Annex 22: Estimation of exposed workers - Example: Acrylamide

MODULE 1: Assessment of the total production, export and import (MS and/or EU)

Acrylamide Cas no: 3845-76-9 / EC no: 223-342-4

Acrylamide is a colorless, odorless, crystalline amide that polymerizes. Acrylamide is classified by CLP as 1B and IARC as 2A[1]. In 2010 it was added to the REACH Candidate list. Since 2012 some of the uses are restricted in the EU (Quote from the restriction decision[2]: *Shall not be placed on the market or used as a substance or constituent of mixtures in a concentration, equal to or greater than 0,1 % by weight for grouting applications after 5 November 2012*. The largest amount is used as monomer for polymerisation.

According to the SHEcan study[3] the total EU production of acrylamide is estimated between 80,000-100,000 tonnes. However, the use in the EU is higher due to imports of acrylamide powder for the production of polyacrylamides. Acrylamide is also exported outside the EU but the majority of EU acrylamide production is used within the EU (SHEcan study).

MODULE 2: Assessment of the use in sectors (MS and/or EU)

The largest use for acrylamide is as a reactive monomer and intermediate in the production of organic chemicals and in the synthesis of polyacrylamides. It is a component of polymers and co-polymer materials used in gel chromatography and in waste water management, pulp and paper industry and textile treatment industry and is used as a laboratory reagent[4].

According to the SHEcan study the top three industrial uses of acrylamide are in the sector of wastewater, pulp and paper and mineral processing.

According to ECHA it is not only used as intermediate like in the polymer production but also used for the following end uses: salt damp remediation, as laboratory agent, water shut-off and concrete repair.[5]

According to other sources acrylamide is used for the following industrial and **professional uses**[6]

- Adhesives and sealant chemicals
- Intermediates
- Paint additives and coating additives not described by other categories

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[1] COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT - Accompanying the document: Proposal for a Directive of the European Parliament and of the Council
amending Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work (2016).

[2] https://echa.europa.eu/documents/10162/701f6c15-98ec-4611-ac63-35fcca2e4047

[3] http://ec.europa.eu/social/BlobServlet?docId=10150&langId=en

[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3799507/

[5] https://echa.europa.eu/registration-dossier/-/registered-dossier/15534/3/1/5

[6] https://pubchem.ncbi.nlm.nih.gov/compound/acrylamide#section=Analytic-Laboratory-Methods

- Processing aids, not otherwise listed
- Processing aids, specific to petroleum production
- Solids separation agents

In SPIN only Norway reports a total use of 0.1 tons per year as complexing agent, ending in 2009. Another use is the production of safety glass. The DGUV (BGIA-institute) measured the acrylamide exposure in this sector. These data were compiled in 1999.[7] The current data sheet report only two end uses in laboratories and to immobilise enzymes.[8]

CAREX from FIOH assessed that acrylamide is used in 19 sectors (table 1). The three sectors with the highest numbers of exposed workers are education services, research and scientific institutes, and manufacture of chemicals. CAREX estimates a total of exposed worker population of 30,000.

Table 1: Carex: Industry specific estimates – summary, 1999

EU

ACAM Acrylamide

Industry		Estimate
311-2	Food manufacturing	221
321	Manufacture of textiles	730
331	Manufacture of wood and wood and cork products, except	92
332	Manufacture of furniture and fixtures, except primary of	50
351	Manufacture of industrial chemicals	6599
352	Manufacture of other chemical products	1459
353	Petroleum refineries	45
355	Manufacture of rubber products	686
371	Iron and steel basic industries	84
381	Manufacture of fabricated metal products, except	195
382	Manufacture of machinery except electrical	130
383	Manufacture of electrical machinery, apparatus, appliances	185
42	Water works and supply	610
5	Construction	330
6	Wholesale and retail trade and restaurants and hotels	1350
931	Education services	9398
932	Research and scientific institutes	6480
933	Medical, dental, other health and veterinary services	1489
935-9	Business, professional and other organisation	390
	Total	30523

SHEcan calculates the number of exposed workers by using the Finnish CAREX and the country data from Spain and Italy.

Due to the increase of the number of employees in education and scientific research these two sectors have an even larger relevance than in the Finnish CAREX from 1999. The sector education accounts for more than 50% of all exposed person, in CAREX 1999 it was a little more than 30%.[9]

[7] http://www.dguv.de/medien/ifa/en/pub/rep/pdf/rep01/bgar0199/gesamt.pdf
[8] http://www.dguv.de/medien/ifa/de/fac/erb/stoffliste/stoffblatt_acrylamid.pdf
[9] http://www.ttl.fi/en/chemical_safety/carex/Documents/Definition_of_agents_and_exposures.pdf

Table 2: Classification of industries by exposure level

Industry	NACE (rev 1.1)	Historical Exposure Classification[1]	Number of People Exposed 2006[2,3]
Manufacture of food products, beverages and tobacco	15	Low	0
Manufacture of textiles	17	Low	0
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20	Low	0
Manufacture of coke, refined petroleum products and nuclear fuel	23	Low	0
Manufacture of chemicals and chemical products	24	**High**	12195
Manufacture of rubber products	251	Low	0
Manufacture of basic metals	27	Low	0
Manufacture of fabricated metal products, except machinery and equipment	28	Low	0
Manufacture of machinery and equipment n.e.c.	29	Low	0
Manufacture of radio, television and communication equipment and apparatus	32	Low	0
Manufacture of furniture	361	Low	0
Collection, purification and distribution of water	41	Low	0
Construction	45	Low	0
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	G (50, 51, 52, 55)	Low	0
Research and development	73	Low	5436
Other business activities	74	Low	656
Public Administration and Defence	75	Low	150
Education	80	Low	34473
Health and social work	85	Low	516
TOTAL			**53426**

[1] Relevant to 1975 Exposure Levels

Neither in SHEcan nor in CAREX there is an explanation about the use of acrylamide in education services. We assume that this figure is based on the use in university laboratories, particularly in biochemistry.

MODULE 3: Use in chemical products - Acrylamide

According to ECHA acrylamide is only used for four end uses as one of many substances in complex formulations.

MODULE 4: Assessment of the exposure in certain applications / work places / enterprises /sectors / (MS and/or EU)

SHEcan estimates that the average exposure level of the exposure in 2010 was 0.008 mg/m3 geometric (GM), with 90% of exposures less than 0.038 mg/m^3.

The DGUV report from 1999[10] measured in two sectors the following levels (75 measurements) (table 3):

[10] http://www.dguv.de/medien/ifa/en/pub/rep/pdf/rep01/bgar0199/gesamt.pdf

Table 3: Acrylamide – average exposure levels per shift in the safety glass manufacture (DGUV 1999)

Company type/Work area	Measurements	Companies	50% value	90% value	95% value
	Number	Number	mg/m³	mg/m³	mg/m³
Chemical industry	13	7	0.07	0.15	0.16
Fireproof glass, manufacture and processing	15	4	0.04	0.10	0.11

MODULE 5: Estimation of the number of workers exposed (MS and/or EU)

SHEcan study: Approximately 53,000 workers in the EU are potentially exposed to acrylamide (employment data from 2006), in the NACE sector 24 (manufacturing chemicals and chemical products from which about 12,000 are employed and 1,220 are exposed during acryl manufacturing.

Figure 1: Acrylamide exposure in Canada[11]

[11] http://www.carexcanada.ca/en/acrylamide/occupational_estimate/

Estimate

Table 4: Number and percentage of acrylamid exposed workers

Country/ Region	Source	Exposed workers[12]	Total workforce [13]	Percentage
EU 28	IOM SHEcan Study	53,000	215,000,000[14]	0.025%
EU 15 CAREX 99 (93 figures)	FIOH, Carex consortium	30,523	155,000,000[15]	0.020%
EU 28 CAREX figures extrapolated to EU 28		42,000	215,000,000[16]	0.020%
France (2010)[17]	SUMER	29,800	26,100,000	0.115%
Canada	CAREX Canada	9,300	19,800,000	0.047%

According to most sources between 0.020% and 0.115% of the workers are exposed to acrylamide (table 4). The lowest figures are from CAREX (figure 1), the highest from SUMER 2010. According to ECHA only four end uses still exist, the vast majority of the production volume is used a monomer. The high number of exposed workers in some sectors, based on the CAREX sources and SHEcan, remains unexplained. An update of data is needed.

[12] **Labour force statistics, productivity and unit labour costs, consumer prices,** http://www.bls.gov/fls/#data

[13] Sometimes workforce covers employers, sometimes only employees. In small enterprises, e.g. of the craft sector, employers might be exposed like the workers. As in most country the share of employers is around 10% it would be better to eliminate this factor but this correction will not change the whole picture.

[14] EUROSTAT: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsi_emp_a&lang=de
Sector employment:
http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tec00109&language=en 215 m employees (211 m in 2013), 238 mio employees plus self-employed (237 in 2013) age 15 to 64

[15] Data for EU 15, Eurostat Yearbook 2004, Data 1992-2002

[16] Ibid.

[17] http://www.chu-rouen.fr/sfmt/autres/Argumentaire_201510.pdf