

SCREENING-LEVEL HAZARD CHARACTERIZATION

Corn Steep Liquor (CASRN 66071-94-1)

Chemical Abstract Service Registry Number (CASRN)	66071-94-1
Chemical Abstract Index Name	Corn, Steep Liquor
Structural Formula	See Appendix
Summary	
<p>Corn steep liquor is a viscous, tan-brown-colored liquid composed primarily of the water-soluble extracts of corn soaked (steeped) in water. The organic constituents of this mixture have negligible to moderate vapor pressure and high water solubility. Volatilization is expected to be low for the constituents of this mixture. The rate of hydrolysis is generally negligible for most components of corn steep liquor. Most of the organic constituents of corn steep liquor are expected to possess high mobility in soil. The organic constituents of this mixture are composed of proteins, amino acids, vitamins, sugars, and organic acids which are likely to be quickly degraded by microorganisms present in the environment and thus it is not expected to be environmentally persistent. The rate of atmospheric photooxidation is moderate to slow. The components of corn steep liquor are expected to have low persistence (P1) and low bioaccumulation potential (B1).</p> <p>No data are available for the sponsored substance for the human health SIDS endpoints for the purposes of the HPV Challenge Program.</p> <p>No data are available for the sponsored substance for the ecotoxicity SIDS endpoints for the purposes of the HPV Challenge Program.</p> <p>No data gaps were identified under the HPV Challenge Program. There is low concern for hazard for both ecotoxicity and human health endpoints because the sponsored substance is comprised of approximately 50% water with the majority of the remaining 50% comprised of lactic acid, protein and other nutritive substances.</p>	

The sponsor, The Corn Refiners Association (CRA), submitted a Test Plan and Robust Summaries to EPA for corn steep liquor (CASRN 66071-94-1; CA Index name: corn steep liquor) on November 28, 2006. EPA posted the submission on the ChemRTK HPV Challenge website on January, 19, 2007 (<http://www.epa.gov/oppt/chemrtk/pubs/summaries/cornstlq/c16469tc.htm>). EPA comments on the original submission were posted to the website on January 24, 2008. The sponsor submitted updated/revised documents which were posted to the ChemRTK website on July 7, 2007.

1. Chemical Identity

1.1 Identification and Purity

Corn steep liquor is a viscous, tan-brown-colored liquid composed primarily of the water soluble extracts of corn soaked (steeped) in water. Water composes roughly 50% of this mixture. The organic constituents include water soluble proteins, free amino acids, minerals, vitamins, reducing sugars (such as dextrose), and other natural organic acids (such as lactic acid) which are expected to possess negligible to moderate vapor pressure and high water solubility.

1.2 Physical-Chemical Properties

The physical-chemical properties of corn steep liquor are summarized in Table 1.

Table 1. Physical-Chemical Properties of Corn steep liquor^{1,2}	
Property	Value
CASRN	66071-94-1
Molecular Weight	Complex mixture
Physical State	Viscous, tan to brown, liquid mixture at ambient temperature
Melting Point	No data ³
Boiling Point	204°C (estimated) ⁴
Vapor Pressure	0.0813 mm Hg at 25°C (measured) ⁵
Dissociation Constant (pK _a)	3.86 (measured) ⁵
Henry's Law Constant	<1×10 ⁻⁷ atm·m ³ /mole at 25°C (estimated) ⁴
Water Solubility	Miscible; 1.0×10 ⁶ mg/L at 25°C (estimated) ⁵
Log K _{ow}	-0.72 (measured) ⁵

¹The Corn Refiners Association. 2007. Revised Test Plan and Robust Summary for Corn steep liquor. Available online at <http://www.epa.gov/chemrtk/pubs/summaries/cornstlq/c16469tc.htm> as of July 3, 2012.

²The measured data provided in the test plan and robust summary (boiling point of 100-101 °C and vapor pressure of 17.5 mm Hg) reflect the properties of impure water, and it is meaningless to use these data for the organic components of the corn steep liquor. The data in Table 1a reflect the physical-chemical properties of lactic acid (CASRN 50-21-5) a component of the mixture. Other components such as crude proteins will have negligible vapor pressure and negligible Henry's Law constants, but are expected to be water soluble.

³Complex mixture that will not have a well-defined melting point or will have a melting point consistent with water.

⁴U.S. EPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.10. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at <http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm> as of June 27, 2012.

⁵SRC. 2012. The Physical Properties Database (PHYSPROP). Syracuse, NY: Syracuse Research Corporation. Available online at <http://www.syrres.com/esc/physprop.htm> as of June 22, 2012.

2. General Information on Exposure

2.1 Production Volume and Use Pattern

Corn steep liquor had an aggregated production and/or import volume in the United States between 50 to 100 million pounds during calendar year 2005 (U.S. EPA, 2010).

Non-confidential information in the IUR indicated that the industrial processing and uses of the chemical include other support activities for road transportation as corrosion inhibitors and anti-scaling agents. Non-confidential commercial and consumer uses of this chemical include “other” and not readily obtainable (NRO).

2.2 Environmental Exposure and Fate

Most of the organic constituents of corn, steep liquor, such as lactic acid and the reducing sugars, possess high mobility in soil. No biodegradation data are available for the mixture; however, corn steep liquor is made up of natural constituents such as proteins, reducing sugars, and organic acids, and therefore should be degraded by microbial organisms. Lactic acid (CASRN 50-21-5), an organic constituent of corn, steep liquor, was degraded 76–100% using an activated sludge inoculum and the modified MITI (OECD TG 301C) test after 14 days and is considered readily biodegradable. Volatilization is expected to be low for most of the constituents of this mixture. Corn steep liquor is approximately 50% water with the remaining 50% made up of water soluble proteins, free amino acids, minerals, vitamins, reducing sugars (such as dextrose), and other natural organic acids (such as lactic acid) that are stable in water. The rate of atmospheric photooxidation is moderate to slow. The components of corn, steep liquor are expected to have low persistence (P1) and low bioaccumulation potential (B1).

The environmental fate of corn steep liquor is summarized in Table 2.

Conclusion: Corn steep liquor is a viscous, tan-brown-colored liquid composed primarily of the water-soluble extracts of corn soaked (steeped) in water. The organic constituents of this mixture have negligible to moderate vapor pressure and high water solubility. Volatilization is expected to be low for the constituents of this mixture. The rate of hydrolysis is generally negligible for most components of corn steep liquor. Most of the organic constituents of corn steep liquor are expected to possess high mobility in soil. The organic constituents of this mixture are composed of proteins, amino acids, vitamins, sugars, and organic acids which are likely to be quickly degraded by microorganisms present in the environment and thus it is not persistent. The rate of atmospheric photooxidation is moderate to slow. The components of corn steep liquor are expected to have low persistence (P1) and low bioaccumulation potential (B1).

Table 2. Environmental Fate Characteristics of Corn steep liquor^{1,2}									
Property	Value								
CASRN	66071-94-1								
Photodegradation Half-life	21.7 hours (estimated) ³								
Hydrolysis Half-life	Most constituents are stable								
Biodegradation	76–100% after 14 days (readily biodegradable) ⁴ Corn steep liquor is made up of natural constituents such as proteins, reducing sugars, and organic acids, and therefore, is readily degraded by biological means								
Bioaccumulation Factor	BAF = 0.9 (estimated) ³								
Log K _{oc}	0 (estimated) ³								
Fugacity (Level III Model) ³	<table border="0"> <tr> <td style="padding-left: 40px;">Air (%)</td> <td>1.9</td> </tr> <tr> <td style="padding-left: 40px;">Water (%)</td> <td>36.3</td> </tr> <tr> <td style="padding-left: 40px;">Soil (%)</td> <td>61.8</td> </tr> <tr> <td style="padding-left: 40px;">Sediment (%)</td> <td><0.1</td> </tr> </table>	Air (%)	1.9	Water (%)	36.3	Soil (%)	61.8	Sediment (%)	<0.1
Air (%)	1.9								
Water (%)	36.3								
Soil (%)	61.8								
Sediment (%)	<0.1								
Persistence ⁵	P1 (low)								
Bioaccumulation ⁵	B1 (low)								

¹The Corn Refiners Association. 2007. Revised Test Plan and Robust Summary for Corn steep liquor. Available online at <http://www.epa.gov/chemrtk/pubs/summaries/cornstlq/c16469tc.htm> as of July 3, 2012.

²The data in Table 1b reflect the environmental fate properties of lactic acid (CASRN 50-21-5).

³U.S. EPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v4.10. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at <http://www.epa.gov/opptintr/exposure/pubs/episuitedi.htm> as of June 27, 2012.

⁴National Institute of Technology and Evaluation. 2002. Chemical Risk Information Platform (CHIRP). Available online at <http://www.safe.nite.go.jp/english/db.html> as of June 22, 2012.

⁵Federal Register. 1999. Category for Persistent, Bioaccumulative, and Toxic New Chemical Substances. *Federal Register* 64, Number 213 (November 4, 1999) pp. 60194–60204.

3. Human Health Hazard

No data are available for the sponsored substance for all SIDS endpoints for the purposes of the HPV Challenge Program.

4. Hazard to the Environment

No data are available for the sponsored substance for all SIDS endpoints for the purposes of the HPV Challenge Program.

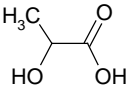
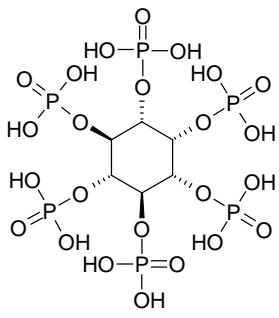
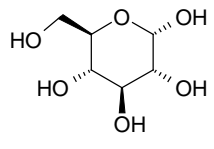
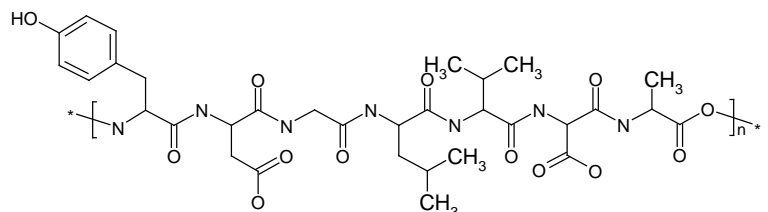
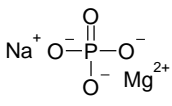
5. References

U.S. Environmental Protection Agency (2010) Non-confidential 2006 IUR Records by Chemical, including Manufacturing, Processing and Use Information for CASRN 66071-94-1. Inventory Update Reporting (IUR); Version 6: Updated May 12, 2010. Available online at <http://www.epa.gov/cdr/tools/previouslycollected.html>

APPENDIX

Corn steep liquor is a mixture consisting of the water soluble extracts of corn soaked (steeped) in water. The compositional information is provided in Table A-1 and the representative structures of the mixture are provided in Table A-2.

Table A-1. Corn, steep liquor composition		
Major Component	Percent Composition (Wet basis)	Percent Composition (Dry basis)
Crude protein	25.1	46.5
Water	46	0
Lactic acid	13.9	25.8
Ash	9.2	17
Phytic acid	4.2	7.8
Reducing sugars (as dextrose)	1.4	2.5
Fat	0.2	0.4
Total	100	100

Table A-2. Representative structures of some components of corn, steep liquor		
 <p>Lactic acid CASRN 50-21-5, on TSCA</p>	 <p>Phytic acid CASRN 83-86-3 on TSCA myo-Inositol, 1,2,3,4,5,6-hexakis(dihydrogen phosphate)</p>	 <p>D-Glucose CASRN 50-99-7, on TSCA</p>
 <p>representative protein</p>		
 <p>Ash</p>		