

### Estimating Fermentable Starch in Fuel Ethanol Production Method

#### Scope

- Measure fermentable starch in a grain sample for the liquefaction process in fuel ethanol production.

#### Rapid Visco Analyser

The Rapid Visco Analyser (RVA) is a cooking stirring viscometer with ramped temperature and variable shear profiles optimized for testing viscous properties. The instrument includes international standard methods as well as full flexibility for customer tailor-made profiles. Combining speed, precision, flexibility and automation, the RVA is a unique tool for product development, quality and process control and quality assurance.



#### Description

This procedure is based on the methods described by Zhao et al. (2008) using sorghum.

In a conventional dry-grind ethanol production process, the cereal grain is ground and mixed with water to form a mash, which is cooked, liquefied, saccharified, and fermented to produce ethanol.

In this method, the pasting properties of the ground grain are monitored in order to predict ethanol yield. Zhao et al. (2008) found a strong linear relationship between ethanol yield and final viscosity as well as setback.

**Table 1.** Coefficient of determination ( $R^2$ ) for RVA parameters and total starch, ethanol yield, and conversion efficiency for 68 sorghum samples. Source: Zhao et al. (2008).

Parameter	Peak viscosity	Holding Strength	Breakdown	Final Viscosity	Setback	Peak Time	Pasting Temp
Total Starch	0.44***	0.29***	0.30***	0.60***	0.55***	0.0019 <sup>ns</sup>	0.0060 <sup>ns</sup>
Ethanol Yield	0.47***	0.27***	0.36***	0.61***	0.57***	0.0017 <sup>ns</sup>	0.0043 <sup>ns</sup>
Conversion Efficiency	0.16***	0.05 <sup>ns</sup>	0.17***	0.18***	0.18***	0.0003 <sup>ns</sup>	0.0005 <sup>ns</sup>

\*\*\* significant at 0.1% level; <sup>ns</sup> not significant at 5% level.

## Method

Standard 2 pasting profile.

## Sample Preparation

Test  $4.00 \pm 0.01$  g sample (at 14% moisture) and 25.0 ml distilled water using the following profile.

## Profile

Time	Type	Value
00:00:00	Temp	50°C
00:00:00	Speed	960 rpm
00:00:10	Speed	160 rpm
00:01:00	Temp	50°C
00:08:30	Temp	95°C
00:13:30	Temp	95°C
00:21:00	Temp	50°C
00:23:00	End	
Idle Temperature: $50 \pm 1^\circ\text{C}$ Time Between Readings: 4 s		

## Measure

PV: Peak viscosity (cP)

TV: Trough/minimum viscosity (cP)

FV: Final viscosity (cP)

SB: Setback (cP) (FV - TV)

High peak and final viscosities and setbacks generally indicate higher starch contents (higher amounts of fermentable starch). This in turn suggests better ethanol yields.

See also RVA Method 37: Fermentation Quality of Grain in Fuel Ethanol Production.

## Reference

Zhao, R., Bean, S., Wu, X. and Wang, D. 2008. Assessing fermentation quality of grain sorghum for fuel ethanol production using Rapid Visco-Analyzer. *Cereal Chemistry* 85(6)830-836.