

# Technology for manufacturing granular mineral fertilizers with a bioactive polymer coating containing lyophilized spore-forming bacteria

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## Introduction

The aim of this work was to develop a technology for manufacturing a granular mineral fertilizer with an external coating containing biologically active agents, while eliminating water from the microbial application step and minimizing process factors that reduce microbial survival. The technological concept was based on physically separating the microorganisms from the mineral fertilizer core by means of a readily soluble polymer coating that remains neutral toward both the fertilizer and the biological preparation.

### The 5-Step Waste-Free Manufacturing Process



### Overcoming the Bottleneck: A Water-Free Innovation

Primary aim: Develop a water-free technology for manufacturing granular mineral fertilizers with a protective, bioactive polymer coating.

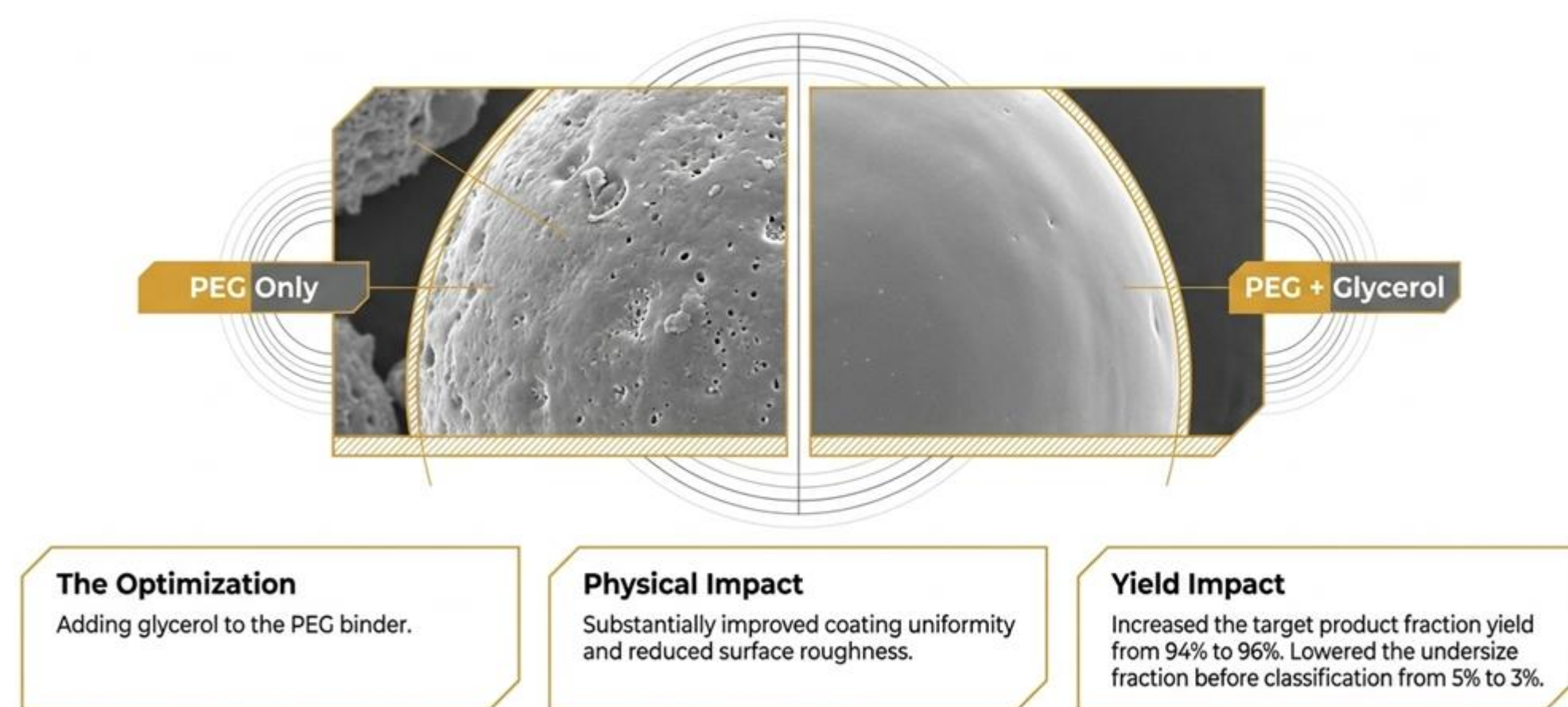
| Traditional Method                      | Our Technology   |
|---|--|
| Water-based microbe application         | Water-free application process                                     |
| Moisture triggers premature activation  | Low-melting Polyethylene Oxide (PEG) binder                        |
| Requires high-temperature final drying  | No heat-induced drying phase required                              |
| Microbes exposed to toxic mineral salts | Physical barrier completely separates microbes from the harsh core |

## Unprecedented Microbiological Survival and Stability

**>95%**  
Microbial survival during the production process

**<20%**  
Maximum loss of viable microorganisms after one month of storage.

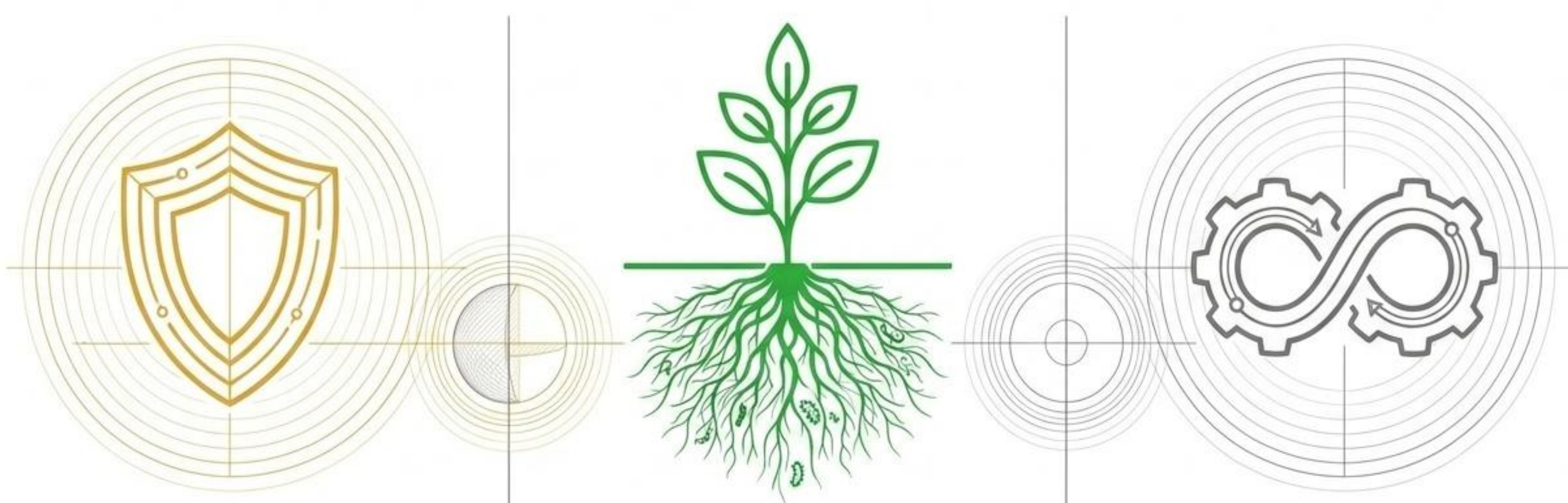
Coating composition dictates both biological stability and physical quality.



- The Optimization**  
Adding glycerol to the PEG binder.
- Physical Impact**  
Substantially improved coating uniformity and reduced surface roughness.
- Yield Impact**  
Increased the target product fraction yield from 34% to 36%. Lowered the undersize fraction before classification from 5% to 3%.

Conclusion: Eliminating water and high-heat drying completely preserves high biological activity.

## A Next-Generation Functional Fertilizer Platform



### Biological Protection

PEG acts as a neutral, physical barrier separating microbes from aggressive salts, securing long-term shelf life without premature activation.

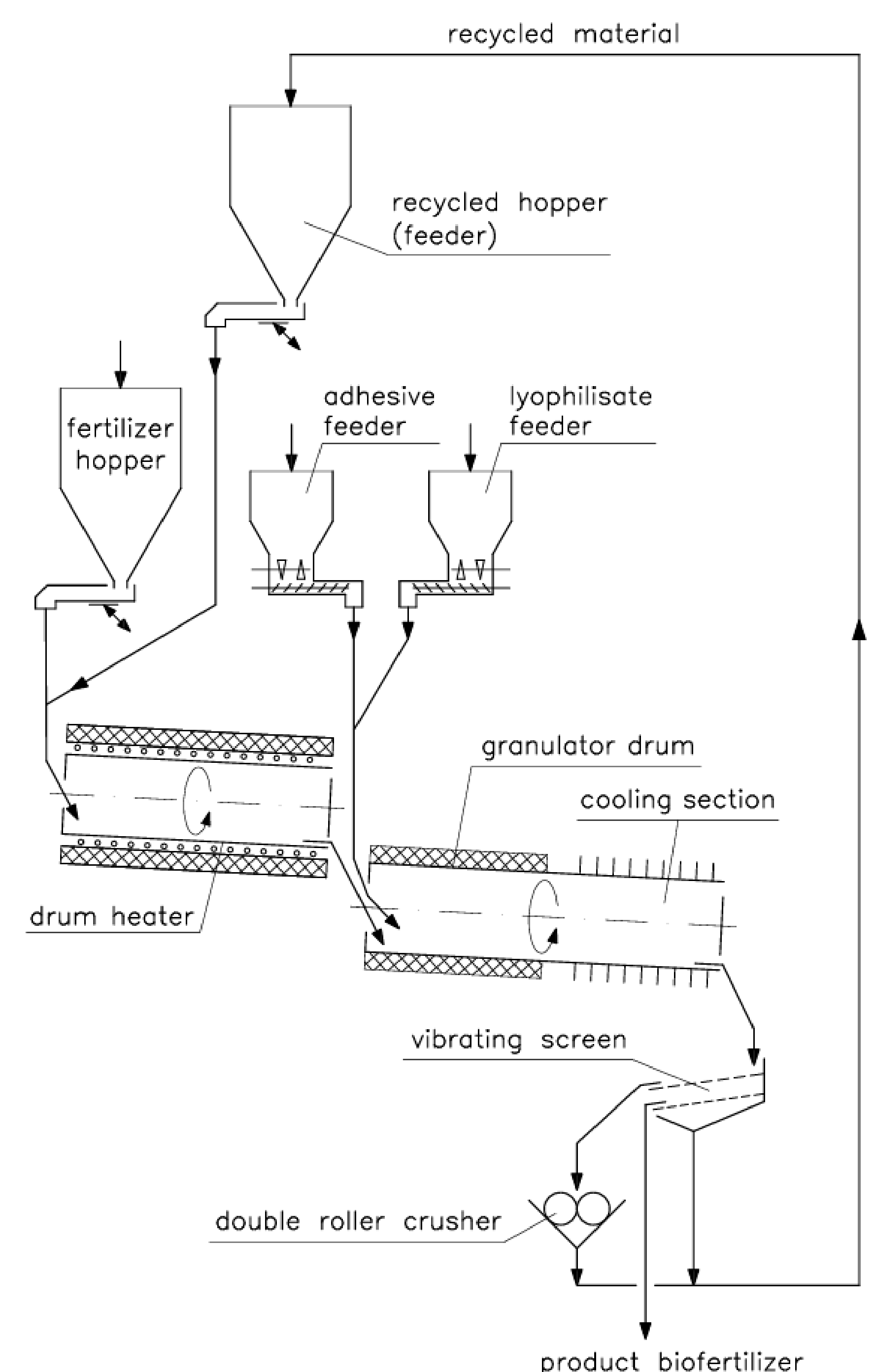
### Agronomic Value

Delivers standard essential macronutrients combined with powerful biological root stimulation for enhanced drought resilience.

### Manufacturing Efficiency

A simple, water-free, waste-free continuous process requiring no expensive high-pressure equipment. Highly adaptable to various mineral cores.

## Granulated fertilizer production scheme with biocomponent enrichment



## References

Patent application P.431350, Patent Office of the Republic of Poland  
Patent application P.431354, Patent Office of the Republic of Poland

