

## Plant Performance Impact Calculations

### Step 1: Know Molar Ratios

- Yeast use glucose to make the following by-products (separate or in combination):

**1 mole of Glucose**      **2 moles of Glycerol**  
   **2 moles of Acetic Acid**  
   **2 moles of Ethanol**

- Bacteria use glucose to make the following by-products (separate or in combination):

**1 mole of Glucose**      **2 moles of Lactic Acid**  
   **2 moles of Acetic Acid**  
   **Other smaller by-products**

- The molecular weight of each by-product is as follows:

Glycerol – 92.14 g/mol

Ethanol – 46 g/mol

Glucose - 180 g/mol

Acetic Acid – 60.06 g/mol

Lactic Acid – 90.08 g/mol

### Step 2: Do Calculation to Determine Potential Ethanol Difference for Each By-product

- **Glycerol:**

$$\frac{\text{g/100 ml}}{92.14 \text{ g/mol}} = \text{mol/100 ml}$$

$$\text{mol/100 ml} * 46 \text{ g/mol ethanol} = \text{g/100 ml or \% w/v ethanol difference}$$

- **Glucose:**

$$\frac{\text{g/100 ml}}{180 \text{ g/mol}} = \text{mol/100 ml}$$

$$\text{mol/100 ml} * 92 \text{ g/mol (2 moles * 46 g/mol) ethanol} = \text{g/100 ml or \% w/v ethanol difference}$$

- **Acetic Acid:**

$$\frac{\text{g/100 ml}}{60.06 \text{ g/mol}} = \text{mol/100 ml}$$

$$\text{mol/100 ml} * 46 \text{ g/mol ethanol} = \text{g/100 ml or \% w/v ethanol difference}$$

- **Lactic Acid:**

$$\frac{\text{g/100 ml}}{90.08 \text{ g/mol}} = \text{mol/100 ml}$$

$$\text{mol/100 ml} * 46 \text{ g/mol ethanol} = \text{g/100 ml or \% w/v ethanol difference}$$

### Step 3: Total Ethanol Difference Resulting from All By-products

$$\text{\% w/v (Glycerol)} + \text{\% w/v (Glucose)} + \text{\% w/v (Acetic Acid)} + \text{\% w/v (Lactic Acid)}$$

$$\text{Total ethanol difference} = \text{\% w/v}$$

$$\frac{\text{\% w/v ethanol}}{0.79 \text{ ethanol density}} = \text{\% w/v ethanol}$$

$$\text{\% v/v ethanol} * [\text{gpm mash flow} * 60 \text{ mins} * 24\text{hrs}] = \text{gals/day ethanol difference}$$



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