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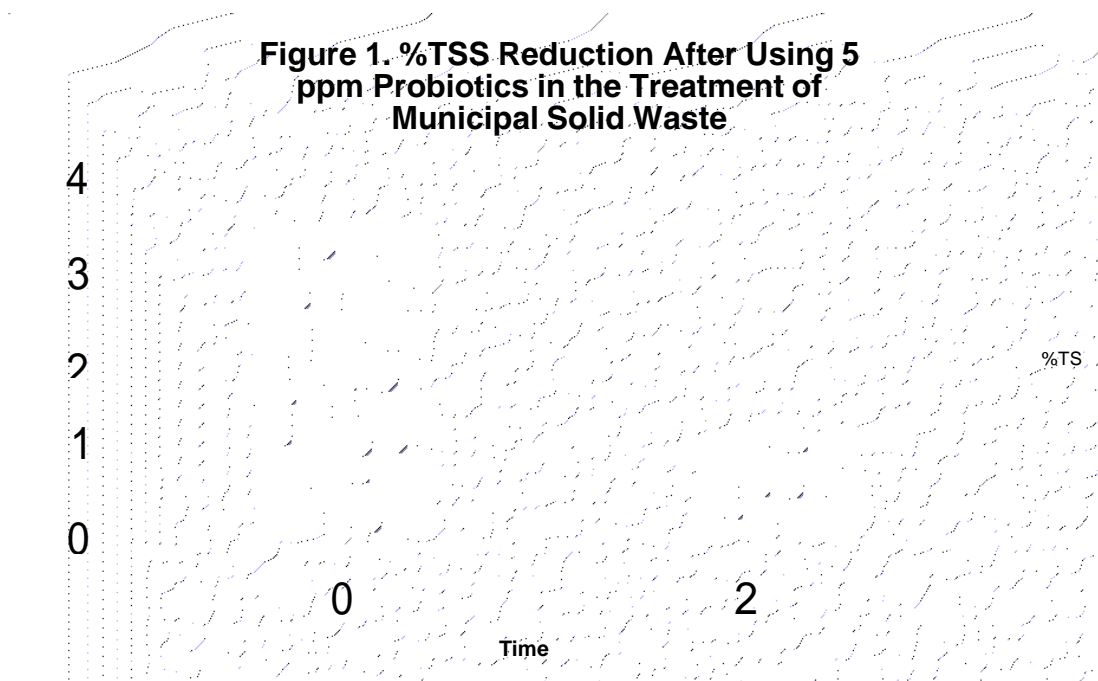
The Use of Probiotics in Bioremediation

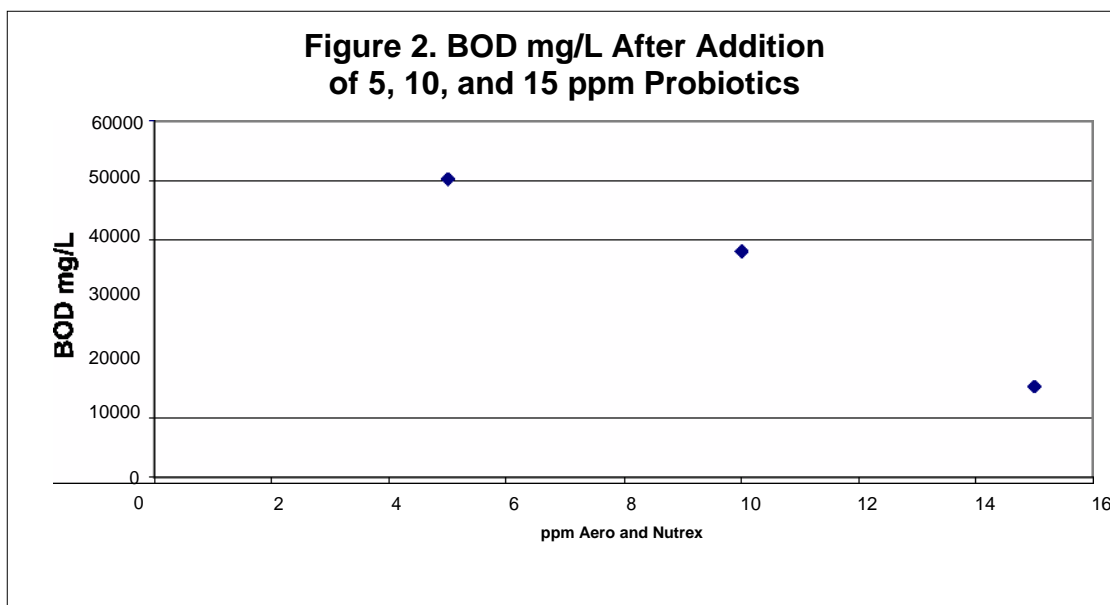
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Probiotics have been used for many years in the field of veterinary medicine. Now a new generation of probiotics for other biological systems and bacterial populations as well as turf and aquaculture has become available. The purpose of this research was to determine if Biofeed® NUTREX™, CHETROL®, AERO™, BIOREMTM, and COZYME-50™ are effective as bio-stimulants in various different wastes. The various waste streams in this study were ponds, lagoons, anaerobic digesters, acid mine drainage streams, poultry processing wastes, heavy metals wastes, and oil wastes.

All the products mentioned above are in liquid form and is typically applied at the rate of 3 parts per million. All products have the ability to buffer pH extremes, increase dissolved oxygen levels, and restore biological systems to optimum health conditions. CHETROL® is also a powerful chelating agent and is used in the bioremediation of heavy metal wastes to immobilize the metals to prevent the contamination of other materials. The primary goal of all of the studied products is to energize the natural biological systems present with the studied waste streams through aeration and biostimulation. All products contain a mix of enzymes, amino acids, and organic acids.

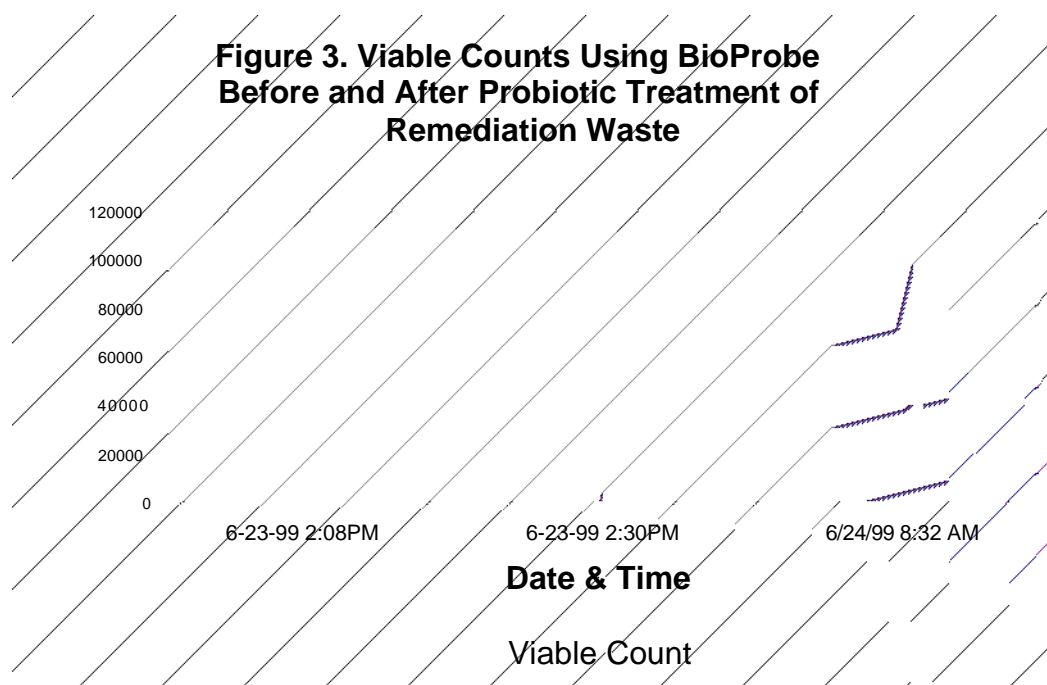
The results of all the above mentioned waste streams showed a increase in dissolved oxygen and alkalinity, and a stabilization of the pH between 7-9 pH units. Odor reduction was also observed where there was a problem. Other benefits included a decrease in total suspended solids (Figure 1.), a reduction in the size of sludge layers, and a reduction in metals, particularly iron, chromium, copper, lead, and mercury. The biggest impact on the bioremediation of processing waste was the reduction of chemical oxygen demand (COD) and biological oxygen demand (BOD) [Figure 2].



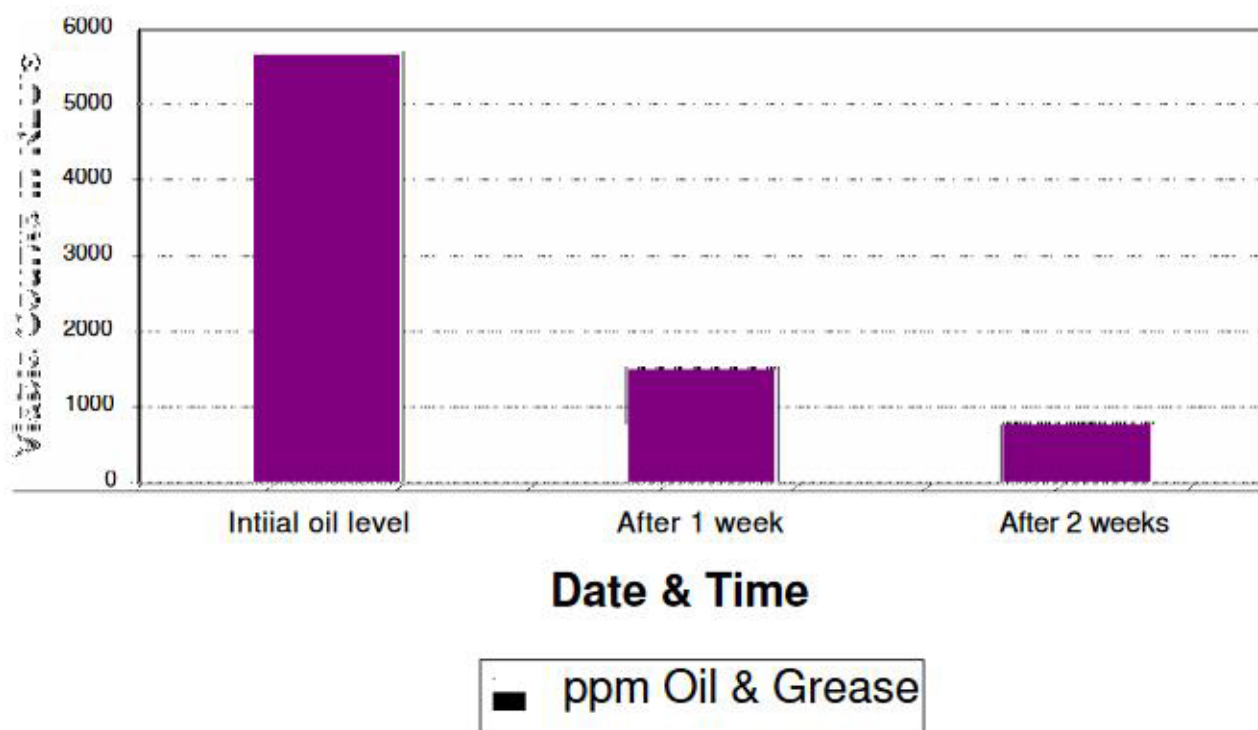


The study showed that the NUTREX™ and AERO™ has significant stimulatory properties when used in biological systems such as ponds and lagoons. Figure 3 shows the increase in viable counts after the addition of these two prebiotics. All viable counts were performed on the Bioprobe luminometer made by Huges Whitlock of Cardiff Wales. This test is based on the lucifer/luciferase reaction and is completed in about 10 minutes as compared to 48 to 72 hours using plate techniques. BART tests show a increase in sulfate reducing, nitrifying, and denitrifying bacterial populations. A reduction in pathogen indicators such as fecal coliforms and e.coli were also observed during the study.

BIOREM™ has also been shown effective in reducing hydrocarbons. This is shown in Figure 4.



**Figure 4. Oil Reduction Using Probiotics
To Remediate Oil Waste**



Biofeed® Products are under further research to determine if they can compete economically with the use of limes, ammonia, and caustics in the treatment of acid mine drainage. NUTREX™ and AERO™ show a nice buffering capacity with additional pH adjustment due to the breakdown of amino acids into ammonia. After reviewing the results from this study's treatment of AMD, Biofeed's formulators are working on new products that may be more beneficial to the mining industry.

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