

Brewing –n- Bioreactor Pre-assignment

ChE 1101 – Fall 2005

Over the last few class periods, you have been introduced “what chemical engineers do”.



The leading employer of chemical engineers is the pharmaceutical industry followed by the paper industry and the petroleum (fossil fuel) industry (picture above). In fact, chemical engineers are involved in the manufacturing of almost every product you use from the cereal you ate this morning to the computer chips that power our world to the plastic and metal chair you are sitting on right now. It is one of the most diverse engineering disciplines available today.

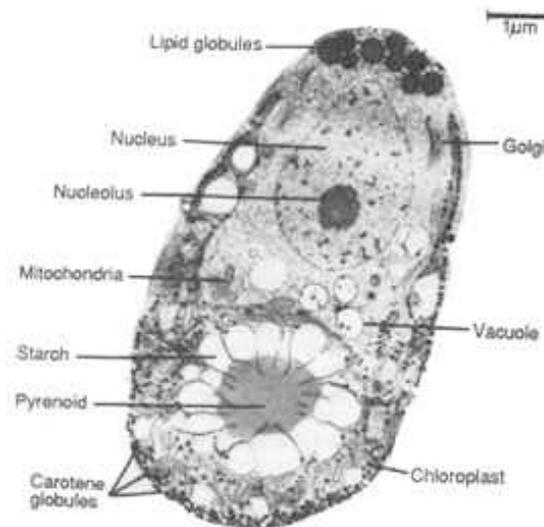
2) Can you think of a few products chemical engineers are involved in manufacturing? What are the ethical issues involved in chemical engineering manufacturing processes. What are some of the environmental issues involved? Please discuss the responsibilities chemical engineers have with respect to each of these topics (another 1/2 page – typed)

One area of chemical engineering is biochemical engineering. In this field, chemical engineers design bioreactors (picture below) – reactors that use single celled organisms

like bacteria or yeast to synthesize useful products. Each cell makes and secretes a little of the desired product, but a whole population or biomass can make a large amount.



One excellent example of this is the manufacture of insulin, a protein diabetics need to survive. Doctors used to prescribe insulin that came from pigs or cows, which was similar enough to human insulin that most people could use it. But through recombinant DNA technology, scientists can now produce human insulin—in bacteria. Scientists at Eli Lilly, a pharmaceutical company, made Humulin, a synthetic insulin by hijacking the bacteria's own protein factories. They did this by splicing a small section of human DNA—the gene that codes for insulin—into the bacteria's little ring of DNA (Gallagher). The bacteria are then grown using tetracycline as food. Since bacteria reproduce by dividing or creating exact copies of themselves, all the resulting bacteria happily go to work manufacturing human insulin according to the instructions in their newly altered DNA. (Zambone).



Processes such as this one are usually designed in one of two ways: batch processes or continuous processes. Please find the definition for these.

3) batch process _____

4) continuous process _____

In all processes, mass is conserved. This means that the amount of mass that goes into the process must also leave the process. During a reaction, mass is consumed in one form and generated in another form, but total mass is still conserved.

mass entering = mass leaving

The resource that enters a process is typically referred to as a **raw material**. The **finished product** then leaves the process. A plant makes money only when the product is more valuable than both the raw material and the production cost together. This is why there is a high demand for chemical engineers with the ingenuity to design energy and mass efficient processes. Chemical process engineers also want to minimize waste and environmental pollutants, which cost them in one form or another.

PROBLEM:

An applesauce corporation wants to make applesauce. Say they have 10 kilograms of whole apples that have just been picked and delivered to their plant. The first step in the process is to peel and core the apples. The peels and cores are weighed at 0.5 kilograms before being shipped off to feed livestock. The fleshy part of the apples are put in a large cooker with 1 kg of sugar and 1 kg of water and cooked for 4 hours. The finished applesauce is then poured into jars, sealed and shipped to your store.

5) What kind of a process is this? _____

6) What are the raw materials? _____

7) How much mass entered the process? _____

8) How much mass left the process? _____

9) If 4 kg of water left the cooker as steam, how much applesauce left the cooker and was poured into jars? _____

With the use and production of energy such a hot topic in the news lately, chemical engineers are looking for new ways to harness or conserve energy in processes. The steam leaving the above applesauce process can be used to power turbines for electricity or recycled to heat up the apple “flesh” entering the process.

10) Can you think of other energy efficient uses for steam?

Another example of conservation of mass is seen with trash in our households. As we bring products into our homes, we throw away packaging, containers, and old or defective items. If we allow this to just go into a landfill, we lose the raw materials. However, if these are recycled, fewer raw materials need to be mined or stripped from the earth. How much trash goes into landfills in Jackson each year? The following link gives data on a recycling program in Jackson? What could be done to improve these numbers?

www.mississippi2020.org/index.html?http://www.mississippi2020.org/communities/glassrecycling.html.