INSTITUTE OF NON-FERROUS METALS

Analytical Chemistry Department
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CERTIFICATE OF ANALYSIS

Copper of high purity

The average results of chemical analysis in ppm

No. / Element	CS6	CS7
Ag	8,5	13,7
As	0,20	0,9
Bi	<0,5	<0,5
Cd	(0,06)	(0,02)
Fe	20,8	4,9
Ni	0,8	4,4
Pb	(0,4)	0,9
Sb	1,0	1,0
Se	<1,0	<1,0
Sn	10,6	0,5
Te	<0,05	<0,05
Zn	1,4	-
Co	(0,20)	0,09
B	<0,5	<0,5
Mn	0,7	2,2
S	5,4	7,0
Cr	0,2	19,7
P	(1,5)	(2,4)
Si	-	<1,0

Director of the Institute

Prof. Ph.D. Zbigniew Śmieszek

Gliwice, November 2002

The uncertainity in ppm at the probability level of 0,05

No. / Element	CS6	CS7
Ag	0,5	0,4
As	0,07	0,1
Bi	-	-
Cd	-	-
Fe	1,5	0,2
Ni	0,4	0,4
Pb	-	0,4
Sb	0,3	0,2
Se	-	-
Sn	0,3	0,2
Te	-	-
Zn	0,4	-
Co	-	0,03
B	-	-
Mn	0,07	0,1
S	0,7	0,8
Cr	0,1	1,4
P	-	-
Si	-	-

Analytical methods applied:

Ag - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry directly on the background of matrix

As - atomic emission spectrometry with ICP and atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH4)

Bi - atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH4)

Cd - atomic emission spectrometry with ICP and atomic absorption spectrometry directly on the background of matrix

Fe - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after co-precipitation on $La(OH)_3$ (pH?)

Ni - atomic emission spectrometry with ICP and low voltage spark, spectrophotometric with dimethylglioxime after electrolytic copper separation and extraction of Ni with chloroform

Pb - atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH?)

Sb - atomic emission spectrometry with ICP and atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH4)

Se - atomic emission spectrometry with ICP and atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH4)

Sn - atomic emission spectrometry with ICP and low voltage spark, spectrophotometric with phenylophluoran after separation on MnO_2

Te - atomic absorption spectrometry after co-precipitation on $Fe(OH)_3$ (pH4)

Zn - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry after electrolytic copper separation

Co - atomic emission spectrometry with ICP, atomic absorption spectrometry directly or after electrolytic copper separation

B - atomic emission spectrometry with ICP

Mn - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry directly on the background of matrix

S - atomic emission spectrometry with ICP and low voltage spark, method of combusting and infrared determination of SO_2

Cr - atomic emission spectrometry with ICP and low voltage spark, atomic absorption spectrometry directly on the background of matrix

P - atomic emission spectrometry with ICP and spectrophotometric with blue-phosphoromolibdenate after extraction

Si - spectrophotometric with amyl-alcohol

The chemical analysis have been carried out in four specialistic industrial laboratories from Poland and in two laboratories of the Institute of Non-Ferrous Metals using when possible three different methods. Melts have been performed using vacuum furnace.

Copper CRMs after extrusion have a form of discs 40 mm in diameter and 25 mm in height or 6 mm in diameter and 100 mm long (CRMs CS6 only in form of discs).

Homogeneity investigations were made taking into account 30 % of the material produced. Investigations were carried out using the atomic emission spectrometry method with low voltage spark. Homogeneity was estimated statistically with application of the test F. Application of CRMs – Atomic emission spectrometry.

CRMs are stable in time.