THE STORY OF *BRASSO* : A POLISHED ACCOUNT?

by **David Jones**

Introduction

Brasso is an iconic British metal polish, well-known to boaters – and used by some more than others. It removes the tarnish from metals that have weathered, making them bright and shiny again. Copper kettles and brass mushroom vents are restored to their former glory. Brass[1] is an alloy of copper and zinc. *Brasso* has other uses, including removing scratches from CDs and DVDs.

While *Brasso* is used to clean brass and copper, other polishes such as *Silvo*® are designed to clean silver.

Brasso® was first manufactured in the United Kingdom in 1921 by Reckitt & Sons, now Reckitt Benckiser. Over the years the composition and packaging have remained essentially the same. *Brasso* is also made in Australia and the United States, and in those countries the composition is slightly different.

A can of *Brasso* has the prestigious *by Royal Appointment* designation, showing the Royal Arms and the words “By Appointment to Her Majesty Queen Elizabeth II Manufacturer of Antiseptics, Air Freshners, Polishes, Cleaners and Laundry Products · Reckitt Benckiser plc. Slough”.

What is *Brasso*?

Brasso contains[a,b]:

- kerosene (petroleum) hydro-desulfurized
- silicon dioxide
- kaolinite
- kaolin
- fatty acids, C14-18 and C16-18 unsaturated
- aqua
- ammonium hydroxide

But what are these substances and why are they in *Brasso*?

Brasso is a mixture of powdered abrasives (silicon dioxide, kaolin and kaolinite)[2] in a liquid medium of kerosene[3], fatty acids[4] and aqueous ammonia[5].

The abrasives scrape the layer of tarnish from the metal surface and smooth any scratch marks.

It is the kaolin that gives *Brasso* its yellow-ochre colour, and the kerosene and ammonia that give *Brasso* its characteristic smell.

Aqua is simply water and acts as a solvent, and "ammonium hydroxide" is a solution of ammonia dissolved in water. Ammonia solution is often sold as "household ammonia" used to clean windows and stainless steel. Ammonia is an alkali and enough is added to make *Brasso* alkaline.

The fatty acids are emulsifiers. Emulsifiers keep the other substances blended/mixed together so they don't separate into distinct layers. e.g. mayonnaise contains emulsifiers, where a smooth blend of oil and water is needed.

However, acids cause many metals to corrode/tarnish. This potential problem is prevented because the ammonia in *Brasso* neutralises the acidic part of the fatty acid.

How safe is *Brasso*?

Potential hazards are identified through **Risk Assessments** which are covered by **COSHH** Regulations (Control of Substances Hazardous to Health)[6].

There are two hazard warning labels on a tin of *Brasso.*

Brasso is an **irritant**, so when used it is best to wear disposable plastic gloves and also keep it away from the eyes.

It is also potentially **hazardous** to the environment, particularly aquatic life, so *Brasso*, and the cloths that have been used for polishing, should be disposed of safely.

Why do metals tarnish?

Metals tarnish because over time they react with substances in the air (oxygen, water and carbon dioxide, and possibly sulfur compounds if the air is polluted) to form a layer which covers the surface of the metal discolouring it and making it dull. This layer will not dissolve and so it can't be removed by simply washing with water. It is this layer that *Brasso* removes.

When **copper** tarnishes, several reactions can take place.

The main reaction is between copper and oxygen which produces a layer of black copper oxide. The oxide layer is thin, so the copper becomes dull.

The equation that represents this reaction is:

$$2Cu + O_2 \rightarrow 2CuO$$

Copper also reacts with water, carbon dioxide and oxygen to form basic copper carbonate, commonly known as verdigris. This forms a green patina on the surface of the metal, often appearing as green spots.

$$2Cu + H_2O + CO_2 + O_2 \rightarrow CuCO_3.Cu(OH)_2$$

Verdigris is frequently seen on roofs made of copper, such as the dome of Darlington Street Methodist Church in Wolverhampton.

When **brass** tarnishes, the copper in the alloy will tarnish as described above. In addition, the zinc in the alloy will react in a similar manner to form zinc oxide and basic zinc carbonate, both of which are white.

$$2Zn + O_2 \rightarrow 2ZnO$$

$$5Zn + 3H_2O + 2CO_2 + 2½O_2 \rightarrow 2ZnCO_3.3Zn(OH)_2$$

However, if copper is **heated** in air (such as when a copper kettle is heated), the copper metal seems to change colour. Copper oxide is formed as before. At first, the copper oxide layer is thin and metallic copper can still be seen through the oxide layer. With further heating the metal appears to change colour, giving so-called "interference colours" which depend on the thickness of the copper oxide layer. A spectrum of colours is often seen: red-brown, brown, purple, violet, blue, blue-green, grey-green, yellow, orange and red. Further heating and thickening of the layer causes the black layer of copper oxide to obscure the copper underneath. Repeated heating and cooling of the kettle causes the metal to expand and contract, and this frequently makes the black copper oxide layer flake off from the surface of the metal.

Whether a metal tarnishes or not usually depends on how reactive the metal is. Metals such as gold and platinum don't tarnish because they are very unreactive.

***Brasso* in action**

Using *Brasso* involves two stages: **cleaning** and **polishing**.

- **Cleaning** removes the tarnish layer from the metal surface.

  Brasso is put on a cloth and rubbed on the surface. The mild **abrasives** in *Brasso* remove both this layer of tarnish and some of the freshly exposed metal. Most of the residue is left on the cloth together with unused liquid *Brasso*, but some will be left on the metal surface.

  When **copper** is cleaned, the layer removed is black copper oxide and this is the black residue left on the cloth. Some copper metal is removed too.

  When **brass** is cleaned, the layer removed is black copper oxide and white zinc oxide; the residue left on the cloth appears black. Some copper and zinc is also removed.

  At this stage the residue is **wet** but it **dries** quickly because **kerosene** and **ammonia** in the *Brasso* evaporate. The residue becomes quite powdery at this stage. However, the metal surface is not yet bright and shiny because it is now covered with the dry residue.

- **Polishing** removes this dry residue to reveal a bright, shiny surface. A clean cloth should be used to do this.

Nearly forgot to mention another ingredient when using *Brasso* – elbow grease.

Additional Notes

(1) **Brass** is an alloy of copper and zinc. Different brasses have different properties and contain different percentages of copper and zinc. Other elements can be present too. A typical brass contains 67% copper and 33% zinc. Brass is much stronger and harder than either copper or zinc.

(2) The mild abrasives which physically remove the layer of tarnish are:

- **silicon dioxide** (SiO_2) is quartz that has been ground to a fine powder.
- **Kaolin** is china clay that contains **kaolinite** (aluminium silicate, $Al_2O_3.2SiO_2.2H_2O$). Kaolin is a mineral that ranges in colour from white to deep brown; the most common type of kaolin is a yellow-ochre colour and this gives *Brasso* its characteristic colour.

(3) **Kerosene (petroleum) hydro-desulfurized** is paraffin obtained from petroleum (crude oil) that has had any sulfur compounds removed by the process of hydrodesulfurization. Kerosene is a solvent and acts as a lubricant for the powdered abrasives, and helps protect the freshly exposed metal surface. If the sulfur compounds were not removed, they would react with the metal causing it to tarnish.

Kerosene is also known as kerosine, paraffin and lamp oil. It is obtained from petroleum by fractional distillation and is the fraction with a boiling range between 150°C and 275°C.
Kerosene is a mixture of alkane hydrocarbons which have between 6 and 16 carbon atoms per molecule. e.g. octane, C_8H_{18}. A hydrocarbon is a compound containing carbon and hydrogen atoms only. Alkanes have a general formula: C_nH_{2n+2}.

The first member of the alkane series is methane, CH_4, commonly known as natural gas. Other alkanes which are well-known to boaters are propane, C_3H_8, sold in orange cylinders and butane, C_4H_{10}, sold in blue cylinders; propane has a lower boiling point than butane, so is less likely to freeze at lower temperatures.

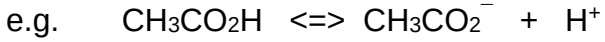
There are different grades of kerosene and these have different properties, including jet aviation fuel and heating oil. A typical kerosene contains alkanes and cycloalkanes (70%), aromatic hydrocarbons (25%) and alkenes (5%).

(**4**) **Fatty acids** are carboxylic acids. They can be saturated or unsaturated. The fatty acids in *Brasso* act as emulsifiers and have between 14 and 18 carbon atoms per molecule.

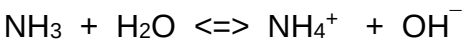
- The **C14-18 (saturated) fatty acids** have between 14 and 18 carbon atoms in each molecule. They are *saturated* which means they don't have carbon/carbon double bonds or triple bonds in their molecules.
- The **C16-18 *unsaturated* fatty acids** have between 16 and 18 carbon atoms in their molecules. They are *unsaturated* which means they have carbon/carbon double bonds or triple bonds in their molecules.

The C2 fatty acid is a well-known substance in the home. It is ethanoic acid (acetic acid), CH_3CO_2H; a dilute solution of this acid in water is known as vinegar.

Fatty acids are acidic because they produce hydrogen ions, H^+. Acids have a pH less than 7.



(**5**) **Aqueous ammonia** is a solution of ammonia (NH_3) dissolved in water (H_2O) and is sometimes referred to as "ammonium hydroxide" (NH_4OH):



The solution is alkaline because of the hydroxide ions, OH^-. Alkalis have a pH greater than 7.

Note that water is neutral which means it is neither acidic nor alkaline; this is because water has equal numbers of acid particles (hydrogen ions) and alkaline particles (hydroxide ions): water has a pH = 7.

$$H_2O \quad <=> \quad H^+ \quad + \quad OH^-$$

(**6**) For further information see: "Control of Substances Hazadous to Health Regulations 2002 (amended)" and "The Classification, Labelling and Packaging of Chemicals Regulations 2015".

Sources of Information and Further Reading

(**a**) Correspondence with Dr John Emsley, University of Cambridge.
(**b**) *Chemistry at Home: Exploring the Ingredients in Everyday Products* by John Emsley published by the Royal Society of Chemistry (2015). ISBN: 978-1-84973-940-5.
(c) Correspondence with David Allen, Librarian, Royal Society of Chemistry.
(d) *Brasso* : Wikipedia: https://en.wikipedia.org/wiki/Brasso .
(e) Reckitt Benckiser Website: http://www.rbeuroinfo.com .

Ref: BRASSO article Extra
