities for stainless steel because they are highly dependent on the mixture, the temperature and the concentration of the acid or base.

3.2 Glass

Borosilicate glass is widely used for components of laboratory instruments and is the dominant material for laboratory glassware. It offers a high level of chemical resistance to water, acids, salt solutions, organic solvents and halogens. Resistance to alkaline solutions is relatively good but strong alkaline solutions cause corrosion of the glass, as do hydrofluoric acid and hot concentrated phosphoric acid.

Fused silica (quartz glass) is used in the context of production lines and tool construction, due to its high resistance to saline solutions, acids and water. Except for hydrofluoric acid (HF) and hot phosphoric acid (H_3PO_4), quartz glass is not corroded by acids and acts neutrally against many other substances. The inertness of quartz glass to alkaline solutions is better than of borosilicate glass and effects are only expected in the case of very strong alkaline solutions.

	Borosilicate glass 3.3	Fused silica
Hydrolytic resistance (DIN 12 111)	Class 1	Class 1
Resistance to acids (DIN 12 116)	Class 1	Class 1
Resistance to alkaline solutions (DIN 52 322)	Class 2	Class 1

(Class 1 is the best class in each classification)

3.3 Polymers

PPS (polyphenylene sulfide) is a high performance thermoplastic. It is highly resistant to thermal and chemical stress. PPS is resistant to most acidic and alkaline solutions and bleaches.

PEEK (polyether ether ketone) is chemically resistant and inert with most acids and bases. Due to its purity, high burst pressure, chemical inertness and resistance it is used in the chemical processing industry and in analytical science applications like HPLC. It has very good resistance to solvents and is very resistant to hydrolysis. It has limited resistance to concentrated acids.

PEI (poly ether imide) is chemically resistant and inert to most acids and bases. It is closely related to PEEK, however with reduced impact strength and thermal resistance.

3.4 Fluoropolymers

All used fluoropolymers (**FEP** (fluorinated ethylene propylene), **PTFE** (polytetrafluoroethylene, **PFA** (perfluoroalkoxy alkane), **PCTFE** (polychlorotrifluoroethylene)), have excellent chemical resistance to most solvents and most corrosive liquids. It is rarely the case that the fluoropolymer is not compatible with any liquid that is compatible with the capillary material.

4 Summary

This application note summarizes the wetted materials used in Sensirion's liquid flow sensors. Please consult the datasheets for a list of wetted materials used in your sensor of interest.
The main characteristics of the materials used are also described. While choosing the wetted materials is part of a rigorous development process, Sensirion cannot guarantee the fit to a specific application. It is the responsibility of the customer and the customer's technical experts to check and assess the compatibility with any application-specific liquid. If questions remain, please contact Sensirion for support.

5 Revision History

Revision	Date	Changes Chapter	Description
3	July 2020	2.1, 2.2	Added variants for the SLF3x and LD20 sensor series
2	Aug 2019	All	Complete update
1	Feb 2009	All	First version

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