

Application of Natural Coagulants in Waste Water Treatment

O.Sujana¹, Dr. K.SyamalaDevi² and M.Sreevalli³

Asst. Prof. of Chemistry¹, Asst. Prof. of ES² and Asst. Prof. of Physics³

¹Department of Basic Sciences,

¹G.Narayanamma Institute of Technology & Science (for Women), Shaikpet, Hyderabad - 104

Abstract : Coagulation is well known technique in water treatment process. Usually this process was done by adding chemicals; treatment methods are difficult and expensive. So there is an increase in demand for the innovative, low maintenance and energy efficient technology for water treatment. Natural coagulants show better results and are concerned by many researchers because of their abundant source, low price, multifunction and biodegradation. The advantage of the plant based coagulants is easily available as they are apparent, economically feasible, easily available and easy to store. The main objective of the present investigation is use of natural coagulants such as Neem seeds powder and Cactus leaves powder etc. After treatment the water samples were analyzed for different parameters like Turbidity, and hardness. Results indicated that cactus showed better influence in removal of physicochemical parameters such as turbidity, hardness etc. from waste water. Application of these low cost plants -based coagulants are recommended for eco-friendly, on toxic and for efficiency.

IndexTerms - Azadirachta Indica (Neem) seeds, Cactus Latifaria leaves, water purification, coagulation, turbidity, hardness.

I. INTRODUCTION

The production of potable water from most raw water sources usually entails the use of a flocculation/ coagulation stage to remove turbidity in the form of suspended and colloidal material. Aluminium and iron salts are the chemicals most commonly used together with synthetic organic polymers. With aluminium salts, there is always the concern about residuals in the treated water [Miller et al., 1984] and Alzheimer's disease, string carcinogenic properties in human beings.

Many conventional methods for removal of heavy metals, hardness, turbidity, pH, dissolved impurities etc from aqueous solution were found which includes chemical precipitation, reverse osmosis, solvent extraction, and ionexchange. The major disadvantage that we come across with these conventional processes is that the processes are expensive and not eco-friendly. Other disadvantage includes incomplete metal removal, high reagent and energy requirements generation of toxic sludge and other waste products that require careful disposal.

Therefore it is desirable to replace these chemical coagulants with natural coagulants to counteract the aforementioned drawbacks. [Raguwanshi et al., 2002] Natural coagulants have been used for domestic household for centuries in traditional water treatment in tropical rural areas. Some reports describe natural coagulants from Nirmali seed and Maize [Diaz et al., 1999] Mesquite bean, Neem and Cactus latifaria, Tannins [Mpofu et al., 2003] and Moringa Oleifera seeds [Nasser and James. 2007] etc represents a vital development in 'grass roots' sustainable environmental technology since it focuses on quality of life for under developed communities. The main advantages of using natural plant-based coagulants as water treatment material are apparent; they are cost-effective, unlikely to produce treated water with suitable pH and highly biodegradable. Naturally occurring coagulants are usually presumed safe for human health [Vijayaraghavan et al., 2011].The objectives of this study is to investigate the effect of natural coagulants on turbidity and hardness of water.

This study is concerned with the coagulation activity of extracts of various plant-based coagulants such as “Neem Seeds”, “Cactus leaves”. The aim was to ascertain the above mentioned plant-based coagulants in the influence of coagulation activity. The results indicated that Cactus leaves powder showed better influence in removal of physicochemical parameters such as turbidity, pH, alkalinity, hardness etc. Application of this low cost plant-based coagulants are recommended for eco-friendly, nontoxic, simplified water treatment where rural and peri-urban people living in extreme poverty are presently drinking contaminated water.

ADVANTAGES OF NATURAL COAGULANTS

In recent years there has been considerable interest in the development of usage of natural coagulants which can be produced or extracted from microorganisms, animal or plant tissues. These coagulants should be biodegradable and are presumed to be safe for human health. In addition, natural coagulants produce readily biodegradable and less voluminous sludge that amounts only 20– 30% that of alum treated counterpart [Vijayaraghavan et al., 2011]. The use of natural materials of plant origin to clarify turbid raw waters is not a new idea. Natural coagulants have been used for domestic household for centuries in traditional water treatment in tropical rural areas nowadays, some reports describe natural coagulants from Nirmali seed and Maize Mesquite bean and Cactus latifaria Cassia Angustifolia seed and different leguminose species acting as effective coagulants in water treatment.

The main advantages of using natural plant-based coagulants as POU water treatment material are apparent; they are cost-effective, unlikely to produce treated water with extreme pH and highly biodegradable. These advantages are especially augmented if the plant from which the coagulant is extracted is indigenous to a rural community. In the age of climate change, depletion of earth's natural resources and widespread environmental degradation, application of these coagulants is a vital effort in line with the global sustainable development initiatives. Usage of plant-based coagulants for turbid water treatment dates back to over several millennia ago and thus far, environmental scientists have been able to identify several plant types for this purpose.

These natural coagulants, when used for treatment of waters with low-to-medium turbidity range (50– 500 NTU), are comparable to their chemical counterparts in terms of treatment efficiency. Utilization of these coagulants represents important progress in sustainable environmental technology as they are renewable resources and their application is directly related to the improvement of quality of life for underdeveloped communities.

To address this, this paper provides an overview of the natural coagulant sources, processes and mechanisms involved so that environmental specialists can tailor its usage for a myriad of water contaminants. It is surprising to note that a comprehensive critical analysis of available plant-based coagulants is still non-existent given the importance of sustainable environmental technology in the 21st century and hopefully this review can provide an immediate platform for environmental scientists to intensify their research on these natural materials [Vijayaraghavan et al., 2011].

Current research is oriented towards the use of coagulants such as Neem Seed Powder & Cactus Leaves Powder in water treatment process. The quality of treated water was analyzed and compared with that of the water treated with alum.

II. MATERIALS AND METHODS

As a precautionary exercise, standard procedures were followed for sample handling and collection. Few procedures were discussed below.

A. COLLECTION OF WATER SAMPLE

The water sample used for this study was collected from the industrial area of Patancheru in Sangareddy District of Telangana State.

Neem Seeds: *Azadirachta Indica* is a medicinal value based tree. It has many uses. The bark, leaves, and seeds are used to make medicines. Less frequently, the root, flower, and fruit are also used. The bark is used for, stomach and intestinal ulcers, skin diseases, pain, and fever. The flower is used for reducing bile, controlling phlegm, and treating intestinal worms. The fruit is used for intestinal worms, urinary tract disorders, bloody nose, phlegm, eye disorders, wounds, and leprosy. The seed and seed oil are used for leprosy and intestinal worms. The stem, root bark, and fruit are used as a tonic and astringent. Some people apply neem directly to the skin to treat, skin diseases, wounds, and skin ulcers; as a mosquito repellent; and as a skin softener. Neem is also used as an insecticide [Nasim et al., 2014] in various sectors for various purposes.

Cactus Leaves: *Cactus latifaria* a natural, eco-friendly coagulant, could be a strong alternative to the conventional coagulant in the treatment of water-based paint wastewater [Alima et al., 2013]. Cactus as bio sorbent, The adsorption process is a very important separation method based on the use of a suitable absorbent characterized by porous structure allowing high surface area and showing fast adsorption kinetics. This method is noted to be competitive to other techniques applied for water treatment. This is due to various factors such as the cost efficiency, eco-friendly and insensitivity of the used material to toxic substances, high efficiency level, design simplicity, easy operation; etc.

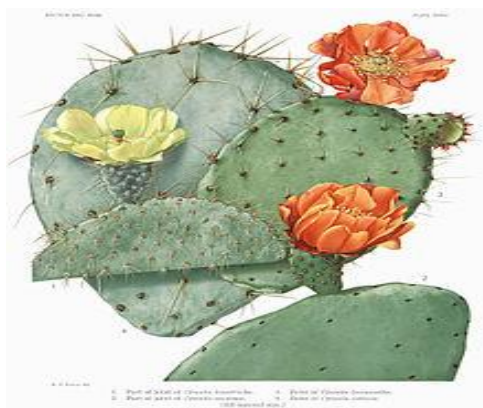
B. PREPARATION OF NEEM SEED POWDER (*Azadirachta indica*)

Neem Seeds were collected and washed with tap water to remove impurities and dirt present in it. The seeds are then dried under sun light for two to three days and it is then grinded to make fine neem seed powder. If required, neem seeds can also wash with acid or alkali to remove very fine dust particle present in the leaf.



B. PREPARATION OF CACTUS LEAVES POWDER:

Plant materials were obtained from different places and dried for five days, then ground in a grinder and sieved to get the fine powder.



C. PHYSICOCHEMICAL ANALYSIS OF THE WATER SAMPLES

The water sample physicochemical parameters were determined before and after treatment with the above said two different natural coagulant seed solutions using standard methods. Jar tests were also conducted for determining the efficiency of a coagulant [American Public Health Association., 1998] [Ndabigengesere and Narasaiah 1998a].

D. DETERMINATION OF TURBIDITY

The turbidity of the water sample was determined using Nephelometer. The Nephelometer was switched on and then calibrated with distilled water .5 ml of the water sample was poured into a cuvette holder with the vertical line on the cuvette aligning with the horizontal mark on the instrument. The value of the turbidity was then read on the CLD(Crystal Liquid Display) [Prasad Maruthi, S.V., and Rao Srinivasa, b., 2016].

E. DETERMINATION OF HARDNESS

The total hardness of water is determined by using complex metric titration of Calcium and Magnesium with an aqueous solution of EDTA at pH value of 10 [Prasad Maruthi, S.V., and Rao Srinivasa, b., 2016].

III. RESULTS:

In this study Neem Seed Powder and Cactus Leaves Powder were used as coagulants and their ability to aid turbidity and hardness removal from water sample was investigated.

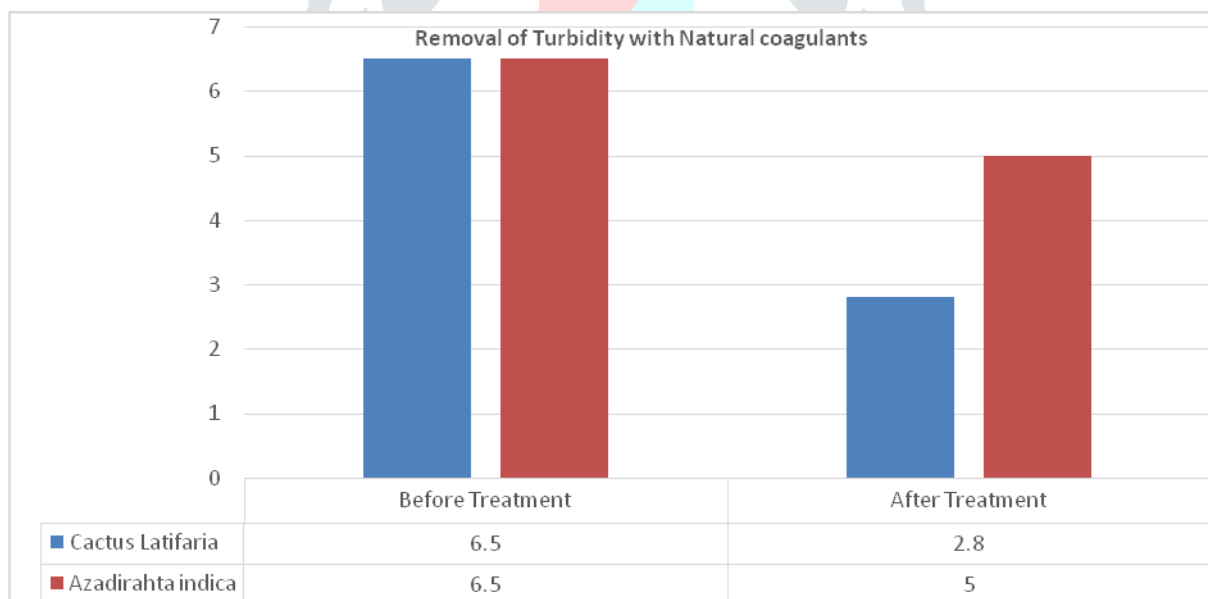


Table-1 and Fig.1 Removal of Turbidity with Natural coagulants

Table-1 and Figure -1 shows that the effect of treating turbid water samples with two different coagulants. It was observed that compared with original turbidity(6.5NTU) of the water sample (figure-1),cactus was more effective than neem seed powder in turbidity removal(2.8NTU).It was observed that the turbidity was slightly decreased when Neem powder is used(5.0 NTU).

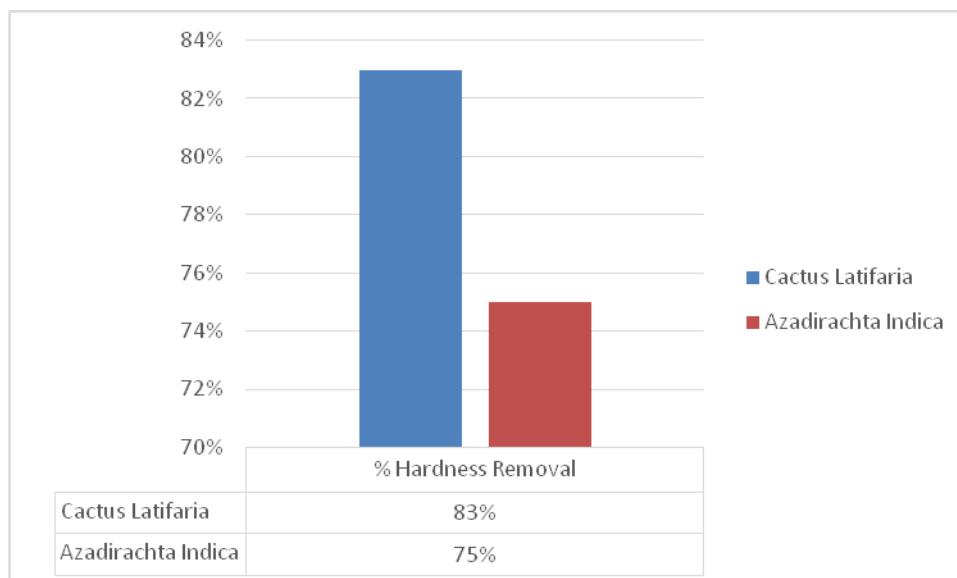


Table-2 and Fig.2 Removal of Hardness with natural coagulants

Table -2 and Figure -2 shows that the total hardness removal of water using Neem seeds powder and cactus leaf powder. The percentage removal of hardness for Neem and Cactus was 75% and 83% respectively. It is clear that Cactus showed a higher percentage of hardness removal compared to Neem [Annika., 2011][Aweng et al., 2012].

IV. DISCUSSION AND CONCLUSION:

The usage of plant based coagulants provides environmental benefits and numerous lab-scale studies have proven that they are technically feasible for small-scale POU utilization. Nevertheless, in terms of commercialization, the bottom line is that it will always be based primarily on whether the scale-up system can sustain similar treatment performance at comparable (or reduced) cost with the natural coagulants when compared with established chemical coagulants [Chun – Yang., 2010].

In the present study it has been observed that Cactus has been found to be effective in removal of turbidity and hardness. The studies reviewed also showed that cactus and neem can be used as water purifiers and it would be possible to develop an eco friendly method of water purification. This will show the way to improve the quality of drinking water. In this study we have presented natural coagulants whose availability is innate, their efficiency is also presented so that they can be considered for further study. It can be concluded that natural coagulants bring with them advantages of being, low cost, and efficient for treatment. Further studies in optimizing working parameter of the coagulants along with increasing shelf life will benefit research in this area. It is concluded that when compared with Neem, Cactus is highly effective in turbidity and hardness removal. Plant – based coagulants also control and regulate turbidity and hardness in drinking water in developing countries where purchase of coagulants is expensive.

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