Regulations to deal with the reuse of excvated (polluted) soil in Germany

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Definition

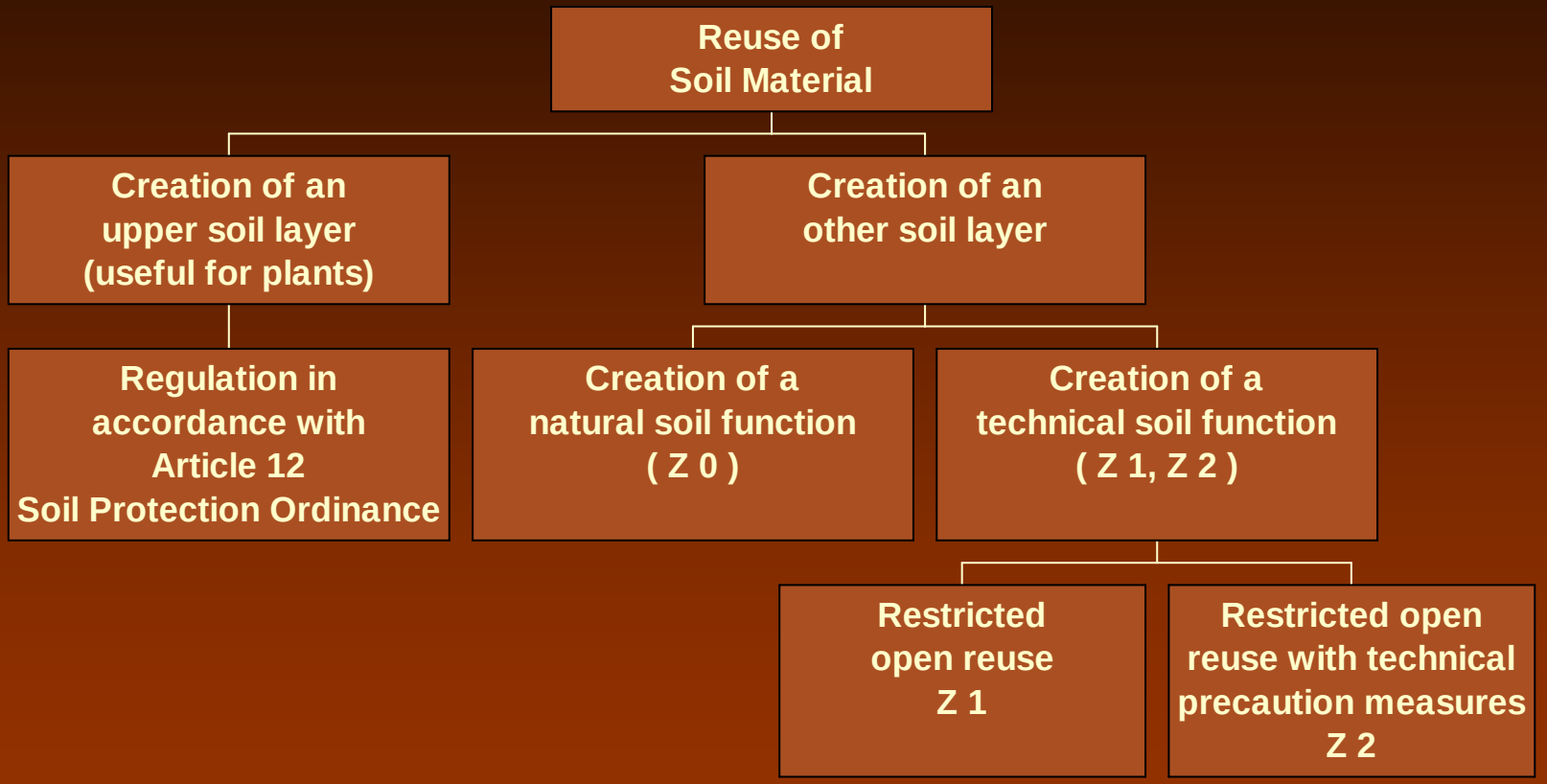
Soil:

- Material from the upper layer of the earth's crust, as far as this layer fulfils the soil functions (natural, archive and use related), including its liquid and gaseous components (soil solution and soil air);
- less than 10 % mineral construction waste;
- soils from soil treatment plants;
- dredged materials from rivers and lakes with less than 10 % clay (< 63 µm).

Classification for Reuse and Deposition

Requirements	Reuse Conditions
Z 0	reuse without restrictions
Z 1	reuse with certain restrictions
Z 2	reuse with restrictions and with technical precautionary measures
Z 3	landfill class I
Z 4	landfill class II
Z 5	hazardous waste landfill

Application



Investigation (I)

- Have a close look at the material before excavation;
- check registers (contaminated site);
- usually no analytical investigation necessary, if
  - no hints about contamination,
  - low quantity (< 500 m^3) and no specific contamination,
  - reuse of naturally or unspecifically contaminated soils at the same place or similar places in the region.

Investigation (II)

Investigation necessary if:

- soils from industrial or commercial areas;
- soils from contaminated sites;
- soils from naturally or unspecifically contaminated areas (e.g flood areas, waste water irrigation areas),
- soils from soil treatment plants;
- dredged soils, if suspicion about contamination;
- soils with suspicion about specific contamination.

Scope of Investigation (I)

- If suspicion about specific contamination:
  ➔ specific investigation;

- If unspecific suspicion (often changed facilities):
  ➔ minimum investigation program

Scope of Investigation (II)

PARAMETER	SOLID MATTER	ELUATE
Hydrocarbons	X	
EOX	X	
PAH	X	
TOC	X	
Grain-size distribution	X	
Arsenic	X	X (SM>Z 0)
Lead	X	X (SM>Z 0)
Cadmium	X	X (SM>Z 0)
Chromium	X	X (SM>Z 0)
Copper	X	X (SM>Z 0)
Mercury	X	X (SM>Z 0)
Nickel	X	X (SM>Z 0)
Zinc	X	X (SM>Z 0)
Chloride		(X)
Sulfate		(X)
Acidity, pH		X
Conductivity		X
Organoloptic investigation	X	

Reuse Class 0 / Solid Matter

PARAMETER	DIMENSION	Z 0 (Sand)	Z 0 (Loam)	Z 0 (Clay)	Z_0 (else soils, treated soils ...)
Arsenic	[mg/kg DM]	10	15	20	15
Lead	[mg/kg DM]	40	70	100	140
Cadmium	[mg/kg DM]	0,4	1	1,5	1
Chromium	[mg/kg DM]	30	60	100	120
Copper	[mg/kg DM]	20	40	60	80
Nickel	[mg/kg DM]	15	50	70	100
Thallium	[mg/kg DM]	0,4	0,7	1	0,7
Mercury	[mg/kg DM]	0,1	0,5	1	1,0
Zinc	[mg/kg DM]	60	150	200	300
TOC	[%]	0,5 (1,0)	0,5 (1,0)	0,5 (1,0)	0,5 (1,0)
EOX	[mg/kg DM]	1	1	1	1
Hydrocarbons	[mg/kg DM]	100	100	100	200 (400)
Σ BTEX	[mg/kg DM]	1	1	1	1
Σ Vol. hal. HC	[mg/kg DM]	1	1	1	1
PCB_6	[mg/kg DM]	0,05	0,05	0,05	0,1
PAH_{16}	[mg/kg DM]	3	3	3	3
Benzo(a)pyrene	[mg/kg DM]	0,3	0,3	0,3	0,6

Reuse Class 0 / Eluate
(not necessary, if SM-Levels < Z 0 Sand, Loam, Clay)

PARAMETER	DIMENSION	Z
Acidity, pH		6,5-9,5
Conductivity	µS/cm	250
Chloride	mg/l	30
Sulfate	mg/l	20
Cyanide	µg/L	5
Arsenic	µg/L	14
Lead	µg/L	40
Cadmium	µg/L	1,5
Chromium	µg/L	12,5
Copper	µg/L	20
Nickel	µg/L	15
Mercury	µg/L	< 0,5
Zinc	µg/L	150
Phenol index	µg/L	20

Reuse Classes 1 / 2 (Solid Matter)

PARAMETER	DIMENSION	Z 1	Z 2
Arsenic	[mg/kg DM]	45	150
Lead	[mg/kg DM]	210	700
Cadmium	[mg/kg DM]	3	10
Chromium	[mg/kg DM]	180	600
Copper	[mg/kg DM]	120	400
Nickel	[mg/kg DM]	150	500
Thallium	[mg/kg DM]	2,1	7
Mercury	[mg/kg DM]	1,5	5
Zinc	[mg/kg DM]	450	1500
TOC	[%]	3	10
EOX	[mg/kg DM]	1,5	5
Hydrocarbons	[mg/kg DM]	3 [1)]	10
Σ BTEX	[mg/kg DM]	300 (600)	1000 (2000)
Σ Vol. hal. HC	[mg/kg DM]	1	1
PCB_6	[mg/kg DM]	1	1
PAH_{16}	[mg/kg DM]	0,15	0,5
Benzo(a)pyrene	[mg/kg DM]	3 (9) [3)]	30

Reuse Classes 1 / 2 (Eluate)

PARAMETER	Dimension	Z 1.1	Z 1.2	Z 2
Acidity, pH	-	6,5-9,5	6-12	5,5-12
Conductivity	µS/cm	250	1500	2000
Chloride	mg/L	30	50	100[2)]
Sulfate	mg/L	20	50	200
Cyanide	µg/L	5	10	20
Arsenic	µg/L	14	20	60[3)]
Lead	µg/L	40	80	200
Cadmium	µg/L	1,5	3	6
Chromium	µg/L	12,5	25	60
Copper	µg/L	20	60	100
Nickel	µg/L	15	20	70
Mercury	µg/L	< 0,5	1	2
Zinc	µg/L	150	200	600
Phenol index	µg/L	20	40	100

Z 0 : Deposition without Restrictions

Contents below Z 0 : characteristic for natural / little influenced soil.

Conclusions for the Reuse
In general the soil can be reused without restriction.
Soil from contaminated sites or from treatment plants should not be used in particularly sensible areas as:

- children's playgrounds,
- sports grounds,
- school playgrounds (unsealed),
- house gardens,
- agricultural areas,
- drinking water protection areas.

Background levels > Z 0 : background levels replace the Z 0 levels.

Z 1 : Restricted Open Deposition (Z1.1; Z1.2)

In general the Z 1.1 levels are relevant.

Z 1.2 levels may be used in hydrologically insensible areas :
Groundwater is protected by a layer with a high retention capacity (e.g. at least 2 m thick clay or loam layer).

Conclusions for the Reuse

Soil with contents of hazardous substances below the Z 1 levels can be used for

- recultivation of mining areas,
- road construction,
- industry areas,
- parks (with a dense vegetation cover),
- ruderal areas.

Exempted are

- drinking water areas,
- healing spring areas,
- areas with frequent floods,
- nature conservation areas.

Z 2 : Restricted Open Deposition with Technical Precautionary Measures

The Z 2 level is the limit for open deposition.

Conclusions for the Reuse

The reuse of soil < Z 2 is possible for

- anti-noise walls (mineral sealing > 0.5 m, $k < 5 \times 10^{-9}$ m/s, recultivation),
- road substructure (impermeable surface or mineral sealing > 0.5 m, $k < 5 \times 10^{-9}$ m/s)
- for construction measures on waste disposal sites.