

# Zero Cost Water Purification by L. E. D. Light and Copper Complex

Dr. Anil Kumar Gupta & Lokesh Saxena.

Received 31 March. 2016, accepted on 23 Aug. 2016

## Abstract:

*The white light reflects seven colors through prism. All of these colors of light are used in light emitting diode bulbs to produce light that appears white. However out of these colored lights, the orange and blue light may be well utilized for purification of contaminated household water. Purification of household contaminated drinking water by reverse osmosis gives clean water but with low T.D.S. Since household water is already chlorinated therefore this do not necessarily needs reverse osmosis which may cause osteoporosis and arthritis problem in the long run. Therefore a zero cost new technique of household drinking water was designed wherein light of different wavelengths is subjected through LED bulb into a copper vessel having water. The orange component of the light is absorbed by cupric ions to form hexa aqua copper (II) ion which kills the bacteria and the blue component of light kills the viruses. The ceramic filter candles fitted in the upper part of the copper vessel is able to maintain the T.D.S. between the ranges of 100 to 250. The noble features of this Zero cost Copper purifier over other known alternatives are mainly ; pH of the water is found to be 7.03 which is neutral but pH of the R.O. water was 6.54(slightly acidic); no plastic; no motor; nominal consumption of electricity; nominal price; optimum T.D.S.; portable and bactericidal. This purifier can now be afforded by every middle class household and poor. The system cut emissions according to conference of parties at Paris (2015) to tackle global warming because of less consumption of coal which is required to produce electricity.*

**Key words:** Reverse osmosis, osteoporosis, zero cost technique, copper complex, LED.

## Introduction:

Several agencies worldwide are promoting zero maintenance and cost effective method for the purification of contaminated household drinking water. The purification of water by U.V. rays of the sun is not so effective. Purification by reverse osmosis is ideal for river water but for house hold water it proves to be expensive and low down the TDS of water, below 100 and causes mineral deficiency in the people<sup>1</sup>

Ancient civilization exploited the antimicrobial properties of copper. Copper metal ions have toxic effect on Algae, Molds, Spores, Fungi, Viruses, Prokaryotic and Eukaryotic micro organisms even in relatively low concentration. Antimicrobial copper surfaces kill greater than 99.9% various kinds of bacteria within two hours of exposure. Greeks, Romans and others also used copper for treatment of intestinal worms. During the process of creating rust molecules,

1. **Dr. Anil Kumar Gupta**, Head Department of chemistry, D. A-V. College, Kanpur  
E-mail: [ak\\_gupta56@yahoo.co.in](mailto:ak_gupta56@yahoo.co.in)
2. **Lokesh Saxena**, Associate professor, Department of Chemistry, DAV College, Kanpur, India

copper pulls electrons from the membrane of the bacteria's cell wall, lipids, oxygen or proteins [2] [3] [4].

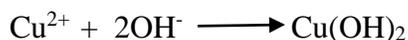
Copper can interact with lipids, opening holes in the cell membranes. Copper damages the respirator chain in *Escherichia coli* cells and is associated with impaired cellular metabolism. Cupric ion,  $\text{Cu}^{2+}$  is believed to be responsible for the antimicrobial action. [5] [6] [7] [8].

Inactivation of micro organisms may be due to increased availability of cupric ions  $\text{Cu}^{2+}$  is believed to be responsible for antimicrobial action. Copper cations dissolve on surface of bacteria and causes damages penetrating in the bacteria cells. Copper complexes form radicals that inactivate virus [9] [10].

Copper may disrupt enzyme structures and functions by binding to sulfur containing amino groups of proteins. According to health benefits of copper water, mentioned in ayurveda, copper has anti inflammatory properties and helps in arthritis pain [11].

Copper is also an antioxidant prevents cell damage and aging. Apart from this it is a vital element required in melanin production, works as brain stimulant helps in healing wounds faster and maintains digestive system.

Copper, like all metals forms coordination complexes with ligands. In aqueous solution Copper (II) exists as  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ . This complex exhibits the fastest water exchange rate (speed of water ligands attaching and detaching) for any transition metal aqua complex. Adding sodium hydroxide causes the precipitation of light blue solid Copper (II) hydroxide.



upon adding excess of ammonia the precipitate dissolve forming tetra ammine copper(II).



$[\text{Cu}(\text{H}_2\text{O})]^{2+}$  exhibit tetragonal distortion to give  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ . The stability constant of  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  can be calculated by thermodynamic data using  $\Delta G^0 = -RT \ln K$  and the value of  $\log K_1, \log K_2, \log K_3$  and  $\log K_4$  give the value 4.3, 3.6, 3.04 and 2.3, molecules of  $\text{H}_2\text{O}$  are replaced by aq  $\text{NH}_3$  giving  $[\text{Cu}(\text{H}_2\text{O})_5]^{2+}$  aq  $[\text{Cu}(\text{H}_2\text{O})_4(\text{NH}_3)_3]^{2+}$  aq  $[\text{Cu}(\text{H}_2\text{O})_5(\text{NH}_3)_3]^{2+}$  and aq  $[\text{Cu}(\text{H}_2\text{O})_4(\text{NH}_3)_4]^{2+}$ . During this process  $\Delta G^0$  is found to be large and negative with increase in disorder or increase in entropy.

White light emitting materials have attracted significant attention in recent years as key components in display and lighting devices based on LEDs. Even pigments in fruits and vegetables can produce light. The chlorophyll, the green pigment of leaves is when exerted by ultraviolet light on it through a torch produces a blood red colour.

Some scientists have effected white light emission from easily available plants extracts- turmeric and red pomegranate seed juice- paying way for further research. The extract of red pomegranate contains polyphenols and anthocyanines as dyes. In the extraction of curcumin the root of the turmeric plant was grinded with ethanol as solvent.

This extract was separated through an apparatus to obtain a clear yellow liquid that contained curcumin as the dye. Under ultraviolet excitation the extracts produced white light.

Human and animal are a primary source of bacteria in water. Bacterial contamination cannot be detected by sight, smell and taste. Coliform bacteria may not cause diseases, but can be indicators of pathogenic organisms that cause disease like intestinal infections, dysentery, hepatitis, typhoid fever, cholera and other illness. The term pathogen is used to describe an infectious agent such as virus, bacterium, prion, fungus, viroid or parasite that causes diseases in its hosts. The host may be an animal, a plant, a fungus or even another microorganism [12] [13] [14] [15].

## Methods

The equipment of copper purifier required two Copper vessels, a ceramic filter candle, a mixture of colored light emitting unbreakable non glass bulb. Out of two copper vessels the upper vessel was fitted with the bulb at its top and ceramic candle filter at the base. The lower part of the vessel was adjusted below upper vessel so as to collect the water drops poured by filter candle. The  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  complex and blue component of the colored light produced from the bulb are the main anti microbial component of the purifier and kill more than 99.9% of the pathogens. The bulb is shielded and fitted inside the closed copper vessel to limit the exposure. The human skin exposure to the LED bulb has no side effect of sunburn and skin cancer.

1. First of all 1 litre of water taken from storage tank was placed inside the Copper purifier vessel fitted with ceramic water filter candle and LED bulb. The light was passed for two hours.
2. Now we had two samples A and B. Sample A was named as treated and B was named as untreated.
3. One drop of sample A was then placed in a nutrient (Agar Agar) culture plate in an incubator for 24 hours at 35 degree C for culturing.

## DISCUSSION

The principle of white light which results seven distinct colors through prism and their recombination in light emitting diode to give light that appears white, was exploited for the purification of the contaminated household water. Since copper is a transition metal, first of all influenced by the dissolved oxygen and surface oxidation of copper produces Copper (I) oxide. The Copper (I) oxide is then subsequently oxidized to copper (II) ion. When the mixture of colored light is passed from the bulb the Copper ions absorb the orange component of the combined seven colored light (appearing white) to produce the octahedral hexa aqua copper complex  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ .

## RESULT

The  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  and the blue component of the light passing from the bulb are mainly found to be the anti microbial components of the purifier and were capable to kill more than 99.9% of the pathogen of household contaminated water. Besides copper complexes, the irradiation of light of different energies from the bulb facilitates the purification of contaminated household water because highly energetic blue light kills or inactivate all the pathogens by destroying nucleic acids and disrupting their DNA leaving them unable to form vital cellular function. Ceramic candle filter is a simple device made out of clay and is used to filter drinking water and to remove turbidity or sediments to give drinking water, TDS less than 300 ppm.

### Conclusion:

When the plates of sample A and B are removed from the incubator, not a single coliform bacteria colony was found in treated sample A, but in sample B colonies of coliform bacterias were significantly observed, even without staining. Hence it was concluded that all of the coliform bacteria present in the sample of contaminated stored tank water was completely killed by copper complex and the blue light produced from this novel water purifier equipment. Absence of any other pathogens including virus was also confirmed due to absence of coliform bacteria in sample A. An application for financial assistance for patenting of this equipment was already sent by inventor to National Research Development Corporation of India on dated 02 /12/2015.

### *Advantages over other known alternative and substitutes:-*

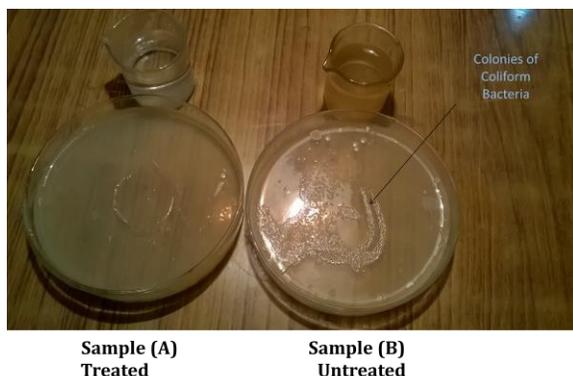
No plastic use. No motor usage. No use of ultraviolet rays. No side effect of low water TDS, No wastage of water, Portable, economical, low cost maintenance. Kill Pathogens completely. Eco-friendly. Purified water had  $\text{p}^{\text{H}}$  7.03 hence not acidic. The equipment is also able to cut emissions according to conference of parties at Paris (2015) to tackle global warming issues.

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**Fig.1. Household Water Purifier**



**Fig.2. Treated and Untreated samples**

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