Supporting Documents for Initial Risk-Based Prioritization of HPV Chemicals

Chemical/Category: *n*-Butyric Acid/Anhydride Category

CAS No. 107-92-6 *n*-Butyric acid
CAS No. 106-31-0 *n*-Butyric anhydride

Metabolic precursors:
CAS No. 123-86-4. *n*-Butyl acetate
CAS No. 71-36-3, *n*-Butanol
Additional analogs:
CAS No. 79-09-4, Propionic acid
CAS No. 79-31-2, Isobutyric acid
CAS No. 109-52-4, Pentanoic acid

Contents:

QUALITATIVE SCREENING-LEVEL RISK CHARACTERIZATION FOR
n-Butyric Acid/Anhydride Category
***n*-Butyric acid** **CAS No. 107-92-6**
***n*-Butyric anhydride** **CAS No. 106-31-0**

1. Background

The High Production Volume (HPV) Challenge Program[1] is a voluntary initiative aimed at developing and making publicly available screening-level health and environmental effects information on chemicals manufactured in or imported into the United States (U.S.) in quantities greater than one million pounds per year. In the Challenge Program, producers and importers of HPV chemicals voluntarily sponsor chemicals; sponsorship entails the identification and initial assessment of the adequacy of existing toxicity data/information, conducting new testing if adequate data do not exist, and making both new and existing data and information available to the public. Each complete data submission contains data on 18 internationally agreed to "SIDS" (Screening Information Data Set[Error! Bookmark not defined.,2]) endpoints that are screening-level indicators of potential hazards (toxicity) for humans or the environment and environmental fate.

The Environmental Protection Agency's Office of Pollution Prevention and Toxics (OPPT) is evaluating the data submitted in the HPV Challenge Program on approximately 1,400 sponsored chemicals. Data submitted to the Organisation for Economic Co-operation and Development (OECD) HPV Program are also being evaluated. OPPT developed a screening-level hazard characterization that consists of an objective evaluation, conducted according to established EPA guidance**Error! Bookmark not defined.**[,3], of the quality and completeness of the data set provided and is based primarily on hazard data provided by sponsors. The characterization does not draw conclusions regarding the completeness of all data generated with respect to a specific chemical substance or mixture. The OECD SIDS documents (SIDS Initial Assessment Profile; SIAP and SIDS Initial Assessment Report; SIAR) provide similar information. Under both the HPV Challenge and OECD HPV Programs, chemicals that have similar chemical structures, properties and biological activities may be grouped together and their data shared across the resulting category. Evaluation of chemical category formation and data extrapolation(s) among category members is performed in accord with established U.S. EPA[1] and OECD[4] guidance.

In 2006 and 2007, EPA received data on uses of and reasonably likely exposures to chemicals on the Toxic Substances Control Act (TSCA) Inventory of existing chemicals, submitted in accordance with the requirements of the Inventory Update Reporting (IUR) rule[5]. Information is collected every five years under IUR, promulgated under the authority of section 8(a) of TSCA. The most recent reports pertain to chemicals manufactured in (including imported into) the U.S. during calendar year 2005 in quantities of 25,000 pounds or more at a single site. Information is reported on the identity of the chemical manufactured or imported and the quantity, physical form, and number of persons reasonably likely to be exposed during manufacture of the chemical. For chemicals manufactured or imported in quantities of 300,000 pounds or more at a single site during calendar year 2005, additional information was reported on the industrial processing and uses of the chemical, the number of industrial processing sites and of employees reasonably likely to be exposed to the chemical at these sites, the consumer and commercial uses of the chemical and an indication whether the chemical is used in products intended for use by children under 14 years of age.

For these qualitative screening-level risk characterization documents, EPA has reviewed the IUR data to evaluate exposure potential. In addition, exposure information that may have become available through prior Agency actions has been considered, as appropriate. The resulting exposure information has been combined with the screening-level hazard characterizations to develop this qualitative screening-level risk characterization[6,7]. These screening-

[1] U.S. EPA. High Production Volume (HPV) Challenge Program; http://www.epa.gov/chemrtk/index.htm.
[2] U.S. EPA. HPV Challenge Program – Information Sources; http://www.epa.gov/chemrtk/pubs/general/guidocs.htm.
[3] U.S. EPA. Risk Assessment Guidelines; http://cfpub.epa.gov/ncea/raf/rafguid.cfm.
[4] OECD. Guidance Document on the Development and Use of Chemical Categories; http://www.oecd.org/document/7/0,2340,en_2649_34379_1947463_1_1_1_1,00.html.
[5] U.S. EPA – Basic IUR Information: http://www.epa.gov/opptintr/iur/pubs/guidance/basic-information.htm
[6] U.S. EPA Guidelines for Exposure Assessment; http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=15263

level risk characterizations are technical documents intended to support subsequent decisions and actions by OPPT. Accordingly, the document is not written with the goal of informing the general public. The purpose of the qualitative screening level risk characterizations is two-fold: to support initial risk-based decisions to prioritize chemicals and inform risk management options and to identify data needs for individual chemicals or chemical categories.

2. Category Justification

The *n*-butyric acid/anhydride category includes *n*-butyric acid and butyric anhydride. The category members are closely related since the anhydride rapidly hydrolyzes in the presence of water to form the acid. Since testing of the anhydride is in reality testing of the acid form, these materials share toxicity characteristics that form the basis of the category. In addition, increased blood levels of *n*-butyric acid have been demonstrated experimentally following administration of the metabolic precursors of *n*-butyric acid; *n*-butyl acetate (CAS No. 123-86-4) and *n*-butanol (CAS No. 71-36-3). Therefore, data from these precursors are used as analogs to address or supplement the respective systemic toxicity endpoints for *n*-butyric acid. This category is considered acceptable and reasonable for the OECD HPV Program and for the purposes of the HPV Challenge Program.

3. Physical-Chemical Properties and Environmental Fate

This report was prepared using the best available data from a number of sources, but draws no conclusions regarding whether additional relevant data may exist. *n*-Butyric acid is a four carbon acid that occurs in butter and animal fat as the glycerol ester. These compounds are liquids at 25° C and have high water solubilities. *n*-Butyric acid has a moderate-to-high vapor pressure and butyric anhydride has a moderate vapor pressure. Both compounds are expected to be not significantly volatile from water. They are highly mobile in soil systems and are not expected to adsorb to suspended solids and sediment in water. The anhydride is expected to hydrolyze rapidly to the acid and the acid is expected to biodegrade rapidly. They are not persistent and are not bioaccumulative: both chemicals are classified as P1B1. The analogs propionic, isobutyric and pentanoic acid have similar properties to those of butyric acid and will also have essentially the same environmental behavior. Isobutyric acid has a slightly lower vapor pressure which, like butyric anhydride, is classified as moderate.

4. Hazard Characterization

This summary is based on information compiled from the OECD SIDS Initial Assessment Profile (SIAP) which is available publicly at the following URL operated by the OECD HPV Programme: http://cs3-hq.oecd.org/scripts/hpv/Index2.asp?CASNUM=107926. This document is presented in an international forum that involves review and endorsement by governmental authorities around the world. The U.S. EPA is an active participant in these meetings and accepts this process as a reliable screening-level hazard assessment for the purpose of the U.S. HPV Challenge qualitative risk characterization process. Thus, when such documents exist there is no need to generate a separate Hazard Characterization document.

Aquatic Organism Toxicity: Aquatic toxicity data are only available for *n*-butyric acid, due to the rapid hydrolysis of *n*-butyric anhydride in water. Since the duration of the butyric acid studies was either shorter or longer than current OECD guidelines, and also because of other uncertainties with study details, data for analogous chemicals were used to evaluate acute aquatic toxicity. The evaluation of the available aquatic toxicity data for fish, aquatic invertebrates and aquatic plants for propionic (CAS No. 79-09-4), isobutyric (CAS No. 79-31-2) and pentanoic (CAS No. 109-52-4) acids indicates that the potential acute hazard of the members of the *n*-butyric acid/anhydride category to aquatic organisms may be partly due to pH effects, but is considered low overall.

Human Health Toxicity: The potential acute toxicity of the *n*-butyric acid/anhydride category members is low via the oral, dermal and inhalation routes. *n*-Butyric acid is a moderate skin and severe eye irritant while *n*-butyric anhydride is corrosive. The category members should be considered respiratory irritants. Repeated exposures to *n*-butyl acetate or *n*-butanol (both identified as acceptable analogs as described above in the Category Justification) via the inhalation route in adult animals show low toxicity. At high doses, reductions in body weights, increases in

[7] U.S. EPA. Risk Characterization Program; http://www.epa.gov/osa/spc/2riskchr.htm.

testicular and adrenal weights, and localized necrosis of olfactory epithelium have been reported. The increases in relative testes weights were not considered treatment-related because they occurred in the presence of reduced body weight gain and in the absence of any observable changes in epididymal and testicular sperm counts or testes histopathology. Transient central nervous system effects following both repeated inhalation and oral exposures consist of hypo-activity and post-dose ataxia. The available data on developmental and reproductive toxicity is limited, but generally show little to no effects, consisting only of slight decreases in fetal body weights at high inhalation concentrations. The category members are not mutagenic and do not induce chromosomal aberrations. Based on the available data submitted in the OECD HPV Program, the overall human health hazard is considered low.

5. Exposure Characterization

This exposure characterization was completed using available 2006 Inventory Update Rule (IUR) submissions. Data and information that are claimed Confidential Business Information (CBI) by the submitter were reviewed and considered by EPA in preparing this assessment but are not disclosed in this summary.

In addition, the following sources were reviewed to identify exposure and use information: OECD SIDS data (there was no US HPV Challenge Submission), the Toxics Release Inventory, OSHA PEL documentation, various databases, and public sources. See the separate Exposure Characterization for references.

Both *n*-Butyric acid and *n*-butyric anhydride were manufactured in the United States at a production volume in the range of 100,000,000 to 500,000,000 pounds in 2005.

n-Butyric acid is used as an intermediate, food additive, and ingredient in varnish, cosmetics and detergents. The major use of *n*-butyric anhydride is as an intermediate in the manufacture of other chemicals.

Exposure to Workers
The National Occupational Exposure Survey (NOES), conducted between 1981 and 1983, reported 4,817 and 11,600 as the possible number of workers exposed to *n*-butyric anhydride and *n*-butyric acid, respectively. The 2005 IUR data submitted indicate that workers may be exposed to *n*-butyric acid and *n*-butyric anhydride (between 1,000 and 10,000 workers for both chemicals). The vapor pressure values for both substances (see attached Physical/Chemical and Environmental Fate Characterization supporting document) are above 0.001 torr. OPPT has established 0.001 torr as a value above which worker exposures to vapors should be estimated for chemical assessments. Therefore, both substances' vapor pressure could result in significant worker exposures to vapors if workers are proximal to the liquid. There is no OSHA Permissible Exposure Limit for either substance.

> *n-Butyric acid:* Based on IUR data, specifically the number of potentially exposed workers and use codes, the potential for worker exposure is considered high.
>
> *n-Butyric anhydride:* Based on IUR data, specifically the number of potentially exposed workers and use codes, the potential for worker exposure is considered medium to high.

Exposures to General Population and the Environment
Neither substance is on the Toxics Release Inventory. Based on use information, EPA assumes for the purpose of this risk prioritization that there is potential for exposures to the general population and the environment, although the degree of exposure that can be attributed to TSCA uses cannot be determined from the references examined.

> *n-Butyric acid:* Environmental sources include fugitive emissions during its production and use and its presence in motor vehicle exhaust. It naturally occurs in vegetable oils and animal fluids, and also natural metabolic and fermentative processes. The IUR-based ranking for the general population and the environment is high due to the assumption that there will be exposure to this chemical.
>
> *n-Butyric anhydride:* The IUR-based ranking for the general population and the environment is low because it will degrade quickly to *n*-butyric acid.

Exposure to Commercial Workers and Consumers
Although commercial workers and consumers may use TSCA-regulated products made with *n*-butyric acid or *n*-butyric anhydride, the IUR data indicate that exposure to *n*-butyric acid in these products is not expected because all (100%) of the production volume for both chemicals is reported to be used as an intermediate. The IUR-based ranking for commercial workers/consumers is low due to the assumption that these chemicals will not be present in commercial and consumer products.

Exposure to Children
Although children may use or be exposed to TSCA-regulated products made with *n*-butyric acid or *n*-butyric anhydride, the IUR data indicate that exposure to *n*-butyric acid in these products is not expected because all (100%) of the production volume for both chemicals is reported to be used as an intermediate. The IUR-based ranking for children is low due to the assumption that these chemicals will not be present in products intended for use by children.

6. Risk Characterization

The statements and rationale provided below are intended solely for the purpose of this screening-level and qualitative risk characterization and will be used for prioritizing substances for future work in the U.S. HPV Challenge Program.

6.1 Risk Statement and Rationale

Potential Risk to Aquatic Organisms from Environmental Releases (LOW CONCERN): Although *n*-butyric acid and *n*-butyric anhydride may be present in environmental media from a variety of sources, data indicate a low potential for exposure to aquatic organisms from environmental releases during production of TSCA-related products because both *n*-butyric acid and *n*-butyric anhydride are used as chemical intermediates. The low acute aquatic hazard and the overall environmental fate characteristics (e.g., not persistent or bioaccumulative) for both chemicals suggest a low concern for potential risk to aquatic organisms from environmental releases.

Potential Risk to General Population from Environmental Releases (LOW CONCERN): Although *n*-butyric acid and *n*-butyric anhydride may be present in environmental media from a variety of sources, data indicate a low potential for exposure to the general population from environmental releases during production of TSCA-related products because both *n*-butyric acid and *n*-butyric anhydride are used as chemical intermediates. The low overall human health hazard profile and the environmental fate characteristics (e.g., not persistent or bioaccumulative) for both chemicals suggest a low concern for potential risk to the general population from environmental releases.

Potential Risk to Workers (LOW CONCERN): There is the potential for worker exposure from the production and use of both chemicals in TSCA-related products or in the event of accidental release. However, because both *n*-butyric anhydride and *n*-butyric acid are eye, skin and respiratory irritants, it is presumed that potentially exposed workers will follow standard hazard communication/industrial hygiene practices and wear personal protective equipment that will likely be sufficient to address this concern. Thus, although there is a potential human health hazard, the exposure issues (use as an intermediate, corrosive and thus self-limiting in terms of personal protective equipment) suggest a low concern for potential risk to workers.

Potential Risk to Commercial Workers and Consumers from Known Uses (LOW CONCERN): It is assumed from the available IUR-based information that *n*-butyric acid and *n*-butyric anhydride are not present in TSCA-related commercial and consumer products. Coupled with the low hazard profile, the information suggests a low concern for potential risk to commercial workers and consumers.

Potential Risk to Children (LOW CONCERN): It is assumed from the available IUR-based information that *n*-butyric acid and *n*-butyric anhydride are not present in TSCA-related products intended for use by children. Coupled with the low hazard profile, the information suggests a low concern for potential risk to children.

6.2 Uncertainties

The *n*-butyric acid/anhydride category may have minor uses that were not reported in IUR.

6.3 Data Needs

No data needs have been identified.

Exposure Characterization for HPV Challenge Chemical

Butyric Acid

CAS #107-92-6

March 14, 2008

Prepared by

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Exposure Characterization for HPV Challenge Chemical

Butyric acid (CAS #107-92-6)

Non-CBI Executive Summary

Butyric acid is used as an intermediate, food additive, and ingredient in varnish, cosmetics and detergents (HSDB, 2007; OECD, 2003). The quantity manufactured in the United States during calendar year 2005 was in the range of 100 million to 500 million pounds (U.S. EPA, 2006).

Although information on the fate, transport, and toxicity of butyric acid are available in submissions for the HPV Challenge Program, information on uses and possible exposures of butyric acid were not included in the submission. A SIDS Initial Assessment Profile (SIAP) has been prepared for this chemical (OECD, 2003).

Exposure was characterized using both public, non-confidential sources and one or more IUR submissions available at the time this exposure characterization was written. If additional information warrants an update of the exposure characterization, the update will be posted on the EPA website.

Exposures to Workers

Based on IUR data, there are workers who may be exposed to butyric acid by dermal contact and by inhalation of vapors. This chemical has a vapor pressure of 1.65 torr at 25^{o} C (U.S. EPA, 2007b). OPPT has established 0.001 torr as a value above which worker exposures to vapors should be estimated for chemical assessments. Below this value, OPPT assumes vapor exposure to be negligible unless the chemical is aerosolized or sprayed. Therefore, this chemical's vapor pressure could result in significant worker exposures to vapors if workers are in the vicinity of areas where liquid butyric acid is manufactured or processed. Butyric acid does not have an OSHA Permissible Exposure Limit (NIOSH, 2007a).

The number of manufacturing and industrial workers reasonably likely to be exposed to butyric acid is estimated to be between 1,000 and 10,000. A search of the National Occupational Exposure Survey (NOES), conducted between 1981 and 1983, indicated that approximately 11,600 persons were likely to be exposed to butyric acid in their work (NIOSH, 2007b).

Differences between numbers of workers estimated by IUR submitters and by the NOES are attributable to many factors, including time, scope, and method of the estimates. For example, NOES estimates are for all workplaces while IUR are for industrial workplaces only, and NOES used a survey and extrapolation method while IUR submitters simply provide their best estimates based on available information for the specific reporting year.

Based on IUR data, specifically the number of potentially exposed workers and use codes, the potential for worker exposure is considered high.

Exposures to General Population and the Environment

Butyric acid is not on the Toxics Release Inventory (U.S. EPA, 2007a). Environmental sources for butyric acid include fugitive emissions during its production and use, and its presence in motor vehicle exhaust. It naturally occurs in vegetable oils and animal fluids, and also natural metabolic and fermentative processes (OECD, 2003). It is also used as a food additive. It has been detected in air, water and sediment/soil (HSDB, 2007).

Based on the totality of the information considered and expert judgment, EPA assumes, for the purposes of this risk based prioritization, that the potential for general population and/or environmental exposure to this chemical is high, although the degree of exposure that can be attributed to TSCA uses cannot be determined from the data and information examined.

Because butyric acid is easily biodegradable and does not appreciably bioaccumulate, it is classified as low in persistence (P1) and bioaccumulation (B1) (U.S. EPA, 2007b).

Exposure to Commercial Workers and Consumers

Although commercial workers and consumers may use TSCA-regulated products made with butyric acid, the IUR data indicate that exposure to butyric acid in these products is not expected because 100 percent of the reported production volume is used as an intermediate. Based on the IUR data, the likelihood that manufactured butyric acid will be present in commercial and consumer products is low.

Exposure to Children

This chemical is not in the Voluntary Children's Chemical Evaluation Program (USEPA, 2007c). Although children may use or be exposed to TSCA-regulated products made with butyric acid, the IUR data indicate that exposure to butyric acid in these products is not expected because 100 percent of the reported production volume is used as an intermediate. Based on the IUR data, the likelihood that manufactured butyric acid will be present in children's products is low.

References

HSDB, 2007. Hazard Substances Databank. Accessed August and December 2007, BUTYRIC ACID. http://toxnet.nlm.nih.gov/

NIOSH, 2007a. OSHA PEL Project Documentation. Accessed August, 2007. http://www.cdc.gov/niosh/pel88/npelcas.html.

NIOSH, 2007b. National Occupational Exposure Survey (NOES). Accessed December 2007. http://www.cdc.gov/noes/

OECD, 2003. Organisation for Economic Co-operation and Development (OECD),OECD Integrated HPV Database, Screening Information Data Set (SIDS) Information. SIDS Initial Assessment Profile, n-Butyric Acid (CAS No. 107-92-6) and N-Butyric Anhydride (CAS No. 106-31-0), SIAM 16, 27-30 May 2003.
http://cs3-hq.oecd.org/scripts/hpv/

U.S. EPA, 2006. 2006 Partial Updating of TSCA Chemical Inventory.

U.S. EPA, 2007a. Toxic Release Inventory. Accessed August, 2007.
http://www.epa.gov/tri/.

U.S. EPA, 2007b. Physical/Chemical and Environmental Fate Characterization for High Production Volume Chemicals, Butyl Series Metabolic Category (Butyric acid CAS No. 107-92-6, Butyric anhydride CAS No. 106-31-0), October 12, 2007.

USEPA, 2007c. Voluntary Children's Chemical Evaluation Program. Accessed December 2007. http://www.epa.gov/oppt/vccep/pubs/vcceprsp.pdf

Exposure Characterization for HPV Challenge Chemical

Butyric Anhydride

CAS #106-31-0

March 14, 2008

Prepared by

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Exposure Characterization for HPV Challenge Chemical
Butyric anhydride (CAS #106-31-0)

Non-CBI Executive Summary

Butyric anhydride was manufactured in the United States in the range of 100,000,000 to 500,000,000 lbs. in 2005 (U.S. EPA, 2006). The Hazardous Substances Databank indicates that butyric anhydride is used as an intermediate in the manufacture of other chemicals (HSDB, 2007).

A SIDS Initial Assessment Profile (SIAP) has been prepared for this chemical (OECD, 2003).

Exposure was characterized using both public, non-confidential sources and one or more IUR submissions available at the time this exposure characterization was written. If additional information warrants an update of the exposure characterization, the update will be posted on the EPA website.

Exposures to Workers

Based on IUR data, the number of manufacturing and industrial processing workers who are reasonably likely to be exposed to butyric anhydride is between 1,000 and 10,000. This chemical has a vapor pressure of 0.3 torr at 20^{o} C (U.S. EPA, 2007b). OPPT has established 0.001 torr as a value above which worker exposures to vapors should be estimated for chemical assessments. Below this value, OPPT assumes vapor exposure to be negligible. Therefore, this chemical's vapor pressure could result in significant worker exposures to vapors if workers are employed in areas where butyric anhydride is manufactured or processed. The National Occupational Exposure Survey (NOES), conducted between 1981 and 1983, indicated that approximately 4,817 workers were exposed to this chemical at that time (NIOSH, 2007b).

Differences between numbers of workers estimated by IUR submitters and by the NOES are attributable to many factors, including time, scope, and method of the estimates. For example, NOES estimates are for all workplaces while IUR are for industrial workplaces only, and NOES used a survey and extrapolation method while IUR submitters simply provide their best estimates based on available information for the specific reporting year.

This chemical does not have an OSHA Permissible Exposure Limit (NIOSH, 2007a).

Based on IUR data, specifically the number of potentially exposed workers and use codes, the potential for worker exposure is considered high based on uncertainty associated with the IUR data.

Exposures to General Population and the Environment

Butyric anhydride is not on the Toxics Release Inventory (U.S. EPA, 2007a). Based on the totality of the information considered, and expert judgment, EPA expects any release to the environment to be limited because the single U.S. manufacturer uses enclosed processes and because butyric anhydride is reactive, hydrolyzes rapidly, and its breakdown products are biodegradable (OECD, 2003; U.S. EPA, 2007b). Therefore, the EPA assumes for the purposes of this risk based prioritization, that the potential for general population and/or environmental exposure to this chemical is low.

Because butyric anhydride rapidly hydrolyzes to butyric acid, is easily biodegradable and does not appreciably bioaccumulate, it is classified as low in persistence (P1) and bioaccumulation (B1) (U.S. EPA, 2007b).

Exposure to Commercial Workers and Consumers

The IUR data indicate that exposure to commercial workers and consumers are not expected because 100 percent of the reported production volume is used as an intermediate. Based on the IUR data, the likelihood that this chemical will be present in commercial and consumer products is low.

Exposure to Children

Butyric anhydride is not on Voluntary Children's Chemical Evaluation Program (U.S. EPA, 2007c). The IUR data indicate that children's exposure is not expected because 100 percent of the reported production volume is used as an intermediate. Based on the IUR data, the likelihood that this chemical will be present in children's products is low.

References

HSDB, 2007 Hazard Substances Data Bank. Accessed August and December 2007, BUTYRIC ANHYDRIDE. http://toxnet.nlm.nih.gov/

NIOSH, 2007a. OSHA PEL Project Documentation. Accessed August, 2007. http://www.cdc.gov/niosh/pel88/npelcas.html.

NIOSH, 2007b. National Occupational Exposure Survey (NOES). Accessed December 2007. http://www.cdc.gov/noes/

OECD, 2003. Organisation for Economic Co-operation and Development (OECD), OECD Integrated HPV Database, Screening Information Data Set (SIDS) Information. SIDS Initial Assessment Profile, n-Butyric Acid (CAS No. 107-92-6) and N-Butyric Anhydride (CAS No. 106-31-0), SIAM 16, 27-30 May 2003. http://cs3-hq.oecd.org/scripts/hpv/

U.S. EPA, 2006. 2006 Partial Updating of TSCA Chemical Inventory.

U.S. EPA, 2007a. Toxic Release Inventory. Accessed August, 2007. http://www.epa.gov/tri/.

U.S. EPA, 2007b. Physical/Chemical and Environmental Fate Characterization for High Production Volume Chemicals, Butyl Series Metabolic Category (Butyric acid CAS No. 107-92-6, Butyric anhydride CAS No. 106-31-0), October 12, 2007.

U.S. EPA, 2007c. Voluntary Children's Chemical Evaluation Program. Accessed December 2007. http://www.epa.gov/oppt/vccep/pubs/vcceprsp.pdf

PHYSICAL/CHEMICAL AND ENVIRONMENTAL FATE CHARACTERIZATION FOR HIGH PRODUCTION VOLUME CHEMICALS

Butyl Series Metabolic Category

CHEMICAL NAMES:

BUTYRIC ACID **CAS NO. 107-92-6**

BUTYRIC ANHYDRIDE **CAS NO. 106-31-0**

MARCH 14, 2008

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1. Executive Summary

This report was prepared using the best available data from a number of sources. The butyl series metabolic category includes n-butyric acid and butyric anhydride. The category members are closely related since the anhydride rapidly hydrolyzes to butyric acid. Butyric acid is a four carbon acid that occurs in butter and animal fat as the glycerol ester. These compounds are liquids at 25° C and have high water solubilities. n-Butyric acid has a high vapor pressure and butyric anhydride has a moderate vapor pressure. Neither compound is expected to undergo significant volatilization from water. They are highly mobile in soil systems and are not expected to adsorb to suspended solids and sediment in water. The anhydride is expected to hydrolyze rapidly to the acid and the acid is expected to biodegrade rapidly. They are not persistent and are not bioaccumulative: both chemicals are classified as P1B1 and they are not Persistent Organic Pollutants (POP). The analogs propionic, isobutyric and pentanoic acid have similar properties to those of butyric acid and will also have essentially the same environmental behavior (not reported here). Isobutyric acid has a slightly lower vapor pressure which, like butyric anhydride, is classified as moderate.

2. Fate Characterization Summary for Chemical Category Butyl Series Metabolic

The following butyl series metabolic are considered in this review:

n-Butyric acid	CAS No. 107-92-6
n-Butyric anhydride	CAS No. 106-31-0

The following summary of the fate of the butyl series metabolic category (n-butyric acid and butyric anhydride) was derived from information contained within the Hazardous Substance Data Bank (HSDB, 2007), ChemIDplus Advanced (NLM, 2007), Screening Information Dataset (SIDS) Initial Assessment Profile of the Organization for Economic Cooperation and Development (OECD, 2007), and EPIWIN (USEPA, 2007).

If released to water or soil, butyric anhydride is expected to rapidly hydrolyze to butyric acid. If butyric anhydride is released to the atmosphere, it is expected to react with photochemically-produced hydroxyl radicals with a half life of about 3 days.

If released to soil, n-butyric acid is expected to be highly mobile based upon an estimated K_{oc} of 64 and experimental K_{oc} values of 19.1, 27.6, and 14.7 in mud, muddy sand, and sand. Leaching to groundwater will be limited by rapid hydrolysis. The pKa of n-butyric acid is 4.82, indicating that this compound will primarily exist in the anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts.

Volatilization from moist soil surfaces is expected to be low based upon a Henry's Law constant of 5.35×10^{-7} atm-m^3/mole. n-Butyric acid may volatilize from dry soil surfaces based upon its vapor pressure.

If released to water or formed by the hydrolysis of the anhydride in water, n-butyric acid is not expected to adsorb to suspended solids and sediment based upon the estimated and experimental Koc values. n-Butyric acid is expected to biodegrade in the environment based on the observed degradation of 72% after 5 hours when incubated with activated sludge. Volatilization from water surfaces is expected to be low based upon this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 64 and 471 days, respectively. An estimated BCF of 3.2 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process for butyric acid since this compound lacks functional groups that hydrolyze under environmental conditions.

If released to air, a vapor pressure of 1.65 mm Hg at 25° C indicates n-butyric acid will exist solely as a vapor in the atmosphere. Vapor-phase n-butyric acid will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 7 days. n-Butyric acid does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight.

3. Persistence and Bioaccumulation

Persistence and bioaccumulation are qualitatively characterized according to the criteria set forth in the PMN program (FR, 1999). Because butyric anhydride rapidly hydrolyzes to butyric acid, both are classified as easily biodegradable and do not appreciably bioaccumulate, therefore both chemicals are classified as P1B1 and are not Persistent Organic Pollutants (POP).

4. Data Gaps

None identified.

5. Summary of Physical Chemical Properties

Figures 1 and 2 show the structure of n-butyric acid and butyric anhydride. Basic physical-chemical properties and environmental fate properties of these compounds are listed in Tables 1 and 2. Persistence and bioaccumulation rankings are given in Table 3, showing a ranking of P1B1 for both chemicals.

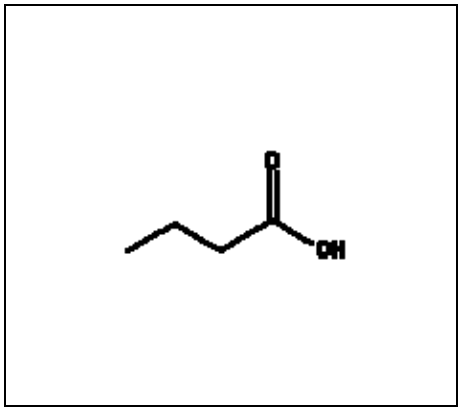

Figure 1. Structure of n-Butyric Acid (USEPA, 2007)

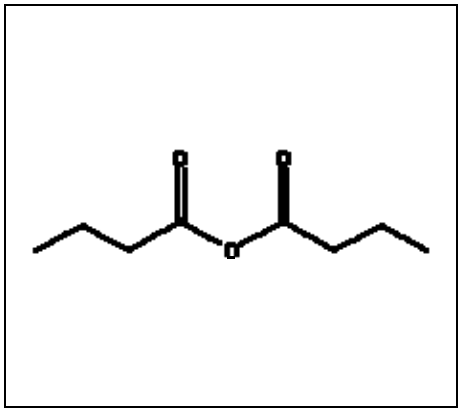

Figure 2. Structure of Butyric Anhydride (USEPA, 2007)

Table 1. Physical-Chemical Properties of n-Butyric Acid and Butyric Anhydride.

Property	Value/Quality of n-Butyric Acid	Value/Quality of Butyric Anhydride	References
CAS No.	107-92-6	106-31-0	
IUPAC	Butanoic acid	Butanoyl butanoate	
Molecular Weight	88.10	158.19	HSDB (2007)
Physical State	Colorless liquid	Colorless liquid	HSDB (2007)
Melting Point	-7.9° C	-75° C	HSDB (2007)
Boiling Point	163.5° C	199.4–201.4° C	HSDB (2007)
Vapor Pressure	1.65 mm Hg at 25° C	0.3 mm Hg at 20° C	HSDB (2007)
Water Solubility	60,000 mg/L at 25° C (soluble)	4,560 mg/L at 25° C (estimated; soluble)	HSDB (2007); NLM (2007)
Density	0.959 at 20° C	0.9668 at 20° C	HSDB (2007)
Log K_{ow}	0.79 at 25° C (experimental)	1.39 at 25° C (estimated)	HSDB (2007); NLM (2007)

Table 2. Environmental Fate Properties of n-Butyric Acid and Butyric Anhydride.

Property	Value/Quality of n-Butyric Acid	Value/Quality of Butyric Anhydride	References
Photodegradation	Half-life = 3.96–4.46 days (calculated) 7 days	Half-life = 3.1–3.2 days (calculated)	OECD (2003) HSDB (2007)
Aerobic Degradation	72% after 5.8 days when incubated with activated sludge (readily biodegradable)	No data[a]	OECD (2003)
Hydrolysis	No data	Half-life = 2–17 minutes at pH 4–9 at 22° C	OECD (2003)
Bioaccumulation	BCF=2.3–3.16 BCF=3.2	No data	OECD (2003) HSDB (2007)
Henry's Law Constant	$5.35x10^{-7}$ atm-m^3/mole at 25° C	$1.11x10^{-4}$ atm-m^3/mole (estimated)	HSDB (2007); NLM (2007)
Direct photolysis	No data	No data	
K_{oc}	64 mL/g (estimated)	No data	HSDB (2007)
Fugacity[b]	Air: Water: 45.8% Soil: 46.5% Sediment:	Air: Water: 45.8% Soil: 46.5% Sediment:	OECD (2003)

[a]Biodegradation testing cannot be performed for butyric anhydride because it hydrolyzes to butyric acid.
[b]Level III fugacity modeling results for n-butyric acid is representative of n-butyric anhydride.

Table 3. Persistence and Bioaccumulation of n-Butyric Acid and Butyric Anhydride.

Property	Value/Quality n-Butyric Acid	Value/Quality Butyric Anhydride	References
Persistence	P1 (low)	P1 (low)	FR (1999)
Bioaccumulation	B1 (low)	B1 (low)	FR (1999)

6. References

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

HSDB. 2007. Hazard Substances Data Base. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB. As cited in records for: n-Butyric acid http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~Nstb6R:1 and Butyric anhydride http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~X0UKth:1. Accessed August 30, 2007.

NLM. 2007. ChemIDplus Advanced. n-Butyric acid and Butyric anhydride. http://chem.sis.nlm.nih.gov/chemidplus/. Accessed August 30, 2007.

OECD. 2003. Organization for Economic Cooperation and Development. SIDS Initial Assessment Profile. http://ecb.jrc.it/Documents/Existing-Chemicals/IUCLID/DATA_SHEETS/107926.pdf. Accessed August 30, 2007.

European Commission. 2000. IUCLID dataset. Butyric acid. European Chemicals Bureau. http://ecb.jrc.it/documents/Existing-Chemicals/IUCLID/DATA_SHEETS/107926.pdf. Accessed August 30, 2007.

USEPA. 2007. EPI Suite™ (version 3.2) PC-Computer software developed by the EPA Office of Pollution Prevention Toxics and Syracuse Research Corporation. http://www.epa.gov/opptintr/exposure/pubs/episuite.htm.