Converting Industrial Waste into Eco-Friendly Products for Pharmaceutical Applications

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According to the United States Statistics Division, the production of hazardous wastes around the world has increased drastically by a rate of 40,000% in just one generation. Hazardous industrial wastes materials may pose a threat to the environment or elevate human health risks. The present study discusses the electrochemical synthesis of 4-Aminophenol, which is an important pharmaceutical chemical intermediate, from toxic 4-Nitrophenol. Prominently, it is used in the industrial synthesis of N-(4-hydroxyphenyl) ethanamide, commonly known as Paracetamol. A glass electrochemical cell that consists of two containers attached by a salt bridge and fitted with lead electrodes connected to a power source was used in the experiment. This setup caused an electron transfer reaction across the solution interface to reduce 4-Nitrophenol into 4-Aminophenol. Titanium Dioxide was added to the reaction mixture as a protecting media for the electrolyte. The starting material 4-Nitrophenol is a toxic chemical present in many industrial products. The experiment was repeated 5 times and the end product was analyzed using different techniques. The Nuclear magnetic resonance (NMR) and Fourier transform infrared spectroscopy (FTIR) spectroscopy were used to determine the chemical composition of the prepared product, while Differential Scanning Calorimetry (DSC) was used for product purity determination. The results indicated a highly pure 4-Aminophenol presence in the end product based on the results obtained from the differential scanning calorimetry. This project can be applied in pharmaceutical industries and will potentially lower the amount of environmentally harmful substances by reducing the waste materials.

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