GREENING FERTILIZER: Building a path to sustainable agriculture

Innovations in fertilizer production” at list by reading “Sustainable agriculture: Is there a path to more sustainable agricultural practices, starting with greener approaches to fertilizer?

Many countries will have a hard time meeting the growing demand for food, especially in the developing world. Chemical fertilizers that fueled widespread growth are manufactured from non-renewable resources and their production has a high carbon footprint, exacerbating climate change. Yet without ready access to fertilizer, many countries will continue to struggle.

The third agricultural revolution of the mid 1900s paved the way for tremendous increases in agricultural productivity throughout the world, but these practices are not sustainable. The chemical fertilizers that have been critical to productivity need to be rethought.

In 2014, the United Nations released the report “Building a Path to Sustainable Agriculture,” which highlighted the need for new, sustainable agricultural practices. The report recommended focusing on the following areas:

- Developing new, efficient, and sustainable agricultural practices
- Investing in research and development to improve crop yield and efficiency
- Enhancing soil health and fertility through the use of organic and inorganic fertilizers
- Developing new and innovative technologies for fertilizer production

Building a path to sustainable agriculture.

**MAJOR NUTRIENTS**

- **Nitrogen**
  - Mined from potash ore
  - Extracted from atmosphere
- **Phosphorus**
  - Mined from rock
  - Extracted from phosphate rock
- **Potassium**
  - Mined from potash ore

**ECO-FRIENDLY SYNTHETIC FERTILIZERS**

- **Smart Nano-fertilizers**
- **BIOREFINERIES**
- **Biological wastewater treatment**
- **Chemical wastewater treatment**
- **Electrolysis**
- **Osmosis**
- **Forward osmosis**

**NUTRIENT RECOVERY FROM WASTE**

- **Struvite (MgNH₄PO₄)**: Adequate nutrient source
- **Blood meal**, **Fish meal**, **Alfalfa meal**: Nutrient release and accumulation in soil

**PROMISING TECHNOLOGIES IMPROVE NUTRIENT RECOVERY FROM WASTE**

- **Chemical treatment concepts for struvite production**
- **Biological treatment concepts for struvite production**

**INCREASED NUMBER OF PUBLICATIONS**

- **Publications related to struvite**
- **Publications related to wastewater treatment**
- **Publications related to nutrient recovery**

**TRENDS IN CAPACITIES FOR GREEN AMMONIA SYNTHESIS**

- **Expensive to mass produce**
- **Also have challenges**

**BROADLY RELATED TO SUSTAINABLE FERTILIZERS**

- **Biochar production with composting**
- **Patents for processes**
- **Wastewater/sewage**, **Wood ash**

**INNOVATIONS IN FERTILIZER**

- **NPK**, **Fertilizer**, **Ammonia**, **Haber-Bosch**
- **Chemical wastewater treatment**, **Aeration wastewater treatment**
- **Electrochemical wastewater treatment**, **Neutralization wastewater treatment**
- **Wastewater treatment sludge**, **Activated-sludge wastewater treatment**

**IN TRENDS FOR GREEN AMMONIA SYNTHESIS**

- **7 years, 14.007**, **500 million metric tons CO₂ emitted annually**

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