

Enzymes for Alcohol

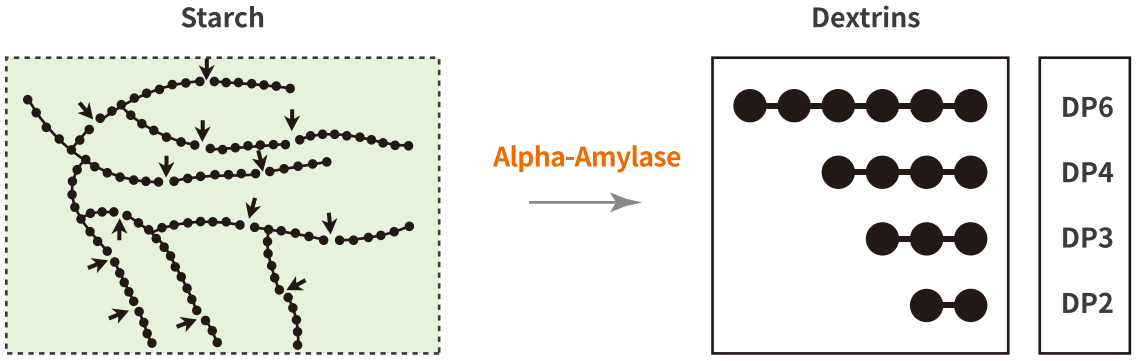
BOLI® enzymes catalyze your success!

Application of Boli Enzymes for Alcohol

Enzymes play an important role in the production of alcohol.
First, during the liquefaction stage, heat-stable alpha-amylase should be added to gelatinize and liquefy the starch materials.
Second, during the saccharification stage, glucoamylase should be added to convert the liquefied starches to fermentable sugars.
Third, during the fermentation stage, protease and fungal alpha-amylase should be added to improve the fermentation efficacy.

1st Stage: Liquefaction

Alpha-Amylase can randomly hydrolyze macromolecular amylopectin and amylose into small molecules of dextrin mixture.



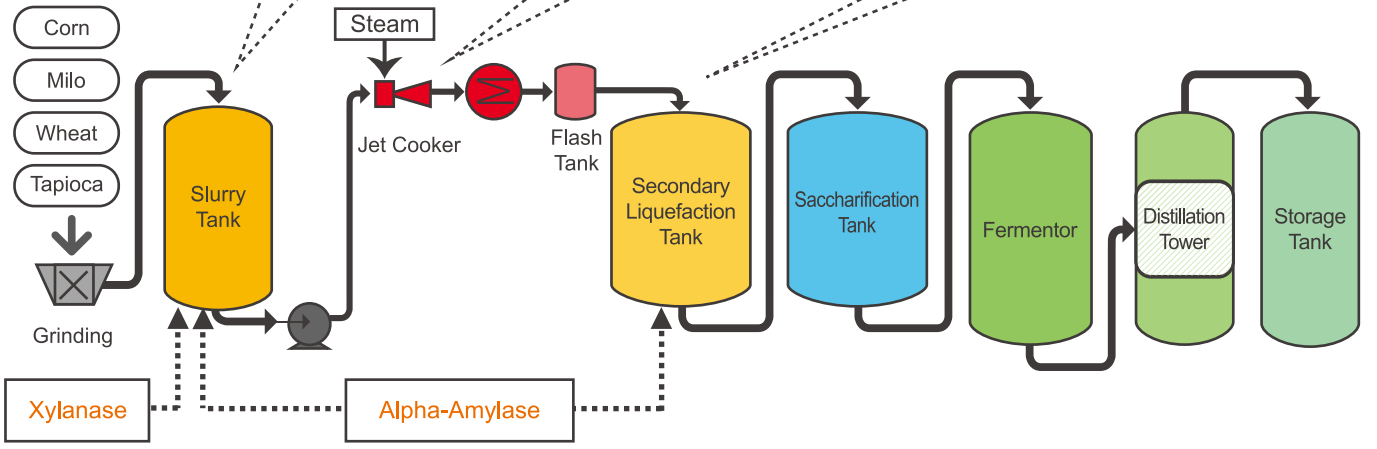
Liquefaction of Starch by Alpha-Amylase

Liquefaction Process: Option A

Pre-liquefaction:
Mix raw materials with water, select the right type of alpha-amylase depending on the pH of the slurry, and then add 40% of the total dose of the alpha-amylase needed for the liquefaction. In case the viscosity of the slurry needs to be decreased, Xylanase XM-308 should be added together. Temperature of water should be lower than the gelatinization temperature (< 68°C) to avoid formation of dough; heat the slurry with steam. Residence time should be 30~60 minutes for a cold slurry process below 66°C or for a hot slurry process at 83~86 °C; Control the DE value at 4~6.

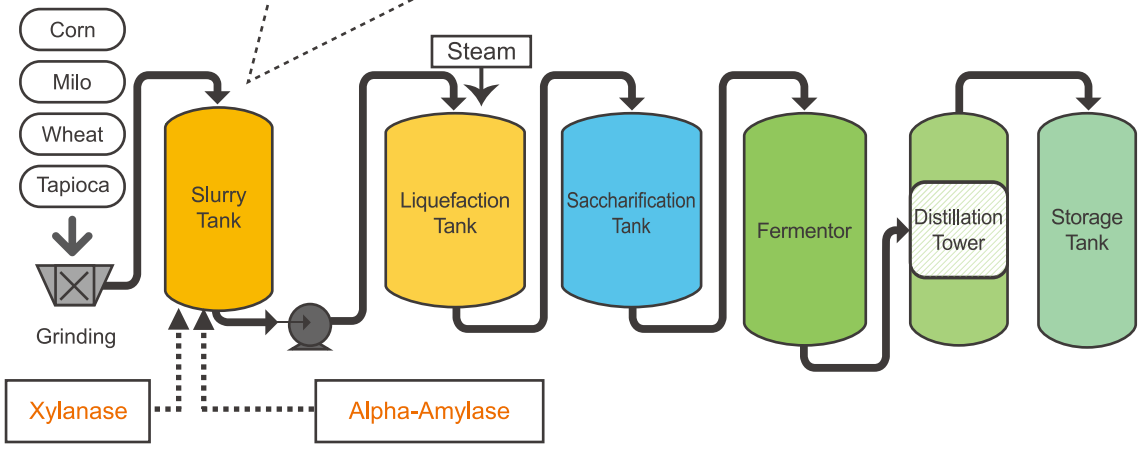
Spray liquefaction:
Heat the slurry evenly to make the starches easier to be liquefied by alpha-amylase and to further reduce the viscosity.
Temperature: keep at 105~110°C for 5~7 min, then go through the flash tank and cool down to below 90°C.

Secondary liquefaction:
Approx. 60% of the total enzyme dose should be added into the secondary liquefaction tank; Secondary residence time 90~150 min at 83~86 °C; Control the DE value at 10~12.



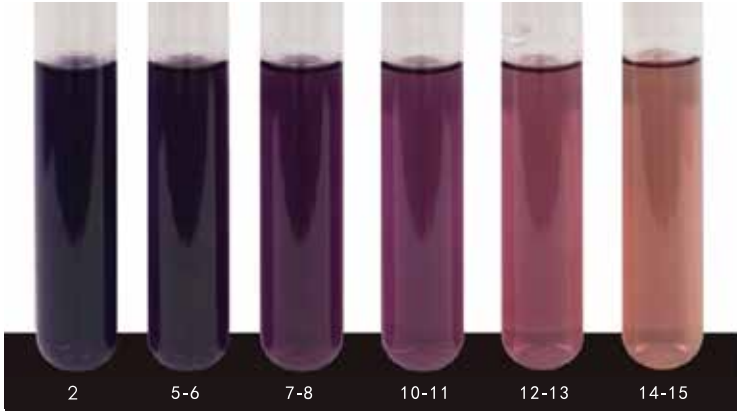
Liquefaction Process: Option B

- Mix corn, water, and Alpha-Amylase vigorously in the slurry tank. Temperature of water should be lower than the gelatinization temperature (<68°C) so as to avoid formation of dough; If the viscosity of the slurry needs to be decreased, xylanase XM-308 should be added meanwhile.
- Heat the slurry with steam to 60~65°C, and keep at this temperature for 45minutes, then continue to heat to 83~86°C. Residence time should be 90~150 minutes .
- The DE value should be controlled at 10~12 and not exceed 20.



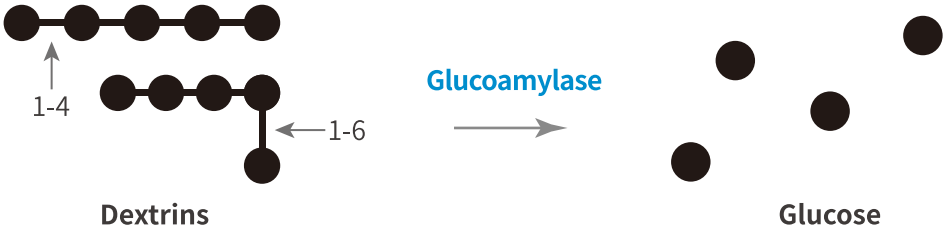
Evaluation of Liquefaction Results

- DE value (Dextrose Equivalent Value) should be determined by titration at the laboratory.
- Assay by Iodine: different lengths of the polyamide chains show different colors.



2nd Stage: Saccharification

In the production of alcohol and spirits, the saccharification enzymes degrade gelatinized starch and dextrins into fermentable sugars. These sugars are then fermented by the yeast cells and converted into alcohol. Glucoamylase can hydrolyze α-D-1, 4 glucosidic bonds from the non-reducing end of starch one after another. It can also hydrolyze the α-D-1, 6 glucoside branch bonds of starch and cleaves the α-1, 3 bonds, releasing glucose as the substrate for yeasts to ferment.



Saccharification Process

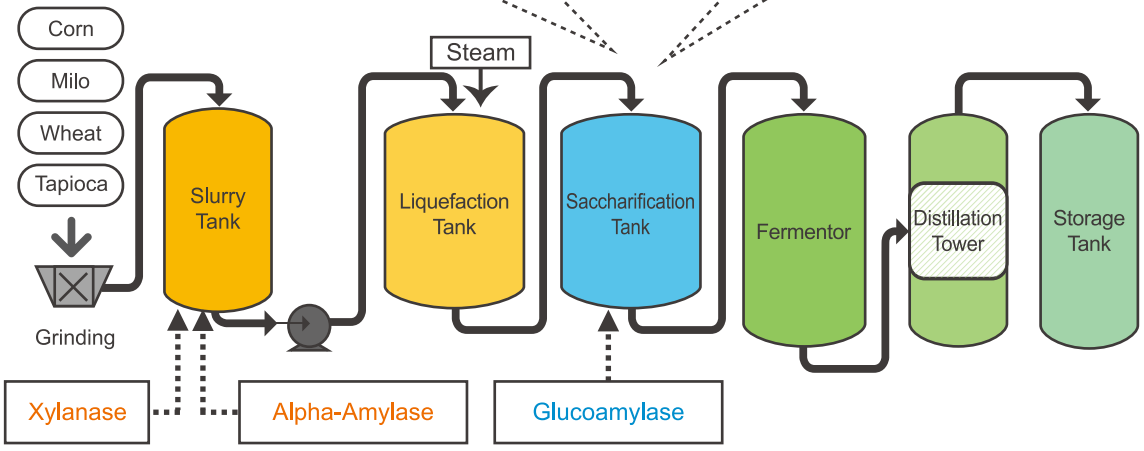
For optimum results, the saccharification enzyme Glucoamylase should be added into the saccharification tank right after the liquefaction is finished when the temperature is cooled down to 60°C.

Option A:
Pre-saccharification

- Keep at 60~65°C for 30~60 min;
- Then cool down to fermentation temperature;
- Add yeasts into the fermentor for fermentation.

Option B:
Simultaneous Saccharification and Fermentation (SSF)

- Pre-saccharification is not needed.



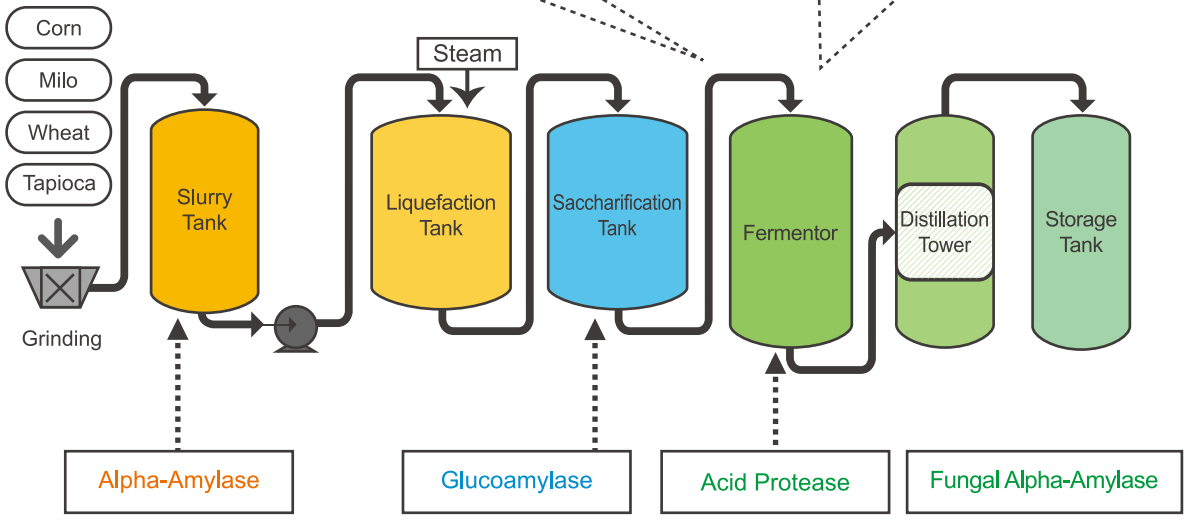
3rd Stage: Fermentation

Acid Protease can benefit the fermentation process as follows:

- ✓ Promote dissolve of raw material particles
- ✓ Promote growth of yeasts
- ✓ Beneficial to high concentration fermentation

Fungal Alpha-amylase can convert the starch fractions that cannot be liquefied by Heat-stable Alpha-amylase, thus enhance the efficiency of saccharification. Fungal Alpha-Amylase can benefit the production of alcohol as follows:

- ✓ Maximized utilization of raw materials
- ✓ Increased alcohol yield
- ✓ Less residual sugars at drop
- ✓ Less residual starch in DDGS



Enzymes for Alcohol and Fuel Ethanol

Liquefaction

Product Name	Type	Benefits					Effective/ Optimal pH	Effective/ Optimal Temp. (°C)	Dosage
		Rapid viscosity reduction enables the liquefaction of slurries with higher concentrations of solids.	Lower viscosity enhances heat exchange efficiency, more cost-effective liquefaction at low slurry temperature	High activity enables less dosage, saves shipping and storage costs	Enables more complete liquefaction with a desirable iodine test color	More compatible with lower pH, suitable for high-temperature spray liquefaction			
Heat-stable Alpha-Amylase	HA-306L	✓	✓	✓	✓	✓	4.8~6.5 / 5.0~5.9	80~110 / 85~92	0.055~0.078kg/ ton of cassava
	HA-450L	✓	✓	✓✓	✓	✓			0.05~0.07kg/ ton of cassava
	HA-580L	✓	✓	✓✓✓	✓	✓			0.025~0.035kg/ ton of cassava
	HA-306LP	✓	✓	✓	✓	✓	4.8~6.5 / 5.0~5.9	80~110 / 83~90	0.15~0.20 kg/ ton of corn
	HA-450LP	✓	✓	✓✓	✓	✓			0.14~0.18 kg/ ton of corn
	HK-540A	✓	✓	✓✓✓	✓	✓✓	4.5~6.5 / 4.8~5.8	Spray at 105~120 keep at 90~97	0.08~0.1 kg/ ton of corn 0.025~0.035kg/ ton of cassava

Saccharification

Product Name	Type	Benefits	Effective/ Optimal pH	Effective/ Optimal Temp. (°C)	Dosage
Glucoamylase	SUPERMEI 332P	Improve fermentation rate Increase alcohol yield Efficient starch-to-dextrin degradation Less residual starch in the distillers Hydrolysis of unconverted starch Improve performance of the pre-saccharification process	3.0~5.5/ 3.5~4.5	30~70/ 60~65	0.4~0.5 kg/ ton of raw materials
	SUPERMEI FD				0.35~0.45 kg/ ton of raw materials

Improve Fermentation

Product Name	Type	Benefits	Effective/ Optimal pH	Effective/ Optimal Temp. (°C)	Dosage
Acid Protease	AP-100	Promote yeast growth Improve fermentation Increase the alcohol yield Reduce urea/ammonia usage	2.0~6.0/ 2.5~3.5	30~55/ 40~50	0.01~0.075 kg/ ton of raw materials
	AP-530				0.006~0.05 kg/ ton of raw materials
Fungal Alpha-amylase	FA-280	Full utilization of raw materials Lower residual sugars at the drop Increase alcohol yield Lower residual starch in DDGS	3.0~6.6/ 4.8~5.4	30~65/ 45~55	0.04~0.08 kg/ ton of raw materials

Viscosity Reduction

Product Name	Type	Benefits	Effective/ Optimal pH	Effective/ Optimal Temp. (°C)	Dosage
Xylanase	XM-308	Contains xylanase, cellulase, and beta-glucanase activity Capable of handling wheat, rye, barley, triticale, oats, corn, etc. Break the cell structure of wheat and promote the release of active ingredients Improve saccharification and increase the yield of fermentable products Increase alcohol production Helps reduce energy and water consumption and saves operating costs	3.0~5.5/ 3.5~5.0	30~70/ 45~65	0.1~0.4 kg/ ton of raw materials



We are a technical leading enzyme manufacturer in China with an established reputation. Equipped with most advanced technologies of submerged fermentation, extraction, and refining process, our world-class factories are ISO9001,14001, 22000 and FSSC 22000 certified and comply with GMP standard. Our products are Halal and Kosher certified, and have been delivered to 18+countries worldwide. Our strong technical team brings more than two decades of expertise in close cooperation with the most prestigious research institutes and universities in China, which has enabled us to produce innovative quality products to satisfy customer needs.

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