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Our ref: GG/GLS/956994

8 August 2002

For the attention of Mr P Johns

Report No: 956994

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).

Middlesex University have been developing a new Sterling quality silver alloy with the registered name Argentium® Sterling*. The formation of a regenerative oxide protects the Argentium® Sterling 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:-

1. BS EN ISO 4538: 1995 Thioacetamide tarnish test.
2. Dilute Ammonium Polysulphide solution tarnish test.

Before testing, polished samples of both alloys were degreased in a n-propyl bromide based solvent cleaner to remove 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 both the BS EN ISO 4538: 1995 Thioacetamide test and the Ammonium Polysulphide test, Standard Sterling developed severe dark discolouration. In comparison, Argentium® Sterling, remained clean and bright.

* Argentium® Sterling supplied by Thessco Limited, Sheffield, UK.

2.0 Experimental

2.1 *Materials*

The (3.5 cm x 1 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 in an ultrasonic bath using a n-propyl bromide based solvent, ***figure 1***.

2.3 Test Methods

2.3.1 Thioacetamide

BS EN ISO 4538:1995 Thioacetamide corrosion test, ***figure 2***, 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 a relative humidity of 75% at 20 $^{+}$5°C within the sealed container. The samples sat 65 mm above the plate at an ambient temperature of 24°C.

2.3.2 Ammonium Polysulphide

The ammonium polysulphide laboratory test, ***figure 3***, involves suspending the sample on steel mesh above a 5 litre beaker (250 mm high; 200 mm diameter) containing 0.5 mls ammonium polysulphide in 200 mls distilled water.
The apparatus was situated in a fume cupboard with a flow rate of 0.75 m/s and 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 over a period of 6 hours. The Argentium® Sterling did not tarnish whilst the Standard Sterling gradually discoloured over this period.
A photograph showing the degree of tarnish is shown in ***figure 4***.

2.4.2 Ammonium Polysulphide

The solvent cleaned samples were suspended over the ammonium polysulphide solution and examined after one hour, two hours and 24 hours, ***figure 5a,b & c*** respectively.

Conclusion

The Argentium®Sterling alloy remained tarnish resistant in both the BS EN ISO 4538: 1995 Thioacetamide test, and the dilute Ammonium Polysulphide solution test, compared to the Standard Sterling silver that gradually tarnished with time to become brown or dark blue in colour.

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Figure 1

Ultrasonic Solvent Cleaning Bath

Figure 2

Thioacetamide Test Chamber

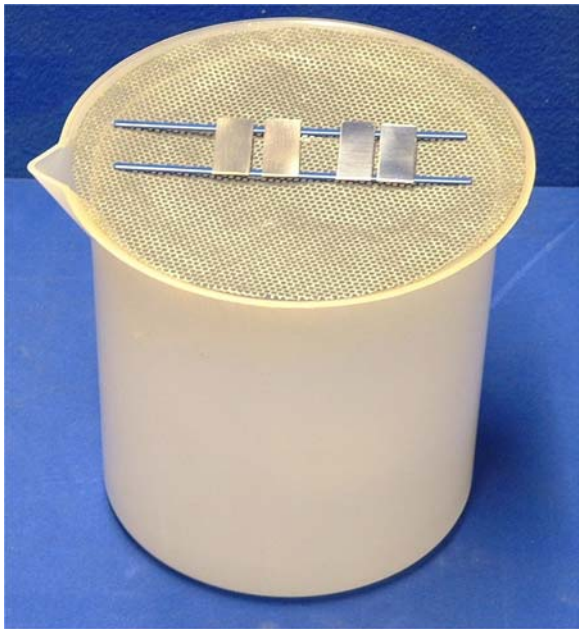
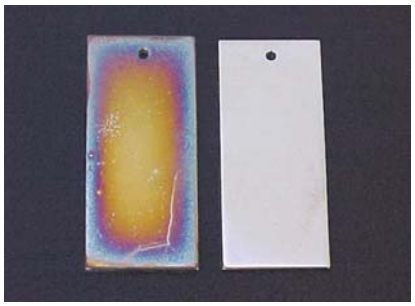


Figure 3

Ammonium Polysulphide Chamber

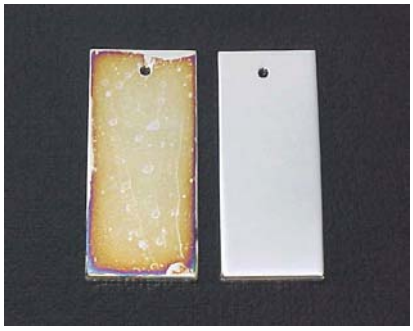
Standard Sterling – left side of each photograph.
Argentium Sterling – right side of each photograph.

BS EN ISO 4538: 1995 Thioacetamide tarnish test – solvent cleaned samples:-



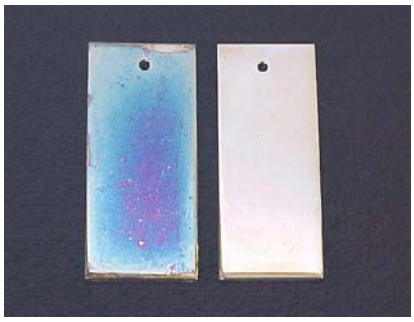
6 hours exposure **Figure 4**

Dilute Ammonium Polysulphide solution tarnish test – solvent cleaned samples:-



1 hour exposure **Figure 5a**

2 hours exposure **Figure 5b**



24 hours exposure **Figure 5c**

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