p-Toluenesulfonyl Isocyanate Background Information

CAS No. 4083-64-1

June 2004

Introduction

p-Toluenesulfonyl isocyanate (PTSI) is a highly reactive sulfonyl isocyanate. The reactivity of PTSI toward active hydrogen atoms makes it useful as a scavenger for water and other isocyanate reactive groups such as free acid in powdered aluminum alkanoates and active hydrogen present in carbon black pigments which cause polyurethane coatings, sealants and adhesives to thicken during storage. PTSI is recommended especially for one-component, low-VOC polyurethane coatings. The reaction of PTSI with water introduced from pigments and solvents in the paint formulation generates carbon dioxide and soluble inert chemical products. This highly reactive sulfonyl isocyanate is also used as an intermediate in the synthesis of other useful chemical compounds.

PTSI (Figure 1) reacts rapidly with excess water to form the corresponding carbamic acid, which in turn, undergoes immediate decomposition to form carbon dioxide and p-toluenesulfonamide (CAS number 70-55-3; Figure 2). p-Toluenesulfonamide has been tested. Some environmental fate and effects and mammalian toxicity data for p-toluenesulfonamide will be used to represent PTSI .

Background Information: Manufacturing and Commercial Applications

Manufacturing

PTSI is a member of the sulfonyl isocyanate class of chemicals. Sulfonyl isocyanates were first obtained by the reaction of arylsulfonyl chlorides with silver cyanate. The direct, high temperature phosgenation of p-toluenesulfonamide was first described by Krzikalla; an improved synthesis has been disclosed by Sayigh and Ulrich. The reactivity of the isocyanate carbon in PTSI is greatly enhanced by the adjacent sulfonyl group. The reaction of sulfonyl isocyanates with active hydrogen compounds is extremely rapid and requires no catalyst in contrast to alkyl and aryl isocyanates. PTSI does not dimerize, trimerize or form carbodiimides as do the alkyl and aryl isocyanates

PTSI is shipped in accordance with USA DOT regulations as Chemicals NOS, in 10, 50 and 500 pound drums.

Commercial Applications

PTSI (p-toluenesulfonyl isocyanate) is a low-viscosity reactive additive used as a water scavenger in the formulation of specialty urethane products, including adhesives, sealants and coatings. PTSI can be used

as a raw material in the synthesis of a number of commercially important pharmaceuticals of the oral hypoglycemic class, a variety of agricultural chemicals including herbicidal antidotes, have also been prepared using PTSI and other aromatic sulfonyl isocyanates. The wide variety of reactions possible with PTSI suggests additional applications in the synthesis of agricultural, veterinary, pharmaceutical and polymer products. PTSI is used widely as a stabilizer for organic isocyanates and as a water scavenger in the formulation of specialty urethane products.

Matrix of SIDS Endpoints

The summary of available and valid data for PTSI and p-toluenesulfonamide are provided in **Table 1**. **Appendix A** contains the Robust Summaries for PTSI and p-toluenesulfonamide.

Table 1: Matrix of Available and Adequate Data on PTSI

Test	PTSI CAS No. 4083-64-1	p-Toluenesulfonamide CAS number 70-55-3
Chemical/Physical Properties		
Melting Point	-2 deg C	NR
Vapor Pressure	1 mm Hg @ 100 deg C	NR
Boiling Point	144 deg C @ 10 mm Hg	NR
Partition Coefficient	NA*	.82
Water Solubility	1318 - mg/l at 25 °C (estimated)*	NR
Environmental Fate		
Hydrolysis	<10 minutes at 25 °C	NR
Photodegradation	~9 days	NR
Biodegradation	NA*	low biodegradability
Environmental Transport	Air 6.04% Water 31.3% Soil 62.5% Sediment 0.174%	NR
Aquatic Toxicity		
Acute Fish	NA*	60 d EC = 9 mg/l; 96-hr LC50 = 1314 mg/l (estimated)
Acute Daphnia	NA*	48-hr LC50 = 1307 mg/l (estimated)
Acute Algae	NA*	96-hr EC50 = 768 (estimated)
Mammalian Toxicity		
Acute Oral	LD50=2600 mg/kg	NR
Repeated Dose	NA*	NOEL = 120 mg/kg/d (rat)
Genotoxicity (*in vitro* -bacteria)	NA*	negative
Genotoxicity (*in vitro* - mammalian)	NA*	negative
Reproductive/Developmental	NA*	NOAEL F1 offspring = 300 mg/kg/d (rat); NOAEL teratogenicity = 300 mg/kg/d (rat)

NA = Not applicable due to chemical/physical properties
NR = Not required
* = PTSI reacts rapidly with water to form the corresponding carbamic acid, which in turn, undergoes immediate decomposition to form carbon dioxide and p-toluenesulfonamide (CAS number 70-55-3). PTSI is not likely to be found in the environment.

A description of the results of this evaluation follows.

- **Physicochemical Properties**

Melting point, boiling point and vapor pressure information are available for PTSI. Partition coefficient data for p-toluenesulfonamide have been provided; PTSI rapidly hydrolyses to form p-toluenesulfonamide. The water solubility of PTSI was estimated using EPIWIN; this modeling is not likely to be applicable as PTSI rapidly hydrolyzes in water.

Additional testing is not proposed.

- **Environmental Fate**

Rapid reaction with water would result in rapid disappearance from water and moist soil. The rate of hydrolysis has been determined to be less than 10 minutes at 25 deg C. This information confirms that PTSI is a hydrolytically unstable material and will immediately hydrolyze upon contact with water or water vapor. Consequently, biodegradation of PTSI is best represented by the biodegradation of p-tolunesulfonamide. This material has a low biodegradability. Photodegradation has been modeled using EPIWIN; the half-life of PTSI is about 9 days. The environmental fate of PTSI was evaluated using the EQC multimedia fugacity model (Level III). The results indicate PTSI will partition primarily to soil (~63%) and water (~31%). Modeling may not be appropriate as PTSI is not expected to be found in the environment due to its rapid hydrolysis.

Additional testing is not proposed.

- **Ecotoxicity**

There is no data available for PTSI; this material is not expected to be present in the environment due to rapid reaction in the presence of water or moisture. Based on the rapid hydrolysis of PTSI to p-toluenesulfonamide (and carbon dioxide), ecotoxicity is best described by the hydrolysis product. In a 60-day study with *Oncorhynchus mykiss*, p-toluenesulfonamide had an effect concentration (EC) of 9 mg/l. Predicted 96-hr and 48-hr LC50s for fish and daphnia, respectively, are greater than 1000 mg/l for p-toluenesulfonamide. No data were located regarding the toxicity of p-toluensulfonamide to algae; modeling indicates a 96-hr EC50 of 768 mg/l.

Additional testing is not proposed.

- **Health Effects**

The acute oral toxicity (LD50) of PTSI is 2600 mg/kg. Based on the rapid hydrolysis of PTSI to p-toluenesulfonamide (and carbon dioxide), repeated dose, reproductive, and developmental toxicity, as well as genotoxicity are best described by the hydrolysis product. In an OECD 422 (repeated dose toxicity with screening reproductive toxicity and developmental effects in rats), p-toluenesulfonamide had a systemic toxicity NOEL of 120 mg/kg. The NOAEL for F1 offspring was 300 mg/kg/d; the NOAEL for teratogenicity was 300 mg/kg/d. p-Toluenesulfonamide was negative for mutagenicity in both bacterial and mammalian in vitro test systems.

Additional testing is not proposed.

Table 2 presents the proposed test plan for PTSI. Based on the rapid hydrolysis of PTSI to carbon dioxide and p-toluenesulfonamide, no testing is proposed.

Table 2: p-Toluenesulfonyl Isocyanate Test Plan

Physical-Chemical				
Melting Point	**Boiling Point**	**Vapor Pressure**	**Partition Coefficient**	**Water Solubility**
A	A	A	R	Calc

Environmental Fate			
Photodegradation	**Stability in Water**	**Transport/ Distribution**	**Biodegradation**
Calc	A	Calc	R

Ecotoxicity		
Acute Toxicity to Fish	**Acute Toxicity to Aquatic Plants (e.g., Algae)**	**Acute Toxicity to Daphnia**
R	R	R

Mammalian Toxicity					
Acute Toxicity	**Bacterial Genetic Toxicity *In Vitro***	**Mammalian Genetic Toxicity *In Vitro***	**Repeat Dose Toxicity**	**Reproductive Toxicity**	**Developmental Toxicity**
A	R	R	R	R	R

Legend	
Symbol	**Description**
Calc	Endpoint requirement fulfilled based on calculated data (modeling)
A	Endpoint requirement fulfilled with adequate existing data
R	Other (endpoints fulfilled with data from hydrolysis product)

FIGURES

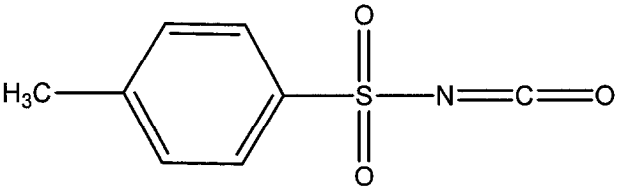

Figure 1 – Structure of PTSI

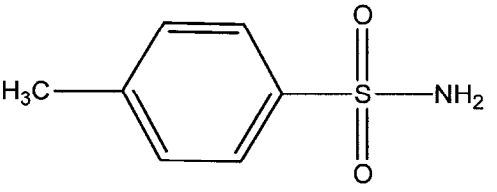

Figure 2 – Structure of p-Toluenesulfonamide