# Removing Nitrate from Drinking Water

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**I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree of any tertiary educational institution.**

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## Abstract

Water resources in many parts around the world are becoming critical because of human activity. This leads many countries around the world to rely more on their groundwater as an essential source of drinking water. The situation in Libya is critical because there is no access to surface fresh water. The rainfall rate is very low, but there is a huge quantity of ground water with good quality (average TDS around 1030 mg/l) and this leads the country to rely on this water source. The Great Man-Made River Authority (GMRA) was established to produce and transfer water from the southern part of the country (desert) where ground water is available to the northern coastal strip where most of the population is concentrated. However, the water in some wells in the East Japal Hassouna (EJH) well-field has a high nitrate concentration, more than 50 mg/L as $NO_3^-$. To solve this problem and reduce the nitrate content to less than the limits of WHO Guidelines (50 mg/l as $NO_3^-$ and10 mg/L $NO_3^-$-N), one of the available techniques of nitrate removal has to be applied. Previous studies have assessed techniques for nitrate removal from drinking water including analysis of their efficiency, ease of operation, impact on the environment and cost of production. Moreover, the characteristics of ground water (good quality) in the EJH well-field and the potential to use solar energy during the whole year was considered. Experimental trial investigated the use of reverse osmosis (RO) powered by solar

energy to remove nitrate from synthetic water similar to water in EJH wellfield by operating a RO unit in a closed system and using a single solar pump to deliver feed water to the RO unit and through the unit as well. A range of nitrate concentrations treated by applying different pressures for each nitrate concentration. Nitrate removal percentages ranged between 78% to 90% depending on the initial nitrate concentration of feed water and the applied pressure. An ion exchange experiment was also conducted to remove nitrate from synthetic water similar to water in the EJH wellfield and from a nitrate solution by performing column and batch test experiments. Several nitrate concentrations and contact times were applied. Nitrate removal for the synthetic water were excellent (100% nitrate removal) but chloride concentration in the produced water increased over the limits of WHO guidelines. When the same nitrate concentration (20 mg/L $NO_3^-$-N) in feed water was applied in both techniques, both of them gave a good result in terms of nitrate removal capacity as mentioned above. However, the produced water by ion exchange still contained chloride concentrations over the limits of WHO guidelines in contrast to reverse osmosis which did not produce this unintended effect.

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