Avoiding Waste: Atom Economy.

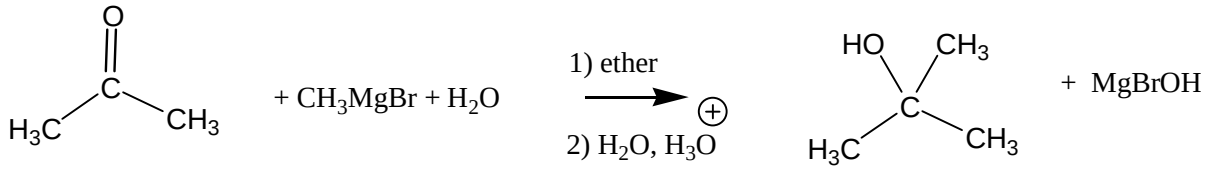
A main focus of green chemistry is to reduce the amount of pollution created in chemical processes. Reactions in which a large proportion of the reactant atoms end up in waste products contribute to pollution, make ineffective use of resources, and raise the costs of production. While percent yield is often considered a measure of how efficiently reactants are used in making a final product, it neglects to measure what fraction of the reactant atoms end up in the desired product versus how many end up in products that considered waste. Atom economy is a ratio that lets us know what percent of the reactant's atoms make their way into the desired product.

The concept of atom economy was developed by Barry Trost, a professor of chemistry at Stanford University, who received a 1998 Presidential Green Chemistry Challenge Award for his work.

To quantify the concept of atom economy, we can calculate "percent atom economy." To do this we divide the formula weight of the desired product by the formula weight of all the products of the reaction and multiply the result by 100.

$$\frac{\text{Formula Weight of Desired Product(s)}}{\text{Forumla Weight of all products}} \times 100 = \text{Percent Atom Economy}$$

For example:



<u>The Desired Product</u>:

2-methyl-2-propanol F.W. = 74.12

<u>All Products</u>:

2-methyl-2-propanol F.W. = 74.12
MgBrOH = 121.23

<u>The Equation</u>:

74.12x100/(74.12 + 121.23) = 37.94 % Atom Economy

From_ "Introduction to Green Chemistry" ACS (2002)