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Denitrification of the steel plant effluent using moong and tamarind plants

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ABSTRACT

Effluent with nitrates can be treated in a biological method. Impact of nitrates on nature is very high. It causes cancers, blue baby syndrome in infants, thyroid, miscarriages in women, live stock toxicity, also effect the aquatic life in sea when released at uncontrolled measures leading to the death of fishes, marine organisms. Leguminous plants available can easily reduce the nitrate level in the water. This paper explains the use of moong plant and the tamarind plants in treating the nitrates level in the effluent with estimated amount of nitrates taken.

KEYWORDS

Nitrates; Biological method; Leguminous plants; Pretreatment; Moong; Tamarind plant.

INTRODUCTION

The nitrogen is the most essential element in nature. It acts as a building block in the synthesis of genetic matter. Nitrates and nitrites are nitrogen-oxygen chemical units which combine with various organic and inorganic compounds. In drinking water nitrates penetrate through sources that include fertilizers, sewage and animal manure[1]. Once taken into the body, nitrates are converted to nitrites. Infants below six months who drink water containing nitrate in excess of the maximum contaminant level (MCL) could become seriously ill and, if untreated, may die. That blood disorder is methemoglobinemia, also called blue baby syndrome, in severe cases death occurs due to brain damage from suffocation lack of oxygen[2]. And pregnant women are more sensitive to the effects of nitrate and result in abortions, effect the breast milk in women when consumed and effects also include oxygen deprivation (for some animals), when plants with high accumulation are taken by animals nitrogen poisoning symptoms include amplified heart and respiration rates (livestock toxicity)[3], and also cause thyroidal problems and cancers. U.S. Environmental Protection Agency established MCL for public drinking water systems as 10ppm[1]. International Standards set by WHO for drinking water should be maintained in order to reduce the effects[4]. And the nitrates in the contaminated water should be treated well by introducing new and cheaper techniques.

Nitrogen fixation by plants

Plants in nature play a major role in treating the nitrate in the effluent by nitrogen fixation cycle.

The nitrogen sources taken up by higher plants in the form of nitrate or ammonium as inorganic nitrogen sources and amino acids under particular conditions of soil composition[5]. Leguminous plants are found on all continents, except on Antarctica, and in most terrestrial habitats. The family consists of about 19,400 species; nearly 110 of these have been recorded in the Maltese islands. Legumes have been utilized by man since the earliest times. Common and broad beans have been cultivated for nearly 8,000 years in Europe, Asia and in the American countries. The flowers of the typical legume develop into a simple fruit known as a legume (miżwet). When mature, the dry legume splits open along a line of weakness to release the seeds. Beans and pea pods are typical legumes. Leguminous plants are also well known for being able to utilise atmospheric nitrogen. They do this by forming a symbiotic relationship with nitrogen-fixing bacteria which live in structures known as root nodules. The bacteria convert the nitrogen into compounds which can be utilized by the plants. The availability of a good source of nitrogen compounds allows leguminous plants to synthesize amino acids which are the building blocks of proteins, making leguminous plants a good source of proteins. Furthermore, when leguminous plants die and decompose, their nitrogen compounds enrich the soil and become important components of crop rotation systems.

Selective use of moong sprouts and tamarind plants for treating nitrates

The Mung: or Moong bean is the seed of *Vigna radiata*, native to the Indian subcontinent, and mainly cultivated in the Philippines, Thailand, India, Bangladesh, Vietnam, Cambodia, China, Burma and Indonesia.

This leguminous plant can easily be grown (sprouts). Mostly used for culinary purposes with great nutritional value.

Tamarind plants

It is a leguminous plant that belongs to the fabaceae family. The origin of this plant is from the sudan and tropical Africa. The tamarind is well adapted to semi arid tropical conditions, although it does well in many humid tropical areas of the world with seasonally high rainfall. Young trees are very susceptible to frost, but mature trees will withstand brief periods of 28° F without serious injury. Dry weather is important during the period of fruit development. The tree is too large to be grown in a container for any length of time. A mature tree annually produces 150 to 225 kg of fruits, the pulp of the fruit could be around 30 -45%, the shell can be 11 to 30% and the 33 to 40% of seeds[6]. And some studies showed that the use of tamarind seed as an adsorbent seems to be an economical and worthwhile alternative over conventional methods[7].

MATERIALS AND METHOD

The plant moong was grown for 3 days in flask with soil. The sprouts turned into with small plantlets. There were two plantlets taken in the flasks. One flask was supplied with 50ml of untreated and the other with the pretreated sample of effluent. The nitrate level was observed for 1 day, 2 days and the 3days.

Figure 1: Moong plants having both crude and pretreated effluents in two different flasks

The tamarind plant was grown at flask level for 10 days. Both treated and untreated of 50ml were added to each flask and nitrates were estimated on the day 1, day 2 and the day 3.

Figure 2: Tamarind plant having crude effluent in conical flask

Nitrate estimation

10 ml of sample(effluent) is to be taken

To the sample 1ml of NaOH is added.

Add 1ml of methylanthranalite to the above and shake it for 5min.

Then add 1ml of salfanalic acid.

Add 2ml of 1N Hcl to the above.

Finally add 10 ml of distilled water to it.

Take readings of absorption under UV spectrophotometer at 490nm.

The readings taken by the above method indicate the amount of nitrates in the sample. Hence, amount of nitrates reduced by the plants were studied with the estimation method both before and after pretreatment. The readings were taken till the minimum amounts of nitrates were observed.

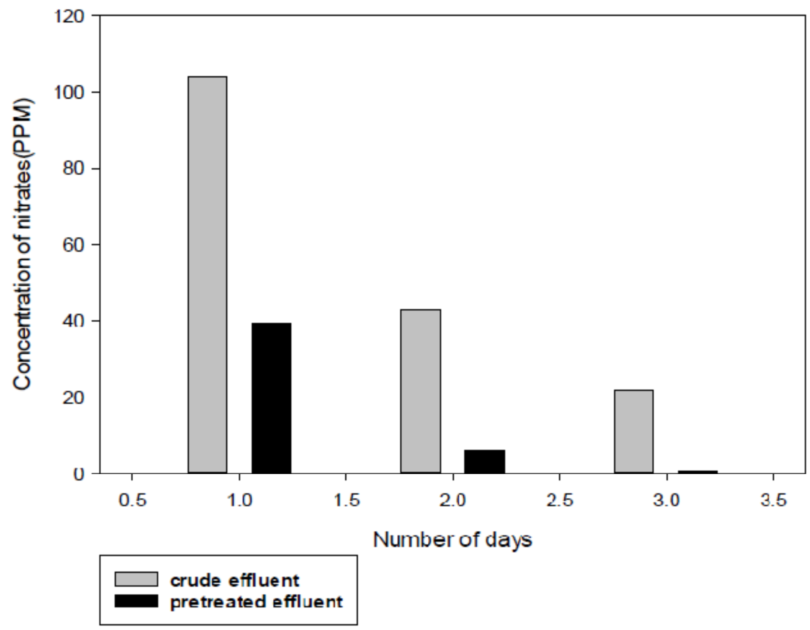
RESULTS AND DISCUSSION

Initial nitrate concentration found in the effluent: 1198ppm
Nitrate concentration after pretreatment (using Alum, dolomite, PVA) : 535ppm

TABLE 1: Nitrate reduction by the Moong plant observed in terms of the change in concentration

s.no	days	Concentration of nitrates in crude effluent (PPM)	% conversion of nitrates in crude effluent	Concentraion of nitrates in pretreated effluent (PPM)	% conversion of nitrates in pretreated effluent.
1	1	104	91.3	39.3	92.6
2	2	43	96.4	6	98.8
3	3	22	98.16	0.6666	99.8

Nirate concentration after pretreatement: 535ppm
Nitrates concentration crude effluent after reduction by Moong plant after 3 days: 22ppm
Nitrates concentration pretreated effluent after reduction by moong plant afer 3 days: 0.666ppm

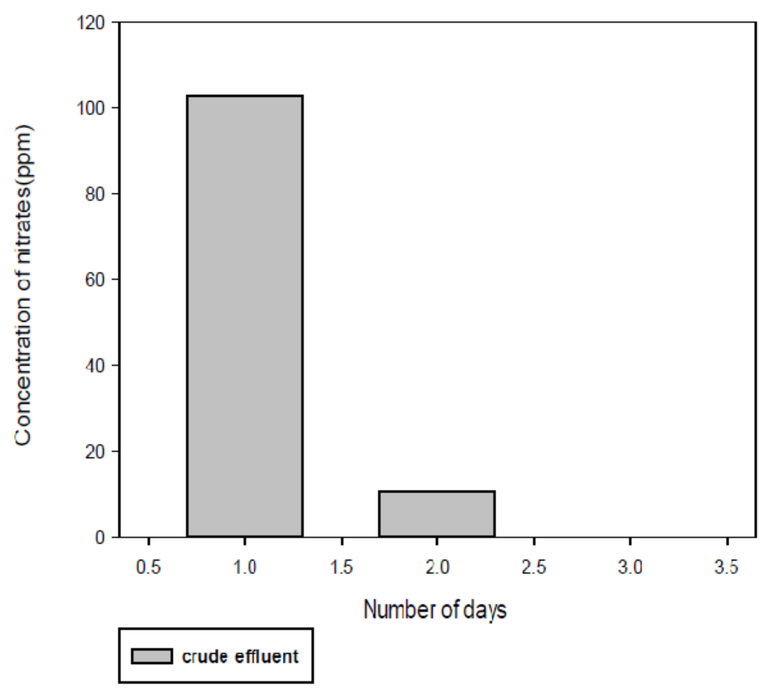


Graph 1: Nitrate reduction by moong plantnumber

TABLE 2: Nitrate reduction by the tamarind plant observed in terms of the change in concentration

S.no	Days	Concentration of nitrates in crude effluent (PPM)	% conversion of nitrates in crude effluent
1	1	103	91.4
2	2	10.6	99.1
3	3	0.5	99.9

Initial nitrate concentration: 1198ppm
Nitrates concentration crude effluent after reduction by Tamarind plant after 3days: 0.5 ppm



Graph 2: Nitrate reduction by tamarind plant

CONCLUSION

The methods used in the treatment, the pretreatment, biological treatment (tamarind and moong plant) proved to be very effective and cheap source of denitrification. Initially the pretreatment which includes the treatment of the effluent with alum, dolomite, and the polyvinylalcohol, has resulted as an effective step, cheaper, faster and better treatment of the effluent and later being treated by the plants chosen was a more successful step of denitrification indicating negligible amount of nitrates in the treated effluent, compared to the untreated effluent sample. The conclusion reveals the effectiveness of the pretreatment and the benefits of plants in treating the nitrates in the effluent.

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