



PlasticsEurope
Association of Plastics Manufacturers

*Eco-profiles of the
European Plastics Industry*

HYDROGEN CYANIDE

A report by

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for

PlasticsEurope

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IMPORTANT NOTE

Before using the data contained in this report, you are strongly recommended to look at the following documents:

1. Methodology

This provides information about the analysis technique used and gives advice on the meaning of the results.

2. Data sources

This gives information about the number of plants examined, the date when the data were collected and information about up-stream operations.

In addition, you can also download data sets for most of the upstream operations used in this report. All of these documents can be found at: www.plasticseurope.org.

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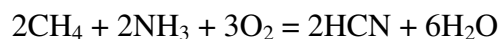
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HYDROGEN CYANIDE PRODUCTION

Hydrogen cyanide, HCN, is manufactured by the reaction between ammonia, (NH₃) and natural gas (CH₄). The reaction is:



ECO-PROFILE OF HYDROGEN CYANIDE

Table 1 shows the gross or cumulative energy to produce 1 kg of hydrogen cyanide and Table 2 gives this same data expressed in terms of primary fuels. Table 3 shows the energy data expressed as masses of fuels. Table 4 shows the raw materials requirements and Table 5 shows the demand for water. Table 6 shows the gross air emissions and Table 7 shows the corresponding carbon dioxide equivalents of these air emissions. Table 8 shows the emissions to water. Table 9 shows the solid waste generated and Table 10 gives the solid waste in EU format.

Table 1

Gross energy required to produce 1 kg of hydrogen cyanide. (Totals may not agree because of rounding)

Fuel type	Fuel prod'n & delivery energy (MJ)	Energy content of delivered fuel (MJ)	Energy use in transport (MJ)	Feedstock energy (MJ)	Total energy (MJ)
Electricity	5.79	2.60	0.32	-	8.70
Oil fuels	1.12	12.64	0.07	0.01	13.84
Other fuels	3.88	36.16	0.08	12.27	52.39
Totals	10.79	51.40	0.47	12.28	74.94

Table 2

Gross primary fuels required to produce 1 kg of hydrogen cyanide. (Totals may not agree because of rounding)

Fuel type	Fuel prod'n & delivery energy (MJ)	Energy content of delivered fuel (MJ)	Fuel use in transport (MJ)	Feedstock energy (MJ)	Total energy (MJ)
Coal	1.98	2.64	0.11	<0.01	4.73
Oil	1.08	12.72	0.16	0.01	13.97
Gas	5.29	84.63	0.11	12.06	102.10
Hydro	0.31	0.21	0.01	-	0.54
Nuclear	1.98	0.81	0.07	-	2.86
Lignite	<0.01	<0.01	<0.01	-	<0.01
Wood	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphur	<0.01	<0.01	<0.01	0.20	0.20
Biomass (solid)	0.04	0.02	<0.01	<0.01	0.07
Hydrogen	<0.01	<0.01	<0.01	-	<0.01
Recovered energy	<0.01	-49.68	<0.01	-	-49.68
Unspecified	<0.01	<0.01	<0.01	-	<0.01
Peat	<0.01	<0.01	<0.01	-	<0.01
Geothermal	<0.01	<0.01	<0.01	-	<0.01
Solar	<0.01	<0.01	<0.01	-	<0.01
Wave/tidal	<0.01	<0.01	<0.01	-	<0.01
Biomass (liquid/gas)	0.06	0.02	<0.01	-	0.08
Industrial waste	0.01	<0.01	<0.01	-	0.01
Municipal Waste	0.03	0.01	<0.01	-	0.05
Wind	0.01	<0.01	<0.01	-	0.01
Totals	10.79	51.40	0.47	12.28	74.94

Table 3

Gross primary fuels used to produce 1 kg of hydrogen cyanide expressed as mass.

Fuel type	Input in mg
Crude oil	310000
Gas/condensate	1900000
Coal	170000
Metallurgical coal	47
Lignite	2
Peat	11
Wood	41

Table 4
Gross raw materials required to produce 1 kg of hydrogen cyanide.

Raw material	Input in mg
Air	520000
Animal matter	<1
Barytes	1
Bauxite	260
Bentonite	<1
Biomass (including water)	17000
Calcium sulphate (CaSO ₄)	<1
Chalk (CaCO ₃)	<1
Clay	<1
Cr	<1
Cu	<1
Dolomite	1
Fe	120
Feldspar	<1
Ferromanganese	<1
Fluorspar	16
Granite	<1
Gravel	<1
Hg	<1
Limestone (CaCO ₃)	1400
Mg	<1
N ₂	12000
Ni	<1
O ₂	98000
Olivine	1
Pb	1
Phosphate as P ₂ O ₅	6000
Potassium chloride (KCl)	1
Quartz (SiO ₂)	<1
Rutile	<1
S (bonded)	<1
S (elemental)	22000
Sand (SiO ₂)	11000
Shale	<1
Sodium chloride (NaCl)	7200
Sodium nitrate (NaNO ₃)	<1
Talc	<1
Unspecified	<1
Zn	<1

Table 5
Gross water consumption required for the production of 1 kg of hydrogen cyanide. (Totals may not agree because of rounding)

Source	Use for processing (mg)	Use for cooling (mg)	Totals (mg)
Public supply	13000000	-	13000000
River canal	2000000	63000000	65000000
Sea	69	1100	1200
Well	390000	1	390000
Unspecified	430000	8100000	8500000
Totals	16000000	71000000	87000000

Table 6

Gross air emissions associated with the production of 1 kg of hydrogen cyanide. (Totals may not agree because of rounding)

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	From biomass (mg)	From fugitive (mg)	Totals (mg)
dust (PM10)	1100	390	4	110	-	-	1600
CO	3000	990	44	130	-	-	4100
CO2	640000	3700000	7300	330000	6	-	4700000
SOX as SO2	3000	5400	59	3	-	-	8400
H2S	<1	-	<1	<1	-	-	<1
mercaptan	<1	<1	<1	<1	-	-	<1
NOX as NO2	1600	5200	64	420	-	-	7300
NH3	<1	-	<1	110	-	-	110
Cl2	<1	<1	<1	<1	-	-	<1
HCl	55	35	<1	<1	-	-	90
F2	<1	<1	<1	<1	-	-	<1
HF	2	1	<1	<1	-	-	3
hydrocarbons not specified	3300	440	18	220	-	<1	4000
aldehyde (-CHO)	<1	-	<1	<1	-	-	<1
organics	<1	<1	<1	30	-	-	30
Pb+compounds as Pb	<1	<1	<1	<1	-	-	<1
Hg+compounds as Hg	<1	-	<1	<1	-	-	<1
metals not specified elsewhere	1	2	<1	<1	-	-	3
H2SO4	<1	-	<1	<1	-	-	<1
N2O	<1	<1	<1	<1	-	-	<1
H2	67	<1	<1	13	-	-	79
dichloroethane (DCE) C2H4Cl2	<1	-	<1	<1	-	<1	<1
vinyl chloride monomer (VCM)	<1	-	<1	<1	-	<1	<1
CFC/HCFC/HFC not specified	<1	-	<1	<1	-	-	<1
organo-chlorine not specified	<1	-	<1	<1	-	-	<1
HCN	<1	-	<1	48	-	-	48
CH4	97000	1100	<1	4000	-	<1	100000
aromatic HC not specified	<1	-	<1	1	-	<1	1
polycyclic hydrocarbons (PAH)	<1	<1	<1	<1	-	-	<1
NM VOC	<1	-	<1	1	-	-	1
CS2	<1	-	<1	<1	-	-	<1
methylene chloride CH2Cl2	<1	-	<1	<1	-	-	<1
Cu+compounds as Cu	<1	<1	<1	<1	-	-	<1
As+compounds as As	-	-	-	<1	-	-	<1
Cd+compounds as Cd	<1	-	<1	<1	-	-	<1
Ag+compounds as Ag	-	-	-	<1	-	-	<1
Zn+compounds as Zn	<1	-	<1	<1	-	-	<1
Cr+compounds as Cr	<1	<1	<1	<1	-	-	<1
Se+compounds as Se	-	-	-	<1	-	-	<1
Ni+compounds as Ni	<1	<1	<1	<1	-	-	<1
Sb+compounds as Sb	-	-	<1	<1	-	-	<1
ethylene C2H4	-	-	<1	<1	-	-	<1
oxygen	-	-	-	<1	-	-	<1
asbestos	-	-	-	<1	-	-	<1
dioxin/furan as Teq	-	-	-	<1	-	-	<1
benzene C6H6	-	-	-	<1	-	<1	<1
toluene C7H8	-	-	-	<1	-	<1	<1
xylenes C8H10	-	-	-	<1	-	<1	<1
ethylbenzene C8H10	-	-	-	<1	-	<1	<1
styrene	-	-	-	<1	-	<1	<1
propylene	-	-	-	<1	-	-	<1

Table 7

Carbon dioxide equivalents corresponding to the gross air emissions for the production of 1 kg of hydrogen cyanide. (Totals may not agree because of rounding)

Type	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	From biomass (mg)	From fugitive (mg)	Totals (mg)
20 year equiv	6700000	3800000	7400	580000	6	<1	11000000
100 year equiv	2900000	3700000	7400	420000	6	<1	7100000
500 year equiv	1300000	3700000	7400	360000	6	<1	5400000

Table 8

Gross emissions to water arising from the production of 1 kg of hydrogen cyanide. (Totals may not agree because of rounding).

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	Totals (mg)
COD	4	-	<1	720	720
BOD	1	-	<1	49	50
Pb+compounds as Pb	<1	-	<1	<1	<1
Fe+compounds as Fe	<1	-	<1	<1	<1
Na+compounds as Na	1	-	<1	900	910
acid as H+	1	-	<1	99	100
NO ₃ -	<1	-	<1	33	33
Hg+compounds as Hg	<1	-	<1	<1	<1
metals not specified elsewhere	<1	-	<1	240	240
ammonium compounds as NH ₄ +	2	-	<1	970	970
Cl-	2	-	<1	4200	4200
CN-	<1	-	<1	43	43
F-	<1	-	<1	6	6
S+sulphides as S	<1	-	<1	<1	<1
dissolved organics (non-	1	-	<1	15	16
suspended solids	41	-	7	910	950
detergent/oil	<1	-	<1	<1	<1
hydrocarbons not specified	<1	<1	<1	<1	<1
organo-chlorine not specified	<1	-	<1	<1	<1
dissolved chlorine	<1	-	<1	<1	<1
phenols	<1	-	<1	<1	<1
dissolved solids not specified	<1	-	<1	790	790
P+compounds as P	<1	-	<1	940	940
other nitrogen as N	<1	-	<1	<1	<1
other organics not specified	<1	-	<1	<1	<1
SO ₄ --	<1	-	<1	2500	2500
dichloroethane (DCE)	<1	-	<1	<1	<1
vinyl chloride monomer (VCM)	<1	-	<1	<1	<1
K+compounds as K	<1	-	<1	<1	<1
Ca+compounds as Ca	<1	-	<1	1	1
Mg+compounds as Mg	<1	-	<1	<1	<1
Cr+compounds as Cr	<1	-	<1	<1	<1
ClO ₃ --	<1	-	<1	2	2
BrO ₃ --	<1	-	<1	<1	<1
TOC	<1	-	<1	1	1
AOX	<1	-	<1	<1	<1
Al+compounds as Al	<1	-	<1	<1	<1
Zn+compounds as Zn	<1	-	<1	<1	<1
Cu+compounds as Cu	<1	-	<1	<1	<1
Ni+compounds as Ni	<1	-	<1	<1	<1
CO ₃ --	-	-	<1	1	1
As+compounds as As	-	-	<1	<1	<1
Cd+compounds as Cd	-	-	<1	<1	<1
Mn+compounds as Mn	-	-	<1	<1	<1
organo-tin as Sn	-	-	<1	<1	<1
Sr+compounds as Sr	-	-	<1	<1	<1
organo-silicon	-	-	-	<1	<1
benzene	-	-	-	<1	<1
dioxin/furan as Teq	-	-	<1	<1	<1

Table 9

*Gross solid waste associated with the production of 1 kg of hydrogen cyanide.
(Totals may not agree because of rounding)*

Emission	From fuel prod'n (mg)	From fuel use (mg)	From transport (mg)	From process (mg)	Totals (mg)
Plastic containers	<1	-	<1	<1	<1
Paper	<1	-	<1	<1	<1
Plastics	<1	-	<1	7	7
Metals	<1	-	<1	<1	<1
Putrescibles	<1	-	<1	<1	<1
Unspecified refuse	3700	-	<1	<1	3700
Mineral waste	22	-	71	2900	3000
Slags & ash	7900	3600	27	300	12000
Mixed industrial	3100	-	3	83	3200
Regulated chemicals	4500	-	<1	40	4500
Unregulated chemicals	3400	-	<1	1700	5000
Construction waste	<1	-	<1	<1	<1
Waste to incinerator	<1	-	<1	1000	1000
Inert chemical	<1	-	<1	30000	30000
Wood waste	<1	-	<1	1	1
Wooden pallets	<1	-	<1	<1	<1
Waste to recycling	<1	-	<1	<1	<1
Waste returned to mine	32000	-	3	260	32000
Tailings	1	-	2	7	10
Municipal solid waste	-4300	-	-	<1	-4300
Note: Negative values correspond to consumption of waste e.g. recycling or use in electricity generation.					

Table 10

Gross solid waste in EU format associated with the production of 1 kg of hydrogen cyanide. Entries marked with an asterisk (*) are considered hazardous as defined by EU Directive 91/689/EEC

Emission	Totals (mg)
010101 metallic min'l excav'n waste	590
010102 non-metal min'l excav'n waste	35000
010306 non 010304/010305 tailings	10
010308 non-010307 powdery wastes	3
010399 unspecified met. min'l wastes	81
010408 non-010407 gravel/crushed rock	<1
010410 non-010407 powdery wastes	<1
010411 non-010407 potash/rock salt	22
010499 unsp'd non-met. waste	<1
010505*oil-bearing drilling mud/waste	4300
010508 non-010504/010505 chloride mud	3400
010599 unspecified drilling mud/waste	3700
020107 wastes from forestry	1
050106*oil ind. oily maint'e sludges	<1
050107*oil industry acid tars	<1
050199 unspecified oil industry waste	130
050699 coal pyrolysis unsp'd waste	25
060101*H ₂ SO ₄ /H ₂ SO ₃ MFSU waste	<1
060102*HCl MFSU waste	<1
060106*other acidic MFSU waste	<1
060199 unsp'd acid MFSU waste	<1
060204*NaOH/KOH MFSU waste	<1
060299 unsp'd base MFSU waste	<1
060313*h. metal salt/sol'n MFSU waste	23
060314 other salt/sol'n MFSU waste	<1
060399 unsp'd salt/sol'n MFSU waste	140
060404*Hg MFSU waste	<1
060405*other h. metal MFSU waste	<1
060499 unsp'd metallic MFSU waste	5
060602*dangerous sulphide MFSU waste	<1
060603 non-060602 sulphide MFSU waste	44
060701*halogen electrol. asbestos waste	1
060702*Cl pr. activated C waste	<1
060703*BaSO ₄ sludge with Hg	<1
060704*halogen pr. acids and sol'ns	8
060799 unsp'd halogen pr. waste	5
061002*N ind. dangerous sub. waste	1000
061099 unsp'd N industry waste	4
070101*organic chem. aqueous washes	<1
070103*org. halogenated solv'ts/washes	<1
070107*hal'd still bottoms/residues	<1
070108*other still bottoms/residues	3
070111*org. chem. dan. eff. sludge	<1
070112 non-070111 effluent sludge	<1

continued over

Table 10 - continued

Gross solid waste in EU format associated with the production of 1 kg of hydrogen cyanide. Entries marked with an asterisk () are considered hazardous as defined by EU Directive 91/689/EEC*

070199 unsp'd organic chem. waste	20
070204*polymer ind. other washes	<1
070207*polymer ind. hal'd still waste	<1
070208*polymer ind. other still waste	23
070209*polymer ind. hal'd fil. cakes	<1
070213 polymer ind. waste plastic	<1
070214*polymer ind. dan. additives	<1
070216 polymer ind. silicone wastes	<1
070299 unsp'd polymer ind. waste	1600
080199 unspecified paint/varnish waste	<1
100101 non-100104 ash, slag & dust	11000
100102 coal fly ash	9
100104*oil fly ash and boiler dust	<1
100105 FGD Ca-based reac. solid waste	<1
100113*emulsified hydrocarbon fly ash	<1
100114*dangerous co-incin'n ash/slag	270
100115 non-100115 co-incin'n ash/slag	1
100116*dangerous co-incin'n fly ash	<1
100199 unsp'd thermal process waste	14
100202 unprocessed iron/steel slag	35
100210 iron/steel mill scales	3
100399 unspecified aluminium waste	4
100501 primary/secondary zinc slags	<1
100504 zinc pr. other dust	<1
100511 non-100511 Zn pr. skimmings	<1
101304 lime calcin'n/hydration waste	<1
130208*other engine/gear/lub. oil	12
150101 paper and cardboard packaging	<1
150102 plastic packaging	<1
150103 wooden packaging	<1
150106 mixed packaging	<1
170107 non-170106 con'e/brick/tile mix	<1
170904 non-170901/2/3 con./dem'n waste	<1
190199 unspecified incin'n/pyro waste	<1
190905 sat./spent ion exchange resins	30000
200101 paper and cardboard	<1
200108 biodeg. kitchen/canteen waste	<1
200138 non-200137 wood	<1
200139 plastics	7
200140 metals	<1
200199 other separately coll. frac'ns	-540
200301 mixed municipal waste	<1
200399 unspecified municipal wastes	-680
Note: Negative values correspond to consumption of waste e.g. recycling or use in electricity generation.	