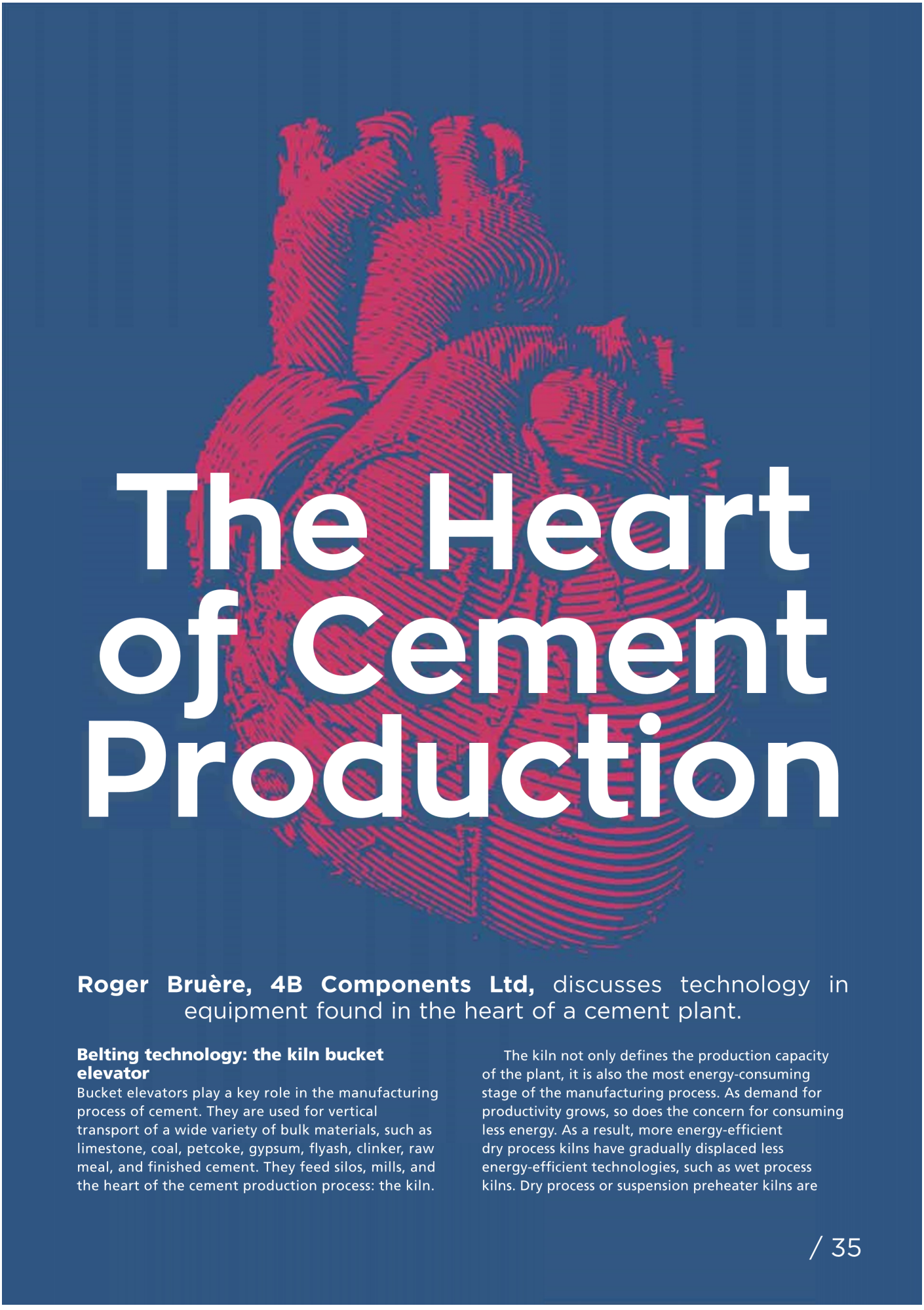


The Heart of Cement Production

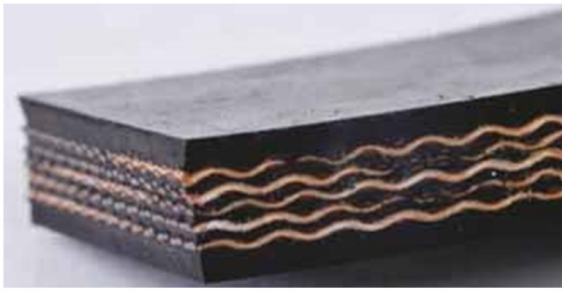
Roger Bruère, 4B Components Ltd, discusses technology in equipment found in the heart of a cement plant.

Belting technology: the kiln bucket elevator

Bucket elevators play a key role in the manufacturing process of cement. They are used for vertical transport of a wide variety of bulk materials, such as limestone, coal, petcoke, gypsum, flyash, clinker, raw meal, and finished cement. They feed silos, mills, and the heart of the cement production process: the kiln.

The kiln not only defines the production capacity of the plant, it is also the most energy-consuming stage of the manufacturing process. As demand for productivity grows, so does the concern for consuming less energy. As a result, more energy-efficient dry process kilns have gradually displaced less energy-efficient technologies, such as wet process kilns. Dry process or suspension preheater kilns are

typically fed by a bucket elevator via a tower with a series of cyclones that use hot gases from the kiln to heat the raw meal. Today, with global cement production approaching 4 billion tpy, kiln bucket elevators can achieve capacities and lift heights never before possible, thanks primarily to advancements in elevator belting technology.



EP textile belt.

Traditional steel cable conveyor belt.

Modern steel cord mesh belt for bucket elevators.

Modern kiln elevator with steel cord mesh belt and mechanical splice.

1000 x 325 x 300 mm NYRIM® chain elevator bucket, weighing 18 kg.

Historically, kiln elevators operating with textile carcass belting have shared a common problem of excessive elongation. For example, in a kiln elevator with a discharge height of 100 m, a textile belt can be expected to elongate up to 2% or 2 m. Because bucket elevators have limited take-up adjustment, the belt would need to be trimmed several times before its elongation settles. In the meantime, the operation is put at serious risk since the elevator buckets could potentially hit the bottom of the elevator casing causing a catastrophic failure.

In response to this concern, the industry began to use traditional steel cable conveyor belting in bucket elevators. The change solved the elongation problem, but it created new ones, as cement plants began to experience issues with belts not training properly, delamination of rubber covers, and bucket bolts pulling through the belt. The tracking problems were caused mainly by the belt's inability to run over crowned pulleys; insufficient adhesion between cables and covers resulted in delamination; and bucket bolts were pulling through the belt due to the belt's weak ability to retain buckets stemming from bucket bolts being placed in cable-free zones. It was clear that traditional steel cable conveyor belting was unable to perform reliably in bucket elevators. Belt manufacturers saw a market opportunity and the result was a new breed of steel cord belting designed specifically for tall, high performance bucket elevators.

A high quality steel cord elevator belt will incorporate a steel mesh carcass consisting of low elongation, yet high elasticity, close-pitched longitudinal steel cords and cross rigid transversal steel cables, all embedded in a solid rubber mass that cannot delaminate. Some of the advantages brought by this belting technology include the following:

- Tensile strengths of up to 4000 N/mm.
- Low elongation of 0.35% at 10% of the tensile strength.
- Able to run over crowned pulleys.
- High rubber to steel adhesion (no delamination).
- Flexible longitudinal cables for improved shock resistance.
- Dense and cross-rigid transversal cables for straight running ability.
- Increased bucket retention ability.
- Special rubber cover compounds for operating temperatures up to 150°C.

Today, modern kiln elevators can – safely and reliably – reach heights up to 175 m and convey capacities up to 2000 cubic meters/hour, thanks to this new steel cord belting technology.

Bucket technology: chain bucket elevators

Chain bucket elevators are used for the vertical transport of hot, abrasive, coarse, and fine-grained

bulk materials such as coal, limestone, gypsum, and clinker. They typically feed silos and milling operations. Depending on the lift height and capacity conveyed, chain elevators can utilise one or two strands of chain combined with buckets that can be as wide as 1000 mm and weigh as much as 70 kg.

The conditions under which chain elevators operate are very demanding. An elevator chain is continuously subjected to cyclic loads from lifting heavy buckets filled with heavy material, high shock loads from buckets digging through product, and the constant exposure to hot dust and debris. Severe wear and tear is expected from these machines.

For that reason, chain elevators often use costly high performance chains with special heat treatment and sealed joint construction for greater fatigue strength and longer wear life.

The fact that elevator chain wear is inherently difficult to monitor, combined with the imminent risk of a potential catastrophic fatigue failure, often forces chain elevator users to play it safe by regularly replacing their chain. This makes the lifespan of elevator chain a critical factor for budgeting and maintenance planning.

One way to extend the life of an elevator chain is to reduce the weight of the buckets by using a thermoplastic material in lieu of carbon steel. Compared to fabricated steel buckets of the same size, thermoplastic buckets can be up to 75% lighter. However, only high performance thermoplastic materials can withstand the harsh operating conditions experienced by these machines. One example of such material is NYRIM®.

NYRIM is a nylon/rubber thermoplastic material with exceptionally high impact strength and abrasion resistance over a continuous temperature range from -40 – 140°C. It performs well in bucket elevators, where a balance in toughness, fatigue, and abrasion resistance is required. Another key characteristic of NYRIM material is its resilience or ability to maintain its shape; critical in this application as buckets must continuously dig through product.

Some of the benefits of NYRIM elevator buckets are:

- 75% lighter than carbon steel.
- Reduces wear and tear of chain and sprockets.
- Reduces motor amperage.
- High impact strength.
- Retains shape after impact.

Modern elevator buckets made from high performance materials, such as NYRIM, can help reduce operating costs of cement manufacturers by extending the lifecycle of critical and costly components such as those found in high performance chain bucket elevators.

About the author

Roger Bruère is the Vice-President of 4B USA, and a Mechanical Engineer.