Trends in utilizing WTE residues in Europe

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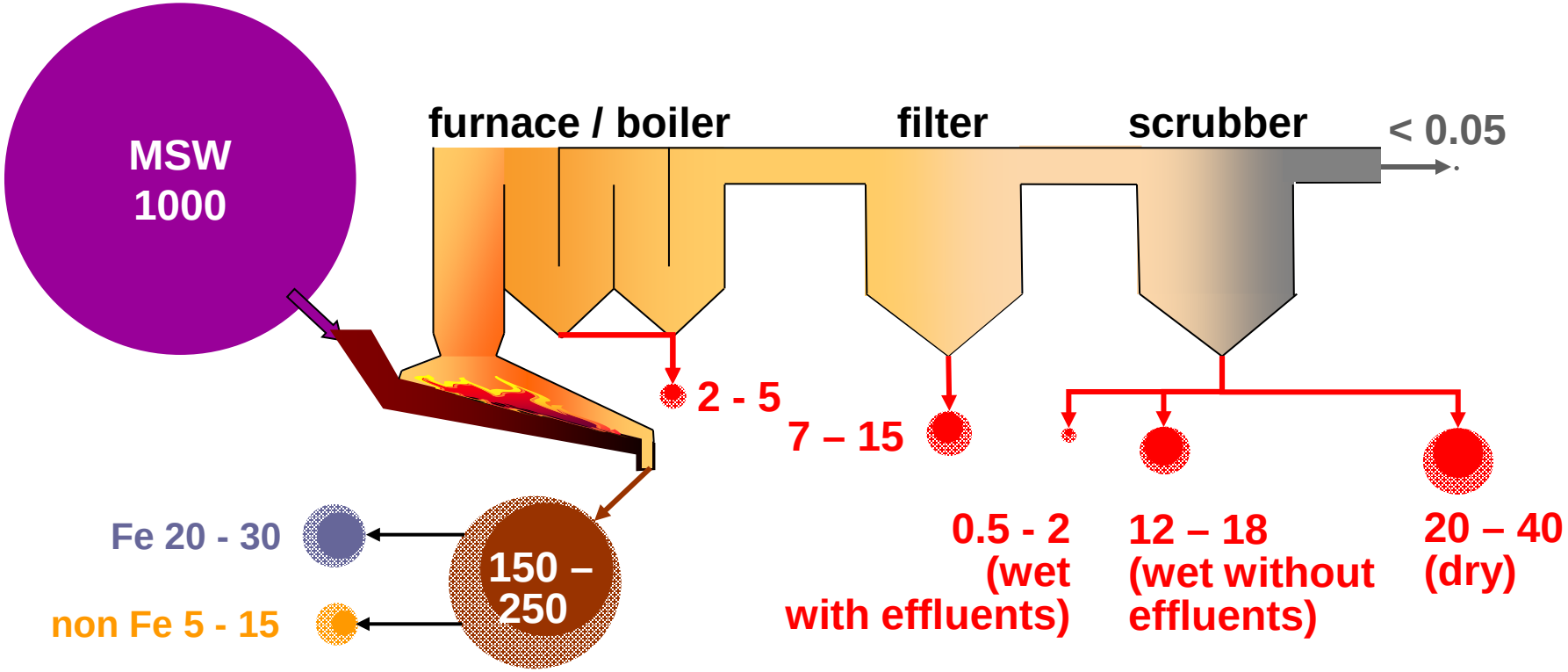
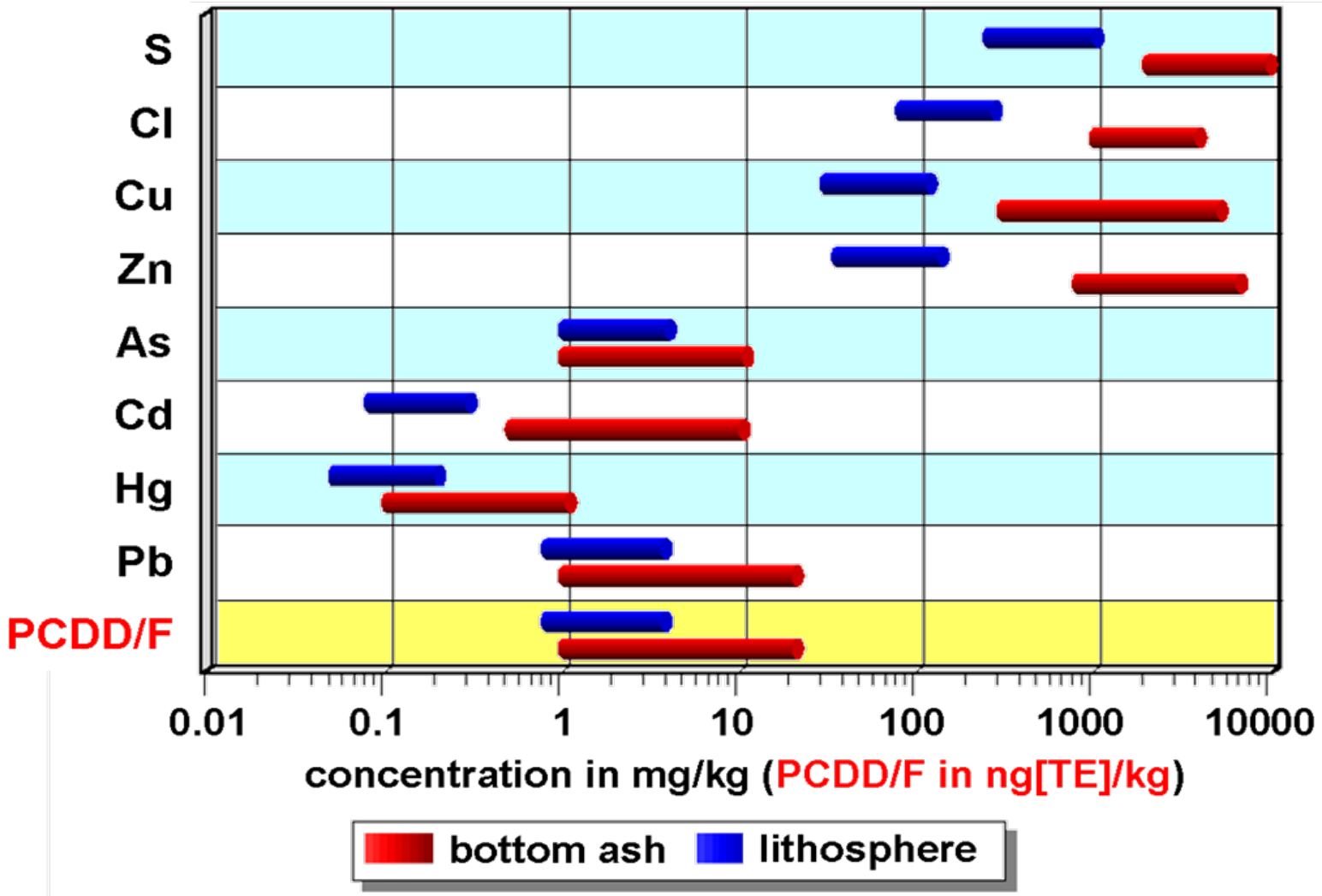


flows of solid masses in a MSWI plant in kg

fundamentals of WtE residue management in Europe

- almost uniform regulations for disposal (in EU based on Council Decision 2003/32/EC)
- no common standards or recommendations for utilisation
- bottom ashes are generally classified as non hazardous
- depending on national regulations they are either landfilled or utilised
- boiler ash and filter ashes are classified as hazardous waste
- APC residues are also classified as hazardous waste



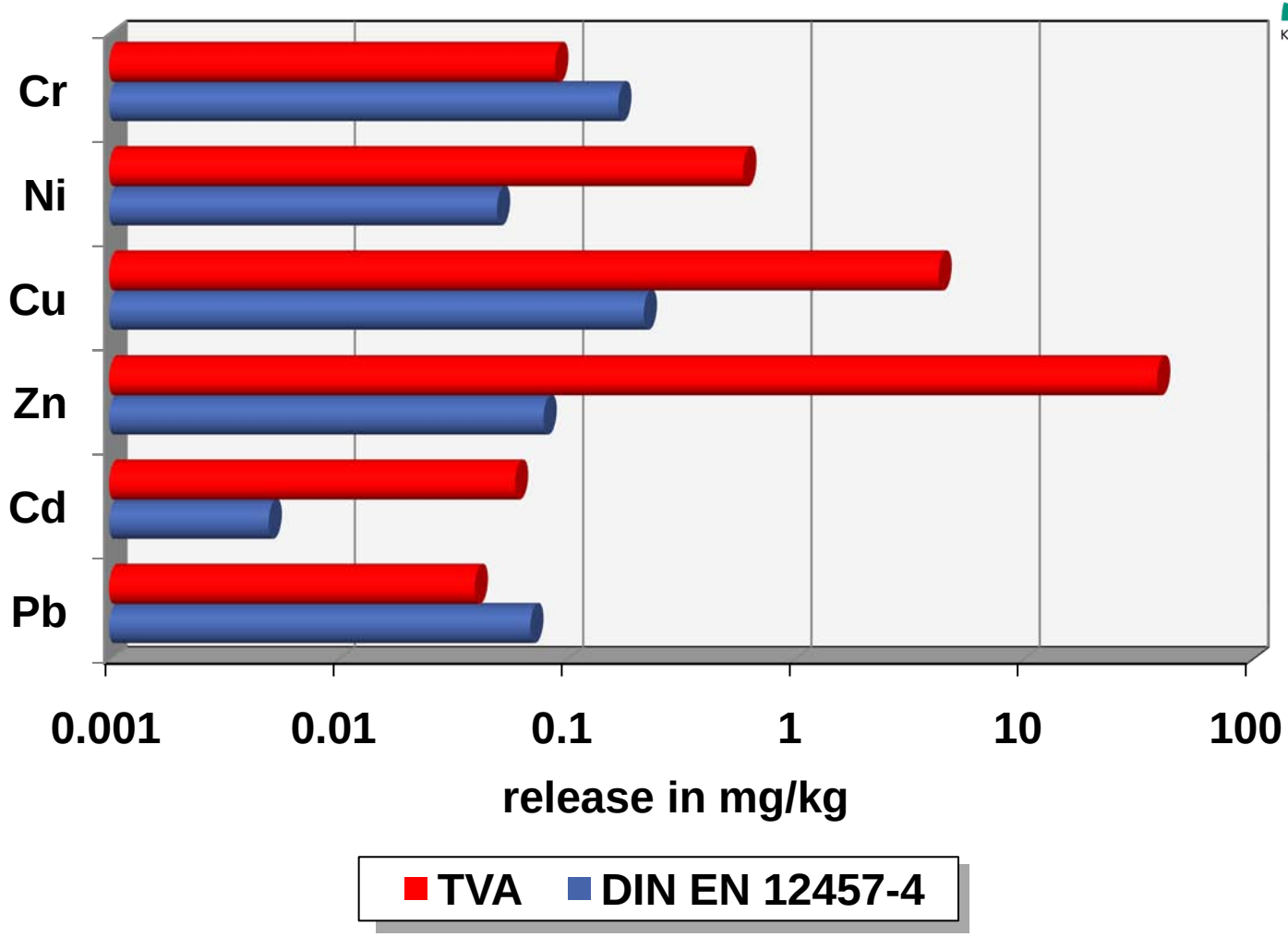
selected elements in bottom ash and lithosphere

important parameters for bottom ash management

- total organic carbon
- chemical composition
- leaching stability
  - access criterion for landfills
  - main quality parameter for utilisation
- mechanical parameters in case of utilisation

selected leaching compliance tests

test	EN 12457-3	EN 12457-2/ DIN EN 12457-4	TVA	NEN 7243	NEN 7243
country	EU	Germany	Switzerland	The Netherlands	The Netherlands
type	serial batch	batch	serial batch	column	serial batch
max- particle size (mm)	10	actual size	H_2O	4	0.125
leachant	H_2O	H_2O	CO_2 saturated H_2O	1 mol/l HNO_3	1^{st} step: pH=7 2^{nd} step: pH=4
number of steps	2	1	2	7	2
L/S (l/kg) per step	1^{st} step: 2 2^{nd} step: 8	10	10	0.1 - 10	50
contact time	1^{st} step: 6 h 2^{nd} step: 18 h	24 h	24 h per step	≈ 16 d	3 h
agitation	end over end/ roller table	end over end/ roller table	CO_2 injection	leachant pumped through column	stirring



leaching of bottom ash using the Swiss and the German test

regulations for bottom ash management in Germany

disposal

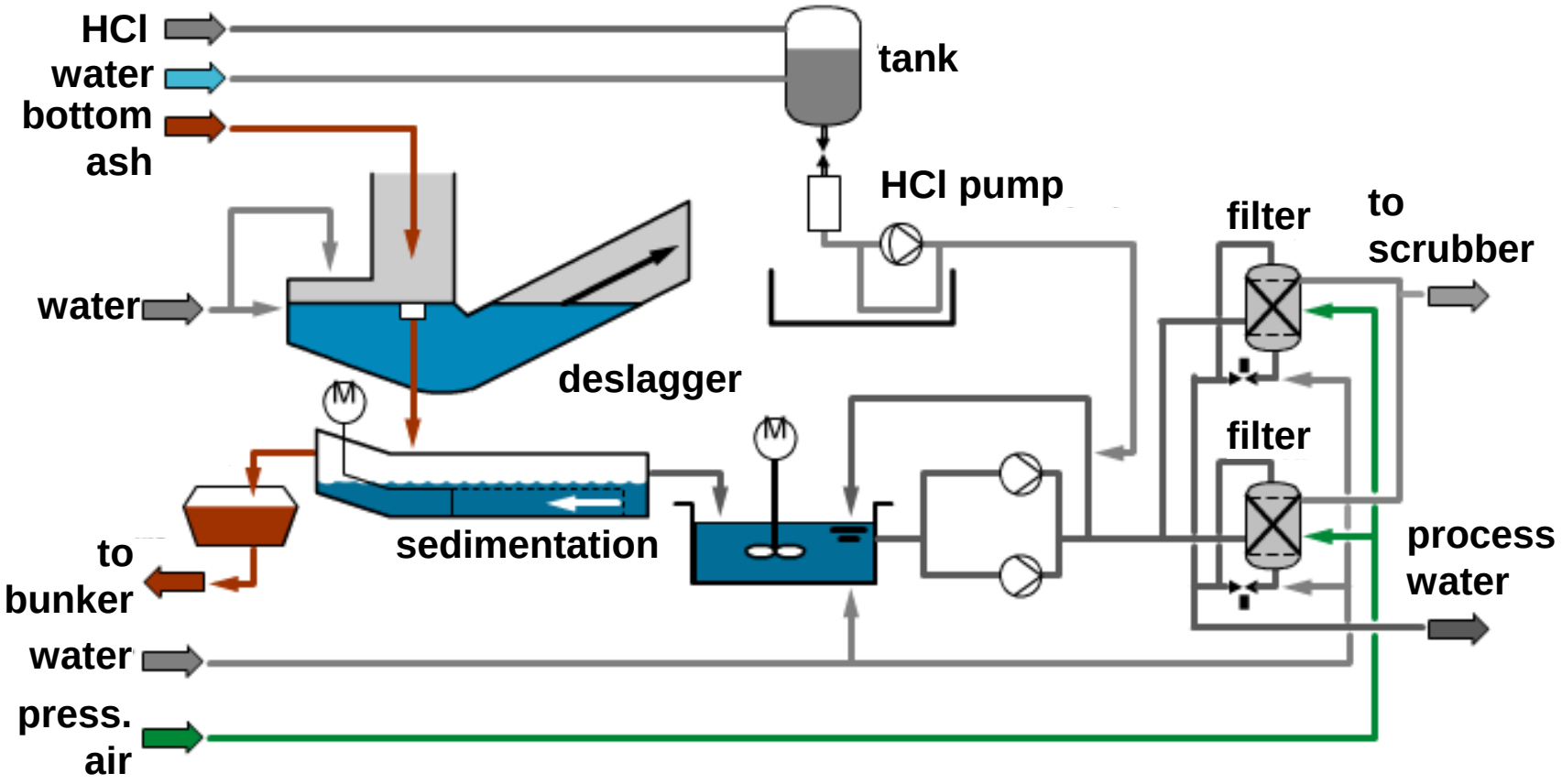
- **Ordinance on Environmentally Compatible Storage of Waste from Human Settlements (AbfAblV, 2001)**

utilisation

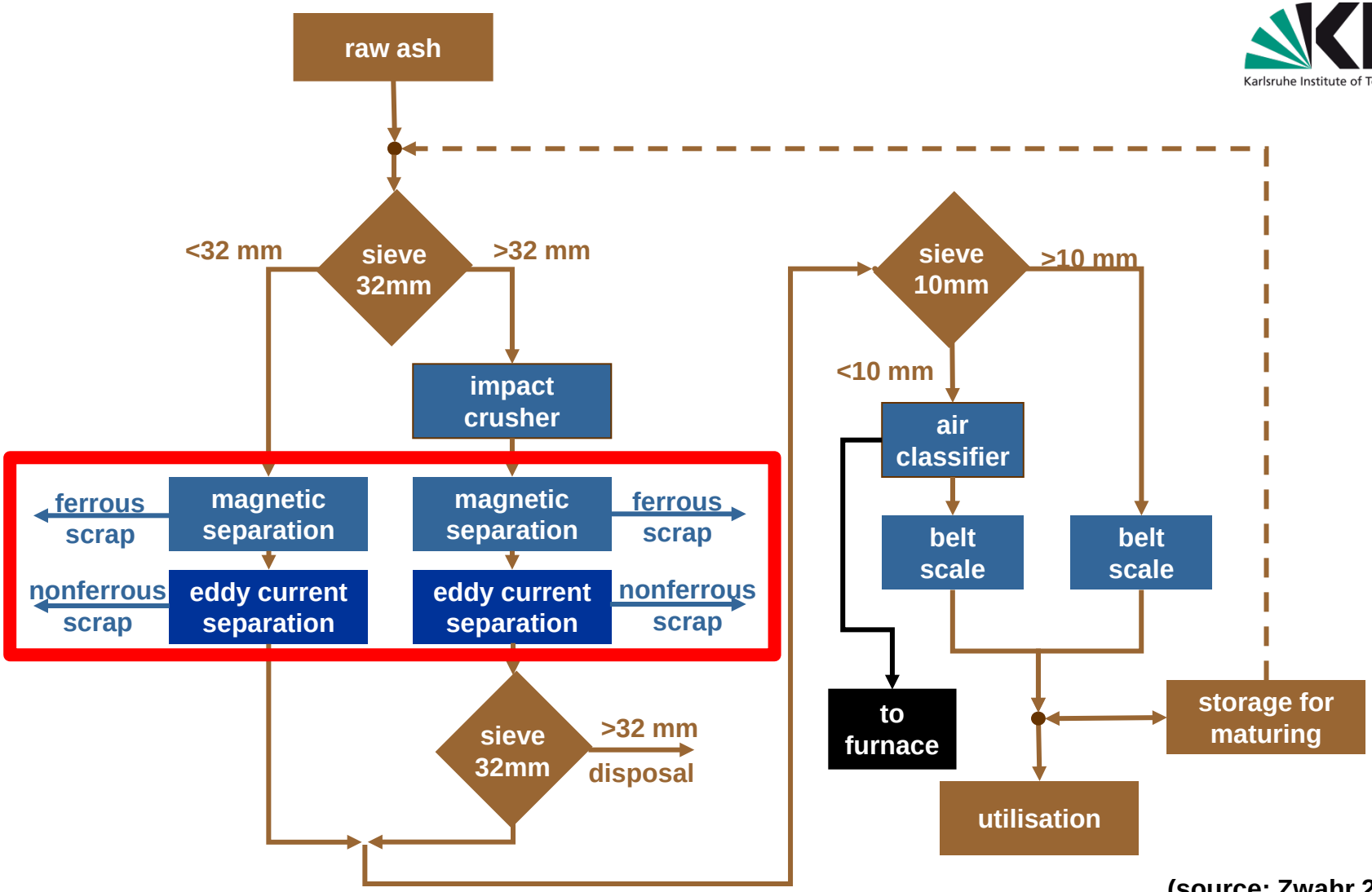
- **LAGA M19**
  - **investigation of raw bottom ash**
- **LAGA M20**
  - **regulations for utilisation**
- **leaflets of federal states,**
  road construction regulations (FGVS),
  ...

German landfill and utilisation standards

parameter	dimension	landfill class 1	landfill class 2	utilisation (LAGA M20)
LOI	%	3	5	
TOC	%	1	3	1
DIN EN 12457-4				
sol. fraction	%	3	6	
el. cond.	mS/m	1,000	5,000	600
Cl	mg/l			250
Ni	mg/l	0.2	1	1
Cu	mg/l	1	5	0.3
Zn	mg/l	2	5	0.3
Cd	mg/l	0.05	0.1	0.005
Pb	mg/l	0.2	1	0.05
strength				
vane shear strength	kN/m^2	25	25	25
axial deformation	%	20	20	20
uniaxial compr. strength	kN/m^2	50	50	50



bottom ash washing at MVR Hamburg



(source: Zwahr 2005)

treatment of bottom ash for utilisation (Hamburg)

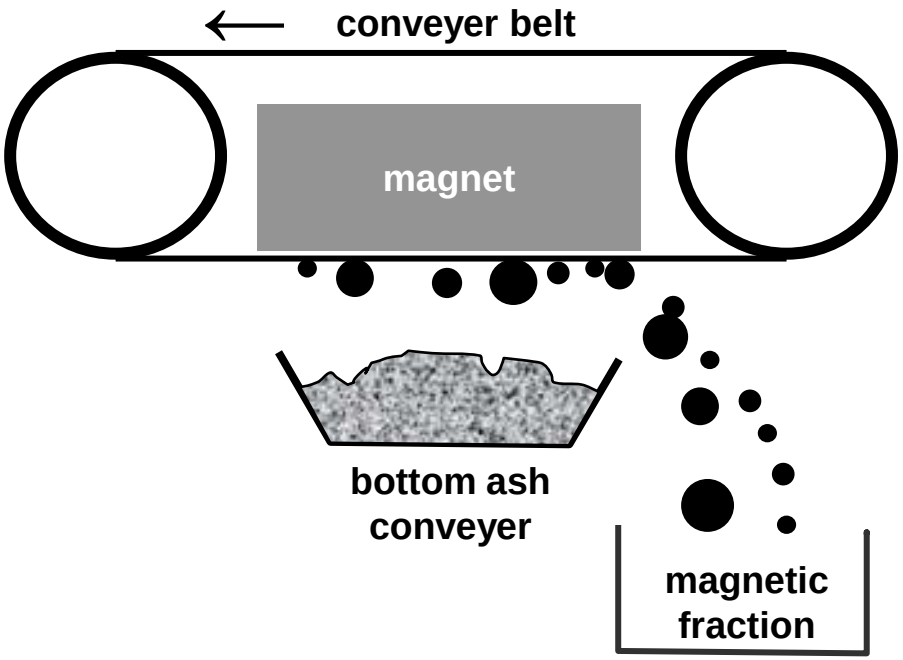
importance of metal separation

drivers

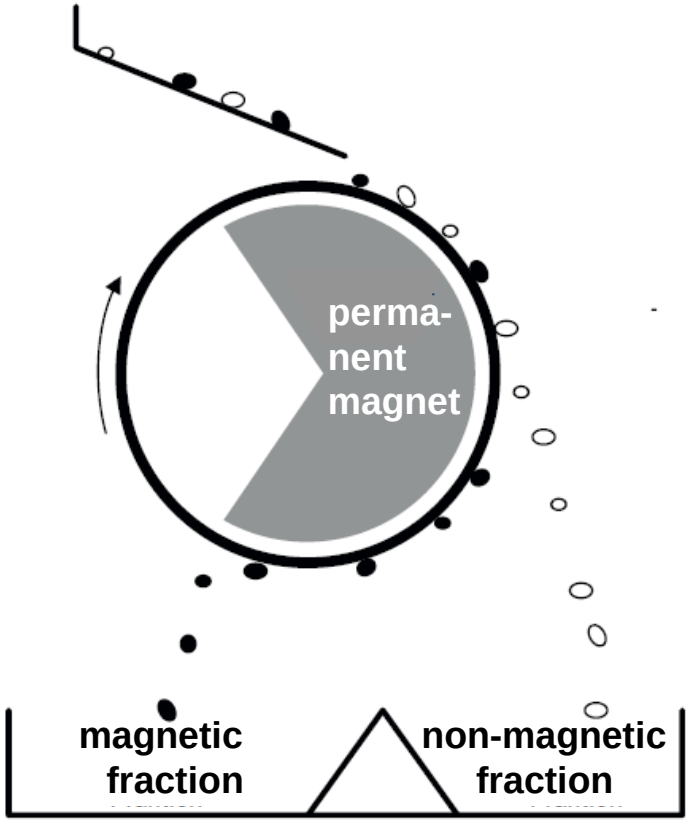
- unwanted effects in application (H_2 formation, swelling)
- economy, esp. for non-ferrous metals

status

- almost all plants practice ferrous scrap separation
- most plants implement eddy current systems
- conventional systems remove 60 – 70 % of ferrous and ≈ 30 % of non ferrous scrap
- many plants try to do special separation from fine fractions
- in Switzerland dry ash discharge is considered

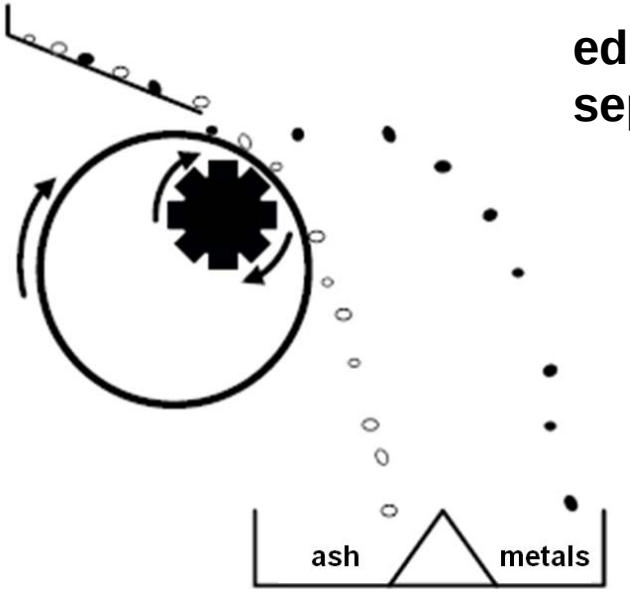


over-band system

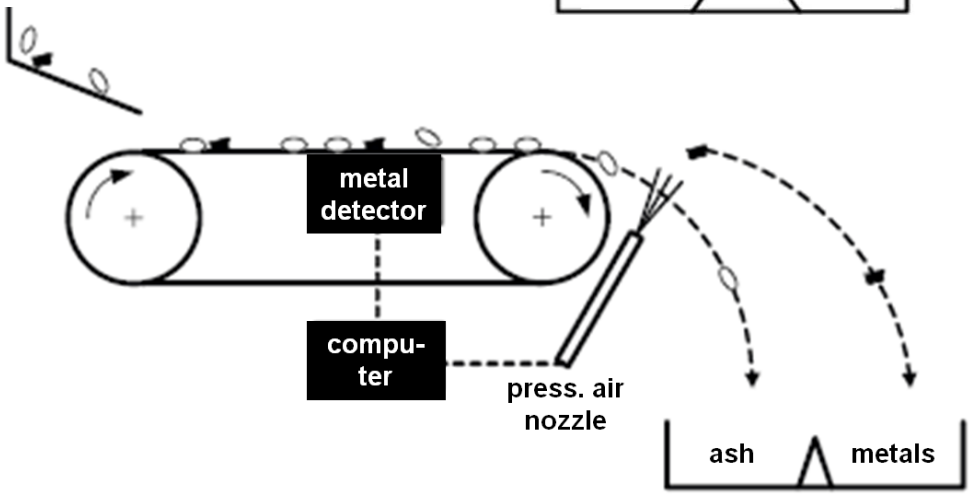


drum system

magnetic separation systems

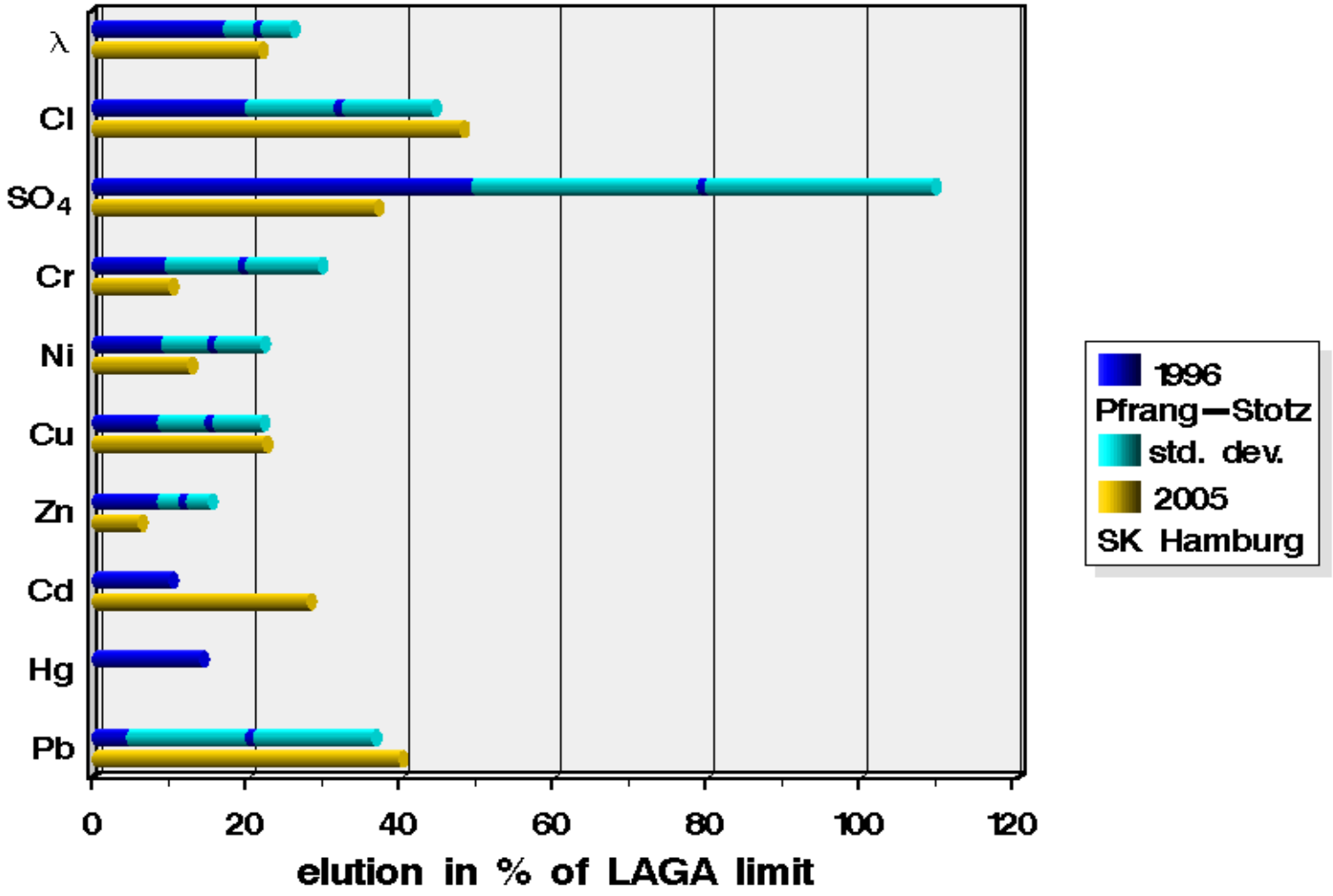


eddy current separator

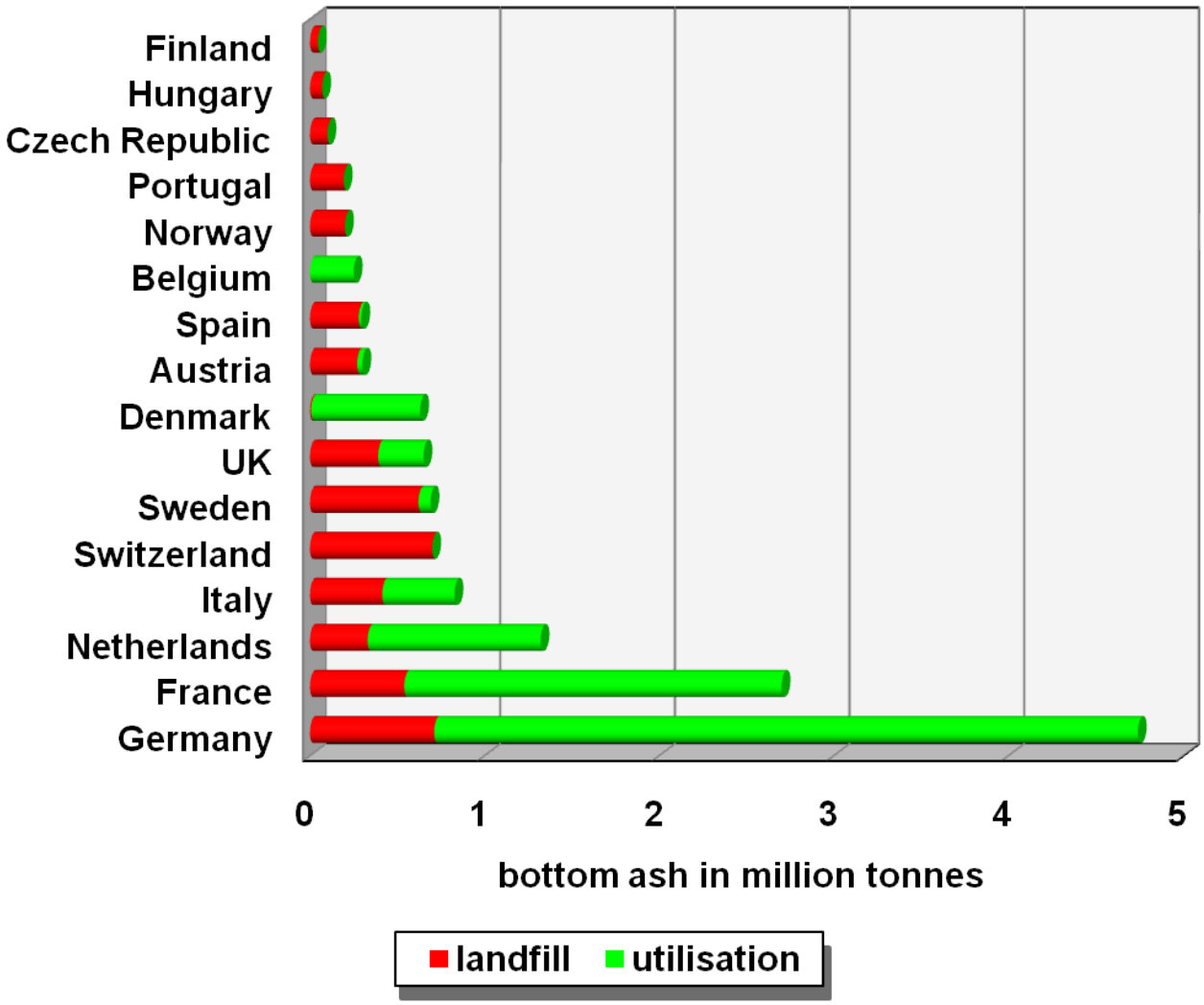


sensor operated separator

new metal separation systems



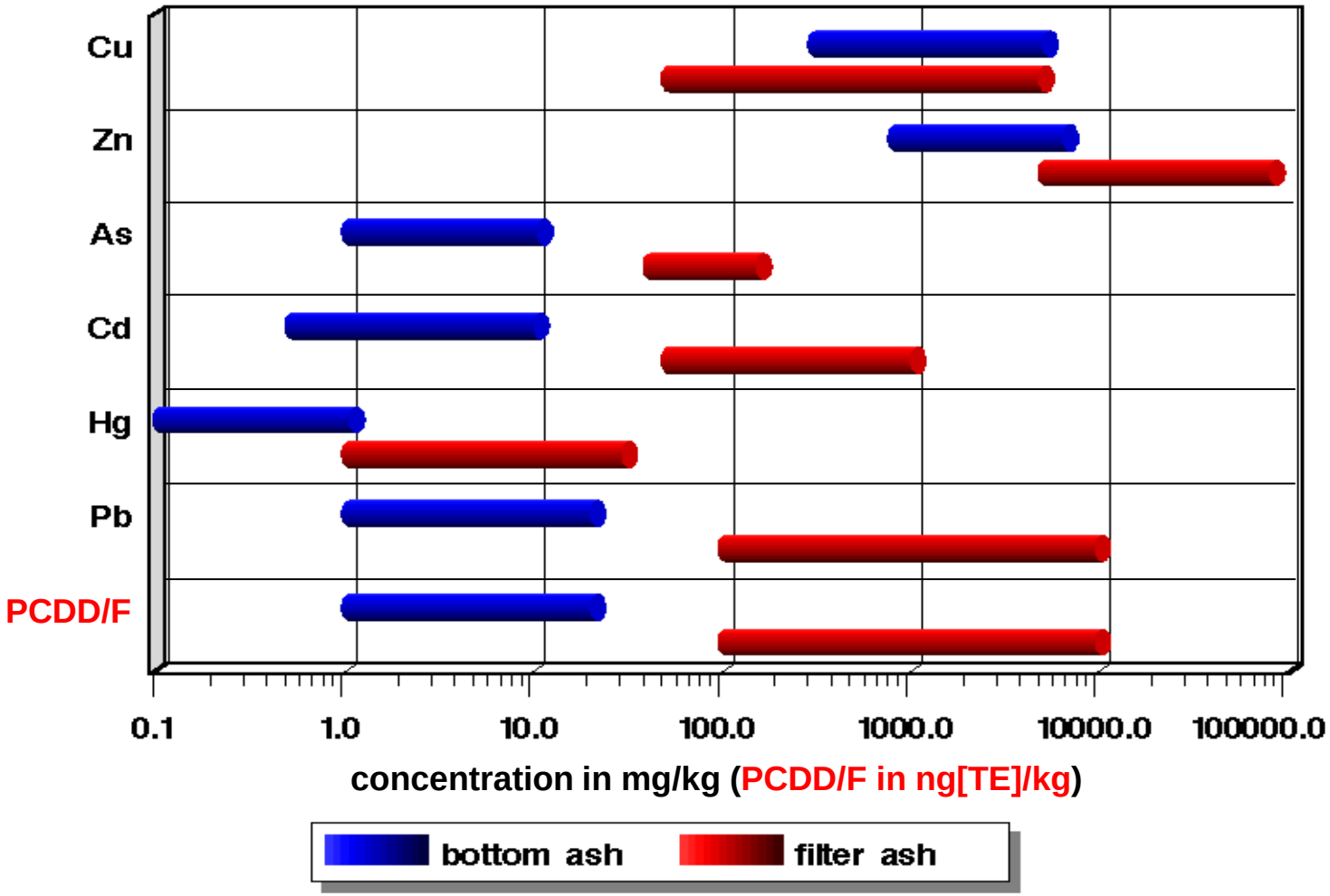
DEV S4 results of bottom ash samples



bottom ash management in selected countries

bottom ash management in selected countries

	year	*production [Mg/a]*	*utilisation [%]*	*specifics*
Austria	2008	358,000	10	'slag concrete for landfill'
Belgium	2008	490,000	100	secondary building material
Czech Republic	2008	100,000	0	landfilling
Denmark	2008	631,000	99	80% road construction
Finland	2008	45,000	0	landfilled
France	2008	2,700,000	80	civil engineering
Germany	2009	4,740,000	85	mainly road construction
Hungary	2008	105,000	0	landfilling
Italy	2008	827,310	50	landfilling
Netherlands	2009	1,500,000	100	building material
Norway	2008	200,000	0	landfilling
Portugal	2008	193,000	0	landfilling
Spain	2005	293,693	5	road construction
Sweden	2008	690,000	10	few cases of road construction
Switzerland	2008	700,000	0	landfilling
United Kingdom	2008	650,000	40	building material



selected pollutants in bottom and filter ash

filter ash management

problem

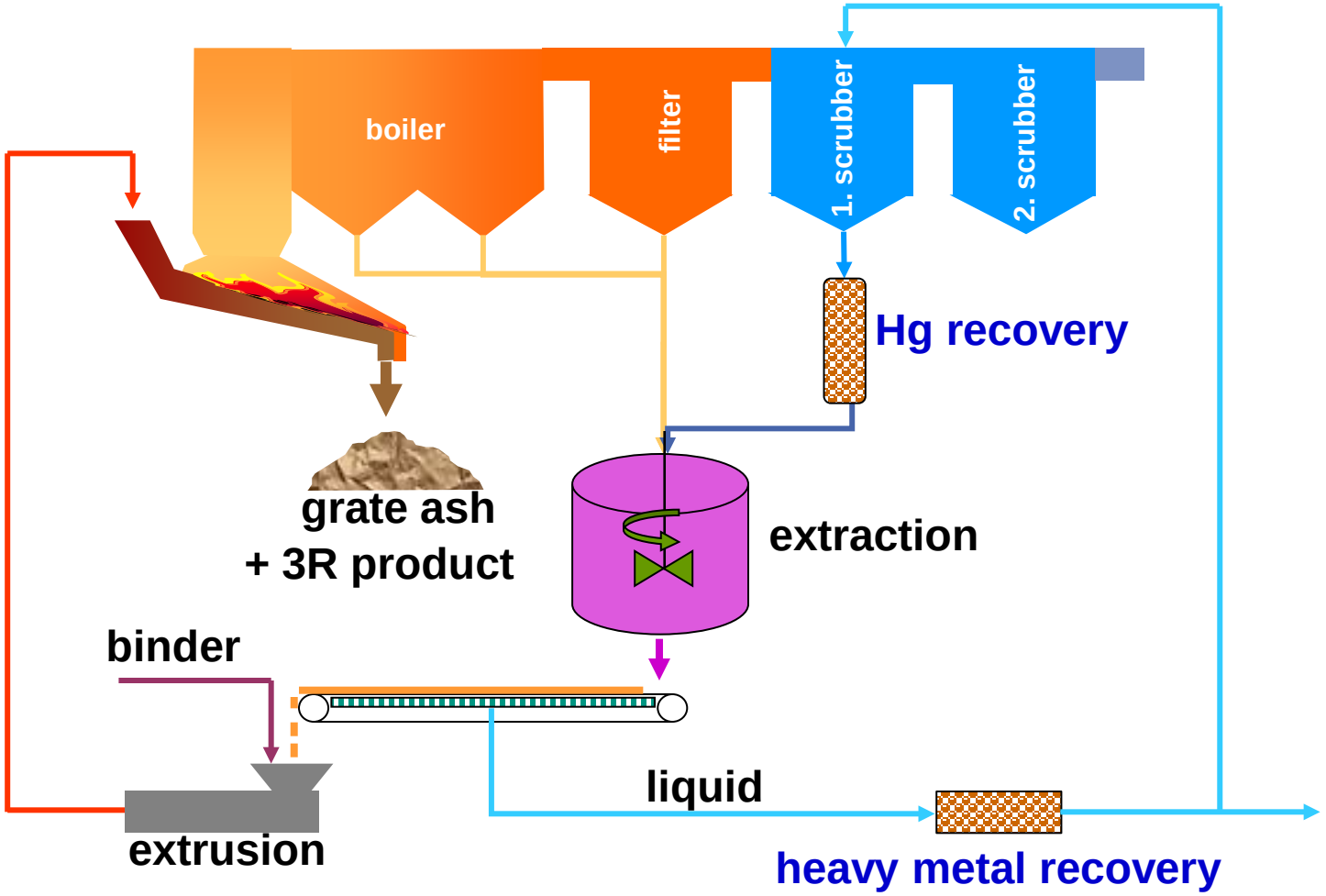
- high loads of salts, low volatile organics, and heavy metals

status

- hazardous landfill still preferred disposal practise
- so-called utilisation for
  - backfilling of salt mines in Germany
  - filling of an old quarry on Norwegian Island Langøya
- utilisation as asphalt filler in The Netherlands
- especially in Switzerland acid metal extraction (FLUWA)
  - option of thermal treatment of residues and metal recovery

filter ash management in selected countries

country	*year*	*production [Mg]*	*comments*
Austria	2004	40,000	mainly salt mine backfilling, hazardous landfill
Belgium	2004	50,000	solidification and haz. landfill
Czech Republic	2004	6,000	5000 hazardous landfill, 1000 underground mine
Denmark	2004	86,834	100% recycled (salt mine after special treatment)
France		400,000	
Germany	2005	650,000	utilisation in salt mine, minor amount haz. landfill
Hungary	2005	13,585	hazardous landfill
Italy	2004	75,000	hazardous landfill
Netherlands	2003	82,200	50% utilised in mines and as asphalt filler
Portugal	2005	40,000	inertisation before hazardous landfill
Spain	2005	94,420	hazardous. landfill
Sweden	2004	138,000	landfilling. partly utilisation in Norway (Langoya)
Switzerland	2008	70,000	metal extraction, landfill
United Kingdom	2000	78,125	hazardous landfill



scheme of the 3R Process

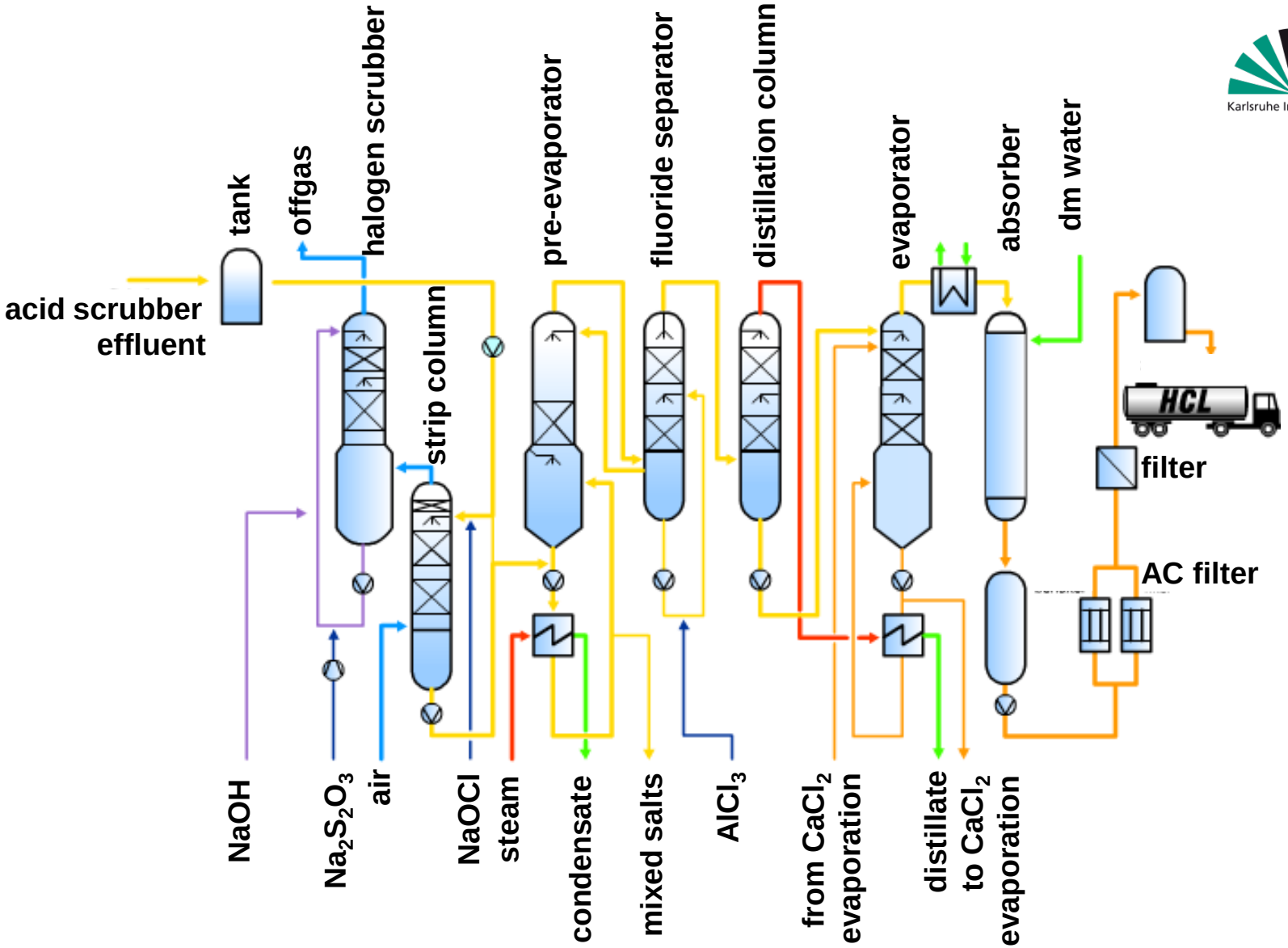
APC residue management

problem

- high loads of salts
- Hg
- heavy metals & organics in case of dry scrubbing without separate fly ash removal

status

- hazardous landfill still preferred disposal practise
- so-called utilisation in mines
- recovery of HCl and gypsum in few plants



HCl recovery at MVR Hamburg (Germany)

conclusions

bottom ashes

- are to an increasing extent utilized as building material
- secondary treatment pays only if a high quality of the products can be achieved

fly ashes

- hazardous landfill
- depending on availability backfilling of mines or quarries
- inertisation with metal recovery may come

APC residues

- recovery in case of Neutrec process
- few cases of HCl, NaCl, and gypsum recovery
- else: see fly ashes