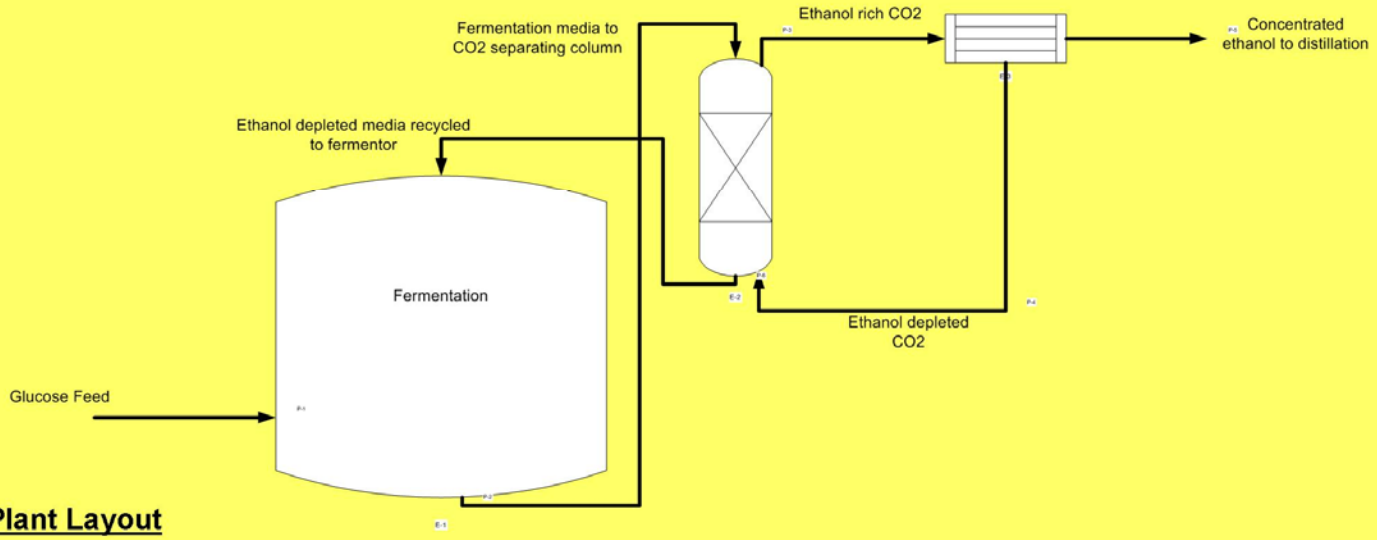
Carbon Dioxide Separation and Overall Plant Layout

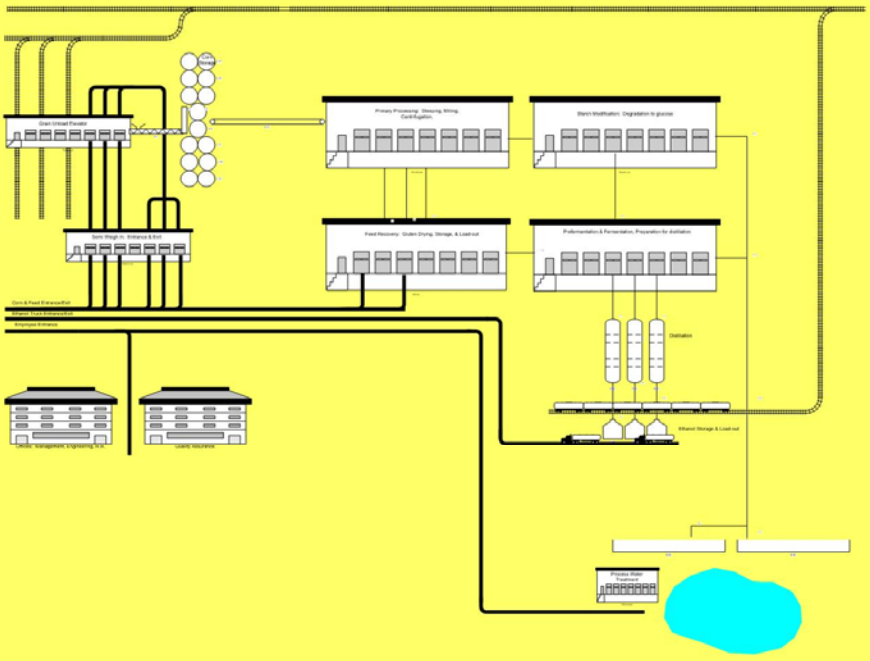
Methodology

In order to increase glucose conversion in a batch fermentation, ethanol needs to be removed. At high concentrations, ethanol inhibits its own formation and causes cellular death. Therefore, it would be beneficial to remove ethanol from a fermentation medium so that the life span of the fermenting microorganisms would be increased. By sparging CO_2 throughout the fermentation media, ethanol would be removed. The diagram below depicts how we propose to remove ethanol by sparging CO_2 throughout the media. While the fermentation is occurring, the media would be pumped to the top of an external fluid contacting column. The media would flow down the column while CO_2 is sparged counter-currently up the column. Ethanol (along with some of the media) would be absorbed by the CO_2 and transported out of the top of the stripping column. The CO_2/ethanol vapor would then be passed through a condenser. The liquid condensate would be enriched with ethanol and transported to distillation for further purification. The CO_2 would then be recycled to the stripping column to further separate ethanol from the fermentation media. The fermentation media passing through the bottom of the stripping column would be relatively free of ethanol and would be recycled back to the fermentor. Using this methodology, ethanol would be continuously removed from the fermentor and maintained at a low concentration. The longevity of the fermenting microorganisms would then be increased and consequently the glucose conversion would be increased as well.



Plant Layout

In order to produce one million gallons of ethanol per day, approximately 550,000 bushels of corn will be processed per day. This production rate requires a robust plant layout that is capable of operating efficiently. In order to meet this requirement, corn will be received in the plant by two primary methods: tractor-trailer and railcar. The receiving area poses two significant problems. The first is that it will be a high traffic area, and the second is that corn dust may become a significant problem. Large amounts of corn dust cause a potential problem for fires; therefore, the corn receiving area will be isolated from the remainder of the process. Corn will be transported to the processing buildings via belt conveyors. The processing area consists of four main buildings. The first is a primary processing building where the corn is steeped, wet milled, and separated into fermentable and non-fermentable components. Non-fermentable components will be pumped to an adjacent building, dried to a specified moisture content, and sold as animal feedstock. The fermentable components (starch solution) are pumped to a second adjacent facility for further processing (saccharification). After conversion of starch to glucose, the liquid media is used for fermentation in the fourth building of the complex. In this facility, pre-fermentation, fermentation, and CO_2/ethanol separation will occur. The enriched ethanol liquid is then pumped to the distillation area where ethanol is purified and stored. Also included on the complex are the management and engineering offices, quality assurance offices and laboratories, and process/waste water treatment facilities. Some characteristics of the production complex are:



- 300 acre facility
- $182,040,000 total capital investment
- $293,138,670 total product cost
- $363,500,000 total gross annual sales
- $47,009,145 net annual cash flow
- ~4 year recovery period