Nutrient segregation reduced by matching granule size of blended fertilisers

Producing blended fertilisers with a greater emphasis on matching granule size of individual nutrients has reduced segregation and therefore increased the spread accuracy and nutrient distribution, providing precise and complete fertilisation.

The fertiliser market has seen an increase in demand for blends over many decades. Some of this has been driven by policy changes and the need to comply with sustainability goals, such as the Sustainable Farming Incentive for UK farmers, but others are to combat rising fertiliser costs, along with the greater requirement for prescription nutrition to match soil and crop requirements.

The criticism regularly levelled at blends is regarding the segregation of granules during production, handling and spreading, which can lead to application inaccuracy compared with a complex compound product. However, the focus of an International Fertiliser Society paper at its 75th anniversary programme has been to match granule size of different nutrients to better influence spread consistency. Peter Scott, current president of the European Fertilizers Blenders Association (EFBA), was one of the co-authors of the paper and explains being able to distinguish between poor-quality and high-quality blends is essential.

“Nutrient segregation has been the biggest factor holding back blended products, so we wanted to prevent this from happening. Understanding what happens regarding agronomic and nutrient distribution between poor- and high-quality blended fertilisers will help influence production techniques in the future.”

The need for blended fertilisers

Blended fertilisers account for an estimated 50% of the UK fertiliser tonnage, with prescription nutrition a key reason for end users adopting this approach. Matching tissue and soil analysis data to the type of nutrients being applied has been proven to increase crop growth and quality. The requirement for this type of crop nutrition was highlighted by soil sampling results released by a Professional Agricultural Analysis Group (PAAG) report in 2019-20. It showed that of the 126,089 soil samples analysed, only 9% were at the optimum P and K indices.

Mr Scott continues: “EFBA views prescription nutrition, with its agronomic and environmental benefits, to significantly grow and offer end users a more complete crop nutrition alternative.”

The role of prescription nutrition in agriculture is changing the image of blended fertiliser, too. No longer are they only considered a more economical alternative to complex compounds; there are the attributes to make it more agronomically beneficial. “End users don’t want to be constrained to a small selection of products that compromise on the soil’s needs. Blends can offer individual chemical analyses for specific farms and fields.”

How to prevent segregation

Producing blends that do not segregate relies on three areas: the selection of raw material to match granule size; blending and bagging design; and avoiding bulk transport of blended fertiliser. It is the first of these factors that is now thought to have a greater influence on minimising segregation and by implementing EFBA’s Granulometric Spread Index (GSI) model when selecting the raw materials, high quality blends can be reliably produced.

The GSI model has been part of the EFBA handbook since 1997 but research into the practical implementation of it on the production of blends is limited. GSI is a mathematical model that quantifies a numerical value for each raw material based on its granule size – measured as a diameter in mm. Poor quality blends tend to be those with a wide range of GSI values, which encourages segregation between smaller and larger granules, and therefore causes inaccurate distribution.

A sample of a raw material being assessed under the GSI model is put through a mechanical shaker with a selection of seven varying sized sieves which provide an indication of where the mean sizes are. The percentage retained in each sieve size is plotted on a graph to determine the granulometric curve of the granule size, with measurements taken along the curve at 16%, 50% and 80% used to evaluate the GSI (figure 1). Mr Scott explains EFBA's handbook parameters.

"EFBA recommends that 90% of granules should be between 2.5–4mm, with a mean granule size of 3.25mm and a GSI value of <18. Blending raw materials with similar granule size distribution will minimise the risk of segregation across the production and supply process."

Due to fertiliser price increases, and shutdown of large output European factories, there has been significant demand from end users for nitrogen sulphur (NS) fertilisers not just as a straight, but using raw materials to create a blended NS fertiliser.

By comparing the granulometric curves of two nitrogen and two sulphur products, it showed that N1 and S1 products have GSI values much closer than a blend of N2 and S2 (figure 2), so would be less likely to segregate in the bag. "The mean granule size of N1 and S1 is also comparative, whereas the N2 and S2 products have a larger gap between the mean figures, so there is greater risk of segregation when blending these two products together," advises Mr Scott.

Can it work in practice?

Although in theory the GSI model offers the potential to reliably produce high-quality blends, can the nutrient analysis remain consistent, and will it deliver an even distribution of individual nutrients once the blend is loaded into the spreader?

Independent verification in Iceland by Trading Standards Officers over a six-year period (figure 3), assessed the analysed NPK values of blends and complex compounds. The blends were made to the EFBA handbook using the GSI model, and both products were analysed in the same way

"Looking at the declared and analysed NPK values, the deviations between these were more accurate across the 86 samples of blended fertiliser compared with the 46 samples of the complex compounds. This offers evidence that the GSI model can not only eradicate the production of poor-quality blended fertiliser, but it can also compete with complex compounds for nutrient distribution consistency," comments Mr Scott.

The data collated from Trading Standards demonstrates that blends made using the GSI model do not segregate, and consistency of the nutrient analysis is accurately maintained throughout the production processes.

Spreading tray tests

To verify the nutrient distribution during spreading, tests were undertaken at Bogballe's test facility in Denmark. Samples were taken across multiple runs at 1m intervals to not only analyse the spread pattern consistency, but the nutrient distribution across the width.

The graph (figure 4) shows the spatial distribution of N, P_2O_5 and K_2O a 20:10:10 'poor quality' blend that has not been produced in accordance with EFBA's handbook. The three nutrients differ in size and weight and therefore offer very different spreading characteristics contributing to inconsistent application.

Conversely, figure 5 shows the same fertiliser blend spread to the same width, but this time produced in accordance with the EFBA handbook. Mr Scott explains the results further.

"There was significant segregation of all nutrients in the poor-quality blend across the full spread width. This was highlighted in the nitrogen percentage at 20% next to the spreader but dropping to 10.64% at 13m and just 7.23% at the full 16m width on the right-hand side. This level of segregation would lead to stripping of crops and would certainly affect yield and quality."

The only difference between the blends was the source of the nitrogen, which demonstrates that the GSI value of raw materials should have a greater bearing in blended fertiliser production.

Even distribution of nutrients

The role of blended fertiliser in crop and soil nutrition is helping from an agronomic perspective, with thousands of tailored blends for prescription nutrition requirements. This wide selection of products does pose impracticalities for blenders to supply spreader settings to farmers for each individual blend.

However, Mr Scott says that blenders can provide information that will help determine spreader settings on farm. "As blenders we know the crush strength range and average crush strength of the product, the bulk density and average diameter of the granules in the bag. Alongside this information, farmers will need to work out the flow rate, which is more accurately tested on farm as it accounts for humidity and spreader wear, and use it all to find their ideal spreader settings."

EFBA will be encouraging blenders using the GSI model to provide farmers with this practical information to make it easier to achieve the correct spread of nutrients across the width.

Assurance scheme

EFBA is in the process of developing an assurance scheme in conjunction with independent certification body, Kiwa. It is hoped that this scheme will allow blenders that adopt the GSI model for production to be certified under the scheme and offer independent recognition of high-quality blends.

"There is currently no accreditation that blenders producing high-quality fertiliser in accordance with EFBA's handbook guidelines can differentiate their products from those of a lower quality," says Mr Scott.

Producers who want to comply with the scheme will be subject to an independent audit, with initial test audits planned for summer 2023, and a full release of the scheme intended for autumn 2023. “It will enable farmers to easily identify a high-quality blend from a poorer-quality blend, allowing growers to confidently choose prescription nutrition for precise fertiliser application,” concludes Mr Scott.

The research into the GSI model has shown that blended fertiliser can compete with complex compounds when produced to these guidelines and EFBA will be encouraging all blenders to adopt this model to improve fertiliser accuracy.