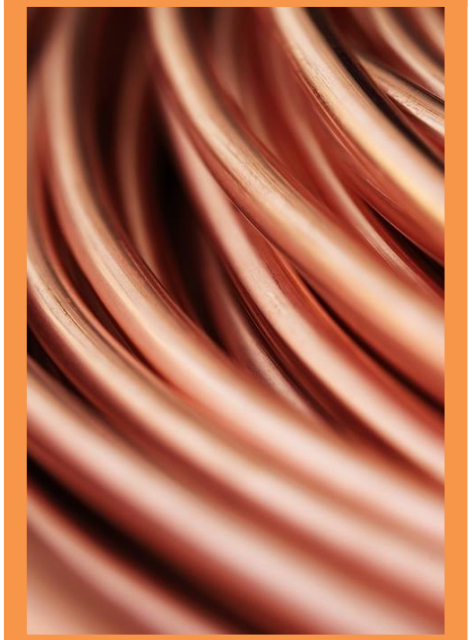
OE750

Determination of copper alloys

HITACHI
Inspire the Next



OE750 FOR HIGH-DEMAND COPPER ANALYSIS

BACKGROUND

The new OE750 is a ground-breaking new OES metals analyser. Covering the complete spectrum of elements in metal, it has some of the lowest detection limits in its class.

Fast measurement times, high reliability and low operating costs mean the OE750 is invaluable for everyday analysis and total quality control, with performance on a par with larger and more expensive spectrometers.

The OE750 analyses all alloying, treatment, trace, residual and tramp elements for copper applications.

It comes with software that makes analysis faster, more accurate and easier to interpret. This offers results analysis that helps with process control, and data management functionality allows full traceability of results – essential when it comes to audit time.

Optional extras include: adapters for wires and small samples, floor stand version, consumables and spare part kits, and sample preparation devices

KEY FEATURES

- Mid pressure system for extreme stability and highest transparency
- Wavelength range : 120 – 780 nm
- State-of-the-art CMOS high dynamic detectors
- Best optical resolution in class
- Minimised maintenance time
- Better reliability from newly developed excitation source

OE750

Determination of copper alloys

APPLICATION OF CU ALLOYS

Copper is a soft, malleable, and ductile metal with very high thermal and electrical conductivity. Copper is used as a conductor of heat and electricity, as a building material, and as a constituent of various metal alloys, such as sterling silver used in jewelry, cupronickel used to make marine hardware and coins, and constantan used in strain gauges and thermocouples for temperature measurement.

Numerous copper alloys have been formulated, many with important uses, brass is an alloy of copper and zinc. Bronze usually refers to copper-tin alloys, but can refer to any alloy of copper such as aluminum bronze.

Copper is one of the most important constituents of silver and karat gold solders used in the jewelry industry, modifying the colour, hardness and melting point of the resulting alloys. The alloy of copper and nickel, called cupronickel, is used in low-denomination coins. The alloy of 90% copper and 10% nickel, remarkable for its resistance to corrosion. is used for various objects exposed to seawater. though it is vulnerable to the sulfides sometimes found in polluted harbors and estuaries. Alloys of copper with aluminum (about 7%) have a golden colour and are used in decorations. Copper alloys have high resistance against corrosion. The best known traditional types are bronze, where tin is a significant addition, and brass, using zinc instead. Copper-alloy compositions loosely grouped into the categories: copper, high copper alloy, brasses, bronzes, copper nickels, copper–nickel–zinc (nickel silver), leaded copper, and special alloys.

The OE750 analyses copper anodes in copper refining companies and brass, bronzes, gun metals and other copper alloys in foundries.

Lyon, Stuart, (2010), Corrosion of Tin and its Alloys*, Shreir's Corrosion, 3, 2068-2077, 10,1016/B978-044452787-5,00099-8.

SAMPLE PREPARATION

Correct sample preparation is very important for precise and accurate OES results. A flat sample surface is essential. To achieve this, different techniques, like grinding or milling, are appropriate, depending on the material and the elements to be analysed.

Our recommendation is to use a milling machine equipped with indexable inserts specified for copper alloys. The machine should be optimised for each Cu alloy.

Alternatively, you can use a turning lathe.

For the results presented in this application note, all copper alloys were milled.

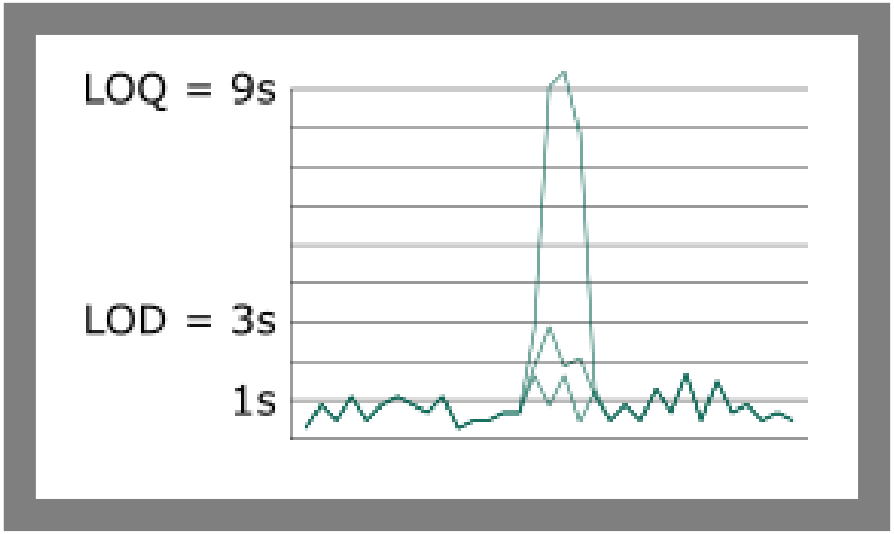
DIFFERENCE BETWEEN LOD AND LOQ

The BEC (equivalent concentration of spectral background) value is the concentration of the analysis sample required to produce the same intensity signal as the background at a given wavelength. The BEC is obtained from the calibration curve and is a fundamental process variable as it directly affects the LOD (**limit of detection**). The LOD is the smallest amount of an element detectable and it is calculated as follows:

$$LOD = \frac{3}{100} RSD_0 \times BEC$$

RSD_0 is correlated to the relative standard value of spectral background. With the BEC value calculated from the calibration curve, we are able to detect different elements in an alloyed copper base down to the level of precision (1δ).

However the **lowest quantitatively determinable amount** (Limit of Quantitation or LOQ) must be larger than the spectrometric LOC by a multiple of three. The resulting LOQ is the quantitatively readable value with our instrument.



Slickers. K. 1993. *Automatic-Atomic-Emission-Spectroscopy*. 2nd Edition. D-35334 Giessen. Germany: Brühlsche Universitätsdruckerei

OE750

HITACHI
Inspire the Next

Determination of copper alloys

SUB-programs & calibration range Cu base

		Cu_050 Pure copper		Cu_100 Be/Co/Ag alloy		Cu_200		Cu_300		Cu_350		Cu_400		Cu_450		Cu_500 Cu-Al alloy		Cu_000 Global		Copper Matrix	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Ag	Silver	0.0002	10	0.0005	15	0.0005	0.5	0.0005	1.2	0.0005	1.2	0.0002	0.5	0.0002	0.2			0.0005	5	0.0002	15
Al	Aluminum	0.0002	0.25	0.0002	0.1	0.0005	4	0.0005	1	0.0005	1	0.0004	1.7	0.0002	0.3	0.0004	13	0.001	12	0.0002	13
As	Arsenic	0.0002	0.5			0.0002	0.5	0.0005	1.8	0.0005	1.8					0.0002	0.5	0.001	2	0.0002	1.8
Au	Gold	0.0002	0.015																	0.0002	0.015
B	Boron	0.0001	0.1									0.0001	0.1					0.0001	0.05	0.0001	0.1
Be	Beryllium	0.0001	1	0.0005	2.5							0.0001	0.2					0.0005	2.2	0.0001	2.5
Bi	Bismuth	0.0005	0.1			0.001	7	0.0005	7	0.0005	1	0.0005	0.4					0.001	7	0.0005	7
C	Carbon											0.0002	0.1							0.0002	0.1
Cd	Cadmium	0.0001	1.3			0.0005	0.6	0.0005	0.5	0.0005	0.5	0.0005	0.5					0.0005	1.2	0.0001	1.3
Co	Cobalt	0.0003	1	0.0005	3.6	0.0005	0.5	0.0005	0.75	0.0005	0.75	0.0005	0.2	0.0005	0.5			0.001	3.6	0.0003	3.6
Cr	Chromium	0.0002	1.5	0.0005	0.1	0.0002	0.5	0.0002	0.1	0.0002	0.1	0.0002	3.2			0.0005	0.5	0.0005	3.2	0.0002	3.2
Fe	Iron	0.0003	0.5	0.0005	0.5	0.0003	2	0.0003	2.5	0.0003	1	0.0003	3	0.0003	0.5	0.0003	8	0.0005	7	0.0003	8
Mg	Magnesium	0.0001	0.1			0.0001	0.05					0.0001	0.1			0.0001	0.25	0.0001	0.2	0.0001	0.25
Mn	Manganese	0.0001	0.2	0.0005	0.1	0.0005	20	0.0002	2.5	0.0002	1	0.0001	5	0.0001	1	0.0001	7	0.0005	22	0.0001	20
Nb	Niobium											0.0005	1							0.0005	1
Ni	Nickel	0.0005	0.6	0.0005	0.6	0.001	5	0.0005	3.5	0.0005	3.5	0.0005	42	3	20	0.001	8	0.002	40	0.0005	42
O	Oxygen	0.001	0.05																	0.001	0.05
P	Phosphorous	0.0002	0.3	0.0002	0.3	0.0002	0.25	0.0002	1.2	0.0002	1.2	0.0002	0.3	0.0002	0.15	0.0002	0.2	0.0005	1.2	0.0002	1.2
Pb	Lead	0.0005	1	0.0002	0.75	0.0005	5	0.0005	24	0.0005	24	0.0002	0.5	0.0002	2.25	0.0002	1	0.0002	24	0.0002	24
S	Sulphur	0.0002	0.1	0.0002	0.1	0.0002	0.1	0.0002	0.2	0.0002	0.2	0.0002	0.2	0.0002	0.1	0.0002	0.5	0.0005	0.5	0.0002	0.5
Sb	Antimony	0.0005	0.4			0.001	0.8	0.001	4.5	0.001	1.2	0.001	0.5					0.001	5	0.0005	4.5
Se	Selenium	0.0001	0.4			0.0002	1.5	0.0002	1.6			0.001	0.5					0.001	1.6	0.0001	1.6
Si	Silicon	0.0002	2	0.0002	1	0.0002	4	0.0002	1	0.0002	1	0.0002	4	0.0002	1	0.0002	1	0.0005	4	0.0002	4
Sn	Tin	0.0001	0.5	0.0001	0.5	0.0001	11	0.0001	18	0.0005	18	0.0005	0.5	0.0001	0.5	0.0001	1	0.0005	20	0.0001	18
Te	Tellurium	0.0005	1															0.002	1	0.0005	1
Ti	Titanium											0.0002	0.1					0.0002	0.08	0.0002	0.1
Zn	Zinc	0.0002	0.5	0.0005	0.5	0.0005	50	0.0002	15	0.0002	15	0.0002	1.5	15	45	0.001	1	0.25	50	0.0002	50
Zr	Zirconium	0.0002	0.1									0.0001	0.1					0.0005	0.1	0.0001	0.1
		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard		Internal Standard	

OE750

HITACHI
Inspire the Next

Determination of copper alloys

Table of precision Cu alloys

Element	Ag	Al	As	Au	B	Be	Bi	C	Cd	Co	Cr	Fe	Mg	Mn
LOD	2	2	1	2	1	1	1	2	1	3	2	3	1	1
Concentration range (%)	0.0002 - 15	0.0002 - 13	0.0002 - 2	0.0002 - 0.015	0.0001 - 0.1	0.0001 - 2.5	0.0005 - 7	0.0002 - 0.1	0.0001 - 1.3	0.0003 - 3.6	0.0002 - 3.2	0.0003 - 8	0.0001 - 0.3	0.0001 - 20
Precision (1s) in % - ranges														
0.001	0.0002	0.0002	0.0005	0.0001	0.0001	0.0004	0.001	0.001	0.0001	0.0004	0.0002	0.0005	0.0001	0.0005
0.005	0.0002	0.0003	0.001	0.0003	0.0001	0.0005	0.001	0.001	0.0003	0.0004	0.0002	0.0005	0.0003	0.0005
0.01	0.0004	0.0003	0.0012	0.0005	0.0002	0.001	0.001	0.001	0.0005	0.0006	0.0002	0.0005	0.0004	0.0005
0.02	0.0005	0.0004	0.0015			0.0015	0.002	0.0015	0.001	0.0005	0.0005	0.0005	0.0005	0.0005
0.05	0.001	0.0005	0.002			0.002	0.002	0.002	0.002	0.001	0.0005	0.0005	0.0006	0.0005
0.1	0.002	0.0005	0.003			0.003	0.0025	0.0035	0.0035	0.0015	0.0005	0.001	0.001	0.001
0.2	0.004	0.0015	0.0045			0.0035	0.003		0.0075	0.002	0.001	0.0025	0.005	0.002
0.5	0.005	0.007	0.007			0.0045	0.005		0.008	0.004	0.003	0.006	0.001	0.006
1	0.01	0.015	0.003			0.0055	0.01		0.01	0.008	0.007	0.01		0.011
2	0.02	0.031	0.006			0.006	0.01		0.02	0.016	0.02	0.016		0.025
3.5	0.1	0.053				0.01	0.1			0.03	0.06	0.018		0.04
5	0.1	0.0725					0.1					0.01		0.055
10	0.15	0.12										0.011		0.1
15		0.15												0.135
20		0.15												0.15
30														
50														

Determination of copper alloys

Table of precision Cu alloys

Element	Nb	Ni	P	Pb	S	Sb	Se	Si	Sn	Te	Ti	Zn	Zr
LOD	5	5	2	2	2	5	1	2	1	5	2	2	1
Concentration range (%)	0.0005 - 1.0	0.0005 - 42	0.0002 - 1.2	0.0002 - 24	0.0002 - 0.5	0.0005 - 5	0.0001 - 1.6	0.0002 - 4	0.0001 - 20	0.0005 - 1	0.0002 - 0.1	0.0002 - 50	0.0001 - 0.1
Precision (1s) in % - ranges													
0.001	0.001	0.001	0.0008	0.0002	0.0001	0.0005	0.001	0.0005	0.0005	0.001	0.001	0.0001	0.0002
0.005	0.001	0.001	0.0007	0.0005	0.0005	0.0005	0.001	0.0006	0.0005	0.001	0.001	0.0002	0.0004
0.01	0.001	0.0015	0.0008	0.001	0.001	0.001	0.001	0.0006	0.004	0.0012	0.001	0.0003	0.0004
0.02	0.0015	0.0015	0.001	0.001	0.0015	0.002	0.0015	0.001	0.004	0.0015	0.0015	0.0005	
0.05	0.002	0.0015	0.002	0.0005	0.0025	0.005	0.002	0.001	0.0045	0.002	0.002	0.001	
0.1	0.0035	0.002	0.007	0.0015	0.0035	0.005	0.0035	0.0015	0.005	0.003	0.0035	0.0015	
0.2	0.006	0.002	0.005	0.0045	0.006	0.005	0.006	0.0025	0.006	0.0045		0.003	
0.5	0.015	0.004	0.01	0.0125	0.01	0.01	0.015	0.005	0.01	0.007		0.003	
1	0.025	0.007	0.015	0.025		0.03	0.025	0.009	0.015	0.003		0.005	
2		0.016		0.05		0.1	0.04	0.015	0.03			0.012	
3.5		0.04		0.075		0.3		0.015	0.05			0.025	
5		0.065		0.1		0.5		0.015	0.075			0.04	
10		0.07		0.1				0.065	0.16			0.075	
15		0.07		0.15				0.2	0.25			0.11	
20		0.08		0.2				0.25	0.3			0.15	
30		0.15		0.3								0.2	
50		0.25										0.3	

OE750

Determination of copper alloys

PERFORMANCE DISCLAIMER

Calibration ranges can be extended with customer's samples. Values obtained for certified reference samples only! Samples must be flat grinded or milled!

The published values are averaged data from very different type of material and should be regarded as "typical" values.