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The Evolution of Screening Systems for Optimum Granular Fertilizer Product Quality

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Abstract

Until around the 1980's, the accepted typical size distribution standards for granular fertilizer was Tyler 6 to 16 (1.18-3.35 mm) in the U.S. and 1-4 mm in many other parts of the world. However, in order to avoid caking dust problems during handling operations and to improve the evenness of fertilizer distribution from mechanical spreaders, fertilizer product quality expectations in the marketplace have changed. Attention has been focused on eliminating small granules, moving towards a much more closely sized product and generally increasing the median size of granular products.

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Nomenclature

SGN	size guide number
UI	uniformity index
d	granule diameter, mm
F	rate of granule growth
R	recycle ratio

1. Definition

The new sizing expectations are defined by two important criteria; Size Guide Number (commonly referred to as SGN) and Uniformity Index (commonly referred to as UI). The definitions of these terms are:

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1.1. Size Guide Number (SGN)

The median granule diameter multiplied by one hundred. In other words, the size at which 50% of the product is retained expressed in millimetres multiplied by one hundred.

$$SGN = d_{50} \times 100 \quad (1)$$

1.2. Uniformity Index

The ratio of the small granules (particles retained at 95%) to large granules (particles retained at 10%) multiplied by one hundred.

$$UI = d_5/d_{90} \times 100 \quad (2)$$

or

$$UI = [95\% \text{ retained}] / [10\% \text{ retained}] \times 100 \quad (3)$$

Where a UI of 100 means all granules are the same size.

2. Market Expectations

Product is now expected to be essentially between 2 and 4 mm. Furthermore, while 90% of 2-4 mm was once considered good, the expectation is now 93-95% or even 98% in range. In addition, the trend has moved towards larger sized product and the expectation for SGN has increased from around 225 to approximately 300. In some markets, even larger SGN is sought. A more closely sized product is also highly desirable and the expectation for UI has increased from around 50 to 60 or greater.

This paper will discuss the evolution of screening system arrangements designed to meet these new expectations.

3. Stage 1 – Double Deck Screens

Many older plants were designed with double deck screens located downstream of the dryer. In fact, until rather recently some new plants (not designed by Jacobs) continued to use this arrangement. The advantage was that the arrangement was compact, saved space and was relatively inexpensive. The disadvantage is the product size distribution was typically poor, particularly by today's standards.

In a double deck screen, the upper deck separates oversize granules and the lower deck separates fines. Product sized granules pass through the upper deck but are retained on the lower deck. For almost all MAP/DAP plants it is necessary to recycle some on-size granules along with crushed oversize and fines in order to control granulation at the optimum point. For a plant that is granulating "well", a typical size distribution of the feed to the screens is as follows:

Table 1

+ 4mm	20%
+ 3mm	22%
+ 2mm	33%
- 2mm	25%

The typical recycle ratio requirements in a DAP plant is 4:1. Therefore approximately 60% of the on-size material generated has to be recycled. A typical arrangement using double deck screen is shown in Figure 1 below.