

RAUTOMEAD UPWARDS VERTICAL CASTING MACHINES

COPPER CATHODE FEEDSTOCK

Introduction

Rautomead upwards vertical casting machines have been designed to accept copper cathode as the feedstock in production of oxygen-free copper rod and certain copper alloys. In all but the smallest models, the cathode sheets are fed (without pre-cutting) into the machine and are melted and cast in a single furnace.

Where a manually operated cathode feed is specified, the cathodes must be stacked vertically adjacent to the machine and from that position they are lifted by pneumatically-operated gripper jaws suspended from an electric hoist, advanced and lowered into the furnace crucible under the control of the operator.

Where an automatic cathode feed system is specified, the pallets of horizontally stacked cathodes are loaded into a cathode stacking bin on the floor at rear of the operating platform from where they are fed automatically to the casting machine without manual attention.

Quality

The Rautomead process is metallurgically a very clean system and is designed to remove residual oxygen from the copper. On the other hand, the process is not a refining one. Thus, it is important that the specification of the cathode used is carefully considered, having regard to the properties required in the cast rod.

Grade A Cathode

It is **strongly recommended** that only cathode conforming to the London Metal Exchange (LME) 'Grade A' **electrolytically refined** specification is used. This material specification conforms to British Standard BS EN 1978:1998. The cathode grade designation is Cu-CATH-1. See chemical composition Appendix I. The equivalent American standard is ASTM B 115-72.

Units of Quantity

Cu-CATH-1 is available in lots of 25 tonnes. Individual bundles are of not more than 4 tonnes.

COPPER CATHODE FEEDSTOCK (cont'd)

Cathode Sizes and Weights

Cathode sheets vary in dimensions and weight. Most cathodes are nominally 1.0 metres square, though this can range from 0.9 metres up to 1.2 metres. Cathodes larger than 1.1 metres in either dimension are not recommended for use with the automatic cathode feed system. Cathode weight varies from approx. 50 kgs up to approx. 160 kgs, cathodes within this weight range may be used with either cathode feed system.

Electrolytically Refined versus Electro-won (SXEW) Cathode

Care must be taken to specify electrolytically refined cathode. Electrolytically refined cathodes may be either ISA Process type or "full deposit" type.

ISA Process

Copper Refineries Pty Ltd, a subsidiary of MIM Holdings Ltd of Queensland, Australia developed the ISA Process, of plating copper on to a stainless steel sheet as an improved cathode production process.

The ISA Process is used in both electrorefining and solvent extraction (SX Electrowon) cathode manufacture.

Though it is still grouped under the generic term 'Grade A', the electro-refined ISA process produces a particularly pure type of copper cathode - see examples of chemical compositions compared with Standard (copy follows).

The individual copper cathode sheets are thinner and lighter (typically approx. 60 kgs) than traditional "full deposit" cathode. They have no suspension lugs and are relatively smooth surfaced.

Brands

A listing of cathode brands and cathode type (ER or EW) follows. This includes the ISA Process brands (see above). It should be noted that not all Grade A cathode brands are ISA process electro-refined cathodes.

Availability

The LME maintains warehouse stocks throughout the world. Rautomead can assist with introductions to cathode brokers and suppliers around the world.

COPPER CATHODE FEEDSTOCK (cont'd)

Recommendations

1. Rautomead strongly recommends the use of electro-refined Grade A cathode produced by the ISA Process in all applications. This recommendation is made on the basis of:

chemical composition	simpler automatic handling
reputation	consistency
smooth unoxidised surface	free of suspension lugs with their attendant problems of trapped electrolyte
convenient size	
lower trapped impurities	

2. Other types of electro-refined Grade A cathode are also suitable, but care must be taken to ensure that metallic contaminants or heavy oxidation are not present on the surface and that moisture is not trapped either in surface “bubbles” or in the suspension lugs.
3. Careful attention should be paid to levels of impurities in different brands of Grade A cathode. Conformity with the standard specification does not represent an adequate guarantee of success in drawing to fine wire. The presence of bismuth, tellurium, selenium or sulphur, even in small amounts is detrimental to performance.
4. The automatic cathode feed system is suitable for use with either ISA process or full deposit electro-refined cathodes :

Maximum cathode size : 1100 x 1100mm square
 Maximum cathode weight : 160 kgs
 Typical cathode weight : 45 – 100 kgs
 Cathode surface to be dry, clean, bright, flat, unoxidised and free from electrolyte nodules. Lugs (electro-refined) must be removed from cathodes prior to stacking bin.

5. **Gas Inclusions**

Gas inclusions in certain brands of copper cathode can cause explosions when the copper is melted and can be a serious **THREAT TO LIFE**. Explosions caused by gas expansion within the melt will progressively weaken the graphite crucible and will cause premature structural failure.

COPPER CATHODE FEEDSTOCK (cont'd)

Recommendations (cont'd)

6. **Moisture**

In all cases, greatest care and attention must be given to avoid moisture being introduced to the furnace with the cathodes. Moisture risks causing hydrogen gas porosity in the cast rod, represents an explosion hazard and can be a serious **THREAT TO LIFE**. “Bumps” and “pops” occurring as small explosions within the melt will progressively weaken the graphite crucible and will cause premature structural failure.

Surface moisture can be caused by cathodes being transported or stored in the open, or by condensation on the surface of the sheets. Cathodes should be protected in transport and stored under cover. Storage for 5-7 days in proximity to the casting machine is normally sufficient to avoid surface condensation. Operators should be alert to the possibility of finding condensation within a pack of tightly packed cathode sheets.

Internal moisture can be caused by trapped electrolyte under the surface of the copper and around the suspension lugs of full deposit cathode sheets. Brands with trapped electrolyte should not be used.

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Cu-CATH-1 Chemical Composition

Element	Symbol	Specification	ISA Brands (typical)		Typical Rautomead Rod – Customer A	Typical Rautomead Rod – Customer B
			Grade A ppm	JB ppm		
Bismuth	Bi	<2.0	<0.8	<0.2	0.24	0.04
Selenium	Se	<2.0	<0.3	<0.3	---	1.5
Tellurium	Ti	<2.0	<1.0	<0.2	0.05	<0.3
group		<3.0	<2.1	<0.6		
Arsenic	As	<5.0	0.8	0.1	0.86	<0.2
Cadmium	Cd		0.1	<0.1	0.05	<0.1
Chromium	Cr		<0.5	<0.1	0.01	<1
Manganese	Mn		0.4	<0.1	0.005	<1
Phosphorous	P		<0.3	<0.1	0.04	<2
Antimony	Sb	<4.0	<1.0	<0.1	---	<0.5
group		<15.0	<3.0	<0.5		
Lead	Pb	<5.0	2.0	<0.1	0.28	0.5
Sulphur	S	<15.0	6.9	<4.0	8.0	5.9
Cobalt	Co		<0.5	<0.1	0.01	<2
Iron	Fe	<10.0	2.0	<0.7	0.7	1.5
Nickel	Ni		1.3	<0.1	0.19	0.4
Silicon	Si		0.6		0.62	
Tin	Sn		<0.3	<0.1	0.01	0.2
Zinc	Zn		<1.5	<0.1	0.09	0.2
group		<20.0	<6.0	<1.0		
Silver	Ag	<25.0	12.0	<5.0	9.3	7.4
Oxygen	O				1.8	<2
Carbon	C				<0.4	
Aluminium	Al				0.11	
Boron	B				0.01	
Total		<65.0	<32.0	<15.0		