SUPER-PURE OXYGEN-FREE COPPER — Chemical composition

Production Process

We have developed our own technology allowing us to predict, produce and supervise a chemical compound. The basic necessary equipment for our technology was designed and made by ourselves.

Analysis

Material was tested at various leading laboratories in Russia, the USA and China..

Analysis methods included Laser Mass Spectrometry (LMS), Atomic Emission Spectrometry (AES), Spark Source Mass Spectrometry (SSMS), Glow Discharge Mass Spectrometry (GDMS).

Not all methods, the equipment and qualification allow to measure chemical purity of copper equally. Especially it concerns purity of 5N+ and above. Some methods and laboratories cannot measure certain elements or test exactly, like they are real.

Analysis of our Copper requires methods appropriate to this level of purity, very good preparation of equipment, super-quality and super-pure materials and instruments (chemical substances, cutters and other work tools) for preparation of the copper sample for analysis, and the highest qualification level of the laboratory personnel.

Characteristics

Confirmation of quality of our product are characteristics which are independent of methods of the chemical analysis. Conductivity of our Copper is 104-105% IACS.

Traces of impurities (Experimental product according to analysis methods)

TC # 200310		ASTM B170	LMS, AES (ppm)		LMS + AES + SSMS * + GDMS * (ppm)		
Impurity			GRADE BASIC	GRADE EXTRA	GRADE BASIC		GRADE EXTRA		
			Max Typical	Max Typical	Max Typical Min		Max Typical Min		
			Only Limits of Detection LMS *or* AES						
1	P	x		< 0.1	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
2	Ni	x	< 0.1	< 0.08	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
3	Zn	x		< 0.08	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
4	As	x	< 0.08	< 0.1	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
5	Sn	x	< 0.2	< 0.2	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
6	Sb	x	< 0.2	< 0.2	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
7	Pb	x	< 0.2	< 0.2	< 0.02	< 0.01 < 0.01	< 0.02	< 0.01 < 0.002	
8	Bi	x	< 0.2	< 0.2	< 0.02	< 0.01 < 0.01	< 0.02	< 0.01 < 0.002	
9	Cd	x	< 0.2	< 0.02	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
10	Mn	x	< 0.1	< 0.002	< 0.01	< 0.005 < 0.01	< 0.01	< 0.005 < 0.002	
11	Se	x	< 0.1	< 0.2	< 0.1	< 0.04 < 0.01	< 0.1	< 0.04 < 0.002	
12	Te	x	< 0.2	< 0.2	< 0.04	< 0.02 < 0.01	< 0.04	< 0.02 < 0.002	
1-12			> 5N8		> 6N5 ≥ 6N8 ≥ 7N		> 6N5 ≥ 6N8 > 7N7		
			max typical	max typical					
13	Fe	x	1 < 0.5	0.3 ≤ 0.1	1 < 0.5	< 0.05	0.3 ≤ 0.1	< 0.005	
14	Ag	x	2.7 < 1	0.6 ≤ 0.2	2.7 < 1	< 0.1	0.6 ≤ 0.2	< 0.01	
Fe + Ag			≤ 2.7 ≤ 1	≤ 0.6	≤ 2.7 ≤ 1	≥ 0.3	≤ 0.6		
1 - 14			**5N5 5N7**	**5N7 5N8**	**5N7**	**6N 6N5**	**6N**	**> 6N5 > 7N5**	
			Only Limits of Detection LMS *or* AES						
15	S	x	< 3		≤ 0.3	< 0.2 < 0.1	≤ 0.3	< 0.2 < 0.05	
16	O	x	≤ 2 (<1, <2, rarely <3)		≤ 2 as the LMS Limit of Detection, it can be less				
Others :					Depending on method and qualification				
Al			< 0.1	< 0.01	< 0.002- < 0.02- <0.1				
Si			< 0.1 or < 0.2		< 0.002- < 0.02- <0.2				
Ca			< 0.1	< 0.08	< 0.002- < 0.02				
Mg			< 0.1	< 0.06	< 0.002- < 0.02				
Ti			< 0.1	< 0.02	< 0.002- < 0.02				
Cr			< 0.1	< 0.01	< 0.002- < 0.02				
Co			< 0.08	< 0.03	< 0.002- < 0.02				
any other			< 0.1 or < 0.2		< 0.002- < 0.02				
CU OXY-FRE :			**5N 5N2**	**5N3 5N3**	**5N5**	**5N7 5N7**	**5N7**	**5N7+ 5N8**	
O < 1 ppm			5N2- 5N3	5N4 5N4	5N6	5N8 6N	5N8-	5N8+ 6N	
O < 0.1 ppm			5N2 5N4	5N4 5N5	5N6+	6N 6N4	6N	6N2 6N8	
O < 0.05 ppm			5N3 5N4	5N5 5N5	5N7	6N 6N4	6N	6N2 7N	

Oxygen is counted "≤ 2 ppm"" as LMS Detection Limit of the current equipment. In reality, it can be <0.05 - <0.1 - <1 ppm. Our Technology allows to make it, if there will be facilities of such measuring. Needed Detection Limit is <0.01 ppm. In this case Cu OF (can be now or it can be made) :

* **Max- and Typical-** impurities by SSMS+GDMS are not for the best tests, some possible inaccuracies and small possible mistakes were taken into account and added, but still they are for the sufficiently qualified measurement. For **Min** of impurities there is need for the highest level of testing, also possibly by other methods appropriate to this level. Limits of sensitivity " <x - <0.00x " were considered (were subtracted from 100 %) at calculation of purity **as corresponding quantity of impurities**.

SUPER-PURE OXYGEN-FREE COPPER Cu 7-10N

Some part of product can has very high level of purity, like it is presented in the table below. Forecast is based on our Technology and result has to be very close. We do not know where and how to test it. Our Technology can to produce it.

We tested the sample which close to ~med/avg of the current **GRADE EXTRA** lot and have received the result in the form of Certificate T10-28. The result is very good, but some elements have been tested not so well as they are real: the laboratory two times corrected mistakes which we have noted, also we have paid their attention to only the greatest deviations from expected values and their possible reasons. The laboratory does not know why they were so mistaken ... It is complex to measure some elements precisely by method GDMS, at least in its standard execution. Some elements are more correctly tested by method SSMS, but the method has the specificity too.

Our Technology let us control chemical composition of our product and predict the analyses results with high precision. If limits of detection of a method allow to measure a necessary level and result is an unacceptable difference with expected values, we can assert and are assured that measurement is incorrect. That was confirmed and it is not automatically true for other product. Some quality of our product is outside of standard opportunities even of leading laboratories.

Copper below requires the best preparation of equipment appropriate to this level of purity, in super-quality and super-pure materials and instruments (chemical substances, cutters and other work tools) for preparation of the copper sample for analysis and the highest qualification level of the laboratory personnel.

Element	Needed limit of detection	Expected results	Element	Needed limit of detection	Expected results	Element	Needed limit of detection	Expected results
	ppb (0.001ppm)			**ppb** (0.001ppm)			**ppb** (0.001ppm)	
Li	< 0.1	< 1	Ga	< 0.1	< 1	Nd	< 0.1	< 1
Be	< 0.1	< 1	Ge	< 0.1	< 1	Sm	< 0.1	< 1
B	< 0.1	< 1	As	< 0.1	< 5	Eu	< 0.1	< 1
C	-	-	Se	< 0.1	< 5	Gd	< 0.1	< 1
N	-	-	Br	< 0.1	< 1	Tb	< 0.1	< 1
O	< 1	< 10-50?	Rb	< 0.1	< 1	Dy	< 0.1	< 1
F	< 0.1	< 5	Sr	< 0.1	< 1	Ho	< 0.1	< 1
Na	< 0.1	< 1	Y	< 0.1	< 1	Er	< 0.1	< 1
Mg	< 0.1	< 1	Zr	< 0.1	< 1	Tm	< 0.1	< 1
Al	< 0.1	< 5	Nb	< 0.1	< 1	Yb	< 0.1	< 1
Si	< 0.1	< 5	Mo	< 0.1	< 1	Lu	< 0.1	< 1
P	< 0.1	< 5	Ru	< 0.1	< 1	Hf	< 0.1	< 1
S	< 1	< 10-50?	Rh	< 0.1	< 1	Ta	< 0.1	< 1
Cl	< 0.1	< 5	Pd	< 0.1	< 1	W	< 0.1	< 1
K	< 0.1	< 1	Ag	< 0.1	< 5	Re	< 0.1	< 1
Ca	< 0.1	< 5	Cd	< 0.1	< 1	Os	< 0.1	< 1
Sc	< 0.1	< 1	In	< 0.1	< 5	Ir	< 0.1	< 1
Ti	< 0.1	< 1	Sn	< 0.1	< 5	Pt	< 0.1	< 1
V	< 0.1	< 1	Sb	< 0.1	< 5	Au	< 0.1	< 1
Cr	< 0.1	< 1	Te	< 0.1	< 5	Hg	< 0.1	< 1
Mn	< 0.1	< 1	I	< 0.1	< 5	Tl	< 0.1	< 1
Fe	< 0.1	< 5	Cs	< 0.1	< 1	Pb	< 0.1	< 1
Co	< 0.1	< 1	Ba	< 0.1	< 1	Bi	< 0.1	< 1
Ni	< 0.1	< 1	La	< 0.1	< 1	Th	< 0.01	< 0.01
Cu	--	--	Ce	< 0.1	< 1	U	< 0.01	< 0.01
Zn	< 0.1	< 1	Pr	< 0.1	< 1			

The expected result will be close (* If to pay attention only to the level of impurity, not all and not their sums , like sometimes it is done...) :

Cu OF	All metals : > 60	Cu (1 - ≤ 14)	Cu (1 - ≤ 14)*	Cu (1 - ≤ 14), OF *
7N-8N	7N-8N	7N7-8N8	8N-10N	8N-10N