

Enzymes for Starch Sugar

BOLI® enzymes catalyze your success!

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Application of Boli Enzymes for Starch Sugar

Sugars produced from starch are generally referred to as starch sugar.
By composition, starch sugar can be classified into liquid glucose, crystalline glucose (whole sugar), maltose syrup, maltodextrin, malt oligosaccharides, fructose syrup, etc.
The starch sugar industry covers a broad range of products, including glucose, maltose syrup, maltodextrin, sorbitol, mannitol, lysine, monosodium glutamate, glutamic acid, citric acid, etc.

Production Flow Chart of Starch Sugar

Starch Slurry

Starch slurry can be prepared from starch workshop or by adding water into commercial starch.

Adjust Slurry

Add water into the concentration of starch to adjust the dry matter content to 30～35% (16～19°Bé), use sodium carbonate solution to adjust pH, add Alpha-Amylase, mix well.

1st Spray

105～110°C, 5～7min
Purpose: Heat the starch to gel or dissolved, destruct the stable structure of starch granules; decrease the degree of polymerization of starch to a reasonable level so as to prevent the positive reaction and to destruct starch / fat complex.

Maintain Pressure

Flash Evaporation

Decrease pressure and temperature to 98°C.

Liquefaction

95～97°C, 60～120min
Purpose: To completely dissolve the starch, further coagulate the protein, provide a homogeneous substrate for saccharification.

2nd Spray

135～140°C, 5～6min
Purpose: To inactive enzymes, protein coagulation and starch dispersion.

Cooking & Mixing

Cool the liquefied materials down to the process required temperature.
Production of maltodextrin: The liquefied materials should be decolorized, filtered, concentrated and spray dried.
Production of glucose: Adjust pH to 4.2～4.5, add Glucoamylase HGA-101PT
Production of maltose: adding Fungal Alpha-Amylase FAA-280

Saccharification

Production of glucose: 60～62°C, 40～50h
Production of maltose syrup: 55～59°C, 12～20h

Filtration

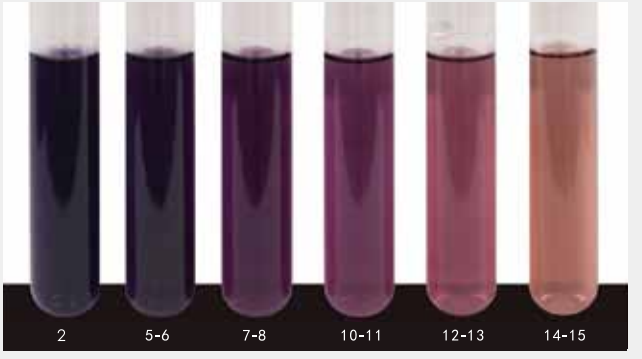
Main purpose: To remove the proteins, fats and other impurities. Usually use frame filter or vacuum drum filter. Filtration efficacy depends on the effect of aggregation of protein, which is a result of the liquefaction effect.

(Next Steps……)

Key Points of Process Control

Liquefaction

- There are several kinds of liquefaction processes in actual practice currently, such as one spray with the addition of enzyme once, one spray with the addition of enzyme twice, twice spray with the addition of enzyme twice, etc.
- For the liquefaction process that requires the addition of enzymes twice, 2/3 of the total dosage of enzyme should be added first during the starch slurry adjustment process, then go through spray jet liquefaction once, the liquefied materials shall go through the flash tank and cool down to 95～97°C, then the other 1/3 of the total dosage of enzyme should be added and liquefy for 60～120 minutes.
- The dosage rate of Heat stable Alpha-Amylase HT-800 should be 0.2～0.3kg/TDS. In case the starch content is above 35%, the recommended dosage rate should be 0.3～0.4kg/TDS. The dosage of other types of Alpha-Amylase is shown in the attached table.
- Standard of the liquefied materials: Iodine test shows red brown, good flocculation of protein with large and close agglomeration, light transmission rate of 70～80%.
- Filtration speed: more than 20ml liquids pass through a quick filter paper within 2 minutes
- DE value of the liquefied material should be controlled at 13~15 for the production of glucose, whilst 15～18 for the production of maltose.



Saccharification

- The liquefied materials should pass through the heat exchanger or flash tank so as to be cooled down to 62～60°C, adjust pH, add saccharification enzyme, enter the saccharification tank for saccharification. The pH values and saccharification enzymes may vary depending on the product requirements.
- For the production of glucose: Adjust pH to 4.2～4.5, directly add Glucoamylase HGA-101PT, the dosage rate should be 0.4～0.5kg per ton of dry substances in general, the saccharification should last for 40～50 hours, and the DX value at the outlet of the saccharification tank should be around 96.5%. For the production of glucose with a DX value above 96.5%, Glucoamylase HGA-101PC should be used and the dosage rate shall be 0.34～0.42kg enzyme per ton of dry substances.The exact dosage should be determined after test.
- For the production of maltose syrup: No need to adjust pH before feeding, the pH value should be maintained at around 5.0; add Fungal Alpha-Amylase FAA-280 at a dosage rate of 0.1~0.5kg per ton of dry substances.In some cases, to get higher maltose content, pullulanase should be added to hydrolyze amylopectin. The final DE value of the saccharification depends on the product requirements.

Enzymes for Starch Sugar

Liquefaction of starch

Product Name	Type	Benefits					Effective/ Optimal pH	Effective/ Optimal Temp.(°C)	Dosage
		Superior stability at low pH	Decrease starch viscosity quickly	Decrease the formation of color substances and non-fermentable sugars	Capable of handling high-concentration dry substances	Better liquefaction efficiency, less dosage			
Alpha-Amylase	HT-800L	✓	✓	✓	✓	✓	5.0~7.0/ 5.2~6.0	Spray: 105~110°C for 5~7 minutes Maintain: 95~97°C for 90~120 minutes	0.2~0.3kg per ton DS
	HT-360L	✓	✓	✓	✓	✓✓			0.1~0.15kg per ton DS
	HTA-430L		✓	✓	✓	✓	5.0~6.2/ 5.4~6.0	Spray: 105~108°C for 5~7 minutes Maintain: 95~97°C for 90~120 minutes	0.18~0.25kg per ton DS
	HK-530L	✓✓	✓	✓✓	✓✓	✓✓	4.5~6.5/ 4.8~5.8	Spray: 105~115°C for 5~7 minutes Maintain: 95~97°C for 90~120 minutes	0.10~0.17kg per ton DS

Production of glucose

Product Name	Type	Benefits					Effective/ Optimal pH	Effective/ Optimal Temp.(°C)	Dosage
		Greater starch-to-glucose conversion rate	Maximize utilization of raw materials	Capable of handling higher concentration substrates	Suitable for the production of glucose				
					With DX value around 96.5%	With DX value around 97%			
Glucoamylase	HGA-101PT	✓	✓	✓	✓		3.5~5.0/ 4.2~4.5	55~65/ 58~62	0.4~0.5kg per ton DS
	HGA-105PT	✓	✓	✓	✓				0.27~0.33kg per ton DS
	HGA-101PC	✓✓	✓✓	✓✓		✓			0.34~0.42kg per ton DS

Production of maltose

Pullulanase	PU-750	Quick debranching of oligosaccharides Suitable for syrups with medium to high maltose levels Increase yield	4.0~5.0/ 4.2~4.6	50~65/ 55~62	0.02~0.1kg per ton DS
Fungal Alpha-Amylase	FAA-280	For syrups with low to medium maltose levels High-temperature tolerance pH robustness Low dextrose (DX) formation	4.0~6.6/ 4.8~5.4	35~65/ 45~55	0.1~0.5kg per ton DS
Beta-Amylase	FBBA-70	Suitable for syrups with low to high maltose levels High temperature tolerance pH robustness Low dextrose (DX) formation	4.2~6.5/ 4.5~5.5	45~70/ 50~60	0.7~0.9kg per ton DS

Filtration

Lysophospho-lipase	LPL-100	Improves the filtration properties of syrups containing lysophospholipids and filtrate clarity	4.0~7.0/ 4.2~6.0	30~70/ 45~65	25~50g per ton of syrup