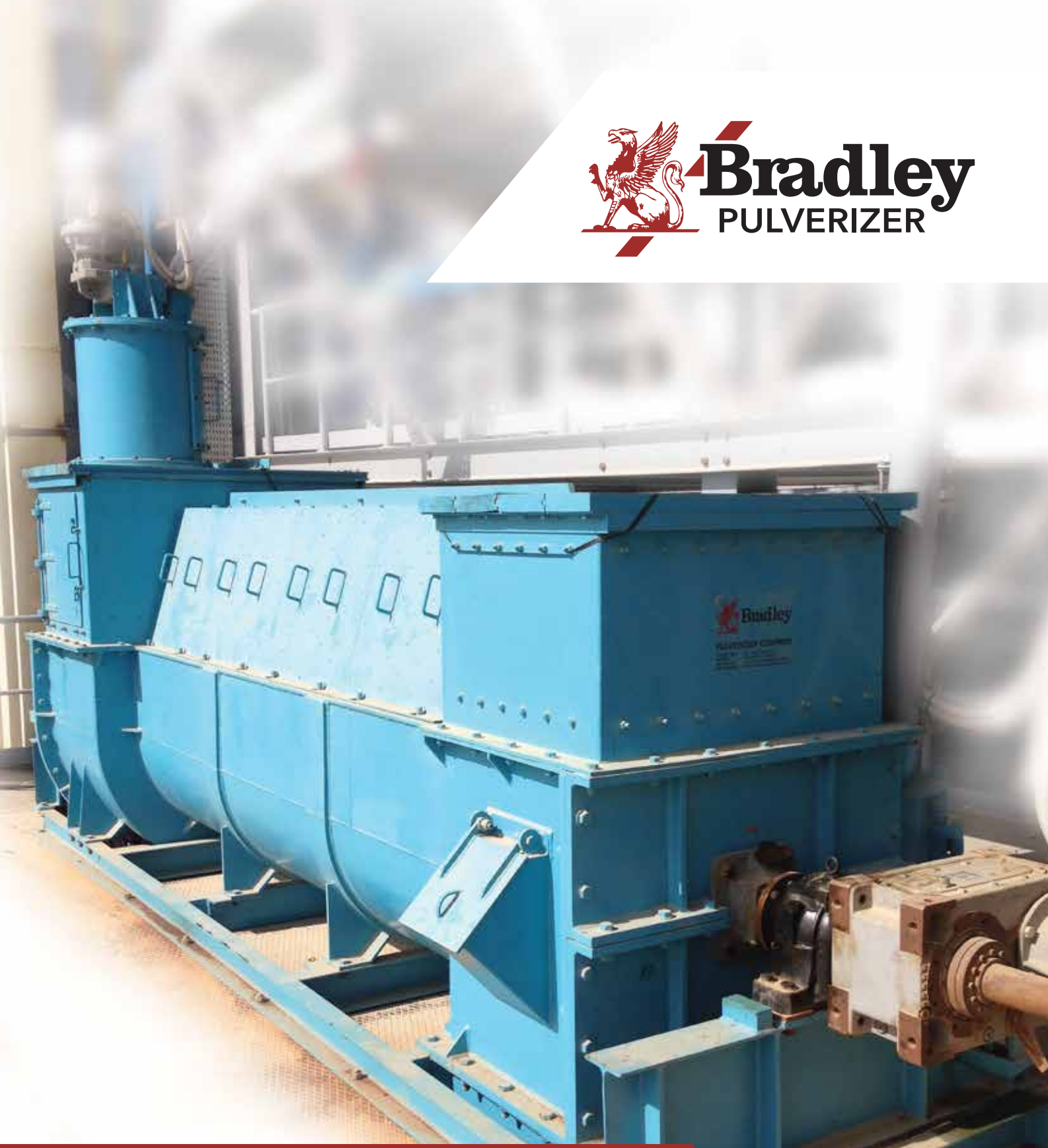
Bradley PULVERIZER



PHOSPHATE PROCESSING with the Bradley BROADFIELD PROCESS

PHOSPHATE PROCESSING

with the Bradley BROADFIELD PROCESS

Phosphate is essential for optimal plant growth. Acidulation processing of phosphate rock with the Broadfield Process is used to produce fertilizers, enriched animal feeds and acid salts to meet your product specifications. The Broadfield Process can produce SSP economically from all known phosphate rock sources.

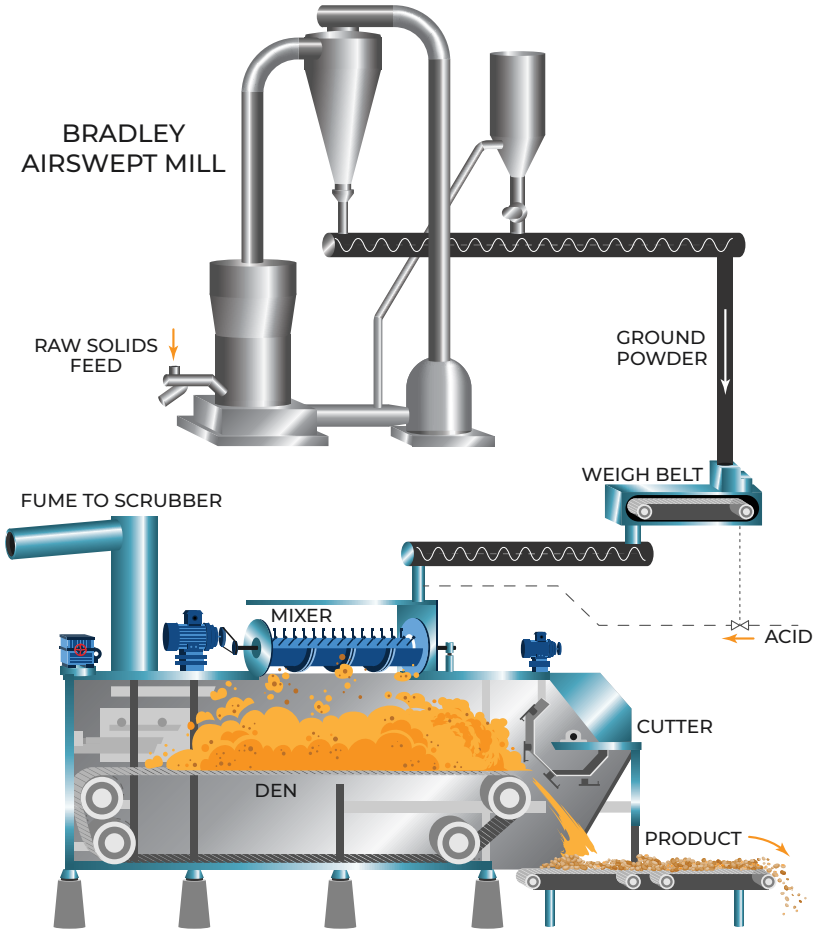
THE BROADFIELD PROCESS CAN PRODUCE:

- ☐ SSP, TSP, MAP, DAP, MCP, DCP
- ☐ Partially Acidulated Phosphate
- ☐ Iron Sulphate
- ☐ Synthetic Gypsum
- ☐ Other Acidic Salts

BRADLEY BROADFIELD PROCESS

The Broadfield Process was the first turnkey continuous phosphate processing system. With a series of connected equipment systems, each unit is individually engineered for optimal output and designed to meet product specifications of the end user based on laboratory testing & raw material composition. The flexibility of the Broadfield Process allows the use of any grade of rock, including low grades not possible to process by other Den methods.

BRADLEY BROADFIELD PROCESS



With over a 100 years of in-depth process knowledge, the Broadfield Process is the gold standard in acidulation processing.

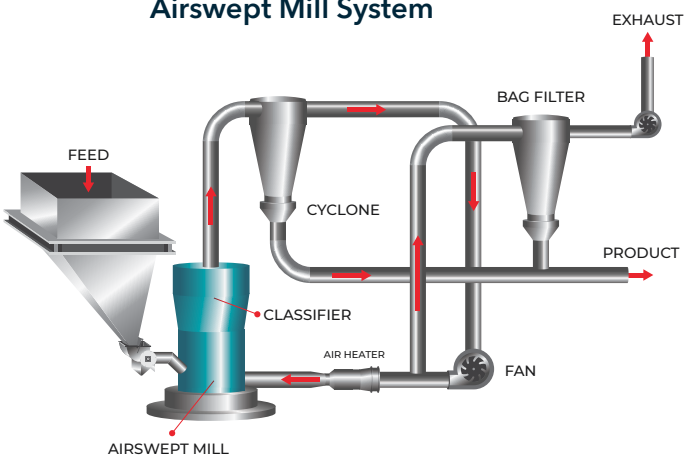
BROADFIELD Process System Design

Bradley Pulverizer offers single source supply of complete process lines including: phosphate rock grinding, acid dilution, effluent scrubbers and powder storage.

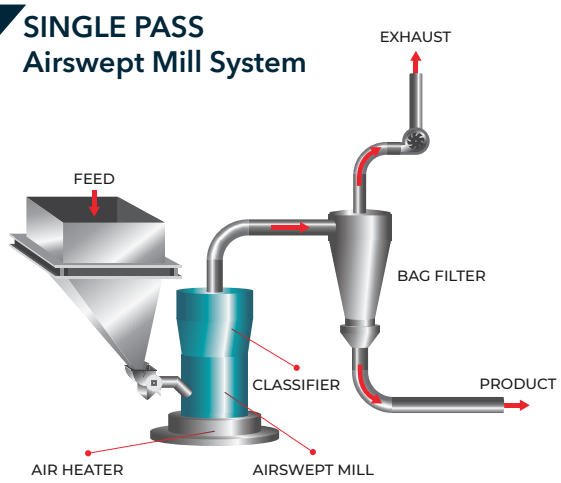
MILLING

The fineness of ground phosphate rock has a direct effect on the reaction rate of acidulation. The goal of milling is to achieve consistent particle size and yield rates. While a coarse grind is preferred, the composition of the phosphate rock will determine the optimal particle size. Typically, low reactive/low grade rock will require a finer grind than high reactive rock. The Bradley Airswept Mill System has the flexibility to adjust for differences in rock reactivity with precise control of particle fineness.

RECYCLED Airswept Mill System



SINGLE PASS Airswept Mill System



The cyclone system is generally recommended for acidulation processing due to its durability and low CAPEX. The filter system is also available for specific situations.

REACTION SYSTEM

The acidulation of inert phosphate rock into water-soluble superphosphate occurs in two steps.

MIXING PHASE: Dilute acid reacts with phosphate in ground rock in the mixer. Mixer selection is based on several factors, including acid strength used, rock quality, material reactivity and the product being manufactured.

For example, the Broadfield, or long paddle mixer, has slow rotating paddles which provide optimal mixing and low wear with opportunity to tune (adjust) the process. The turbine mixer allows material to pass very quickly and does not optimally mix low grade or coarse ground material making it ideal for use with finer ground rock.

DEN PHASE: In this phase, the free phosphoric acid released reacts with the remaining rock in the den. Den size/selection is based on the desired application or plant capacity for your acidulation process.

- ☐ BROADFIELD DEN – capacities from 10 to 100 TPH
- ☐ BROADFIELD BELT DEN – capacities from 1 to 50 TPH

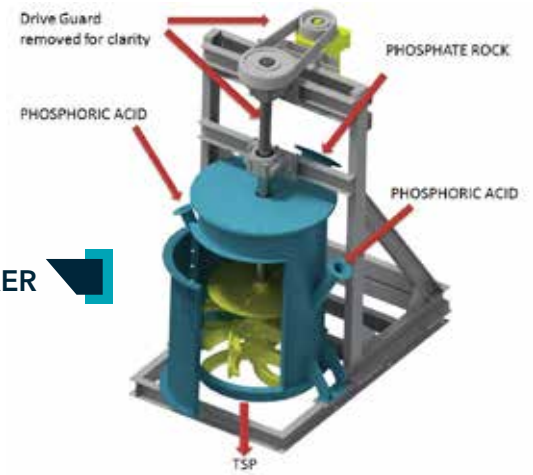
MIXER SELECTION

Selecting the correct mixer is critical for optimal process operation and control – as it is the heart of the acidulation process. If the wrong mixer is selected for the application, sub optimal mixing can occur which can lead to low reaction rates and affect product quality. Low reactive rocks which are commonly encountered can provide challenges which drive the need for special mixer designs. This can include paddle configuration, acid/rock nozzles or special materials of construction.

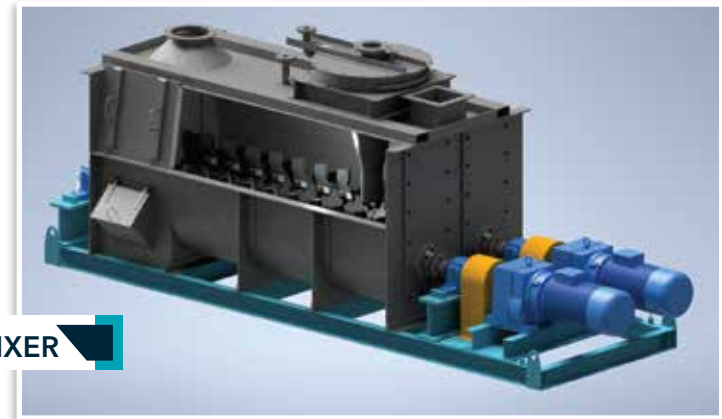
At Bradley Pulverizer, we can perform laboratory testing to determine the optimum mixer design and material of construction for your product and required process, whether it is the production of SSP/TSP or another acidic salt. We can also accommodate special applications, such as adding liquid sulphur using heated pipelines and nozzles to make a sulphur rich product.

MIXER OPTIONS	
Broadfield Mixer (Standard / Paddle)	SSP, MCP, DCP, TAP, ESP, Iron Sulphate & Synthetic Gypsum
Turbine Mixer	TSP (Low Reactivity)
Twin Shaft Mixer	DCP, MCP, Manganese Ore Fluidizing
Pipe Reactor	DAP, MAP, Other Ammonia End Products
Cone Mixer	TSP (High Reactivity)

BROADFIELD PADDLE MIXER



TURBINE MIXER



TWIN SHAFT MIXER

SCRUBBER SYSTEM

A highly efficient scrubbing system is employed to clean the exit gases of dust and fumes prior to discharge from the den. Emission can be collected through several options.

In a recycled airswept system, multiple void towers are recommended to keep emissions within consent limits. This results in a zero effluent plant. With a single pass system, fewer void towers are used however, residual effluent will require clean up.

Operational Considerations in Acidulation Processing

Bradley PULVERIZER

ROCK BLEND

Phosphate rock sources will vary in total phosphorus content, reactivity rate, impurity levels, fluorine volatilization and odorous compounds. Rock blend will directly influence:

- ☐ **Milling Fineness**
- ☐ **Acid Concentrations**
- ☐ **Mixer Speed**
- ☐ **Den Residence Time**
- ☐ **Granulation Conditions**

THE PROCESS VARIABLES IN THE PRODUCTION OF HIGH GRADE SUPERPHOSPHATES

Variable	High	Low
Phosphate Grade (P_2O_5 Content)	Optimal (S)	Low Grade Product
R_2O_3 Content	Sticky Product	Optimal (Ig)
Cadmium Content	Toxic Product	Optimal (Ig)
Carbon Content	Optimal (S)	"Dead" Product
F & Si Content	High Scrubber Load	Optimal (S)
Reactivity	Optimal (S)	Lower Grade Product / Low Production Rate
Strength of Acid	Sticky Product	Wet Product
Retention Time in Den	Dry / Dusty Product	Sticky Product
Retention Time in Mixer	Blockages	Low Grade Product
Acid Temperature	Extra Corrosion	Slow Reaction
Rock Particle Size	Fine	Coarse

(S) - Sedementary Rock Source (Ig) - Igneous Rock Source

KEY PHOSPHATE SOURCE ROCK CONSIDERATIONS IN SUPERPHOSPHATE MANUFACTURING

Soure Rock (Phosphate-rich Apatite)	Key Considerations	Target / Optimal Specifications
Chemical Specicifations	Are the phosphate levels high enough for economic feasability?	27% - 36% Phosphate-rich Rock
Cadium Levels	Can the 280ppm limit be met?	Rock Blend <280ppm Cd
Physical Specifications	Can Level of iron & aluminium be regulated?	<3% (can be reduced by flotation if needed)
Rock Hardness	Expected rate of produciton?	"Optimal Window" Rock Blend
Fluoride Levels	Environmental consents?	Typical Consent is <5mb F/M^3
Odour Levels	Environmental consents?	Particularly a Concern in Populated Areas
Competition	Profitability?	Low Production Cost to Increase Profitability

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