Mercury (Hg) is a transition metal element that is unique because it is the only metal element that exist in a liquid form at room temperature. Due to this property, it is used in thermometers, barometers, gas-pressure regulators, electrodes, and electrical relays and switches.

### Properties of Mercury

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic Number</td>
<td>80</td>
</tr>
<tr>
<td>Mass</td>
<td>200.6 g/mol</td>
</tr>
<tr>
<td>Density</td>
<td>13.534 g/cm³</td>
</tr>
<tr>
<td>Melting Point</td>
<td>-38.83°C</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>356.73°C</td>
</tr>
<tr>
<td>Electronegativity</td>
<td>2.00 (Pauling scale)</td>
</tr>
<tr>
<td>Specific Heat Capacity</td>
<td>27.983 J/mol*K</td>
</tr>
<tr>
<td>Atomic Radius</td>
<td>151 pm</td>
</tr>
<tr>
<td>Covalent Radius</td>
<td>132 +/- 5 pm</td>
</tr>
<tr>
<td>Heat Fusion</td>
<td>2.29 kJ/mol</td>
</tr>
<tr>
<td>Heat Vaporization</td>
<td>59.11 kJ/mol</td>
</tr>
<tr>
<td>Electron Configuration</td>
<td>[Xe] 4f¹⁴ 5d¹⁰ 6s²</td>
</tr>
<tr>
<td>Common Ions</td>
<td>+2, +1</td>
</tr>
<tr>
<td>Crystal Structure</td>
<td>rhombohedral</td>
</tr>
<tr>
<td>Magnetic Ordering</td>
<td>diamagnetic</td>
</tr>
</tbody>
</table>

As one can see from the melting and boiling points (-38.7 C and 357 C, respectively), elemental mercury exists as a liquid at room temperature. Liquid mercury is very volatile (in fact the most of any metal), as seen from its very low vapor pressure of 0.00002 Pa @ -38.7 C. Even though this transition metal is a liquid, it is still conductive, with an electrical conductivity of \(0.0104 \times 10^6/cm \Omega\) and a thermal conductivity of 0.0834 W/cmK. Excited mercury atoms emit light in visible wavelengths, making it especially useful in light bulb applications.

Mercury readily forms amalgams, or solutions, with other metals. For example, an amalgam of mercury, tin and silver is used in dentistry. This tendency for mercury to form amalgams makes it especially dangerous to be handled by people.
wearing gold jewelry, as it can diffuse into the gold.

Mercury or "quicksilver" has been known since ancient times, distinctive because of its liquid form at room temperature. The name and symbol are taken from the Latin hydrargyrus for "liquid silver". Of course, mercury is a good material for thermometers and barometers because it expands and contracts regularly with temperature, does not "wet" or stick to glass and is very dense. It is also used in special motion-sensitive switches and in ordinary fluorescent lamps.

### Occurrence and Extraction of Hg

Mercury is extracted from the ore cinnabar, HgS. Traditionally the ore was heated in a wood fire and the mercury was collected from the ashes. However, modern methods are much more efficient. The cinnabar is crushed and separated, and then it is heated with a stream of air. The reaction is

$$[\text{HgS}_{(s)} + \text{O}_{2(g)} \overset{600^\circ C}{\longrightarrow} \text{Hg}_{(l)} + \text{SO}_{2(g)}]$$

If the ore is especially rich, scrap iron or quicklime can be added to promote the extraction process:

$$[\text{HgS} + \text{Fe} \rightarrow \text{Hg} + \text{FeS}]$$

or

$$[4\text{HgS} + \text{CaO} \rightarrow 4\text{Hg} + 3\text{CaS} + \text{CaSO}_4]$$

The crude mercury can also be washed in nitric acid and air to remove oxides and other impurities. More purification can be achieved if the process is performed at lowered pressures.

### Preparation, properties and uses of Calomel and Corrosive Sublimate

Mercury alloys well with a number of metals. The alloys are known as amalgams. Dental alloy is an example of one such amalgam in common use. Virtually all mercury is derived from the mineral cinnabar which is mainly \((\text{HgS})\).

<table>
<thead>
<tr>
<th>Mercury (I) chloride</th>
<th>(\text{Hg}_2\text{Cl}_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury (II) chloride</td>
<td>(\text{HgCl}_2)</td>
</tr>
<tr>
<td>Mercury fulminate</td>
<td>(\text{Hg(CNO)}_2)</td>
</tr>
<tr>
<td>Mercury (II) oxide</td>
<td>(\text{HgO})</td>
</tr>
<tr>
<td>Mercury (II) sulfide</td>
<td>(\text{HgS})</td>
</tr>
</tbody>
</table>

**Calomel**

\((\text{Hg}_2\text{Cl}_2)\) is known as calomel. It is prepared by heating \((\text{HgCl}_2)\) and \((\text{Hg})\) in an iron vessel.
It can also be prepared by mixing mercury salt with chloride ions.

**Properties**

1. It is a white powder which is insoluble in water.
2. \(\text{Hg}_2\text{Cl}_2\) on heating dissociates into \(\text{HgCl}_2\) and Hg.

\[
\text{Hg}_2\text{Cl}_2 \rightarrow \text{HgCl}_2 + \text{Hg}
\]

**Corrosive Sublimate**

\(\text{HgCl}_2\) is a corrosive sublimate, which is prepared by passing chlorine over heated mercury or mercury chloride.

\[
\text{Hg} + \text{Cl}_2 \rightarrow \text{HgCl}_2
\]

\[
\text{Hg}_2\text{Cl}_2 + \text{Cl}_2 \rightarrow 2\text{HgCl}_2
\]

It can also be prepared by heating mercury sulfate with NaCl.

\[
\text{HgSO}_4 + 2\text{NaCl} \rightarrow \text{HgCl}_2 + \text{Na}_2\text{SO}_4
\]

**Properties**

1. It is a crystalline solid.
2. It is soluble in hot water, ethanol and ether.
3. \(\text{HgCl}_2\) reacts with KI and forms a colorless solution known as **Nessler's reagent**.

\[
\text{HgCl}_2 + 2\text{KI} \rightarrow \text{Hgl}_2 + 2\text{KCl}
\]

\[
\text{Hgl}_2 + 2\text{KI} \rightarrow \underset{\text{Nessler's Reagent}}{\text{K}_2[\text{Hgl}_4]}\]

Nessler's reagent (named after Julius Nessler) can be used to identify ammonia:

\[
\text{NH}_4^+ + 2[\text{Hgl}_4]^{2-} + 4\text{OH}^- \rightarrow \text{HgO \cdot Hg(NH}_2)_{\text{l(s)}} + 7\text{I}^- + 3\text{H}_2\text{O}
\]

**Problems**

1. What is the symbol for mercury?
2. What is the electronic configuration for mercury?
3. What are some uses for mercury?
4. At room temperature, what state does mercury exist as?
5. What is \(\text{Hg(CNO)}_2\) used for?
Answers

1. Hg
2. [Xe] 4f\(^{14}\) 5d\(^{10}\) 6s\(^{2}\)
3. Thermometers, barometers, gas-pressure regulators, electrodes, and electrical relays and switches.
4. Liquid
5. It is a primary explosive.

References


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