



# Zeolite Applications in Agriculture



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## Introduction

Due to many difficulties caused by overuse of chemicals in agriculture during recent years, much attention has been focused on sustainable agriculture concept. Sustainable agriculture provides safe and enough food for human kind and does not damage environment. Zeolites are crystalline porous aluminosilicates containing alkali (e.g. Na) and alkaline earth (e.g. Ca) cations. The unique physical and chemical properties of natural zeolites, based on their ion exchange, catalytic and molecular sieve properties, make them useful for many agricultural and horticultural applications and also for other environmental use. The present paper reviews the properties of natural zeolites in favour of sustainable agriculture.

## Soil Conditioner

Despite of other soil conditioners like lime, zeolites do not break down over time but remains in the soil to improve nutrient retention [1]. Therefore its addition to soil will significantly reduce water and fertilizer costs by retaining beneficial nutrients in the root zone. Zeolite is marginally alkaline and its use with fertilizers can help buffer soil pH levels. Mumpton [2] reported that zeolites tuff doze modified soil pH to neutral field. The porous structure of natural zeolites helps to keep the soil aerated and moist as well as active for a long time.

## Fertilizer Use Efficiency

Nitrogen (N) loss from irrigated cropland, particularly sandy soils, significantly contributes to nitrate contamination in surface and groundwater. Also it decreases fertilizer use efficiency in which enhances the costs. Gholamhoseini et al. [1] investigated the use of zeolite as organic fertilizer carriers to control N release in soil and reported that zeolite-amended cattle manure has a great potential to control the release of N and other nutrients. Zeolites added to fertilizers help to retain nutrients and, therefore, improving the long term soil quality by enhancing its absorption ability. It concerns the most important plant nutrients such as nitrogen (N) and potassium (K), and also calcium, magnesium and micro-elements [3,4]. Zeolite can retain these nutrients in the root zone to be used by plants

when required. Consequently this leads to the more efficient use of N and K fertilizers by reducing their rates for the same yield, by prolonging their activity or finally by producing higher yields. Large losses of fertilizers which move out of the root zone (leaching) often happen in sandy soils, which lose their capability to retain high nutrient levels. Therefore an application of zeolites will enhance the plant growth and development by reducing the loss of nutrients [5].

## Water Supply

Water saturation percentage (SP) is amount of water that soil can hold by overcoming the gravity force. In zeolites, saturation percentage reaches to 60% [5]; therefore it acts as a clay soil and hold high amounts of water while gives up its water to plants easily and act as a sandy soil.

## Removal of Heavy Metal Cations

Many toxic heavy metals have been discharged into the environment as industrial wastes, causing serious soil and water pollution. The use of alternative low-cost materials as potential sorbents for the removal of heavy metals has been emphasized recently. The structures of zeolites consist of three dimensional frameworks of SiO<sub>4</sub> and AlO<sub>4</sub> tetrahedra. The aluminum ion is small enough to occupy the position in the center of the tetrahedron of four oxygen atoms, and the isomorphous replacement of Si by Al<sup>3+</sup> produces a negative charge in the lattice. The net negative charge is balanced by the exchangeable cation (sodium, potassium, or calcium). These cations are exchangeable with certain cations in solutions such as lead, cadmium, zinc, and manganese. [6] Showed that use of natural zeolite decreased the amount of Cu<sup>2+</sup>, Fe<sup>3+</sup> and Cr<sup>3+</sup> in a simulated soil solution.

## Conclusion

The results of the review showed that zeolites are used as soil conditioner in farm lands and are used to promote better plant growth by improving the efficiency of fertilizers. zeolite also acts as a filter to removal of heavy metals by adsorbing them due to the cation exchange capacity.

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