~~Simple~~ Common Fertilizer Calculations

Robert Mullen, PhD, CCA, CPAg

May 14, 2020

Overview

- Calculating material rate based upon desired nutrient rate
- Calculating nutrient price (on a per pound basis) to compare products
  - Including liquid products that are priced differently
- Calculating dry blends

Calculating Material Rates

May 14, 2020

Calculating Material Rate

- Let's assume we are applying potash (0-0-60) and our desired rate is 70 pounds of K2O per acre, how many pounds of potash should be applied?

$$\left(\frac{70\ pounds\ K2O}{acre}\right)\left(\frac{1\ pound\ potash}{0.60\ pounds\ K2O}\right) = \frac{116.7\ pounds\ potash}{acre}$$

$$\left(\frac{116.7\ pounds\ potash}{acre}\right)\left(\frac{0.60\ pounds\ K2O}{1\ pound\ potash}\right) = \frac{70\ pounds\ K2O}{acre}$$

- Let's assume we are applying DAP (18-46-0) and our desired rate is 60 pounds of P2O5 per acre, how many pounds of DAP is required?

$$\left(\frac{60\ pounds\ P2O5}{acre}\right)\left(\frac{1\ pound\ DAP}{0.46\ pounds\ P2O5}\right) = \frac{130.4\ pounds\ DAP}{acre}$$

- How much N is being applied with this application?

$$\left(\frac{130.4\ pounds\ DAP}{acre}\right)\left(\frac{0.18\ pounds\ N}{1\ pound\ DAP}\right) = \frac{23.4\ pounds\ N}{acre}$$

Calculating Material Rate

- Let's assume we are applying UAN (28-0-0) and our desired rate is 180 pounds of N per acre and we want to determine how many gallons per acre to apply?

$$\left(\frac{180\ pounds\ N}{acre}\right)\left(\frac{1\ pound\ UAN}{0.28\ pounds\ N}\right)\left(\frac{1\ gallon\ UAN}{10.66\ pounds\ UAN}\right) = \frac{60.3\ gallons\ of\ UAN}{acre}$$

Calculating Costs

Nutrien™
Feeding the Future™

May 14, 2020

Calculating Cost

- Let's assume we are buying potash (0-0-60) for \$350 per ton, how much does it cost per pound of K2O?

$$\left(\frac{\$350}{ton\ potash}\right)\left(\frac{1\ ton\ potash}{0.60\ tons\ K2O}\right)\left(\frac{1\ ton\ K2O}{2000\ pounds\ K2O}\right) = \frac{\$0.292}{pound\ of\ K2O}$$

- How does that compare to sulfate of potash (0-0-50) at \$600 per ton? (this is not quite a fair comparison)

$$\left(\frac{\$600}{ton\ SOP}\right)\left(\frac{1\ ton\ SOP}{0.50\ tons\ K2O}\right)\left(\frac{1\ ton\ K2O}{2000\ pounds\ K2O}\right) = \frac{\$0.60}{pound\ of\ K2O}$$

- Let's assume we are buying DAP (18-46-0) for \$370 per ton, how much does it cost per pound of P2O5?
  - The first thing we have to do is exclude the cost of the N (assuming urea (46-0-0) costs \$350 per ton) (you could really use any nitrogen source)

N reference

$$\left(\frac{\$350}{ton\ urea}\right)\left(\frac{1\ ton\ urea}{0.46\ tons\ N}\right)\left(\frac{1\ ton\ N}{2000\ pounds\ N}\right) = \frac{\$0.38}{pound\ of\ N}$$

$$\left(\frac{\$0.38}{pound\ N}\right)\left(\frac{0.18\ pound\ N}{1\ pound\ DAP}\right)\left(\frac{2000\ pound\ DAP}{1\ ton}\right) = \frac{\$136.8}{ton\ DAP}$$

$$\left(\frac{\$370}{ton\ DAP} - \frac{\$136.8}{ton\ DAP}\right)\left(\frac{1\ ton\ DAP}{0.46\ ton\ P2O5}\right)\left(\frac{1\ ton\ P2O5}{2000\ pound\ P2O5}\right) = \frac{\$0.253}{pound\ of\ P2O5}$$

- Let's assume we are buying MAP (11-52-0) for $425 per ton, how much does it cost per pound of P2O5?
  - We have to remove the nitrogen again, so we will use the same assumptions as the DAP calculation

N reference

$$\left(\frac{\$350}{ton\ urea}\right)\left(\frac{1\ ton\ urea}{0.46\ tons\ N}\right)\left(\frac{1\ ton\ N}{2000\ pounds\ N}\right)=\frac{\$0.38}{pound\ of\ N}$$

$$\left(\frac{\$0.38}{pound\ N}\right)\left(\frac{0.11\ pound\ N}{1\ pound\ MAP}\right)\left(\frac{2000\ pound\ MAP}{1\ ton}\right)=\frac{\$83.6}{ton\ MAP}$$

$$\left(\frac{\$425}{ton\ MAP}-\frac{\$83.6}{ton\ MAP}\right)\left(\frac{1\ ton\ MAP}{0.52\ ton\ P2O5}\right)\left(\frac{1\ ton\ P2O5}{2000\ pound\ P2O5}\right)=\frac{\$0.328}{pound\ of\ P2O5}$$

- What if a product is priced on a per gallon basis? Let's assume we are buying a product that has an analysis of 7-9-0 (let's call it Fert), sold in a 2.5 gallon jug, and costs $15, what is the cost per pound of P2O5?
  - Let's first get this on a price per ton basis

$$\left(\frac{\$15}{jug}\right)\left(\frac{1\ jug}{2.5\ gal}\right)\left(\frac{1\ gal}{11.7\ pounds}\right)\left(\frac{2000\ pounds}{1\ ton}\right) = \frac{\$1{,}025.64}{ton}$$

  - Using the same nitrogen reference as we used before (after going through the second step of slides 9 and 10)

$$\left(\frac{\$1{,}026}{ton\ Fert} - \frac{\$53.26}{ton\ Fert}\right)\left(\frac{1\ ton\ Fert}{0.09\ ton\ P2O5}\right)\left(\frac{1\ ton\ P2O5}{2000\ pound\ P2O5}\right) = \frac{\$5.40}{pound\ of\ P2O5}$$

Calculating Blends

May 14, 2020

- Let's assume we have determined that a field requires 30 pounds of nitrogen, 50 pounds of P_2O_5, and 60 pounds of K_2O. Let's also assume we are using urea (46-0-0), MAP (11-52-0), and KCl (0-0-60) as our nutrient sources. How much of each is required? And how much will the blend cost?

- You should always start with the single nutrient source that is not impacted by other sources. In this instance, KCl has no phosphorus or nitrogen, and the other sources contain no potassium.

$$\left(\frac{60\ pounds\ K2O}{acre}\right)\left(\frac{1\ pound\ potash}{0.60\ pounds\ K2O}\right) = \frac{100\ pounds\ potash}{acre}$$

Calculating Blends

- Now we have to make a decision about the remaining two nutrient sources. MAP has both nitrogen and phosphorus in it, and urea only has nitrogen. In this instance, you always pick the source that has multiple sources first.

$$\left(\frac{50\ pounds\ P2O5}{acre}\right)\left(\frac{1\ pound\ MAP}{0.52\ pounds\ P2O5}\right) = \frac{96.2\ pounds\ MAP}{acre}$$

- Now we need to calculate the amount of nitrogen coming from MAP

$$\left(\frac{96.2\ pounds\ MAP}{acre}\right)\left(\frac{0.11\ pound\ N}{1\ pound\ MAP}\right) = \frac{10.6\ pounds\ N}{acre}$$

- We are now down to nitrogen and urea. First we have to account for the nitrogen coming from MAP. Then we do our normal calculations.

$$\left(\frac{30\ pounds\ N}{acre} - \frac{10.6\ pounds\ N}{acre}\right)\left(\frac{1\ pound\ urea}{0.46\ pounds\ N}\right) = \frac{42.2\ pounds\ urea}{acre}$$

- We can calculate the blend cost (on a per acre basis at this point) – cost assumptions (urea - \$340/ton, MAP - \$360/ton, KCl - \$360/ton

$$\left(\frac{42.2\ pounds\ urea}{acre}\right)\left(\frac{\$340}{1\ ton\ urea}\right)\left(\frac{1\ ton\ urea}{2000\ pounds\ urea}\right) = \frac{\$7.17}{acre}$$

$$\left(\frac{96.2\ pounds\ MAP}{acre}\right)\left(\frac{\$360}{1\ ton\ MAP}\right)\left(\frac{1\ ton\ MAP}{2000\ pounds\ MAP}\right) = \frac{\$17.32}{acre}$$

$$\left(\frac{100\ pounds\ KCl}{acre}\right)\left(\frac{\$360}{1\ ton\ KCl}\right)\left(\frac{1\ ton\ KCl}{2000\ pounds\ KCl}\right) = \frac{\$18.00}{acre}$$

$$\frac{\$42.45}{acre}$$

Calculating Blends

- Let's assume the field being fertilized is a quarter (160 acres), how much of each product is required in the blend to cover all acres?

$$\left(\frac{42.2\ pounds\ urea}{acre}\right)\left(\frac{160\ acres}{1\ field}\right)\left(\frac{1\ ton\ urea}{2000\ pounds\ urea}\right) = \frac{3.4\ tons\ urea}{field}$$

$$\left(\frac{96.2\ pounds\ MAP}{acre}\right)\left(\frac{160\ acres}{1\ field}\right)\left(\frac{1\ ton\ MAP}{2000\ pounds\ MAP}\right) = \frac{7.7\ tons\ MAP}{field}$$

$$\left(\frac{100\ pounds\ KCl}{acre}\right)\left(\frac{160\ acres}{1\ field}\right)\left(\frac{1\ ton\ KCl}{2000\ pounds\ KCl}\right) = \frac{8.0\ tons\ KCl}{field}$$

- If you created a fertilizer solution by adding APP (10-34-0) and UAN (28-0-0) in a blend ratio of 1:3 (1 part APP:3 part UAN), what would the fertilizer analysis of this new product be?
  - This gets a little complicated, but stay with me. By the way, this calculation also works with dry products.

$$Nitrogen\ content\ (\%) = \left(\frac{(UAN\ N\ \%\ x\ UAN\ ratio) + (APP\ N\ \%\ x\ APP\ ratio)}{(UAN\ ratio + APP\ ratio)}\right)$$

$$Nitrogen\ content\ (\%) = \left(\frac{(28\ x\ 3) + (10\ x\ 1)}{(3 + 1)}\right)$$

$$Nitrogen\ content\ (\%) = \left(\frac{(84) + (10)}{(4)}\right) = \left(\frac{94}{4}\right) = 23.5$$

- Using the same assumptions as the previous slide, what will the phosphorus concentration be?

$$P2O5\ content\ (\%) = \left(\frac{(UAN\ P2O5\ \%\ x\ UAN\ ratio) + (APP\ P2O5\ \%\ x\ APP\ ratio)}{(UAN\ ratio + APP\ ratio)}\right)$$

$$P2O5\ content\ (\%) = \left(\frac{(0\ x\ 3) + (34\ x\ 1)}{(3 + 1)}\right)$$

$$P2O5\ content\ (\%) = \left(\frac{(0) + (34)}{(4)}\right) = \left(\frac{34}{4}\right) = 8.5$$

- Follow the process of tracking your units (that will keep you on the right track)

Thanks. Questions?

www.nutrien.com
www.nutrien-ekonomics.com
www.smartnitrogen.com