Novozymes Quara® Boost

Water degumming with higher yields and zero free fatty acid generation

Quara® Boost is a new PLC enzyme product for enzyme-assisted water degumming of vegetable oils. By releasing diglycerides from the phospholipids contained in crude vegetable oil, the degummed oil yield is significantly increased while oil losses in gum phase are reduced.

Benefits

- **Oil yield gain**
  Oil yield gain in water degumming increases by diglycerides resulting from enzymatic hydrolysis of the phospholipids that usually are retained in the oil phase (Delta DG).
  And this process also reduces the losses of neutral oil in the gums. The estimated yield gain from neutral oil is approx. 0.6 times the delta DG. So, total yield gain expected = delta DG + 0.6*delta DG.

- **No increase in FFA**
  The enzymatic reaction does not increase the content of free fatty acids in oil, helping to keep the levels below maximum specified values even when crude oils with high initial fatty acid contents are processed.

- **Fewer low value by-products: more protein in meal**
  For those producers who mix phospholipid gums at the meal, the protein content in the meal is increased since the volume of gum is reduced and it contains less oil.

Product

Quara® Boost is a liquid phospholipase product that has activity against three out of four major phospholipids present in vegetable oils: Phosphatidyl choline, phosphatidyl ethanolamine and phosphatidyl inositol. The product contains two protein-engineered phospholipase C enzymes (EC 3.1.4.) produced by submerged fermentation of a genetically modified *Bacillus licheniformis* microorganism. The result of the hydrolysis of the phospholipids is formation of di-glycerides and free P-groups as illustrated in figure 1.

Figure 1. Reaction scheme for phospholipase C.

Process

The enzyme assisted water degumming process uses a liquid phospholipase C blend – Quara® Boost. The reaction is carried out in a continuous stirred tank reactor (CSTR). The crude extracted oil is cooled down to 55°C before adding hydration water and enzyme. The total water dosage is 2.0 – 3.5% w/w of the oil. After the enzyme reaction, the oil is heated to minimum 85°C and centrifuged to separated degummed oil and gums. The enzyme is discharged with the gum phase and denatures at 85°C/185°F.

A flow chart for the enzymatic process is shown in figure 2.

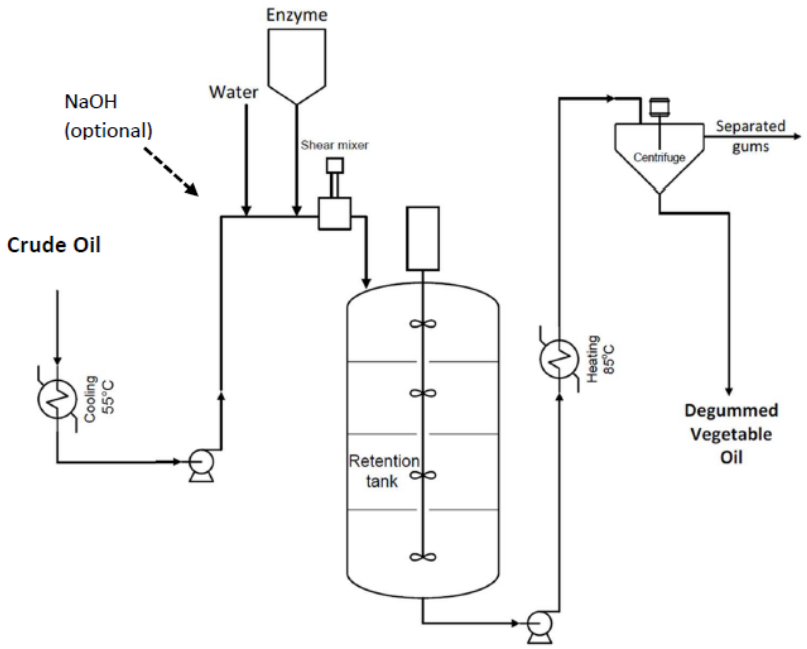

Figure 2. The basic layout of the enzymatic water degumming process. Recommended conditions for the enzyme reactor: See Table 1.

Table 1. Typical conditions for the process

		Enzyme reaction			Separation
Water addition	Caustic dosage*	Quara® Boost dosage	Retention time**	Reaction temperature	Temperature
2.0 – 3.5 %	0 – 200 ppm	150 – 200 ppm	2 – 4 hours	55°C/ 131°F	>85°C/185°F

* Depending on the crude oil quality, adding caustic (sodium hydroxide from 50% solution) can help to achieve optimal conversion of phospholipids. pH in a water extract of the oil must be > 6. Default addition could be 100ppm. All values related to caustic dosages are expressed in dry basis.

** The reactor configuration is important for the retention time in the reactor. A batch setup requires 2 hours, which is the same in a high number of tanks/compartments in a Continuous Stirred Tank Reactor (CSTR). The reactor in figure 2 shows a 4-CSTR which will require approx. 2,5 - 3 hours' retention time.

Enzymatic reaction

For efficient reaction, it is necessary to form a water in oil emulsion as the reaction takes place at the interface between oil and water. A high shear mixer is used for the emulsification. A high shear in-line mixer (e.g. IKA, or Silverson) is used for the emulsification. The recommended dose for Quara® Boost is 200 ppm, with a typical range 150 – 200 ppm. Too little enzyme will not give sufficient reaction (diglyceride increase) to see the benefits. From soybean oil containing 1000ppm P, of which 900 ppm is the form of PC, PE or PI, the maximum amount of diglyceride that can be produced at 100% conversion is approximately 1.6% w/w. In practice, 70-80% degree of hydrolysis is typically obtained in plant scale leading to 1.2% delta diglyceride. Quara® Boost has no hydrolytic activity on the glycerides and no free fatty acid is produced from hydrolyzing glycerides or phospholipids.
In some crude oils containing high NHP, optimal enzyme performance can be ensured by adding a small amount of sodium hydroxide in the hydration water.

Controlling the process

Diglyceride content by HPLC
The diglycerides produced from hydrolysis of the phospholipids stay in the degummed oil phase can be followed by HPLC determination. (AOCS Official Method Cd 11d-96)

Spin-test
The efficiency of the degumming depends upon the degree of hydrolysis and the operation of the centrifuge including the water addition. By making a spin test of the oil from inlet to centrifuge and after the centrifugation it is possible to see whether the sample separates well (volume of gum phase), as well as the quality of degummed oil (P and diglyceride increase), besides helping to identify eventual problems on industrial centrifuge

P-content ICP
Successful degumming is analyzed by the P-content of the oil after centrifugation. Each oil mill has its specification to control.

Customer support

Enzymatic degumming is an innovative technology based on the development of new enzymes as well as a novel application technology. The technology is supported by Novozymes Technical Service team and engineering partners.

Safety, handling and storage

Safety, handling and storage guidelines are provided with all products.

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