

MEGA evaluations for the preparation of REACH exposure scenarios for diethanolamine

1 Introduction

The measured data for workplace exposure evaluated in the following have been gathered and documented in accordance with the principles of the measurement system of the German social accident insurance institutions for exposure assessment (MGU¹, formerly BGMG). The quality of the MGU is upheld by a quality management system that in essence satisfies the requirements of DIN EN ISO 9001. The test laboratories are operated in accordance with DIN EN ISO 17025 “General requirements for the competence of testing and calibration laboratories”.

To measure the diethanolamine (CAS No. 111-42-2) contained in the air at the workplace, a defined volume of air is sucked by a suitable sampling pump through a sampling system equipped with a glass fibre filter. The diethanolamine contained in the air is retained by the glass fibre filter. To prevent readings of diethanolamine lower than the actual values, the glass fibre filter is transferred to a polyethylene screw-cap container filled with 10 ml buffer solution immediately after sampling. Quantitative analysis is performed by ion-chromatography by means of calibration curves according to the method of the external standard; the concentrations of reference standards are plotted against the peak area. The quantification limit for the MGU-standard process is 0,33 mg/m³ for a sample air volume of 60 L. Source: Diethanolamin (ref. no. 7052). In: IFA-Arbeitsmappe Messung von Gefahrstoffen. 26. Lfg. III/2001. Ed.: Deutsche Gesetzliche Unfallversicherung (DGUV), Berlin. Erich Schmidt, Berlin 2011 – loose-leaf edition

All the surveyed data in the MGU are brought together in the MEGA exposure database (measured data on exposure to hazardous substances at the workplace). The MEGA^{Pro} software developed by the IFA makes it possible to statistically analyse the data of the MEGA exposure database on the basis of various selection criteria and evaluation strategies.

¹ Gabriel, S.; Koppisch, D.; Range, D.: The MGU – a monitoring system for the collection and documentation of valid workplace exposure data. Gefahrstoffe – Reinhalt. Luft 70 (2010) No. 1/2, pp. 43-49
<http://www.dguv.de/ifa>, Webcode [m200066](#)

2 Data situation and evaluation strategy

2.1 Overview of the measured values collected in the MGU, data period 2000 to 2011

Diethanolamine (CAS-no.: 111-42-2)

Measured data relating to exposure, MGU-standard process

In Germany there is a MAK (maximum workplace concentration) value of the DFG (German Research Society) for diethanolamine of 1 mg/m³ in the inhalable fraction.

General description	Number of measured values (%)	
Total	995	
Type of sampling:		
stationary	581	(58%)
personal	414	(42%)
Number of data < quantification limit	993 (99.8%)	
Number of data > limit value	1 (0.1%)	
Sampling time representative for:		
Exposure time ≥ 6 h	923	(93%)
Exposure time < 6 h	65	(7%)
Examples: Exposure conditions		
Measurement plan:		
Workplace measurements	994	(99.9%)
Interior measurements	1	(0.1%)
Situation in industry: Unfavourable	14	(1%)
Reason for measurement: investigation in case of suspected occupational disease	106	(11%)
Without mechanical ventilation	462	(46%)
With mechanical ventilation	427	(43%)
No details	78	(8%)
Without local exhaust ventilation	450	(45%)
With local exhaust ventilation	432	(43%)
No details	99	(10%)

General description of
measurements of diethanolamine in
88 branches of industry and 173 work areas

2.2 Evaluation strategy

- Data period 2000 to 2011
- Workplace measurements
- Measured data relating to exposure
- Standard method in the MGU
- Sampling is representative for exposure duration.
- Exposure duration ≥ 6 hours or < 6 hours
- If any single values fell below the measurement method's analytical quantification limit (a. q.), half of each value was adopted in the evaluation.
- Data sets comprising fewer than ten measured data were disregarded.
- There was no statistical evaluation based on branches of industry and work areas, as 993 (99,8%) of the 995 measured values are below the analytical quantification limit.

3 Abbreviations and indices

The following abbreviations and indices are used in the evaluation tables:

Frequency < values	Number of measured values below the analytical quantification limit
a. q.	Analytical quantification limit
*	If any single values fell below the measurement method's analytical quantification limit (a. q.), half of each value was adopted in the evaluation.
+	The distribution value is below the largest analytical quantification limit (a. q.) in the data set. The quantification limit may deviate from the quantification limit quoted in the introduction, e.g. depending on sampling duration or flow rate.
!	The number of measured values below the analytical quantification limit (a. q.) is greater than the number of measured values represented by this cumulative frequency value. No concentration is therefore given for this cumulative frequency value.

4 Statistic evaluations for industry groups

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time ≥ 6 h

D.No. = Data set number/ Designation	Number of measured data	Number of firms	Frequency < number of values%	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³		
						50 per- centile *	90 per- centile *	95 per- centile *
Branch of industry								
D No. 7 No limitation	922	460	920 99.8	2.7	99.9	! a. B.	! a. B.	! a. B.

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time < 6 h

D.No. = Data set number/ Designation	Number of measured data	Number of firms	Frequency < number of values%	Largest quanti- fication limit in mg/m ³	≤ limit value % \$	Concentrations in mg/m ³		
						50 per- centile *	90 per- centile *	95 per- centile *
Branch of industry								
D No. 6 No limitation	65	50	65 100	2	100	! a. B.	! a. B.	! a. B.

5 Statistical evaluations for work area groups

No statistical evaluation has been performed.

6 Further statistical evaluations

No statistical evaluation has been performed.

7 Overview lists

7.1 Branches of industries

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time ≥ 6 h

Industry groups	Number of measured values
Waste water treatment plant, electroplating, anodising plant	1
Plant and equipment construction (metal)	2
Plant engineering and construction, construction of plants	11
Manufacture and processing of coating materials (screen print colours)	2
Apparatus engineering	7
Manufacture of taps and valves	11
Container construction	2
Sheet mill	6
Manufacture of chemicals and chemical products	6
Manufacture of sealings	2
Printing office	5
Manufacture of hardware, sheet metal and metalware products	18
Iron and steel foundry, mixed	3
Iron foundry	2
Electrical engineering, general	37
Vehicle construction	7
Vehicle interior equipment, manufacture	1
Manufacture of vehicle seats	4
Car washing	2
Manufacture of fine mechanics, optics	7
Manufacture and processing of flat glass	10
Forming processes, other	4
Electroplating	26
Electroplating, automatic strip line	2
Electroplating, automatic rack/barrel lines	3
Electroplating, manually fed line	1
Electroplating, manually operated rack/barrel line	1
Manufacture and processing of glass fibres	2
Wholesale trade with iron and metal haberdashery, electrotechnical products, fixtures and household articles, furniture, sports goods	2
Wholesale trade with vehicles, machines, mechanical equipment and related technical supplies (except tyres and rubber articles)	4
Manufacture and processing of hard metals, iron powder	1
Heating, air conditioning, ventilation engineering	3
Manufacture of parts for motor vehicles and engines (automotive supply)	34
Blast furnace	2
Blast furnace, steel mills and hot rolling mills	1
Manufacture and processing of hollow/pressed glass	6
Manufacture and processing of hollow glass	3

Industry groups	Number of measured values
Wood construction including wood preservation, excluding interior work, manufacture	4
Processing and treatment of wood	2
Industrial assembly	1
Industrial cleaning	3
Cold rolling mill	2
Corrosion protection, removal of old coatings	2
Manufacture of plastic and plastic foam	11
Plastics and plastic foam, processing	25
Manufacture of plastic foils	2
Manufacture of plastic sheets, tubes and profiles	22
Plastics injection moulding	1
Construction of agricultural machines	1
Light metal foundry	15
Manufacture of machinery and vehicles, general	31
Mechanical engineering	75
Manufacture of medical engineering	1
Processing and treatment of metals, general	345
Manufacture of food products and beverages	4
Non-ferrous metal foundry, mixed	8
Surface treatment and hardening	17
Manufacture of upholstery	7
General cleaning	8
Detergents and sanitary products	1
Repair shop, electrical equipment	2
Repair shop for motor vehicles	1
Repair shop for machinery	14
Manufacture of pipes, general	3
Pipe rolling mill	4
Grinding shop (metal products)	26
Forging press works	4
Manufacture of special ceramic	2
Manufacture and processing of special glass	3
Steel and light metal construction	5
Steel foundry	4
Manufacture of technical ceramic	1
Finishing of textiles	4
Transport, shipping, transport companies and similar	3
Processing of liquid coating materials (liquid varnish coating)	4
Administration, offices	1
Rolling mills, general	3
Tool/mould-making	1
Manufacture of brick products	1
Drawing works, general	7
Total	922

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time < 6 h

Industry groups	Number of measured values
Waste water treatment plant	1
Manufacture of chemicals and chemical products	5
Electrical engineering, general	9
Manufacture of fine mechanics, optics	1
Manufacture and processing of flat glass	6
Research and testing institutes and laboratories	1
Electroplating	1
Manufacture and processing of glass fibres	1
Wholesale trade with chemicals	2
Wholesale trade with iron and metal haberdashery, electrotechnical products, fixtures and household articles, furniture, sports goods	2
Wholesale trade with fuels, technical oils and fats	2
Wholesale trade with optical and fine mechanical products, jewellery	2
Indoor swimming pool	1
Manufacture of parts for motor vehicles and engines (automotive supply)	3
Plastics and plastic foam, processing	1
Light metal foundry	1
Photoprinting	1
Mechanical engineering	4
Processing and treatment of metals, general	13
Surface treatment and hardening	2
Repair shop, electrical equipment	1
Forging, general	1
Finishing of textiles	2
Transport, shipping, transport companies and similar	2
Total	65

7.2 Work areas

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time ≥ 6 h

Work area plan Work area	Number of measured values
Work area plan 1 General work areas	
Filling station, room	6
Filling scale for barrels, pails etc.	2
Weighing by hand	2
Work area not coded	2
Foam-filling of hollow spaces	4
Processing, room	11
Processing centre	22
Staining	6
Drilling	12
Blowtorch cutting	1
Office	2
CNC processing machines	130
Turning, planing	74
Electro-chemical separation processes	1
Removal of coatings	5
Fat removal system	11
Deburring	1
Paint stripping, chemical	1
Extruder for plastics, injection moulds	2
Ground conveyor, open goods, room	1
Conveying, hydraulic, pumping, general	3
Conveying, mechanical, open, feeding	1
Foaming moulds	26
Moulded parts, pressing (prepreg)	3
Grinding	37
Thread forming	8
Harding kilns, output	1
Harding kilns, charging	1
Harding kilns, room	4
Hardening shop, general	2
Hard soldering, induction soldering	1
Hot presses	2
Cold presses	4
Boiler pressure impregnation	4
Gluing, contact adhesives	2
Gluing, other processes	1
Inspection, auditing	1
Plastic welding	2

Work area plan Work area	Number of measured values
Laboratory, room	1
Warehouse, general	5
Warehouse work, manual (e.g. unloading, stacking) general	2
Laser beam cutting	2
Photoprinting	1
Metal active gas welding (MAG)	1
Installation, general	8
Subsequent treatment	2
Wet (fat) mixer, general	1
Wet mixer, feeding	1
Wet grinding	74
NC processing machines	8
Surface treatment, general	5
Surface treatment, room	13
Surface coating, electroplating	9
Surface coating, brushing, rolling	1
Surface coating, spraying (e.g. with pressurised air)	2
Surface coating, immersing	3
Surface cleaning	22
Plasma smelt cutting, manual	1
Polishing systems	1
Polishing	3
Presses, general	2
Presses, room	1
Test facility	3
Quality inspection	6
Broaching (machining)	1
Reaction container, general	2
Cleaning (wet/steam) with high pressure	6
Material cleaning, general	46
Material cleaning, by blasting with pressurised air	1
Material cleaning, by wiping with liquids	2
Room cleaning, general	1
Cleaning in containers	2
Cleaning of facilities	2
Repair and maintenance, general	3
Repair and maintenance, in workshop	1
Raw material, interim storage area, room	2
Agitation containers, closed	1
Sawing	12
Sharpening	3
Sanding	87
Forging	1
Welding, general	2
Processing methods, miscellaneous	3

Work area plan Work area	Number of mea- sured values
Filling processes, miscellaneous	1
Casting processes, miscellaneous	2
Processes, annealing, quenching, tempering, miscellaneous	1
Punching, cutting	5
Control/operating station	4
Tank storage, filling, decanting	2
Immersion system	1
Technical school, at facilities	1
Technical school, room	1
Thermal processing, mixed process	1
Separating and processing methods, room	17
Cut-off grinding	1
Decanting, general	1
Processing plastic foam, room	4
Packaging, dispatch	4
Packaging foaming	8
Spraying	4
Rolling	9
Soft soldering	2
Soft soldering, rod soldering	1
Soft soldering process, miscellaneous	1
Soft soldering, wave soldering	2
Workshop work, general	5
Tungsten inert gas welding (TIG)	1
Centrifugation	1
Number of analysis for work area plan 1	835
Work area plan 5 Ceramics	
Processing, extruders	1
Firing, top-hat kiln	1
Plastics mould-making	1
Number of analysis for work area plan 5	3
Work area plan 6 Blast furnace	
Repair, maintenance, general	1
Number of analysis for work area plan 6	1
Work area plan 7 Foundry	
Core-making, core-making machine or plant, cold box process	1
Casting, hot-chamber die-casting machine or plant	2
Casting, cold-chamber die-casting machine or plant	2
Foundry general, room	1
Number of analysis for work area plan 7	6

Work area plan Work area	Number of mea- sured values
Work area plan 16 Processing and treatment of wood	
Machines for wood finishing, other workplaces	2
Number of analysis for work area plan 16	2
Work area plan 21 Finishing of textiles	
Pretreatment, washing (if performed as separate process)	1
Dyeing, dyeing unit (pressurised vessel)	1
Chemical finishing, coating, spraying	1
Number of analysis for work area plan 21	3
Work area plan 28 Production of adhesives, glue, stopper, coatings, rendering, cement and binders	
Raw materials processing and mixing, distributor rollers	1
Number of analysis for work area plan 28	1
Work area plan 31 Special work areas in the construction industry	
Unloading	1
Blasting, high-pressure water-jetting	3
Mechanical cleaning, wet	3
Number of analysis for work area plan 31	7
Work area plan 34 Electroplating	
Preliminary treatment, corrosive steeping, chemical	3
Preliminary treatment, degreasing, ultrasound cleaning	1
Coating, general	6
Coating, hard chromium-plating, sulfuric acid bath	1
Coating, nickel-plating, black nickel-plating electrolyte	1
Coating, zinc-plating, alkali	1
Coating, copper-plating, acidic	2
Anodising	1
Coating, other coatings, general	1
Chemical processes, general	1
Phosphating	1
Chromate conversion coating	1
Blueing	1
Stripping (removal of old coatings)	2
Rinsing bath	1
Processes for post-treatment, other	5
Loading and unloading station	1
Number of analysis for work area plan 34	30
Work area plan 35 Printing office	
Printing forme production, copiers	4
Screen decoating	1
Number of analysis for work area plan 35	5

Work area plan Work area	Number of measured values
Work area plan 45 Repair shop, repair and maintenance	
Removal and fitting of body parts and subassemblies	1
Parts cleaning, parts washing machine	1
Number of analysis for work area plan 45	2
Work area plan 48 Plastics articles, manufacture	
Mouldings production, foaming moulds	7
Post-treatment of plastic items, sawing	1
Post-treatment of plastic items, grinding	1
Post-treatment of plastic items, cutting	1
Number of analysis for work area plan 48	10
Work area plan 56 Liquid paint coating	
Workpiece pre-treatment or preparation area, general	1
Paint shop, paint spray walls, pressurised air, manual	1
Paint shop, spraying station, pressurised air, manual	2
Number of analysis for work area plan 56	4
Work area plan 60 Car washing	
Automatic car wash, general	2
Number of analysis for work area plan 60	2
Work area plan 70 Glass	
Blowing machine (excluding the IS machine)	2
Processing, general	5
Sanding, with machines	1
Drilling, sawing etc.	2
Insulation glazing production, filling the cavity between the glass panes	1
Number of analysis for work area plan 70	11
Total number of analysis	922

Diethanolamine, data period 2000 to 2011, workplace measurements
Sampling representative for exposure time < 6 h

Work area plan Work area	Number of measured values
Work area plan 1 General work areas	
Filling station, room	2
Work area not coded	1
Turning, planing	1
Fat removal system	1
Semi-finished and finished goods warehouse, room	1
Harding baths, general	1
Gluing, other processes	1
Laboratory, at facilities	2
Laboratory table or laboratory station in the production facility	1
Warehouse work, manual (e.g. unloading, stacking) general	1

Work area plan Work area	Number of mea- sured values
Subsequent treatment	2
Wet mixer, feeding	1
Wet grinding	1
Surface treatment, general	1
Surface treatment, room	2
Surface coating, electroplating	2
Surface coating, manual, room	1
Surface coating, immersing	1
Surface cleaning	4
Quality inspection	2
Reaction container, general	3
Cleaning (wet/steam) with high pressure	1
Material cleaning, general	3
Room cleaning, with solvents	1
Room cleaning, with cleaning product	1
Cleaning in containers	2
Repair and maintenance, general	1
Sanding	4
Processing methods, miscellaneous	1
Punching, cutting	2
Tank storage, general	2
Tank storage, filling, decanting	1
Immersion process, room	1
Dry sanding	1
Decanting, general	2
Packaging	2
Packaging foaming	2
Soft soldering, other processes	1
Number of analysis for work area plan 1	60
Work area plan 21 Textile finishing	
Making up, room, general	1
Number of analysis for work area plan 21	1
Work area plan 34 Electroplating	
Preliminary treatment, corrosive steeping, chemical	1
Number of analysis for work area plan 34	1
Work area plan 57 Plant and processes of the chemical industry	
Reaction equipment and lines, baths, general (for chemical reactions)	1
Waste water treatment	1
Number of analysis for work area plan 57	2
Work area plan 70 Glass	
Insulation glazing units, mixing station for filling media	1
Number of analysis for work area plan 70	1
Total number of analysis	65

Author:

Ulrike Koch

Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung (IFA), Sankt Augustin