From Factories Waste to Fertilizer: Producing Ammonium Sulfate from Gypsum and Fluorosilicic Acid

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A large amount of gypsum and fluorosilicic acid wastes is produced each year from a fertilizer factor in Hai Phong, Vietnam and negatively affects our environment. The goal of our study is to produce ammonium sulfate fertilizer from these wastes in order to solve an environmental problem as well as to meet the demand for fertilizer for agricultural cultivation. Firstly, ammonium fluoride, an intermediate was prepared by the reaction between fluorosilicic acid and ammoniac at 30oC in 55 minutes. After that, gypsum and ammonium fluoride were mixed at a ratio of 10:11.5 (g/g), then added with 42ml of water, stirred for 1hr at 30oC to produce ammonium sulfate and a calcium fluoride byproduct with the yield of 82.75%. The obtained products, ammonium sulfate and calcium fluoride were characterized by X-ray diffraction and infrared spectroscopy. In addition, 15 rare earth elements and 7 other trace elements were found in ammonium sulfate fertilizer by inductively coupled plasma mass spectrometry. The ammonium sulfate fertilizer containing 22 trace elements was also applied on four species of plants. The results showed that these plants were taller and heavier than the control, confirming that ammonium sulfate has a positive effect on the growth of the plants. From this research, it can be concluded that gypsum and fluorosilicic acid may be recycled for use in agriculture and industrial production, creating an economically viable alternative to pollution.