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For the attention of Mr P Johns

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Thioacetamide Accelerated Tarnish Testing of Silver Alloys

1.0 Abstract

Although silver and high silver content alloys are resistant to many corrosive agents, they are attacked by sulphurous fumes that cause the surface to tarnish and blacken. The tarnish film consists mainly of silver sulphide (Ag_2S) or a mixture of Ag_2S and copper sulphide (Cu_2S) in the case of Standard Sterling (92.5 % Ag; 7.5% Cu).

Argentium™ Silver Company Ltd have been developing a new Sterling quality silver alloy with the registered name Argentium™ Sterling Silver. The formation of a regenerative oxide protects the Argentium™ Sterling Silver from tarnishing.

CATRA, as an independent testing laboratory, have conducted trials to compare the tarnish properties of Standard Sterling and Argentium™ Sterling, by testing to BS EN ISO 4538: 1995 Thioacetamide tarnish test.

The polished samples of Argentium™ Sterling silver and Standard Sterling silver were provided by Stern-Leach, USA.

Before testing, polished samples of both alloys were degreased ultrasonically using solvent cleaners to remove contamination, mainly buffing compounds.

Photographic records were used to visually document the tarnishing behaviour of the two alloys when exposed to the accelerated tarnish test procedures over set periods of time.

In the BS EN ISO 4538: 1995 Thioacetamide test the Standard Sterling started to tarnish at 1 hour and gradually developed severe dark discolouration over a period of 10 hours whilst in comparison, Argentium™ Sterling started tarnishing at 10 hours.

2.0 Experimental

2.1 *Materials*

The (5 cm x 2.0 & 2.25 cm x 1 mm) Standard Sterling and Argentium ™ Sterling alloys were supplied in the polished condition.

2.2 Surface Preparation

The polished surfaces were degreased as follows:

a) N-Hexane – wiped with solvent to remove excess polishing compound.
b) N-Hexane - ultrasonically cleaned in solvent for 5 minutes.
c) Chloroform - ultrasonically cleaned in solvent for 5 minutes
d) IPA - ultrasonically cleaned in solvent for 5 minutes
e) Ethanol - ultrasonically cleaned in solvent for 5 minutes

The solvents used for degreasing the samples were at room temperature (24^0C).

2.3 Test Method

2.3.1 Thioacetamide

BS EN ISO 4538:1995 Thioacetamide corrosion test, ***figure 1***, requires the sample to sit in a closed, gas-tight chamber that contains a saturated solution of sodium acetate tri-hydrate and thioacetamide distributed on a horizontal plate within the chamber (50mg per square decimetre of surface). This ensures that the test atmosphere contains volatile sulphides for the duration of the test, with a relative humidity of 75% at 20 $^{\pm}$5°C within the sealed container
The samples sat 65 mm above the plate at an ambient temperature of 24°C.

2.4 Test Procedure

2.4.1 Thioacetamide

The solvent cleaned polished samples were placed in the thioacetamide chamber and observed frequently over a period of 10 hours. The Standard Sterling started to tarnish at 1 hour whilst the Argentium™ Sterling did not start to tarnish until 10 hours exposure. The Standard Sterling gradually discoloured over this period to become dark brown and dark blue at the edges.
A photograph showing the degree of tarnish at 10 hours is shown in ***figure 2***.

Conclusion

The Argentium™ Sterling alloy remained tarnish resistant in the BS EN ISO 4538: 1995 Thioacetamide test for a period of 10 hours compared to the Standard Sterling silver that commenced tarnishing at 1 hour and gradually deteriorated with time to become brown and dark blue around the edges at 10 hours duration.

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Figure 1

Thioacetamide Test Chamber

Figure 2

After 10 hours exposure in Thioacetamide chamber

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