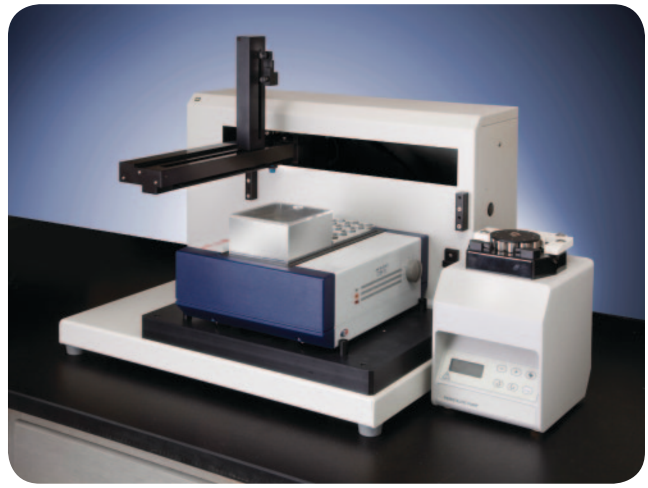
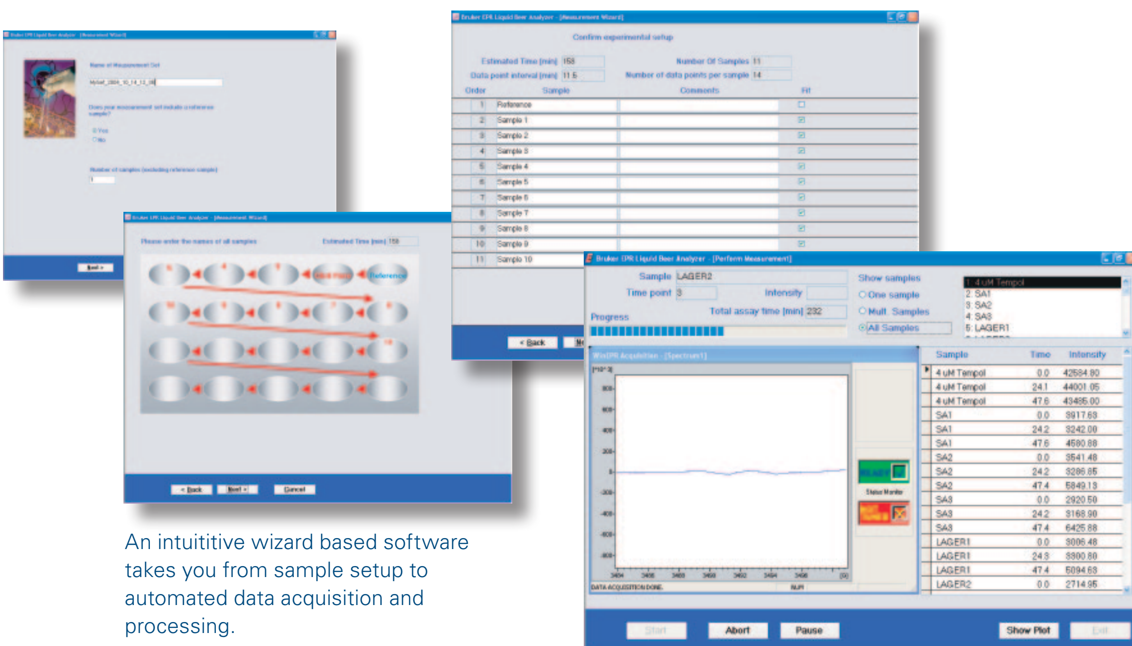
High throughput autosampler:

The EPR oxidation assay is indeed a powerful tool for the brewer, but for routine use, it needs to have high throughput and easy set-up. Traditional EPR spectrometers are designed to perform many different types of experiments but are not always optimized for one particular application.

Bruker has developed the e-scan bench top EPR spectrometer specifically for use with industrial applications. For beer analysis, an automatic sample changer is interfaced with the spectrometer to provide EPR oxidation profile data for up to 20 samples all in one assay period. An intuitive software interface combines easy operation with automatic data acquisition and post processing. A typical assay is performed in a 2 to 3 hour period for 10 to 20 samples.





An intuititive wizard based software takes you from sample setup to automated data acquisition and processing.

Bruker BioSpin

epr@bruker-biospin.com
www.bruker.com/epr

e-scan

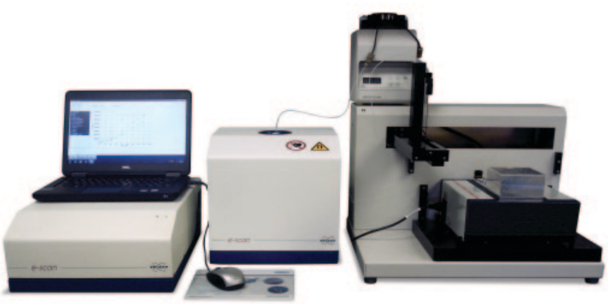
- Rapid, automated analysis for optimizing your beer's shelf life

Innovation with Integrity

EPR

Why use the e-scan?

The EPR oxidation profile provides a truly powerful measure for assessing the antioxidant capacity of beer. Bruker's e-scan Lagtime Analyzer is dedicated to measuring the EPR oxidation profile of your beer. Now you can perform this, once very specialized assay, with a compact, easy-to-use benchtop analyzer.



PC interfaced* bench top EPR Spectrometer

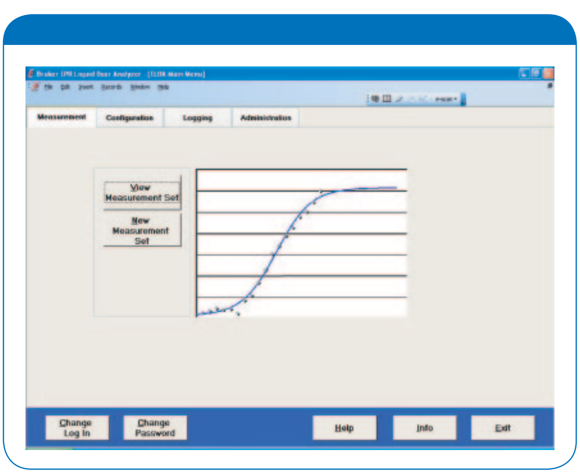
Automatic sample changer

Key Features of the e-scan:

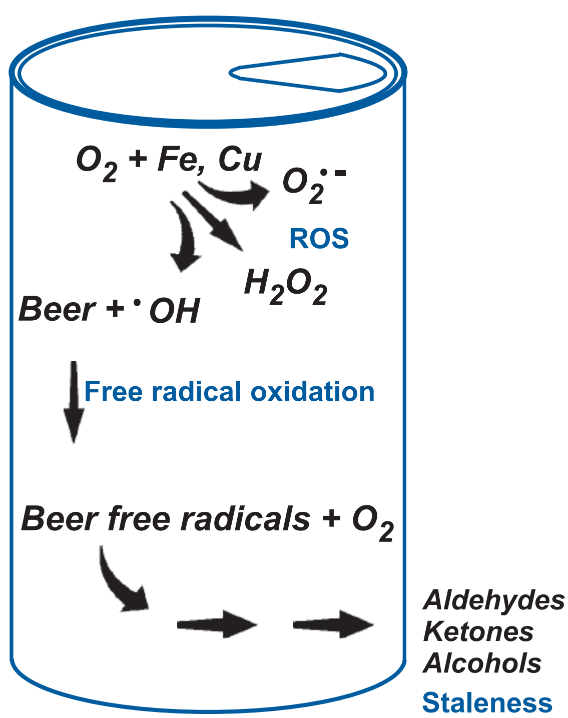
- Fully automated sample handling
- Up to 20 samples per analysis
- Unattended data acquisition
- Automatic lag time calculation
- Easy-to-learn Windows™ software

Introduction:

Oxidative staling of beer occurs by a free radical process. During storage, even trace amounts of transition metals such as iron or copper will catalyze the conversion of molecular oxygen to what are known as "reactive oxygen species" (ROS). One such ROS is the hydroxyl free radical which rapidly oxidizes components of the beer to free radicals. Beer-derived free radicals react further to perpetuate a chain reaction that results in carbonyl end products such as aldehydes and ketones. It is these carbonyl compounds that give rise to the "cardboard like" flavor of stale beer. Antioxidants in beer help them resist free radical oxidation. And although oxidation is inevitable over time, it can be minimized by optimizing brewery operations and storage conditions to provide maximum antioxidant content in the packaged beer. The EPR oxidation profile provides an analytical measure for evaluating the overall antioxidant status of your beer at each stage of the brewing process. The EPR data is also useful for predicting the shelf life of a finished beer before it goes through costly packaging and distribution.



Intuitive automation software



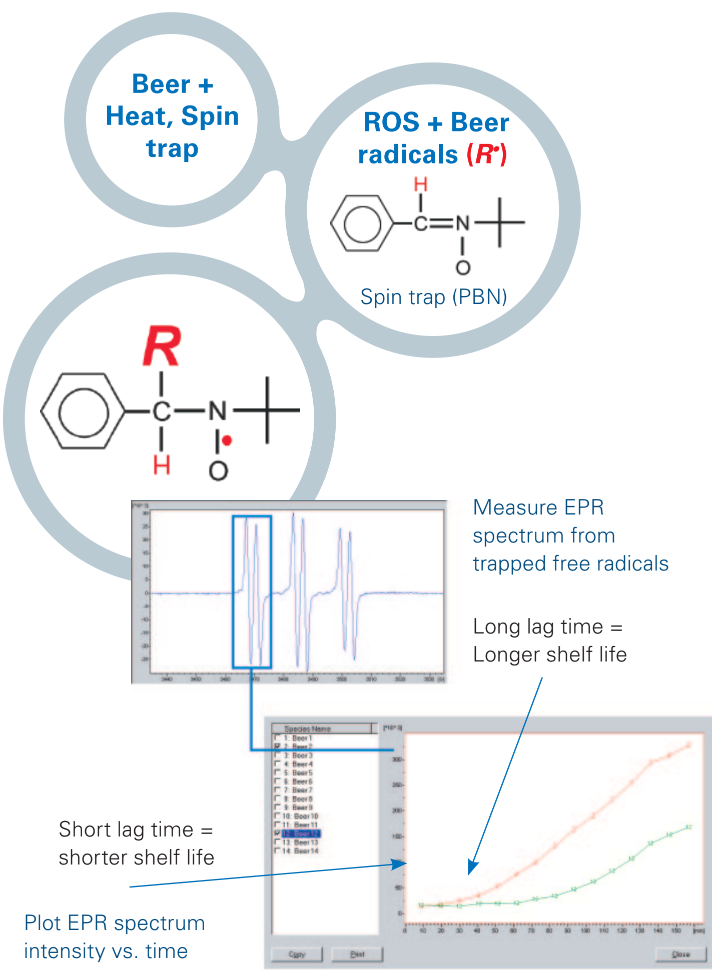
*desktop PC standard, notebook computer optional.

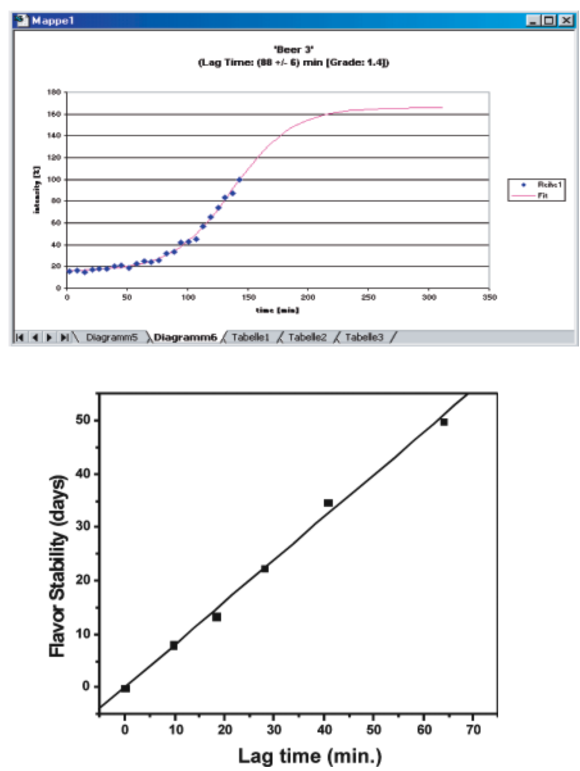
EPR lag time assay:

The lag time assay uses an EPR (electron paramagnetic resonance) spectrometer to measure free radical formation in beer. The beer is heated to 60°C to force its oxidation and a special reagent called a spin trap is added to capture free radicals as they form. Trapped free radicals are measured using the e-scan EPR spectrometer. Initially, antioxidants in the beer quench free radicals before they can be trapped. However, as time progresses, the antioxidants run out and a dramatic increase in free radical trapping occurs. The initial antioxidant quenching causes a characteristic "lag" in the time profile of EPR signal intensity. The duration of the lag time is directly related to the antioxidant content of the beer and is longer for beers with good shelf life stability. The lag time assay is used to test the effects of various processing steps on the final antioxidant content in a beer. For example, oxygen pick-up in unfinished product within the brewery promotes oxidation and lowers antioxidant levels. Filtration media often contain metals such as iron or copper which act as pro-oxidants in the finished beer.

Correlating EPR oxidation profiles with shelf life:

The real advantage of the EPR method lies in its timeliness. Most breweries rely on sensory analysis studies to determine the shelf life of their beer. Although tasting is the true measure of staleness, it is not always a practical or timely method for evaluating the effect of several process changes. Sensory studies are not only confounded by their subjectivity, but also require weeks, even months to perform. Recently, it has been demonstrated that a beer's EPR lag time strongly correlates with data from sensory analysis (Uchida et al. (1996) Am. Soc. Brew. Chem. 54, 198-204). That is, beers with long lag times require longer periods before sensory panels taste the oxidative off-flavor. The brewery first establishes a correlation between the EPR lag time of a beer (in minutes) and the time (in days) before oxidative off-flavor is detected by the sensory panel. Once the correlation is established the brewer can use the lag time assay to predict shelf life in beer.





Lag times from various beer samples are automatically calculated using a sigmoidal fit of the EPR intensity plot. The Lag time values are then correlated with shelf-life scores obtained from sensory analysis.