

Bringing Back Shine to Copper

Copper has been a very important metal in evolution of human civilization. In history books, we have read that extraction and use of metals led to the end of Stone Age. Use of metals tools started with copper from roughly 5000 BC. The use of copper was known in almost all sites of ancient civilizations like the Egyptian, Chinese, Mesopotamian, Native American, and Indian. In India, several ancient copper tools, coins and weapons are found, which tell us about the flourishing copper industry in ancient India. Some notable example are the hoards found in the Gungeria village (now in Madhya Pradesh), the huge copper statue of Buddha discovered in Sultanganj (Bihar) and the copper plates of Kalachuri dynasty (12th century, Karnataka). The modern era of copper industry in India started in 1967 with the formation of Hindustan Copper Limited by the Government of India. Many regions of India have reserves of copper minerals, the largest being in Rajasthan (47%).



Figure 1: (Left) Copper vessel used for household purposes and (Right) copper wires and strips.

Today copper finds its application in telecommunication, electrical wiring, transport, utensils, construction, etc. At our homes, copper objects are used as wires, currency coins, utensils for storing water or for eating, etc. However, due to one problem with copper, its use has been decreasing in our lives. This unit relates to this problem of copper metal.



Figure 2: (Left) Statue of Buddha discovered in Sultanganj, Bihar and (right) copper plates of Kalachuri dynasty.

Materials Required

For Task 1: Small sized tarnished or dull copper items (plates/strips), vinegar, Baking soda, lemon juice, table salt, tamarind juice, liquid detergent, detergent powder, coal or wood ash, curd etc.

For Task 2: Tarnished copper plates/ strips, hand gloves, used toothbrush, watch glass/ saucer, droppers and small spoons/ spatulas, water, any 3-4 cleaning agents: Talcum powder, baking soda, detergent powder, sand (or white rangoli powder), dry soil, common salt, ash.

For Task 3: Solid cleaning agents taken in Task 2, any 2-3 cleaning agent from this list:

vinegar, lemon juice, curd and tamarind (*imli*) juice, used toothbrush, watch glass/ saucer etc.

For Task 4: 3-4 cleaning agents per group (used in task 2/3), litmus papers (Red and Blue), turmeric powder or turmeric paper, watch glass(or saucer), droppers and small spoons/spatula.

Task 1: Recollecting What We Know

Q1. What copper objects have you seen at your home and your surroundings?

Q2. What are the colours of their surfaces?

In countries like India with a hot and humid climate, a lot of copper objects gets tarnished making them look very dull and unattractive. Pollutants in air also increase the tarnishing. Surface tarnish leads to large losses to traders and economy. Therefore, cleaning of surface tarnish of copper (and other metals) is a need in many professions. In this learning unit, we will try to clean such dull/tarnished copper utensils using some common household materials, and in this way learn some science.

Take a small copper object or strip.

Q3. What is the colour of its surface?

Rub the surface using a sand paper (0 grade).

Q4. What is the colour of its surface now? Has it it changed on rubbing with sand paper?
What property of sand paper is responsible for it?

Q5. Is any copper lost in this process?

Now keep this shining copper object near a sink or in chemistry laboratory near chemical storage for two three days after which you do task 2.

Q 6. What substances have you seen being used for cleaning of copper objects/ utensils?

Q 7. The following table lists some substances. Before performing any trials, guess which of these substances can clean the tarnished copper objects and why (because it dissolves many impurities/ has lot of solid particles/ is soapy to touch/ produces a lot of foam/ or any other reason?)?

Substance	Will it clean? (Yes/No)	Why do you think these will clean copper?
Vinegar		
Baking Soda		
Lemon Juice		
Table salt		
Tamarind juice		
Liquid Detergent		
Detergent Powder		
Coal or wood ash		
Curd		

Now, let us understand whether our guesses are correct. Following task (2 -3) can be performed in groups of 3-4 students.

Task 2: The Action of Solid Cleaning Substances on Tarnished Copper

Q 1. After two-three days, did you observe any change on the surface of copper object cleaned in task 1?

Safety Precautions!

DO'S

- ✓ Use hand gloves to cover hands when performing the task.
- ✓ Use the cleaning substances carefully and in amount as mentioned in the instruction.
- ✓ Use only used and old toothbrush for rubbing.
- ✓ Ensure to wash hands properly with water and soap after performing the activities.
- ✓ If any student's hand is itching, wash it with water immediately.

DON'TS

- x Do not spill the cleaning agents on clothes or on table.
- x Do not touch body parts like skin, eyes, lips, mouth or nose, when using the cleaning agents.

Procedure

Add 1/3 of a small teaspoon (approx. 0.5 g) of substance to a small area on the plate/strip and rub gently using a toothbrush for a minute.

Note: At a time, apply only a single cleaning substance on dark/tarnish spots of copper surface. If there is no change, the same plate/strip can be cleaned with a tissue paper/cloth before performing the next test. If there is a change, then another plate/strip or unused area of the same plate should be used to perform the next test. After performing a test, the tooth brush should be kept dipped in water and then dried before using it again to prevent cross contamination.

Solid cleaning agent	Observations (Cleaned/ Not Cleaned/ Scratches formed/ others)

Q 2. Which of the solid cleaning agents removed tarnish?

Q 3. Do you observe any scratches on the surface for any of the cleaning agents? What do scratches tell you about the nature of the cleaning agent?

Q 4. Is rubbing of a solid substance on a copper surface a physical or chemical action?

Task 3: The Action of Liquid Cleaning Agents on Tarnished Copper

Each groups may take the solid agents taken in task 2 and prepare their paste by adding few drops of water. In addition, take 2-3 cleaning agent from this list: vinegar, lemon juice, curd and tamarind (*imli*) juice.

Take water, transfer the liquid cleaning agents on watch glass or in saucer. Dip the tarnished copper object in the cleaning substance and observe for 2-3 minutes. If no change is observed on the surface, then using the toothbrush, gently rub the copper surface (clean the brush under water after every use). Note down your observations (colour change/ evolution of gas/ any smell) in the table given below.

Note: If the copper item is big, then a small area can be used for the testing. In that case, about 0.5 mL (or 5 drops) of the substance can be applied on the metal surface for the testing. If no change is observed, then the same copper object can be used for trying next cleaning agent, else other object or other unused area of the object may be used.

Cleaning substance	Observations	
	Dipping the surface in the liquid/solid-water paste	Rubbing the surface with liquid/paste & toothbrush
Water		

Q 1. From your observations, which of the cleaning agents cleaned your plates/wire strips.

Q 2. Was the action of rubbing necessary for cleaning of copper utensils in all cases?

Q 3. In which cases is cleaning observed on metal surface due to some chemical change?

Task 4: The Acidity/Basicity of the Cleaning Agents

Let us see if acidic or basic nature of a cleaning agent affects its cleaning action for copper tarnish. To understand this, we need to know the nature of the cleaning agents that were cleaned the surface without need for a physical action and compare to substances that didn't. We will check this with the help of indicators.

For solid cleaning agents, take 1/3 of a small teaspoon or ice cream spoon (approx. 0.5 g) of cleaning agent on a watch glass or in a saucer and add 2 mL of water to it. For liquid cleaning substances, take about 5-6 drops of the liquid cleaning substance on a watch glass (or in saucer). Dip blue and red litmus paper one after another in the liquid cleaning substance. Note the colour change of litmus papers in observation table. If liquid indicators are available then add 2 drops of it in the cleaning solution on watch glass. Note the colour change of indicator in observation table.

Note: Wash your hands thoroughly with water before and after using indicator every time.

Cleaning Agent	Red litmus	Blue litmus	Turmeric paper/ other indicator	Conclusion: Nature of cleaning agent (acidic/ basic/ neutral)
Eg; lemon juice				

Q 1. Based on your observations in Tasks 2, 3, and 4, can you say if the acidic/basic/neutral nature of the cleaning agent has some role in the cleaning of the tarnished copper utensil/wire strips?

Yes _____

No _____

Q 2. What can you conclude about the cleaning mechanism of the agents based on all the tasks?

Q 3. Based on the above studies, can you say if the nature of the tarnish in the copper utensil is acidic/basic/neutral? If yes, why?

Q 4. Did you have any unusual findings or observations in the above 3 tasks?

Q 5. Which of the following food substances **cannot** be stored in copper utensils?

Food Material	Can be Stored	Cannot be Stored	Not Sure
Butter Milk			
Common Salt			
Pickles			
Tamarind chutney			
Rice grains			

Q 6. Why do you think the use of copper utensils in households has decreased in our households over past few years?

Tarnishing has led to discolouration in many historical monuments and artifacts in the world. One of the classic examples of copper tarnishing is of the Statue of Liberty, New York (USA). This statue has a core structure of iron with copper sheets on the surface. It was gifted by France to USA in the year 1886 and has been an icon of freedom. The statue has long lost its original copper colour and has gained different colours over the decades, presently having greenish blue colouration on the surface.

Looking at the statue no one can identify the presence of copper in it.

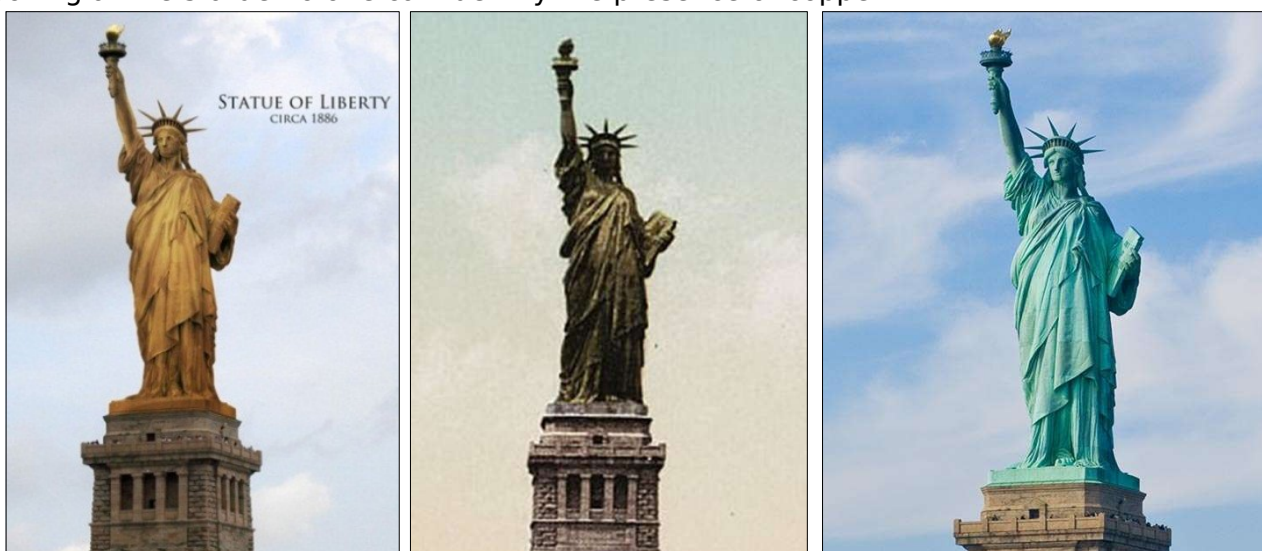


Figure 3: Statue of Liberty and its transition from the original copper (in 1886, left) to the latest image (to right).