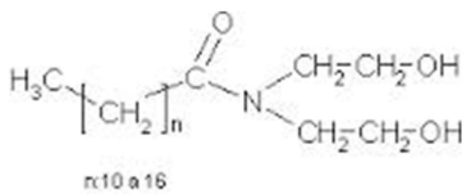
Date: 06/06/2017

Environmnetal Fact Sheet (#16)

Cocamide Diethanolamine (CDEA)

oleochemical non-ionic surfactant

Substance Identification			
IUPAC Name	Amides, coco, N,N-bis(hydroxyethyl)	**CAS Number**	68603-42-9
Other Names	Coco Fatty Acid Diethanolamide, Cocamide diethanolamine		
Molecular Formula	UVCB substance (substances of Unknown or Variable composition, Complex reaction products or Biological materials), no univocal molecular formula available	Structural formula : 	

Physical/Chemical Properties	
Molecular Weight	No data available
Physical state	No data available
Appearance	No data available
Odour	No data available
Density	No data available
Melting Points	No data available
Boiling point	No data available
Flash Point	No data available
Vapour Pressure	No data available
Water Solubility	No data available
Flammability	No data available
Explosive Properties	No data available
Surface Tension	No data available
Octanol/water Partition coefficient (Kow)	No data available
Product and Process Description	Cocamide Diethanolamine (alkanolamide) is a non-ionic surfactant and is an additive used as a refatting agent or to stabilize and enhance foaming properties. This substance is manufactured by the condensation reaction of lauric oils (coconut oil and/or palm kernel oil) with diethanolamine (DEA). Further information about DEA production is explained in the Eco Profile fact sheet of the precursor DEA (#15). For this purpose the triglyceride of lauric oils together with diethanolamine in a molar ratio of 1 to 3 is filled in a stainless steel reactor and gently heated under stirring. Any water traces are removed under vacuum. Under slight pressure and in the presence of an alkaline catalyst (e.g. sodium methylate) the temperature is further increased to 150 - 180°C. After a certain residence time the reaction product is cooled down to ambient temperature. In this process the glycerine formed in the reaction remains in the final product cocamide diethanolamine.
Application	It is an additive used as a refatting agent or to stabilize and enhance foaming properties.

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 Cocamide diethanolamine (CDEA). CDEA is an oleochemical surfactant.

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 [1].

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

Goal and Scope of ERASM SLE Project [1]

The main goal was to update the existing LCI inventories [2] for the production of Cocamide diethanolamine and its main precursors/intermediates.

<table>
<tr><td>Temporal Coverage</td><td>Data collected represents a 12 month averages of CDEA 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.</td></tr>
<tr><td>Geographical Coverage</td><td>Current data are based on three suppliers representing CDEA production in Europe.
The geographical representativeness for Cocamide diethanolamine was considered 'good'.</td></tr>
<tr><td>Technological Coverage</td><td>The technological representativeness for Cocamide diethanolamine was considered 'good'.
Figure 1 provides a schematic overview of the production process of Cocamide diethanolamine.</td></tr>
<tr><td>Representativeness for market volume</td><td>>60% (Represented market volume (in mass) covered by primary data used in ERASM SLE project.</td></tr>
<tr><td>Declared Unit</td><td>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 [2].
Functional Unit: 1 metric tonne of Cocamide diethanolamine 100% active substance.</td></tr>
<tr><td>Cradle-to Gate System Boundaries</td><td>
<table>
<tr><th>Included</th><th>Excluded</th></tr>
<tr><td>Coconut oil production</td><td>Construction of major capital equipment (Infrastructure)</td></tr>
<tr><td>Diethanolamine production (this production is further explained in the fact sheet of the precursor Diethanolamine (#15))</td><td>Maintenance and operation of support equipment</td></tr>
<tr><td>Energy production</td><td>Human labor and employee transport</td></tr>
<tr><td>Utilities</td><td>Packaging</td></tr>
<tr><td>Transportation processes for the main materials</td><td></td></tr>
<tr><td>Water use and treatment of waste water</td><td></td></tr>
<tr><td>Treatment of wastes</td><td></td></tr>
</table>
</td></tr>
<tr><td>Assumptions and Limitations</td><td>Transportation was only considered for the main materials (covers about 90% of the mass of all inputs), other transportation was not considered.</td></tr>
<tr><td>Cut-off Criteria [3]</td><td>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</td></tr>
</table>

	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.	
Calculation Rules	Allocation	For Cocamide diethanolamine production, allocation was not applied to the foreground system. However, allocation was applied for the background system. Allocation by mass was used for the renewable precursors PKO and CNO.
	Aggregated data	Vertical averaging was considered (as long as the final product was the same, different processes with common product intermediates can be aggregated in the average).

Life Cycle Inventory and Impact Assessment [1]

Based on the LCI data an environmental impact assessment was performed for the indicators Primary Energy Demand (PED) and Global Warming Potential (GWP). Other impacts may be calculated from the full LCI dataset.

Table 1. Primary Energy Demand and air emissions related to Global Warming per 1 tonne of Sodium Cocamide diethanolamine 100% active substance

LCI result	Unit	Amount
Primary energy demand		
Primary energy demand from renewable materials (net calorific value)	MJ	23240
Primary energy demand from fossil materials (net calorific value)	MJ	18165
Primary energy demand from fossil and renewable materials (net calorific value)	MJ	41404
Air emissions related to Global Warming Potential		
Carbon uptake, biotic	kg CO_2 equiv.	-3151
Carbon dioxide, fossil	kg	838
Carbon dioxide, biotic	kg	1000
Carbon dioxide, from land use, land use change and peat oxidation	kg	187
Methane	kg	2.99
Nitrous oxide (laughing gas)	kg	0.55
NMVOC emissions	kg	0.99
*Total GWP (according to [**IPCC 2007**])*	*t CO_2-equiv..*	*-0.88*

Primary Energy Demand (PED): An analysis of the inventory data shows that the PED impact is dominated by coconut oil and diethanolamine, contributing to about 97%. The remaining contribution is due to other chemicals, thermal energy and transport.

Global Warming Potential (GWP): An analysis of the inventory data showed that the GWP impact is dominated by coconut oil and diethanolamine, contributing above 97%. The remaining contribution is due to other chemicals, thermal energy and transport.

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 Dr. Yannick Schmidt (2.0 LCA consultants)
References	[1] 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. [2] CEFIC-Franklin (1994). Resource and environmental profile analysis of petrochemical and oleo chemical surfactants produced in Europe. Phase II Final Report, Franklin Associates, LTD [3] 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.

Figure 1. Production process of Cocamide Diethanolamine.