Why viscosity-reducing enzymes?
Producing fuel ethanol from cereals such as wheat, triticale, barley, and rye presents quite a challenge. Nonstarch polysaccharides such as beta-glucans and arabinoxylans create high viscosity, which has a negative impact on downstream processes.

High viscosity limits the dry substance level in the process, increasing energy and water consumption and lowering ethanol yield. Nonstarch polysaccharides reduce the efficiency of separation, evaporation, and heat exchange.

Viscozyme enzymes enable higher ethanol production capacity and lower operating costs. You get greater flexibility in the choice of cereal and raw material quality together with the ability to process at higher dry substance levels.

Flexibility in raw material choice
- Wheat, triticale, barley, and rye can all be used
- Reduced viscosity level and peaks due to raw material variation or change in particle size

Increased ethanol production capacity
- More dry matter in the mash to boost ethanol output

Reduced overall operating costs
- Higher dry matter levels means lower energy consumption as less water has to be heated, cooled, and evaporated
- Better heat exchange operations due to better mash flow
- Optimized enzyme use

Customized solutions
Optimize your plant design and operations with expert assistance from your Novozymes representative.

Rethink Tomorrow
Viscosity of wheat slurry

![Graph showing viscosity vs. temperature on wheat mash](image1)

**Fig. 1.** Viscosity impact of dry solids, time, and Novozymes Viscozyme® Wheat addition. Treated with 0.3 kg Viscozyme Wheat/t DS at pH 5.2, 50 ºC, and shear rate 10/s.

Viscosity vs. temperature on barley mash

![Graph showing viscosity vs. temperature on barley mash](image2)

**Fig. 2.** The relative viscosity from gelatinized starch and from dextrin has been minimized by liquefying for 60 min at 90 ºC and pH 5.7 with a high dosage of Novozymes Liquozyme® SC DS (0.3 kg/t DS) before adding Novozymes Viscozyme® Wheat for 60 min at specified temperature and then cooling to 32 ºC.

Viscosity vs. temperature on barley mash

![Graph showing viscosity vs. temperature on barley mash](image3)

**Fig. 3.** The relative viscosity from gelatinized starch and from dextrin has been minimized by liquefying for 60 min at 90 ºC and pH 5.7 with a high dosage of Novozymes Liquozyme® SC DS (0.3 kg/t DS) before adding Novozymes Viscozyme® Barley HT for 60 min at specified temperature and then cooling to 32 ºC.

Water flow versus DS

![Graph showing water flow vs. DS](image4)

**Fig. 4.** Water flow versus dry solids for a plant producing 1 million hl ethanol a year. The total flow of water through the plant is reduced by approx. 200,000 m³.

Our technical specialists will help you achieve your goals of optimal plant design and operations.