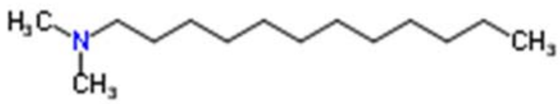
Date: 06/06/2017

Environmental Fact Sheet (#19)

Tertiary Amine (C12-14 Dimethylamine; C12-14 DMA; Lauryldimethylamine)

oleochemical precursor

Substance Identification			
IUPAC Name	N,N-dimethyldodecan-1-amine	**CAS Number**	112-18-5
Other Names	Dodecyldimethylamine		
Molecular Formula	C14H31N	Structural formula: 	

Physical/Chemical Properties [1]	
Molecular Weight	213.4 g/mol
Physical state	Liquid
Appearance	Transparent clear liquid. Colour:0.6 Gardner
Odour	Fatty, amine
Density	0.8009 g/cm^3 at 20°C (read-across based on grouping of substances: category approach)
Melting Points	-11 °C (read-across based on grouping of substances: category approach)
Boiling point	237 °C (read-across based on grouping of substances: category approach)
Flash Point	91 °C (read-across based on grouping of substances: category approach)
Vapour Pressure	6.4 Pa at 20 °C (read-across based on grouping of substances: category approach)
Water Solubility	Slightly soluble (read-across based on grouping of substances: category approach)
Flammability	Non flammable (read-across based on grouping of substances: category approach)
Explosive Properties	Non explosible (read-across based on grouping of substances: category approach)
Surface Tension	69.6 mN/m at 20 °C (read-across based on grouping of substances: category approach))
Octanol/water Partition coefficient (Kow)	log K_{OW} =4.65 at 20°C (read-across based on grouping of substances: category approach)
Product and Process Description	Lauryldimethylamine is a tertiary amine based on dimethylamine and C12-14 Fatty Alcohol (oleo) and used as precursor for alkyldimethylamine oxide - a tertiary amine oxide. Lauryldimethylamine is produced by reductive alkylation, at elevated temperatures and pressures, of ammonia or substituted amines with the corresponding fatty alcohol and catalysts like e.g. copper or nickel; copper chromite is particularly effective [5].
Application	Agricultural; household, industrial and institutional cleaners; personal care; viscosity control in oil and coatings industries.

Life Cycle Assessment

General Introduction

These Environmental Fact Sheets are a product of the *ERASM Surfactant Life Cycle & Ecofootprinting (SLE)* project. The objective of this project was to establish or update the current environmental profile of 15 surfactants and 17 precursors, taking into consideration actual surfactant production technology and consistent high quality background data.

The Fact Sheets are based upon life cycle assessment (LCA) and have been prepared in accordance with the ISO standard [ISO 14040: 2006 and ISO 14044: 2006]. In addition, the project follows the ILCD (2010) handbook. This Fact Sheet describes the cradle-to-gate production for C12-14 Dimethylamine (C12-14 DMA). C12-14 DMA is an oleochemical surfactant precursor.

The ERASM SLE project recommends to use the data provided in a full 'cradle-to-grave' life cycle context of the surfactant in a real application.

Further information on the ERASM SLE project and the source of these datasets can be found in [2].

The full LCI can be accessed via www.erasm.org or via http://lcdn.thinkstep.com/Node/

Goal and Scope of ERASM SLE Project [2]

The main goal was to update the existing LCI inventories [3] for the production of C12-14 Dimethylamine.

Temporal Coverage	Data collected represents a 12 month averages of C12-14 DMA production in the year 2011, to compensate seasonal influence of data. Background data have reference years from 2008 to 2010. The dataset is considered to be valid until substantial technological changes in the production chain occur. The precursor data are not published here due to confidentiality reasons.
Geographical Coverage	The geographical representativeness for Tertiary Amine was considered 'very good'.
Technological Coverage	The technological representativeness for Tertiary Amine was considered 'good'. Figure 1 provides a schematic overview of the production process of Tertiary Amine.
Declared Unit	In ERASM SLE project the declared unit (functional unit) and reference flow is one thousand kilogram (1000 kg) of surfactant active ingredient. This was the reference unit also used in [3]. Functional Unit: 1 metric tonne of tertiary amine 100% active substance.
Cradle-to Gate System Boundaries	(see table below)
Assumptions and Limitations	Transportation was only considered for the main materials (covers about 90% of the mass of all inputs), other transportation was not considered. Some important transports were estimated by European standard distances due to lack of valuable information.
Cut-off Criteria [4]	No significant cut-offs were used. The LCI study included all material inputs that had a cumulative total (refers to unit process level) of at least 98% of the total mass inputs to the unit process, and included all material inputs that had a cumulative total of at least 98% of total energy inputs to the unit process. The study included any material that had environmental significance in its extraction, manufacture, use or disposal, is highly toxic, dangerous for the environment, or is classified as hazardous waste. The sum of the excluded material flows did not exceed 5% of mass, energy or environmental relevance.

Cradle-to Gate System Boundaries:

Included	Excluded
Fatty alcohols production	Construction of major capital equipment (Infrastructure)
Ammonia production	Maintenance and operation of support equipment
Energy production	Human labor and employee transport
Utilities	Packaging
Transportation processes for the main materials	
Water use and treatment of waste water	
Treatment of wastes	

Calculation Rules	Allocation	For Tertiary amine production, allocation was applied to the background system (mass allocation for the renewable precursors PKO and CNO).
	Aggregated data	From public data and literature research.
Life Cycle Inventory and Impact Assessment [2]		
LCI data for C12-14 Dimethylamine is not published here due to confidential reasons. The data are integrated in the surfactant C12-14 Amine Oxide.		

References for the ERASM SLE Project

Data Owner and Commissioner of the study	ERASM (Environment & Health Risk Assessment and Management). A research partnership of the Detergents and Surfactants Industries in Europe (www.erasm.org).
LCA Practitioner	thinkstep AG (www.thinkstep.com)
Reviewers	Prof. Walter Kloepffer, LCA Consult Mrs. Charlotte Petiot and Dr. Yannick Leguern, BiolS by Deloitte
References	[1] ECHA. http://echa.europa.eu [2] Schowanek. D. *et al*. (2017). New and Updated Life Cycle Inventories for Surfactants used in European Detergents: Summary of the ERASM Surfactant Life Cycle and Ecofootprinting Project. Int J. LCA, in press. [3] CEFIC-Franklin (1994). Resource and environmental profile analysis of petrochemical and oleo chemical surfactants produced in Europe. Phase II Final Report, Franklin Associates, LTD. [4] PLASTICSEUROPE (2011). Eco-profiles and Environmental Declarations – Life Cycle Inventory (LCI) Methodology and Product Category Rules (PCR) for Uncompounded Polymer Resins and Reactive Polymer Precursors, version 2.0. [5] Ullmann's Encyclopedia of Industrial Chemistry (2010). John Wiley & Sons, Inc., Hoboken, USA.

Figure 1. Production process of Lauryl DiMethyl Amine.