Everyone talks about ICP why not talk about AAS as a change

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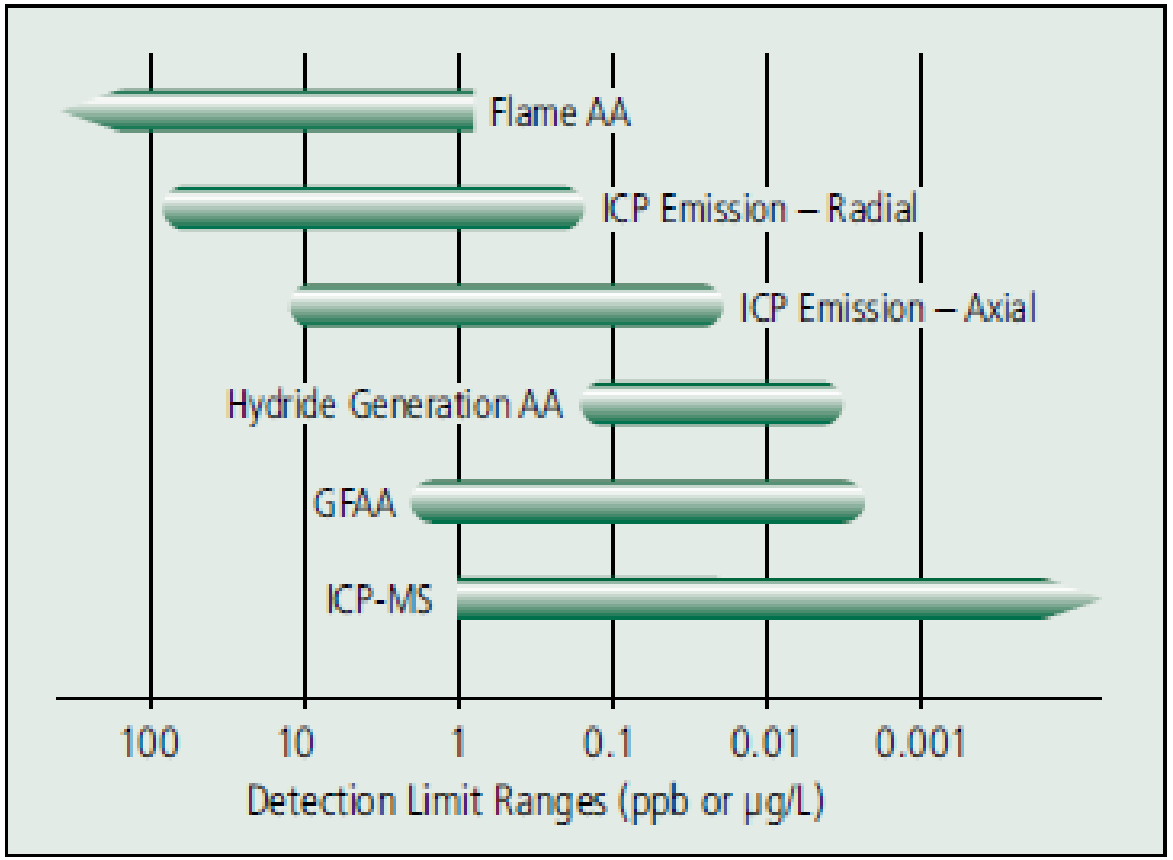
Customer requirements

- Easy to handle
  - Many operators
- Few samples
  - <10/day
- Few elements
  - Mn on daily basis
  - Al weekly
  - NPE monthly

Technique decision matrix

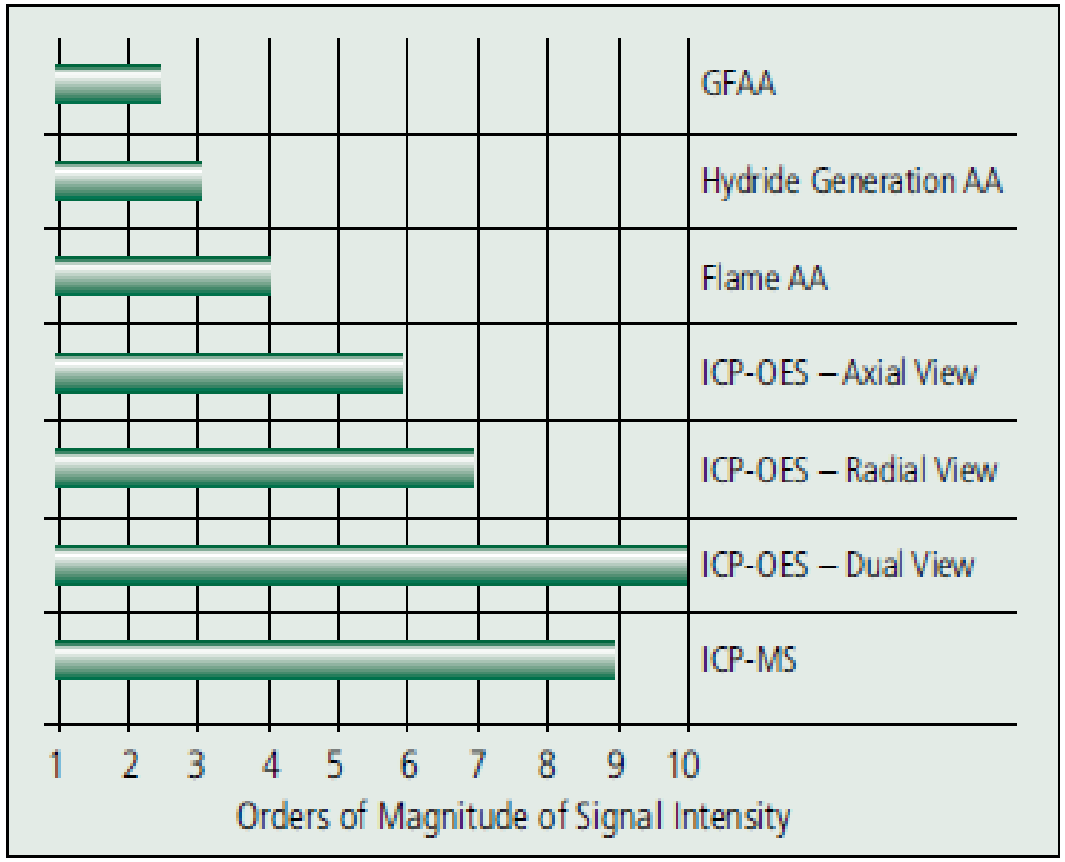
	Flame AA	GFAA	ICP-OES	ICP-MS
Number of elements	Few	Some	Many	Many
Content levels	ppb-%	ppb	ppb-%	ppt-ppb
Number of samples	Very few-few	Very few-few	Few-many	Few-many
Sample size	>5 ml	<1-2 ml	>5 ml	>5 ml

Typical detection limit ranges for the major atomic spectroscopy techniques



From PerkinElmer BRO_WorldLeaderAAICPMSICPMS.pdf

Typical analytical working ranges for the major atomic spectroscopy techniques



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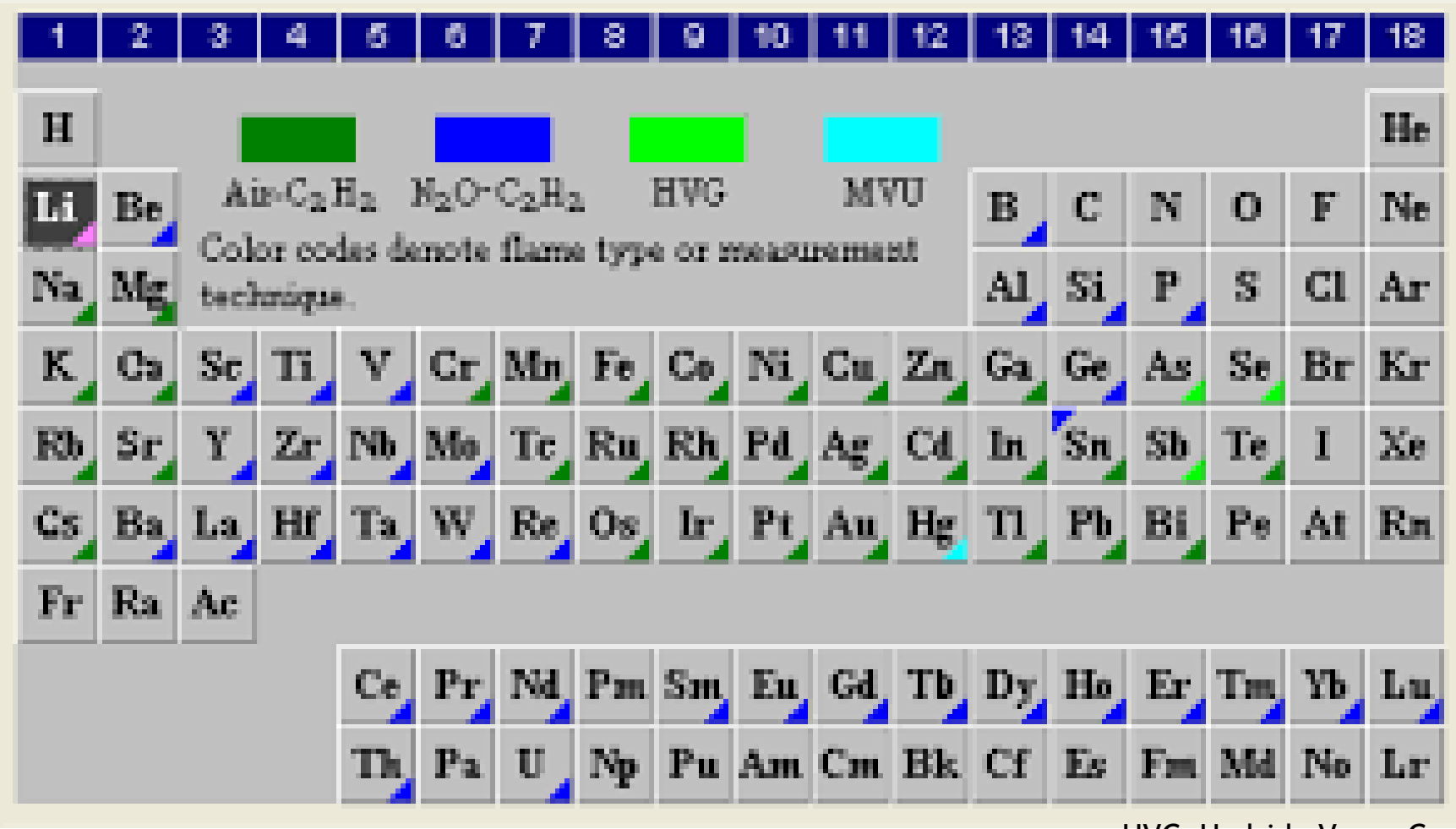
Analytical techniques Flame-AAS

- AAS
- AES
- Graphite Furnace
- Cold Vapor
- Hydride Generation

Gasblandning och analysteknik



HVG=Hydride Vapor Generator
MVU=Mercury Vapor Unit

Temperature for different flames

Oxidant - Fuel	Temperature °C
Air – Methane	1850 – 1900
Air – Natural gas	1700 – 1900
Air – Hydrogen	2000 – 2050
Air – Acetylene (AAS)	2125 – 2400
Nitrous oxide – Acetylene (AAS)	2600 - 2800

Burner system in a AAS

- Nebulizer
- End cap
- Flow spoiler
- Spray chamber
- Burner head

Interferences

Spectral interferences

1) Background

Nonspectral interferences

1) Matrix
2) Chemical
3) Ionization

Recommended conditions Flame – AAS (Mn)

λ (nm)	Relative noise	Sensitivity (mg/L)	Linear range (mg/L)
279,5	1,0	0,052	2,0
279,8	0,77	0,067	3,0
280,1	0,88	0,11	5,0
Flame	Air/Ac	lean, blue	
Slit	0,2 nm		
Flow spoiler			
0,2 % $CaCl_2$ can be added to overcome interference from silicon			

Sample types

- Wood
- Pulp
- Board
- Paper
- Effluent
- White Liquor
- Black Liquor
- Green Liquor
- ESP-ash
- Lime mud
- Lime

Which metals

Element	AAS-flame	AAS-THGA	ICP-OES	ICP-MS
Fe, Mn, Cu, Zn	x		x	x
Ca, Mg, Al	La/Cs (N_2O/Ac)		x	x
Na, K	Cs (ev. AES)		x	
Si	N_2O/Ac		x	
Cd, Co, Cr, Ni, Pb	x	x	x	x
As, Se, Sb	Hydride-AAS		x	x
Ba, V	x		x	x
Hg	CV-AAS			

Metal levels in different sample types

Element	Wood (mg/kg)	Pulp, bleeched (mg/kg)	Board (mg/kg)	White Liquor (mg/L)	Black Liquor (mg/kg)	ESP (mg/kg)
Na		700	600	8-9 %	20 %	31 %
K		5	15	0,8-0,9 %	2 %	4 %
Ca	1000	50-100	700	20	200-1000	50
Mn	150	1	30	5	50-100	40
Cd	0,1	0,002	0,01			1-5

Comparision AAS – ICP-OES in wood (eucalyptus)

	AAS	ICP	AAS	ICP	AAS	ICP	AAS	ICP	AAS	ICP
Digestion	**Fe**		**Mn**		**Cu**		**Ca**		**Mg**	
mg/kg	4,4	4,60	14,1	14,63	0,9	1,11	603	635	233	228
	5,9	6,23	14,3	14,95	1,0	1,38	614	642	239	238
	3,7	3,76	14,0	14,34	0,8	1,11	599	638	234	231
	3,8	3,92	14,1	14,43	0,9	1,12	603	647	236	238
	4,1	4,02	14,2	14,70	0,9	1,11	602	640	237	236
	7,9	8,08	14,0	14,63	0,9	1,11	592	638	234	234
average	**5,0**	**5,10**	**14,1**	**14,61**	**0,9**	**1,16**	**602**	**640**	**236**	**234**
std.dev	1,64	1,72	0,12	0,21	0,06	0,11	7,14	4,15	2,26	4,02

Conclusion

- Easy to handle
- Cheap
- ”Old” technique
- ?