Optimizing Metformin HCl Removal: Utilizing Molecular Sieves and Absorbents within Sand Filtration Units

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Diabetes is one of the most prevalent diseases on Earth. The most commonly used pharmaceutical to treat diabetes is metformin HCl. Attention and alarm over the environmental effects of this drug have increased because metformin has been found in our lakes, rivers, and drinking water. With known detrimental effects on aquatic organisms, including intersex and stunted growth, metformin's presence in the environment calls for a solution that can be implemented in water treatment. In this experiment, three aluminosilicates were tested for their effectiveness at removing metformin: two molecular sieves (zeolite Y, mordenite) and an absorbent (bentonite). These materials were tested under a variety of conditions within constructed sand filtration units to simulate tertiary stage wastewater treatment. Deionized water with metformin concentrations of approximately 400 ug/L were processed through the treatment systems. Sampling was done using liquid chromatography tandem mass spectrometry. Mordenite proved to be the most effective, removing 99.0% of metformin on average, compared to the control's 63.5%. Zeolite Y was 92.8% effective, and bentonite was ineffective. The channel and cage dimensions within the zeolite appear to be the reason for mordenite's high success, as mordenite's channel diameter is congruent to metformin's particle diameter, facilitating increased adsorption. By matching the channel diameter with particle diameter, mordenite could be utilized to remove metformin in water treatment. With an increasing number of pharmaceuticals posing an environmental threat, mordenite and other zeolites could potentially prove to be an inexpensive and easily implemented solution.

Awards Won:
Second Award of $1,500