

Mercury is used primarily for the manufacture of industrial chemicals or for electrical and electronic applications. It is used in some thermometers, especially ones which are used to measure high temperatures. A still increasing amount is used as gaseous mercury in fluorescent lamps, while most of the other applications are slowly phased out due to health and safety regulations, and is in some applications replaced with less toxic but considerably more expensive Galinstan alloy (Fig. 2.1).

Present Use

Medicine

Mercury and its compounds have been used in medicine, although they are much less common today than they once were, now that the toxic effects of mercury and its compounds are more widely understood. The element mercury is an ingredient in dental amalgams. Thiomersal (called *thimerosal* in the United States) is an organic compound used as a preservative in vaccines, though this use is in decline (FDA 2004). Another mercury compound, merbromin (Mercurochrome) is a topical antiseptic used for minor cuts and scrapes and is still in use in some countries (Fig. 2.2).

Mercury(I) chloride (also known as calomel or mercurous chloride) has traditionally been used as a diuretic, topical disinfectant, and laxative. Mercury(II) chloride (also known as

mercuric chloride or corrosive sublimate) was once used to treat syphilis (along with other mercury compounds), although it is so toxic that sometimes the symptoms of its toxicity were confused with those of the syphilis it was believed to treat (Pimple et al. 2002). It was also used as a disinfectant. Blue mass, a pill or syrup in which mercury is the main ingredient, was prescribed throughout the 1800s for numerous conditions including constipation, depression, childbearing, and toothaches (Mayell 2007). In the early twentieth century, mercury was administered to children yearly as a laxative and dewormer, and it was used in teething powders for infants. The mercury-containing organohalide merbromin (sometimes sold as Mercurochrome) is still widely used but has been banned in some countries such as the United States (Cecil 2004).

Since the 1930s some vaccines have contained the preservative thiomersal, which is metabolized or degraded to ethyl mercury. Although it was widely speculated that this mercury-based preservative can cause or trigger autism in children, scientific studies showed no evidence supporting any such link (Parker et al. 2004). Nevertheless, thiomersal has been removed from or reduced to trace amounts in all US vaccines recommended for children 6 years of age and under, with the exception of inactivated influenza vaccine (FDA 2007).

Mercury in the form of one of its common ores, cinnabar, remains an important component of Chinese, Tibetan, and Ayurvedic medicine. As problems may arise when these medicines are exported to countries that prohibit the use of



Fig. 2.1 The bulb of mercury in glass thermometer (Source: English Wikipedia)



Fig. 2.2 Amalgam filling (Source: English Wikipedia)

mercury in medicines, in recent times, less toxic substitutes have been devised.

Today, the use of mercury in medicine has greatly declined in all respects, especially in developed countries. Thermometers and sphygmomanometers containing mercury were invented in the early eighteenth and late nineteenth centuries, respectively. In the early twenty-first century, their use is declining and has been banned in some countries, states, and medical institutions. In

2002, the U.S. Senate passed legislation to phase out the sale of nonprescription mercury thermometers. In 2003, Washington and Maine became the first states to ban mercury blood pressure devices (Health Care without Harm 2003). Mercury compounds are found in some over-the-counter drugs, including topical antiseptics, stimulant laxatives, diaper-rash ointment, eyedrops, and nasal sprays. The FDA has “inadequate data to establish general recognition of the safety and effectiveness” of

the mercury ingredients in these products (FDA 2007). Mercury is still used in some diuretics, although substitutes now exist for most therapeutic uses.

Production of Chlorine and Caustic Soda

Chlorine is produced from sodium chloride (common salt, NaCl) using electrolysis to separate the metallic sodium from the chlorine gas. Usually the salt is dissolved in water to produce brine. By-products of any such chloralkali process are hydrogen (H_2) and sodium hydroxide (NaOH), which is commonly called caustic soda or lye. By far the largest use of mercury (The CRB Commodity Yearbook 2000; Leopold 2002) in the late twentieth century was in the mercury cell process (also called the Castner–Kellner process) where metallic sodium is formed as an amalgam at a cathode made from mercury; this sodium is then reacted with water to produce sodium hydroxide (Chlorine Online Diagram of mercury cell process 2006). Many of the industrial mercury releases of the twentieth century came from this process, although modern plants claimed to be safe in this regard (Leopold 2002). After about 1985, all new chloralkali production facilities that were built in the United States used either membrane cell or diaphragm cell technologies to produce chlorine.

Laboratory Uses

Some medical thermometers, especially those for high temperatures, are filled with mercury; however, they are gradually disappearing. In the United States, nonprescription sale of mercury fever thermometers has been banned since 2003 (Mercury Reduction Act of 2003). Mercury is also found in liquid mirror telescopes.

Some transit telescopes use a basin of mercury to form a flat and absolutely horizontal mirror, useful in determining an absolute vertical or perpendicular reference. Concave horizontal parabolic mirrors may be formed by rotating liquid mercury on a disk, the parabolic form of the

liquid thus formed reflecting and focusing incident light. Such telescopes are cheaper than conventional large mirror telescopes by up to a factor of 100, but the mirror cannot be tilted and always points straight up (Govert Schilling 2003; Gibson 1991).

Liquid mercury is a part of popular secondary reference electrode (called the calomel electrode) in electrochemistry as an alternative to the standard hydrogen electrode. The calomel electrode is used to work out the electrode potential of half cells (Brans and Hay 1995). Last, but not least, the triple point of mercury, $-38.8344\text{ }^{\circ}\text{C}$, is a fixed point used as a temperature standard for the International Temperature Scale (ITS-90) (Hammond 2005).

Niche Uses

Skin tanner containing a low-pressure mercury vapor lamp and two infrared lamps, which act both as light source and electrical ballast. Gaseous mercury, is used in mercury vapor lamps and some “neon sign”-type advertising signs and fluorescent lamps. Those low-pressure lamps emit very spectrally narrow lines, which are traditionally used in optical spectroscopy for calibration of spectral position. Commercial calibration lamps are sold for this purpose; however, simply reflecting some of the fluorescent-lamp ceiling light into a spectrometer is a common calibration practice (Hopkinson et al. 2004). Gaseous mercury is also found in some electron tubes, including ignitrons, thyratrons, and mercury arc rectifiers (Howatson 1965). It is also used in specialist medical care lamps for skin tanning and disinfection (Milo and Casto 1990). Gaseous mercury is added to cold cathode argon-filled lamps to increase the ionization and electrical conductivity. An argon-filled lamp without mercury will have dull spots and will fail to light correctly. Lighting containing mercury can be bombarded/oven pumped only once. When added to neon-filled tubes, the light produced will be inconsistent red/blue spots until the initial burning-in process is completed; eventually it will light a consistent dull off-blue color (Shionoya 1999) (Fig. 2.3).

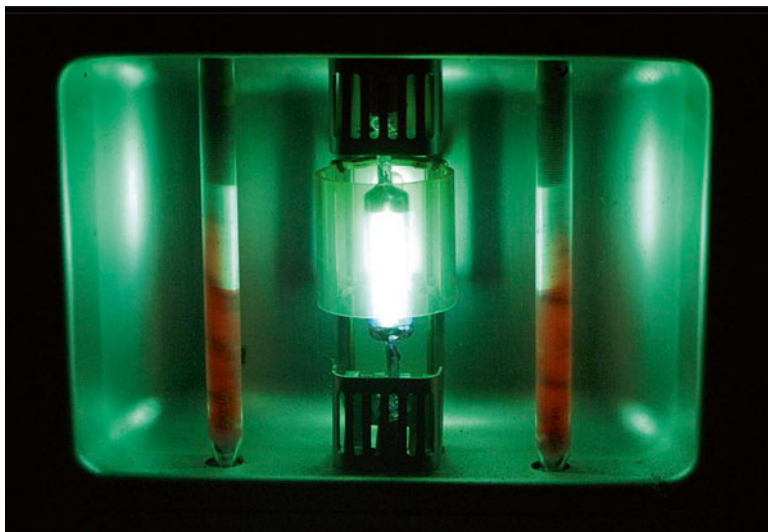


Fig. 2.3 Skin tanner containing low-pressure mercury vapor lamp and two infrared lamps, which act both as light source and electrical ballast (Source: English Wikipedia)

Cosmetics

Mercury, as thiomersal, is widely used in the manufacture of mascara. In 2008, Minnesota became the first state in the United States to ban intentionally added mercury in cosmetics, giving it a tougher standard than the federal government (CIDPUSA Foundation 2008).

Gold and Silver Mining

Historically, mercury was used extensively in hydraulic gold mining in order to help the gold to sink through the flowing water–gravel mixture. Thin mercury particles may form mercury–gold amalgam and therefore increase the gold recovery rates (Hammond 2000). Large-scale use of mercury stopped in the 1960s. However, mercury is still used in small-scale, often clandestine, gold prospecting. It is estimated that 45,000 metric tons of mercury used in California for placer mining has not been recovered (Alpers et al. 2005). Mercury was also used in silver mining (Mercury amalgamation 2009).

Other Present Uses

Gaseous mercury is used in mercury vapor lamps and some “neon sign”-type advertising signs and fluorescent lamps. Those low-pressure lamps emit very spectrally narrow lines, which are traditionally used in optical spectroscopy for calibration of spectral position. Commercial calibration lamps are sold for this purpose; however, simply reflecting some of the fluorescent-lamp ceiling light into a spectrometer is a common calibration practice (Hopkinson et al. 2004). Gaseous mercury is also found in some electron tubes, including ignitrons, thyratrons, and mercury arc rectifiers (Howatson 1965). It is also used in specialty medical care lamps for skin tanning and disinfection (Milo and Casto 1990). Gaseous mercury is added to cold cathode argon-filled lamps to increase the ionization and electrical conductivity.

Some medical thermometers, especially those for high temperatures, are filled with mercury. The triple point of mercury, $-38.83\text{ }^{\circ}\text{C}$, is a fixed point used as a temperature standard for the International Temperature Scale (ITS-90) (Hammond 2000).

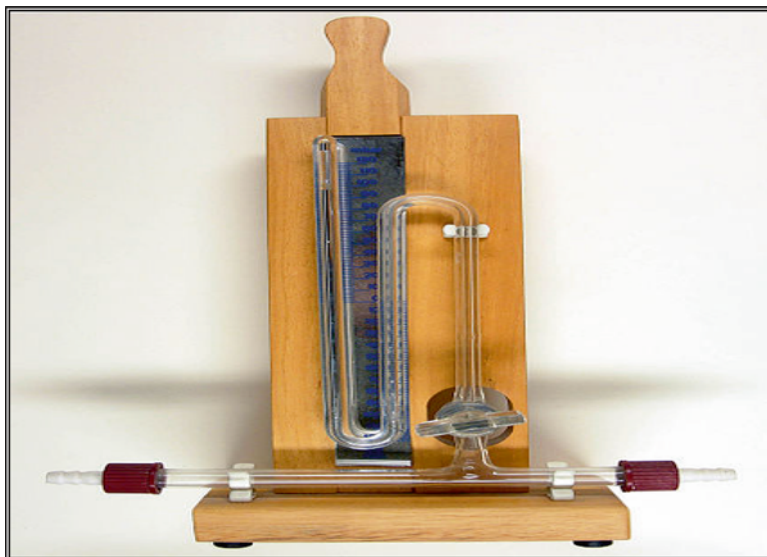


Fig. 2.4 Mercury [manometer](#) to measure pressure (Source: English Wikipedia)

Proposed Uses

Liquid mercury has been proposed as a working fluid for a heat pipe type of cooling device for spacecraft heat rejection systems or radiation panels. A new type of atomic clock, using mercury instead of cesium, has been demonstrated. Accuracy is expected to be within 1 s in 100 Ma (BBC [2001](#); NIST [2001](#)).

Historic Uses

Mercury was used for preserving wood, developing daguerreotypes, silvering mirrors, antifouling paints (discontinued in 1990), herbicides (discontinued in 1995), handheld maze games, cleaning, and road leveling devices in cars. Mercury compounds have been used in antiseptics, laxatives, antidepressants, and antisiphilitics. It was also allegedly used by allied spies to sabotage German planes. A mercury paste was applied to bare aluminum, causing the metal to rapidly corrode. This would cause structural failures (Gray [2004](#)) (Fig. [2.4](#)).

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