field reports

PotashCorp
Helping Nature Provide

FALL 2015

Hammond Warehouse Construction
on Schedule for Early 2016 Commissioning

As nutrient demand grows, PotashCorp has taken numerous steps to ensure its customers receive the timely and efficient service they deserve.

The most recent example of this commitment is the ongoing construction of the company's newest and most modern distribution facility, in Hammond, Indiana. Its strategic location just south of Chicago will benefit customers throughout North America through improved customer service and significantly reduced delivery times.

Phase One of the distribution center included site preparation and construction of a rail yard with 14 miles of track for a standing capacity of approximately 1,000 railcars. Completed in 2012, the rail yard has enabled the company to position loaded potash cars closer to the market, thereby reducing the time for delivery to customer locations. The first railcars carrying potash from Saskatchewan mines arrived on June 12, 2012.

The project's second phase builds on the strengths of the rail yard by adding a state-of-the-art warehouse that can store 120,000 tons of potash. The distribution center's product-handling equipment will allow PotashCorp to efficiently unload and reload railcars while maintaining a high standard of product quality. The warehouse will be commissioned early in 2016 to provide customers with optimal service during the busy spring fertilizer season.

"This new warehouse will enable us to provide an even higher level of service to our customers as we work with our rail carrier partners to move unit trains of potash from our mines in Saskatchewan to Hammond," says Dave Ostertag, Senior Director, Transportation & Distribution, PotashCorp. "Our investment in this facility will improve our ability to get potash to the right place at the right time."

As Phase Two of the $90 million Hammond Regional Distribution Center nears completion, a new 120,000-ton capacity potash warehouse will supplement the adjacent rail yard completed in 2012.

In this issue

See how construction of our new rail yard and warehouse in Hammond, Indiana, has progressed to improve customer service and reduce delivery times for customers across North America.

Get answers to common questions surrounding liquid polyphosphates and how they can benefit your agricultural operation.

Examine the growth in global potash demand and how this can affect future consumption trends.

Meet the PotashCorp customer service team who is available 24/7 to assist with any problems or issues customers may have.

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agriviews

Robert Mullen, Ph.D.
Director of Agronomy
PotashCorp/PCS Sales

Answering Your Questions About **Liquid Polyphosphates**

Every so often questions are raised regarding liquid polyphosphates. Why were polyphosphates created? Are all polyphosphates the same? What are the advantages of liquid polyphosphates? This article will address these questions.

Why were polyphosphates created?

The primary reason polyphosphates have been manufactured for liquid fertilizer use is because of their high nutrient content compared to liquid orthophosphates, stability across a wide range of temperatures and longer storage life. Formation of a liquid phosphate solution made up of orthophosphates would only have a theoretical phosphate concentration of 24 percent. Liquid polyphosphates permit phosphate concentrations to be increased to 37 percent. Well-manufactured polyphosphates should produce clear fertilizers free of sludge. They have a freezing point below -10 F and can be stored for relatively long periods of time (depending on storage temperature). Polyphosphates can be stored for up to a year provided they are not exposed to temperature extremes.

Polyphosphates also mix better with micronutrients than straight orthophosphate solutions. Because there are fewer orthophosphates in solution with a polyphosphate fertilizer there is less concern with micronutrients forming solids that can clog pumps and gum up application equipment. In fact, polyphosphate solutions can dissolve up to 40 times more micronutrients than orthophosphate solutions and remain sludge-free.

Are all polyphosphates the same?

The answer is no. The higher the number of orthophosphates contained in the polyphosphate molecules (the longer the chains), and the higher the concentration of long-chain polyphosphates, the better the quality and storage of the fertilizer. So what dictates how many ortho molecules make up the polyphosphate? The answer is the starting material and the process itself. Liquids that have lower polyphosphate concentrations have shorter storage lives. The polyphosphates begin to degrade as the material ages (as a function of temperature). Once the polyphosphate concentration drops below 55 percent, solids can begin to precipitate out of solution, creating sludge. Thus materials that start at lower initial polyphosphate concentrations have shorter shelf lives (at equivalent temperatures).

Is there an agronomic difference between an orthophosphate and polyphosphates?

The simple answer is no, but there are factors to be considered. Since polyphosphates are essentially multiple orthophosphates created by dehydration, polyphosphates can be broken down back to orthophosphates by hydrolysis (adding water). Hydrolyzing polyphosphates back to orthophosphates will occur over a period of just a few hours or over a matter of days depending upon soil moisture level at the time of application. Thus, after a short period with adequate moisture, there is very little difference in plant availability between the two forms.

There is a specific environment where liquid polyphosphates can be more available to a plant root. Application of a liquid polyphosphate under dry soil conditions can actually increase phosphorus availability (specifically the orthophosphate molecules) because it is already in a liquid form, meaning that it can be slightly more mobile. Think about what happens when a dry fertilizer material is applied to dry soil. In order for the fertilizer granule to dissolve, water must move toward the granule. As water moves toward the granule, so too do other nutrients like calcium. Calcium in soil water can react with the orthophosphate molecules near the fertilizer granule,

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decreasing their immediate availability. Application of a liquid polyphosphate results in less water moving toward the site of application, meaning less calcium actively moving toward the fertilizer material, impacting orthophosphate availability. In fact, the liquid polyphosphate moves away from the site of application, providing an environment where the orthophosphates are temporarily more available than their dry counterparts. As soil moisture content increases, this advantage decreases.

What are the advantages of liquid polyphosphates?

From a fertilizer manufacturer and retailer perspective, polyphosphates have a longer storage life than orthophosphates solutions. Polyphosphates also have a low freezing point and are sludge-free across a wide range of temperatures. This makes them an ideal liquid phosphorus source.

Liquid polyphosphates are also good phosphorus-containing sources for starter fertilizer formulations. The primary advantage is lower risk to germinating seeds (especially pop-up or in-furrow applications). Liquid polyphosphates have a slightly acidic pH, meaning the risk of production of free ammonia is quite low compared to a dry fertilizer material like diammonium phosphate (which creates a relatively high pH near the site of application, creating the risk of free ammonia to be present). Ammonia, in low concentrations, in close proximity to a germinating seed can be very detrimental to that seed. There are other phosphorus sources that have lower salt indexes, but those sources tend to be very expensive and they are orthophosphate based.

Polyphosphates can also be applied by themselves as a starter, but they do have a relatively high salt index. Therefore, care should be taken if ammonium polyphosphate is going to be applied with seed in a pop-up/in-furrow application. The general rule of thumb for corn is typically less than 5 gallons per acre. For coarse-textured, sandy soils, a lower rate would be safer.

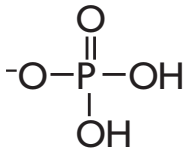
As already stated, liquid polyphosphates have lower potential to precipitate out when mixed with micronutrients. Since starter materials are typically used as a carrier for micronutrients, liquid polyphosphates can act as a good carrier while contributing a relatively large amount of phosphorus. There are other orthophosphate liquid fertilizers, but they carry a greater risk of precipitation and their phosphorus concentrations are lower.

Finally, liquid polyphosphates can be applied below the soil surface, decreasing their risk of runoff and eliminating the need for surface tillage for incorporation. This is an important consideration given the concerns with nutrient impairment of water bodies. Using the concept of 4R Nutrient Stewardship, liquid polyphosphates can be a good method of supplying important phosphorus nutrition for growing crops while being mindful of the potential environmental impact of agricultural activities.

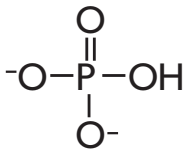
Considering all the factors that have been mentioned – good storage life, high phosphorus analysis, and good starter material, liquid polyphosphates should be considered as a phosphorus source for your farming operation.

What is a polyphosphate?

An orthophosphate is an inorganic compound that has four oxygen atoms connected to a central phosphorus atom (Figure 1). Orthophosphate is the plant-available form of phosphorus that can exist in two different configurations (Figure 1).



$H_2PO_4^-$



HPO_4^{2-}

Figure 1. Plant Available Forms of Orthophosphate

The term polyphosphate refers to an inorganic compound that has two or more orthophosphates connected together to form a chain of orthophosphates (Figure 2). Polyphosphates are produced by dehydrating (removing water) orthophosphate at high temperatures to create chains of orthophosphates. The higher the temperature of dehydration, the more orthophosphates that can be strung together in a chain. However, not all of the orthophosphate used to create a polyphosphate will react and create long chains. A typical ratio of polyphosphate to orthophosphate in a polyphosphate product is around 75:25 or 60:40. This is an important point. Even if a product is marketed as a liquid polyphosphate, it still contains a considerable amount of orthophosphates in solution. Thus when questions arise regarding the immediate plant availability of liquid polyphosphates, a good percentage (around 25% or more) of the phosphate in a polyphosphate is in the ortho-/plant available form.

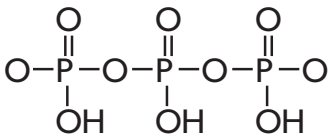


Figure 2. Polyphosphate Molecule (Some Polyphosphate Molecules Can Contain Up to Eight Orthophosphates)

marketviews

Jeff Holzman
Director, Market Research
PotashCorp

Global Potash Consumption
Drivers and Outlook

Global potash consumption rose by approximately 10 percent in 2014 to a record of more than 60 million tonnes. This steep increase was driven by strong demand in all major markets and highlights the supportive underlying fundamentals of the potash business. This article examines historical potash demand drivers and provides insight into the factors that could impact future consumption trends.

The most basic drivers of potash consumption are the steady increase in global crop production and the need to replenish soil nutrients after each harvest. Over the past 20 years, crop production has increased at an annual rate of 2.3 percent, while potash consumption has grown at a rate of nearly 2.7 percent. The higher growth rate for potash is attributed to three major factors:

1. Potash has historically been under-applied relative to nitrogen in developing markets;
2. Significant growth in high potassium-consuming crops such as fruits, vegetables, oil palm and sugar cane;
3. Cropping area has expanded in countries with potassium-deficient soils such as Brazil, China and Indonesia.

We believe these factors will continue to be key drivers for potash as the demand for high-quality crops increases and the pressure to improve soil quality intensifies.

Regional Trends

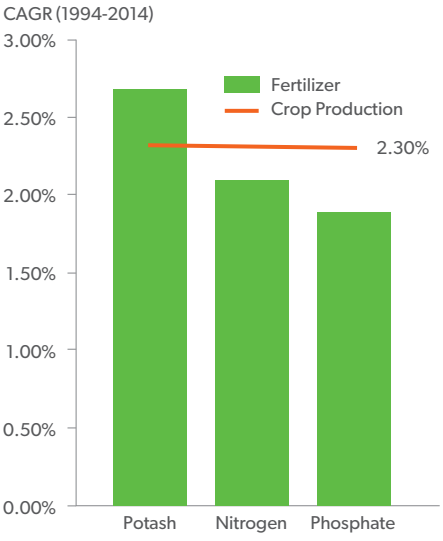
More than 80 percent of global potash consumption occurs in Asia, Latin America and North America. Each region has unique demand drivers but all have significant potential to increase potash consumption.

Asia

In Asia, the world's largest potash-consuming region, usage has nearly tripled in the past 20 years. Rising populations, arable land constraints and a historical over-reliance on nitrogen are key drivers of this demand. While the long-term trend is undeniable, economic and political factors have contributed to short-term fluctuations in demand. This was evident between 2008 and 2013 as

Figure 1: World Fertilizer and Crop-Production Growth Rates

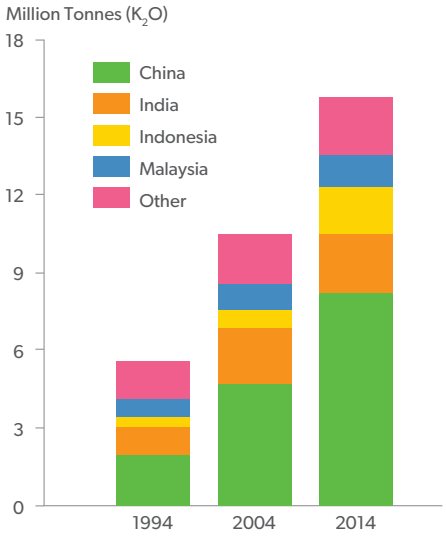
Potash Growth Rate Exceeds Other Primary Nutrients



Source: Fertecon, CRU, USDA, PotashCorp

Figure 2: Potash Consumption in Asia

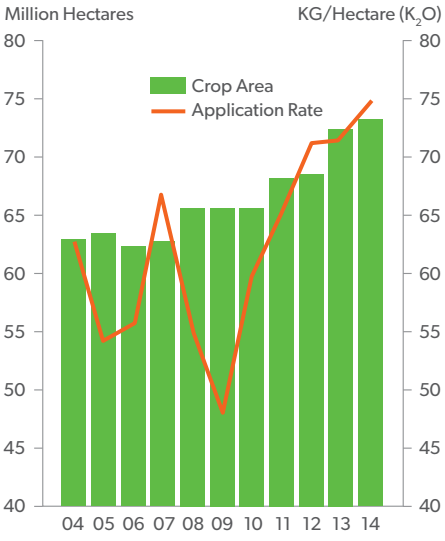
Consumption Rose Nearly Three-Fold Over Past 20 Years



Source: Fertecon, CRU, PotashCorp

Figure 3: Brazil Crop Area and Potash Application Rate

Potash Consumption Driven by Acreage and Application Rate Changes



Source: Fertecon, CRU, FAO, PotashCorp

demand growth stalled due to the global economic downturn, significant volatility in potash prices and government policy changes in India.

This period also focused a spotlight on the need to improve nutrient application balances, particularly in China and India, which consume the largest amounts of potash. Rates increased sharply in both countries in 2014, indicating that a shift is under way. We believe this will mark the beginning of a new wave of growth in demand in Asia's major potash-consuming nations.

Latin America

Potash consumption in Latin America has also nearly tripled over the past two decades. The region is now the largest consumer of granular grade potash. Brazil accounted for most of this growth, driven by crop expansion into regions with tropical climates and low soil fertility. As a result, Brazil's average potash application rate has increased significantly over this period.

Despite a pause in consumption growth during 2015, we expect Latin America will be a long-term growth market for potash. The key drivers will be the potential for additional acreage expansion in Brazil and a shift to higher potash-consuming crops such as oil palm, sugar cane, vegetables and fruits in other Latin American countries.

North America

North America is often referred to as a mature potash market. While crop yields and nutrient removal rates have grown consistently, potash application rates have been fairly static. The result has been a rising application deficit and, subsequently, a reduction in North American soil test levels.

Since 2010, estimated potash removal in the US has exceeded application by more than 7 million short tons KCl per year. We believe this trend is not sustainable and that maintaining soil productivity will require higher application rates in the future. The initial shift will occur in states in the Midwest, the Southeast and the Southern Delta, which have the most soils testing below the critical level and are more likely to respond to additional potash applications.

Global Outlook

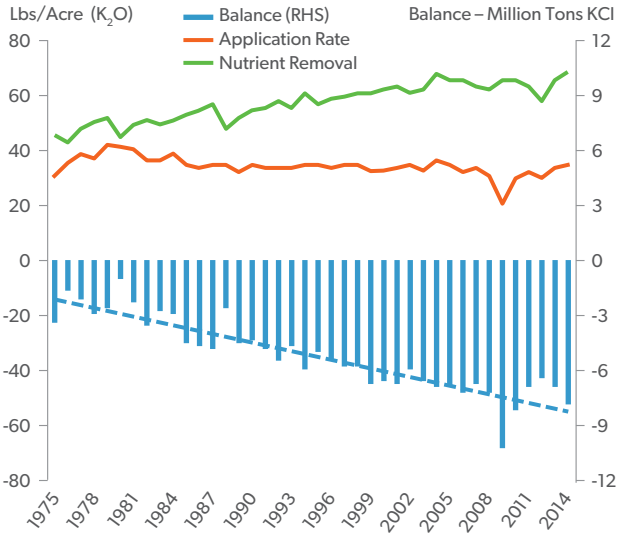
With strong underlying drivers in place, we believe there is great potential for growth in potash demand in the years ahead. We anticipate consumption in 2015 will be similar to the record level achieved in 2014 but with some regional variation. Growth in consumption is expected in China, India and other Asian countries, supported by strong agronomic need and healthy potash affordability. We anticipate some softening in Brazil, North America and Europe, which have been more affected by lower agriculture commodity prices.

Looking beyond 2015, we assume annual consumption growth rates will be similar to the historical average of approximately 2.5-3 percent. Based on this trend line, we believe potash consumption could approach 70 million tonnes before the end of the decade. We expect major markets in Asia and Latin America will account for most of this growth.

While it is not factored into our near-term assumptions, we believe there is significant opportunity for consumption growth in the North American market. With soil test levels declining, it is clear that the rising application deficit cannot be sustained without implications for soil productivity. Eventually, farmers will adjust their fertilization practices to address this agronomic need. The challenge for those planning for the future is determining the timing and magnitude of this shift.

Figure 4: US Potash Application Balance

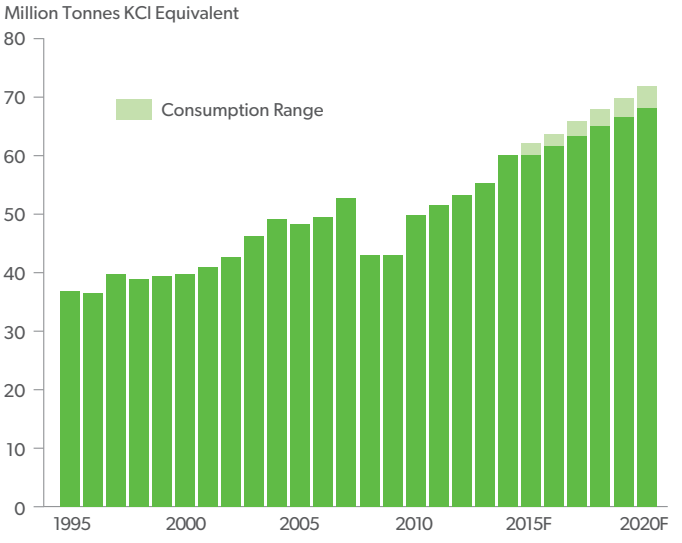
Large Application Deficit Due to Rising Crop Removal



Source: USDA, AAPFCO, PotashCorp

Figure 5: World Potash Consumption

Strong Underlying Consumption Drivers



Source: Fertecon, CRU, IFA, PotashCorp

PotashCorp Customer Service Available 24/7
to Ensure Customer Satisfaction

PotashCorp's commitment to superior customer service is a core element of our business that we believe sets us apart. For more than 15 years we have operated a 24/7 customer service program that allows customers to call the after-hours answering service or email a customer service representative and receive a prompt response.

"PotashCorp is committed to providing reliable, efficient service to our customers across North America," says Debbie Hetzel, Director of Customer Service. "By keeping the lines of communication open 24/7, we are able to ensure that our customers' business isn't delayed, regardless of what time of the day or night."

In addition to serving customers' needs, the department is trained to handle any other issues that may arise. For example, if product is being shipped by truck or rail and there is an accident, customer service staff will work with the Transportation Emergency Team to ensure proper assistance is dispatched to deal with the recovery.

The PotashCorp customer service team consists of seven dedicated representatives – shown at right. The most common concerns the team addresses after hours are related to last-minute orders and delivery details.

"We encourage our customers to reach out at any time to ensure any problems are quickly solved in their entirety," says Hetzel. "To reach us, please call 800-524-0132, 800-654-4514 or email customer.service@potashcorp.com."

Members of the Customer Service team: from left, Brock Hunt, Sean Goretskie, James Jordan, Angela Poole, Dillon Flynn, Brenda Kempf and Debbie Hetzel.

Field Reports is published by PotashCorp. Should you have any questions or comments, please contact Customer Service at (800) 654-4514.

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