Anton Paar

Betalyser

Automated System for Quality Analysis of Sugar Beets

The true value of sugar beet

Sugar beet crop is a raw material for sugar production in the beet sugar industry. Therefore it is the most important trading good besides sugar itself. Payment for sugar beet delivered to factories is usually based on a quality related valuation system. This means that not only the mass of beet, reduced for the amount of tops and leaves, earth, dirt and stones, will be valued, but also the quality of clean sugar beet.

The commercial value of sugar beet depends on its sugar content and on several factors that influence the yield of the obtained crystalline sugar. These factors are the so-called non-sugar compounds potassium, sodium and α-amino nitrogen, the contents of which are used for yield prediction calculations.

Therefore, the exact determination of the four quality relevant components (sucrose, K, Na, and α-amino nitrogen) is of major importance. The technical quality of sugar beet is also important for economical processing. Different qualities of sugar beet have to be assessed by means of suitable analytical methods to determine these compounds.

Since the results of beet quality analysis sometimes lead to controversies between growers and processors, the analytical methods are standardized by the International Commission for Uniform Methods of Sugar Analysis (ICUMSA).

A powerful tool for enhancing sugar beet quality

The polarimetrically determined sucrose content (polarization °Z) of sugar beet alone is not a true measure of the extractable white sugar and is therefore not sufficient for the quality analysis of sugar beet.

To obtain true quality data, sugar beet analysis must include the ingredients that form molasses: potassium (K), sodium (Na), and α-amino nitrogen.

For this analysis, the beet brei samples need to be clarified. This has traditionally been done by using lead acetate, nowadays – for environmental and safety reasons – aluminum sulfate is used.

For sugar factories that still use lead acetate for clarification, but intend to change to aluminum sulphate clarification, the automated laboratory system Betalyser is capable of analyzing both lead and aluminum-clarified beet samples for these ingredients (°Z, K, Na, and α-amino-nitrogen).

The analysis results are used to calculate quality relevant data, such as sugar yield, molasses sugar content and alkalinity, at a sample rate of 120 samples per hour.

Ways to improve sugar quality proven by progressive sugar factories...

Since 1975, Betalyser systems are supplied to sugar factories and seed growers worldwide for analysis of sugar beet quality.

Progressive sugar factories use the Betalyser system to influence the processing quality of their raw material.

This can be achieved by a payment system based on recoverable sugar content data, giving incentives to farmers who produce high-quality sugar beets, and penalizing those who supply beets of poor quality.

A payment system based on the quality of sugar beets (extractable white sugar content) will obviously counteract overpayment for poor-quality beets with low extractable white sugar content and would immediately increase the profits of the factory.

Some factories also offer advice to the farmers on better fertilization and cultivation techniques – based on the quality data of the sugar beets. Within a few years this will result in a general increase of sugar beet quality and therefore the profits of the sugar factory, so that the Betalyser pays for itself within a short period of time.

...and leading seed growing companies

Leading seed growing companies use the Betalyser system for developing better sugar beet varieties with high sucrose content and genetically improved white sugar yield.

This requires accurate measurements of large quantities of samples to obtain statistically relevant data for a successful selection.

Full compliance with latest ICUMSA standards

The Betalyser system is capable of analyzing lead-clarified sugar beet extracts and aluminum-clarified sugar beet extracts in compliance with the latest standards of the International Commission for Uniform Methods of Sugar Analysis (ICUMSA):

Method GS6-1 (1994)

The Determination of the Polarisation of Sugar Beet by Macerator or Cold Aqueous Digestion Method using Lead Acetate as Clarifying Agent - Official

Method GS6-3 (1994)

The Determination of the Polarisation of Sugar Beets by Macerator or Cold Aqueous Digestion Method using Aluminum Sulphate as Clarifying Agent – Official

Method GS6-5 (2007)

The Determination of α-Amino Nitrogen in Sugar Beets by Copper Method ('Blue Number")

- After Defecation with Basic Lead Acetate - Official.
- After Defecation with Aluminum Sulphate - Official.

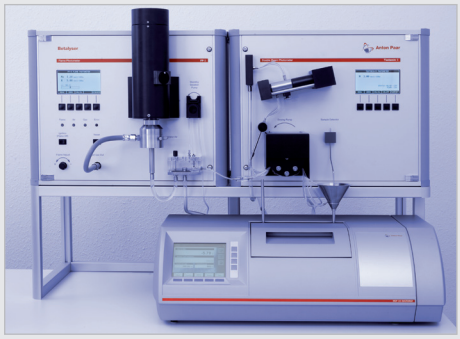
Method GS6-7 (2007)

The Determination of Potassium and Sodium in Sugar Beet by Flame Photometry - Official.

State-of-the-art analytical instruments

All instruments of the Betalyser system are operated by microprocessor and are easily set up and calibrated by menu-guided dialogues.

Maximum performance, long service life, and first-rate user support is guaranteed, because all instruments are developed and manufactured by Anton Paar – assuring competent supply, service and support from the same source.



MCP 300 Sucromat Saccharimeter

Compared to historical methods of sugar content determination, polarimetry is a highly precise method for determining the sucrose content of pure aqueous sugar solutions.

Polarization (°Z) measurements with Sucromat have a long tradition, beginning in the 1980s with the first Sucromat series developed and distributed by Dr. Kernchen GmbH. In 2007 Dr. Kernchen became part of the Anton Paar group. The MCP 300 Sucromat is the new generation of saccharimeters for the sugar industry.

High accuracy, robust design and reliable operation are the reasons for this instrument's renowned reputation.

For further details, refer to the MCP Sucromat brochure.

FP-5 Flame Photometer

The content of sodium and potassium is measured by the intensity of their flame emission radiation at characteristic wavelengths for these alkali metals.

The intensity of this light at the characteristic wavelengths is proportional to the concentration of sodium and potassium.

In order to achieve highest accuracy and stable readings, the FP-5 uses a stabilized flame and performs measurements of the flame emission by permanent comparison with an internal lithium (Li) standard.

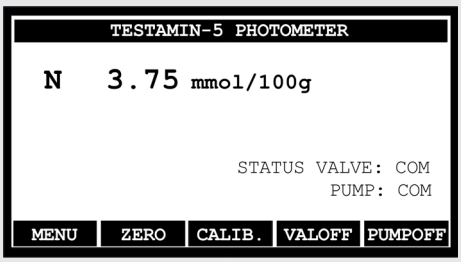
Testamin 5 Double Beam Photometer

α-amino nitrogen contributes to most of 'harmful nitrogen' and is therefore a very important parameter in the quality analysis of sugar beets.

The Testamin 5 analyzes both lead- and aluminum-clarified beet samples for α-amino nitrogen content by means of the 'Blue Number Method' using copper reagent.

α-amino nitrogen and the copper reagent form a blue complex, the absorbance of which is measured at a wavelength of 610 nm. The measured absorbance is proportional to the α-amino nitrogen concentration.

The method is fast and accurate, and the required chemicals can be prepared and stored for the entire campaign. While lead-clarified samples are colorless, filtrates of aluminum-clarified samples are not. The Testamin 5 automatically compensates the inherent color of the aluminum-clarified sample by measuring its color in a reference cell, thus avoiding inaccurate results. Sugar factories and seed growing companies which still use lead acetate for clarifying sugar beet samples, but may change to clarification by aluminum sulphate in the future, do not need to exchange any system components.



PC system control and data processing

All instruments are connected to a PC. Analysis results are displayed on the PC screen and printed. Optionally a bar code reader can be supplied – if sample codes need to be read from bar code labels.

The software package installed on the PC includes a Windows operating system and the BeetLab software program for system operation and diagnosis.

The program offers sugar beet quality data calculations by the following methods:

- New Braunschweig Method
- Method of Reinefeld & Winner
- Method of Wieninger & Kubadinov
- One customer-defined method

The BeetLab program can be supplied to meet special requirements of sugar factories or seed growers on request.

BeetLab speaks your language

The dialog and menu language of the BeetLab software can be selected from the menu, e.g. German, English, Russian, Polish.

If your language is not supported, we can easily install a corresponding language file after translation.

Fully automated and easy to operate

Sugar beet (tare) laboratory work is often performed by seasonal staff. Hence, good operator guidance through clear and understandable messages displayed on the computer screen is an important point of our software design.

The whole analysis cycle is automated and controlled by the PC. At the beginning of each analysis, the sample is poured into the feeding funnel of the polarimeter tube. As soon as the liquid level gets in contact with a sample detecting probe, the dosing pump starts running.

The pump takes equal volumes of sample and lithium standard solution, adds distilled or de-ionized water, and feeds the mixture to the FP-5 flame photometer.

Another part of the sample is mixed with copper reagent and fed to the measuring channel of the Testamin 5. For the reference channel a small volume of the sample is mixed with buffer solution only. As soon as the pump has stopped, the solenoid valve opens and the sample runs into the polarimeter tube of the MCP 300 Sucromat.

A few seconds later the instrument readings have stabilized, the displayed values are registered by the computer, and quality-relevant data such as alkalinity, molasses sugar, and sugar yield are calculated.

Sample code, °Z polarisation, K, Na, α-amino Nitrogen, and quality data are recorded for further processing.

The whole cycle takes less than 30 seconds, allowing throughput of about 120 samples per hour.

Customers on Betalyser:

„...it has given us the capability of running several thousand samples with limited manpower. The equipment is highly versatile and can be used in other associated areas...“

“... in the past, sugar beet growers were paid on the basis of tonnage only. Declining beet quality finally led to payment on sugar content. A new tare laboratory was constructed using state-of-the-art equipment from Germany. This equipment has perfomed as expected, processing between 2500 and 3000 samples daily during peak harvest period. After only two years of operation, the new payment method has resulted in noticeable improvements in beet quality. Now several factories in Europe are using Betalyser with excellent results.“

Specifications

1	**Analytical Section** The sample throughput is approximately 120 samples/hour.	
1.1	**MCP Sucromat Automatic Saccharimeter** for determination of the Pol (°Z) content	
	Principle of operation	Self-balancing circular polarimeter
	Methods	ICUMSA Method GS6-1 (1994) ICUMSA Method GS6-3 (1994)
	Measuring range	± 259 °Z, International Sugar Scale
	Resolution	± 0.01°Z
	Accuracy	± 0.01°Z
	Repeatability	± 0.01°Z
	Wavelength	589 nm
	Light source	Tungsten halogen lamp, 6V, 20W, average life 2,000h
1.2	**FP-5 Flame Photometer** for determination of the potassium (K) and sodium (Na) contents	
	Principle of operation	Flame emission measurement of potassium (K) at 768 nm and sodium (Na) at 589 nm by comparison with internal lithium standard at 671nm
	Method	ICUMSA Method GS6-7 (2007)
	Measuring ranges	0-199.9 mmol/kg beet (K and Na)
	Sensitivity	0.1 mmol/kg beet (K and Na)
	Accuracy	1.5 % or 0.5 mmol/kg beet, whichever is greater
	Data ports	RS232 serial interface port
	Fuel	Propane or propane/butane gas, 50 mbar – 16 bar (0.72-232 psi)
	Compressed air	Dust and oil free, 2-4 bar (29-58 psi)
1.3	**Testamin 5 Double Beam Photometer** for determination of α-amino nitrogen by the Blue Number Method, capable of analyzing lead-clarified and aluminum-clarified sugar beet extracts	
	Principle of operation	Double beam filter photometer with automatic compensation of sample color by measuring the difference of relative transmittance at 610 nm of a) 1:1 mixture of sample and copper reagent in the measuring channel, and b) 1:1 mixture of sample and buffer solution in the reference channel
	Method	Method GS6-5 (2007), Blue Number Method
	Light source	LED lamp, average life 100,000h
	Measuring range	0-100.0 mmol α-amino nitrogen/kg beet
	Sensitivity	0.1 mmol α-amino nitrogen/kg beet

	Accuracy	+/- 0.5 mmol α-amino nitrogen/kg beet
	Data port	RS232 serial interface
	Sample cells	Two flow-through type cells of stainless steel, length 40 mm, one cell in the measuring channel, the other cell in the reference channel
1.4	**Dosing Pump**	7-channel peristaltic pump dosing: Sample, Li standard and distilled water to the FP-5 Flame Photometer Sample, copper reagent, and sodium acetate buffer to the Testamin 5 Photometer
2	**Data Processing and Control Section**	
2.1	Personal Computer	Actual specifications on request.
2.2	Interfaces	USB/Serial interface box (RS232) for connection of analytical instruments
2.3	Laser data printer	Specifications on request
2.4	Software	MS Windows™ operating system, BeetLab standard operating program for Betalyser with choice of three menu-selectable methods for computing sugar beet quality data: - New Braunschweig Method, - Method of Wieninger & Kubadinow, - Method of Reinefeld & Winner - One customer-definable method. Customized versions of the BeetLab program are available on request.
3	**General System Components**	
3.1	UPS	Line interactive UPS, input voltage and frequency to be specified with order, sinus voltage output 230 V, 1500 VA.
3.2	Cables	One set of grounded power cords and interconnecting cables.
3.3	Air filter	Micropore filter for retaining moisture and soil particles > 0.01µm.
3.4	Benches	Instrument bench approx. 160x80x70 cm (LxWxH) Instrument bridge approx. 103x47x32 cm (LxWxH) Computer bench approx. 86x70x70 cm (LxWxH)
3.5	Containers	One set of containers for setup on the instrument bench, for distilled or demineralized water, α-amino-nitrogen reagent, Li standard, and test solution

Specifications are subject to change without prior notice