

Coal Ash in Israel: Occupational and Environmental Health Aspects

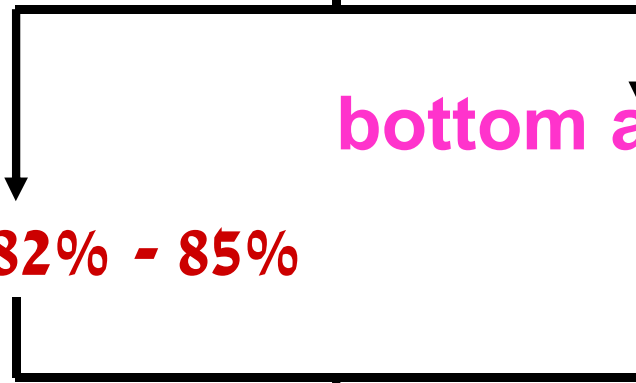
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Bituminous coal



11% ash



fly ash 82% - 85%

bottom ash 12% - 15%

vitreous aluminosilicates 60% - 80%

trace metals

Quartz, minerals, oxides

Respiratory exposure potential to fly ash

Respirable mass may constitute 30% of the fly ash but most of it is removed by electrostatic precipitation before reaching the atmosphere.

Potential of occupational exposure to coal ash

Total suspended particulate

Heavy metals

Polycyclic aromatic hydrocarbons

Natural radionuclides

Free crystalline silica

Heavy metals

Traces in the fly ash. Three orders of magnitude below occ. health standards.

In Israel and the European Commission exposure levels below 10% of the OEL are considered very low and do not require any corrective action.

Polycyclic Aromatic Hydrocarbon

1. Lack of quantitative data on their dispersion in the occupational environment.

2. The estimate of their airborne concentrations is lower than environmental fuel emissions.

Radionuclides

- 1. Their addition to the background radiation is estimated to be 1% - 5%.**
- 2. Three orders of magnitude below occupational health standards.**

Crystalline silica

Classified in the Israeli safety and Hygiene regulations as “hazardous dust” due to its ability to cause pneumoconiosis and cancer.

Crystalline silica

in Israel, unlike many other countries, the crystalline silica regulations hold for inhalable fraction of the dust in addition to the respirable fraction which may cause silicosis or other chronic lung diseases.

Crystalline silica

The ACGIH, which standards have been adopted legally in Israel, has defined a material containing over 1% silica as silica-containing material. This has not yet been accepted in Israel.

Consequently:

Crystalline silica

The classification of coal ash in Israel as “hazardous dust” due to its free crystalline silica (appearing only in the form of quartz) content applies to any weight percent of quartz in the fly ash (even if it is less than 0.1 percent).

The technical committee for hazardous dust in Israel has recently recommended to exclude bottom ash from the regulations corresponding to mineral hazardous dust.

However fly ash still remains hazardous dust as opposed to its definition as nuisance dust in many countries.

Despite the classification of coal ash as hazardous dust, no epidemiological evidence for its pneumoconiotic nature or carcinogenicity exist. Most of the crystalline silica is embedded in a vitreous aluminosilicate phase rendering this form biologically inactive. The potentially active part of the free crystalline silica on the surface of the fly ash particles accounts for less than 1%.

Air monitoring of occupational exposure to fly ash and free crystalline silica is periodically carried out under regulations for inspection of workers' health. This is done at two power plant stations but no data exist for other uses of coal ash.

In previous years most of the measurements assessed crystalline silica in total dust rather than the respirable fraction.

Percent of free silica in coal dust and fly ash

Power station	Medium	N	Range %	Mean %	SD	Median %
A	Coal	7	0.5 – 4.5	2.9	1.9	2.3
	Fly ash	11	1.7 – 12.5	5.8	3.7	6
	mixed	3	2.7 – 3	2.9	0.2	3
B	Coal	4	1.7 – 5	3.2	1.6	1.8
	Fly ash	9	1.5 – 15	3.8	4.3	2.5
	mixed	1	3			

Airborne total free silica levels at the ash sites

Stat	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	GUCL mg/M3
A	P	5	0.009 – 0.024	0.014	1.5	0.015	0.025
A	A	13	0.002 – 0.37	0.05	3.8	0.13	0.29
B	P	14	0.002 – 1.6	0.042	5.8	0.2	0.55
B	A	20	< 0.001 – 0.3	0.007	5.1	0.027	0.06

Stat – power station

P – personal sample

A - area sample

GM – geometric mean

GSD – geometric standard deviation

M – mean (unbiased)

GUCL – upper 95% confidence limit of the mean

TLV-TWA = 0.3 mg/M3

Airborne total free silica levels at the coal sites

Stat	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M 3	GUCL mg/M3
A	P	5	0.006 – 0.05	0.014	2.3	0.02	0.05
A**	A	3	0.004 – 0.01	0.008	1.7	0.009	0.03
B	P	1	0.007				

**** - neighbouring areas**

Stat – power station P – personal sample A - area sample

GM – geometric mean GSD – geometric standard deviation

M – mean (unbiased) GUCL – upper 95% confidence limit of the mean

TLV-TWA = 0.3 mg/M3

Airborne total free silica levels at the production units

Stat	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	GUCL mg/M3
A	P	2	0.2 – 0.34				
A	A	55	0.001 – 0.076	0.007	3.6	0.016	0.022
B	A	2	0.013 – 0.05				

Stat – power station P – personal sample A - area sample

GM – geometric mean GSD – geometric standard deviation

M – mean (unbiased) GUCL – upper 95% confidence limit of the mean

TLV-TWA = 0.3 mg/M3

Airborne silica levels at storage areas

Stat	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	GUCL mg/M3
A Lau	P	4	0.02 – 0.5	0.08	4	0.21	1.9
A	A	18	0.001 – 0.115	0.013	4.7	0.043	0.092
B	P	12	0.005 – 1.68	0.11	4.8	0.37	1.0
B	A	7	0.002 – 0.013	0.004	2.6	0.006	0.015

Stat – power station

P – personal sample

A - area sample

GM – geometric mean

GSD – geometric standard deviation

M – mean (unbiased)

GUCL – upper 95% confidence limit of the mean

Lau – clean and dirty laundry

TLV-TWA = 0.3 mg/M3

Total suspended particulate in the air

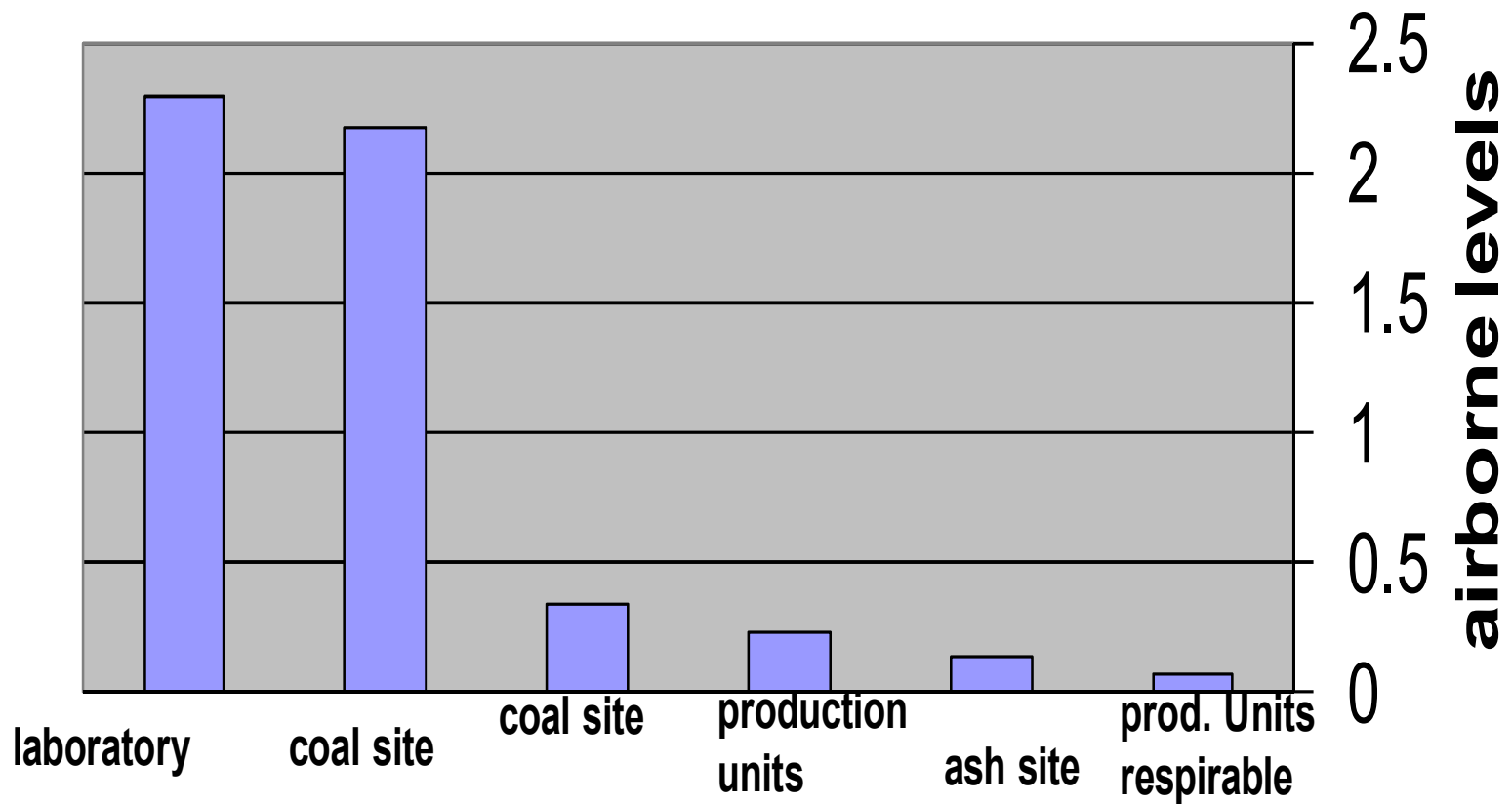
Stat	Site	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	GUCL mg/M3
A	coal	36	0.03 – 29.3	0.66	4.7	2.18	3.68
A	ash	8	0.07 – 0.29	0.12	1.5	0.13	0.18
A	units	51	0.002 – 1.2	0.11	3.4	0.23	0.32
A	lab	2	1.7 – 2.9	0.007	5.1	0.027	0.06
B	coal	11	0.14 – 10	1.17	4.6	3.7	10.2

GM – geometric mean GSD – geometric standard deviation

M – mean (unbiased) GUCL – upper 95% confidence limit of the mean

Means of total suspended particulate of coal and fly ash in the air

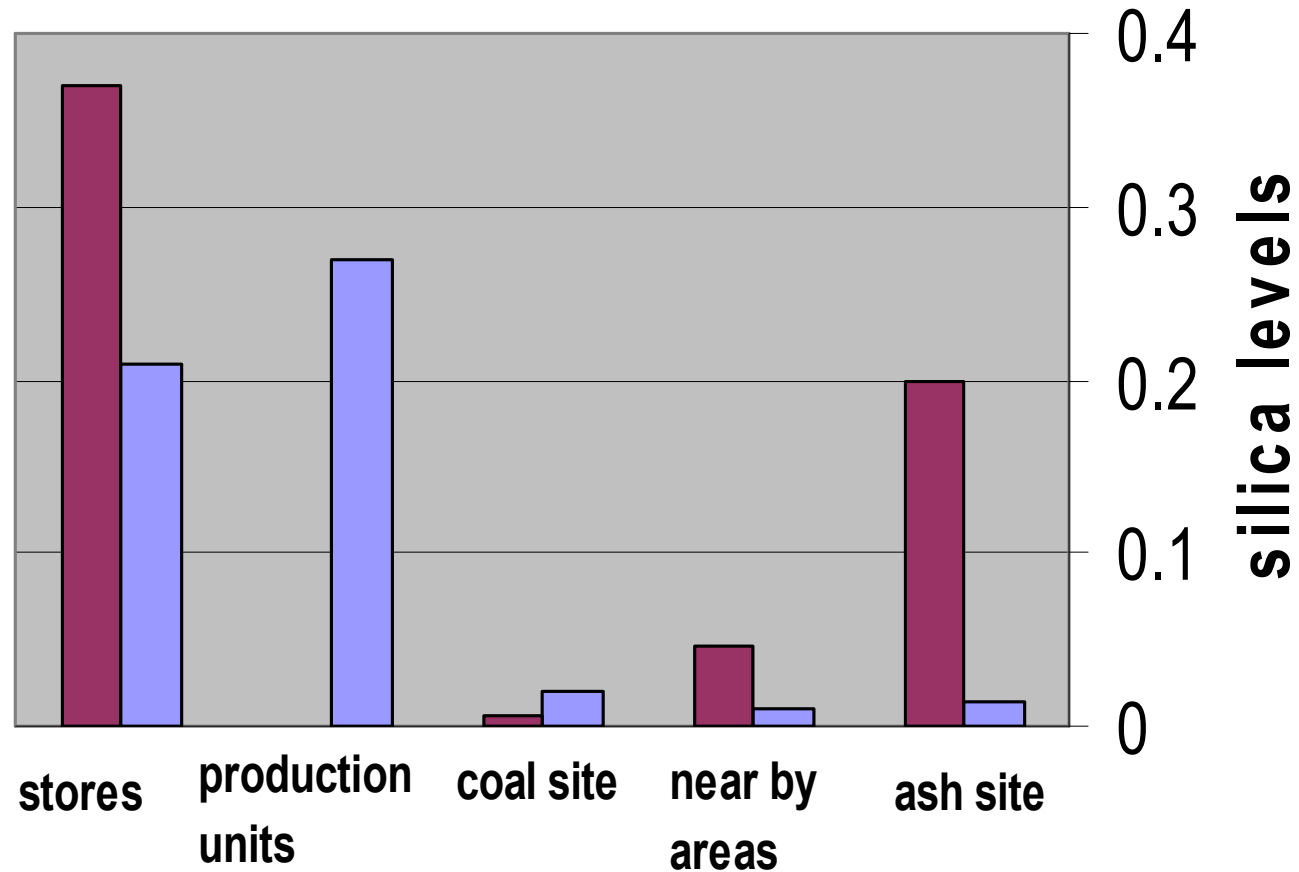
mg/M3



Total free silica in personal samples

TLV-TWA = 0.3 mg/M3

mg/M3



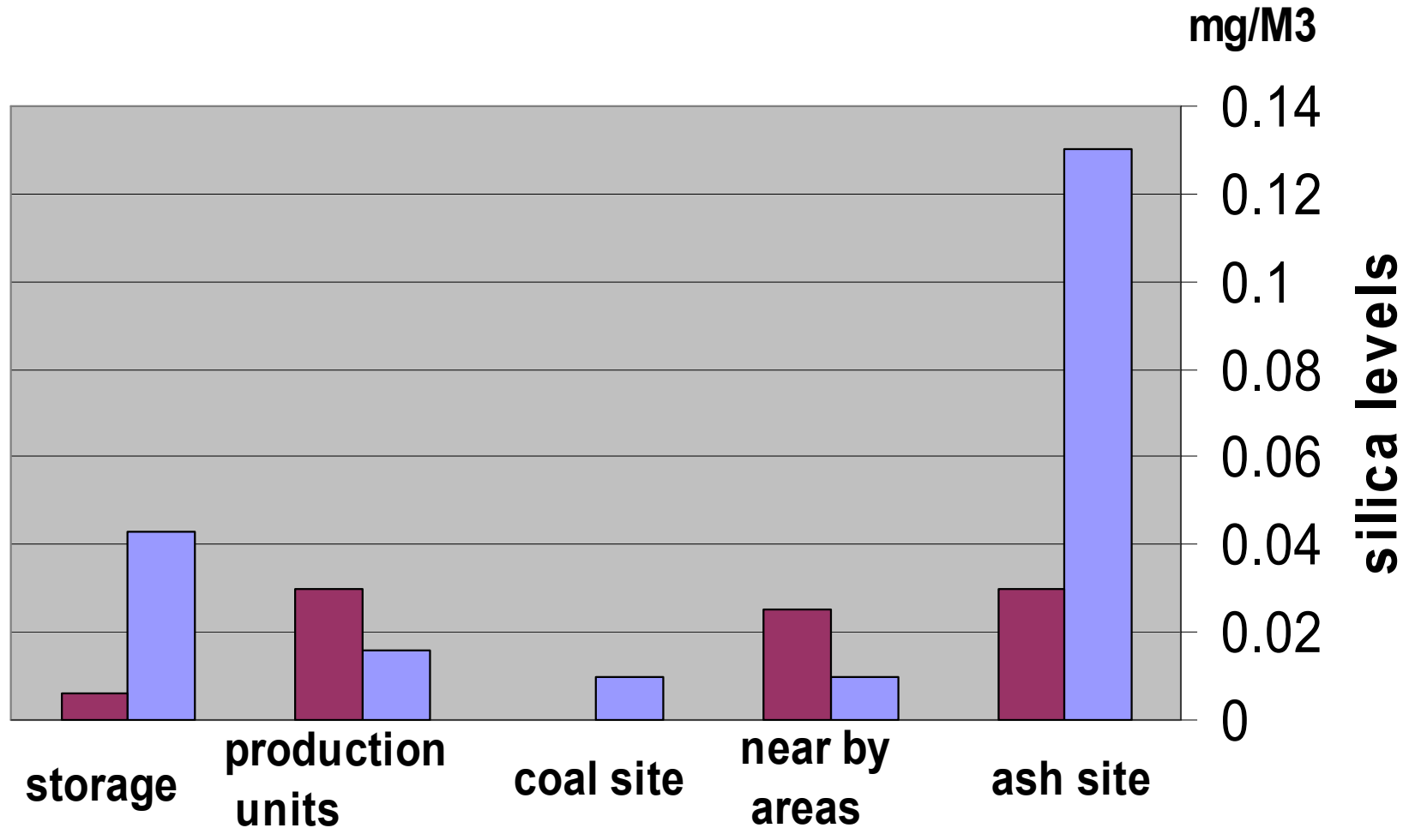
Station A



Station B

Total free silica in area samples

TLV-TWA = 0.3 mg/M3



Station A

Station B

Present years

Percent crystalline silica in coal ash samples

Sample type	Percent crystalline silica			
	N	%	N	%
Bulk coal ash	1	6.3		
Total dust of fly ash	44	<1	4	1.1 – 1.4
Respirable fraction of fly ash	22	B.D.L	2	0.76, 3.64

B.D.L – below limit of detection

Airborne total free silica levels at ash sites (power station A)

Size	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	AM mg/M3
Resp.	Pers.	7	0.0009 – 0.01	0.003	2.46	0.004	
	Area	23	0.002 – 0.17	0.014	3.4	0.029	
Total	Pers.	4	0.002 – 0.07				0.03
	Area	34	0.002 – 0.1	0.014	3.2	0.028	

Resp – respirable fraction

Pers – personal sample

Total – total dust

Area - area sample

GM – geometric mean GSD – geometric standard deviation

M – mean (unbiased) AM – simple arithmetic mean

TLV-TWA = 0.3 mg/M3

Airborne total free silica levels at ash sites (power station B)

Size	Type	N	Range mg/M3	GM mg/M3	GSD	M mg/M3	AM mg/M3
Resp.	Pers.	4	0.008 – 0.175				0.047
	Area	8	0.001 – 0.042	0.006	2.7	0.009	
Total	Pers.	3	0.01 – 0.02				0.01
	Area	15	0.001 – 0.16	0.007	5.6	0.034	

Resp – respirable fraction
 Pers – personal sample

Total – total dust
 Area - area sample

GM – geometric mean GSD – geometric standard deviation

M – mean (unbiased) AM – simple arithmetic mean

TLV-TWA = 0.3 mg/M3

Definition of PNOS (nuisance dust) by ACGIH

- Do not have an applicable TLV.
- Are insoluble or poorly soluble in water (or, preferably, in aqueous lung fluid if data are available).
- Have low toxicity
- Are not cytotoxic, genotoxic, or otherwise chemically reactive with lung tissue.
- Do not emit ionizing radiation
- Do not cause immune sensitization
- Do not cause toxic effects other than by inflammation or the mechanism of "lung overload".

For such particles airborne concentration should be kept below 3 mg/M³ respirable particles and 10 mg/M³, inhalable particles, until such time as a TLV is set for a particular substance. The value is for particulate matter containing no asbestos and <1% crystalline silica.

The crucial questions raised:

Does fly ash comply with the definition of ACGIH for PNOS (since ACGIH standards are adopted legally Israel)?

Should the regulator classify crystalline silica in fly ash differently from silica in other sources based on the existing evidence of its biological activity in coal ash?

Thank you for your attention

