The AFM embodies the ideal screening machine for industrial and academic research on (GM) yeast, potable alcohol and bioethanol.
“The AFM has become one of the most important instruments in our QA lab.”

SAN FENG MALTHA
SCIENTIST, ROYAL NEDALCO

“During the past decade, we at Royal Nedalco in The Netherlands, have used the Alcohol Fermentation Monitor for standard feedstock testing, general process development and design. The AFM provides a very user friendly and easy to clean means for measuring metabolic yeast activity, even for staff that have no experience with fermentation technology. It is now one of the most important QA tools in our fermentation laboratory.”

Royal Nedalco, a subsidiary company of the Dutch sugar producer Cosun, is a leading producer of ethanol of agricultural origin in Europe.

www.nedalco.com
Alcohol has been produced for consumption for thousands of years. The biological process for ethanol production involves the fermentation of sugars that exist in vegetable feed stocks such as grapes, corn, cane or wheat, into alcohol and carbon dioxide under anaerobic conditions.

Over the past couple of decades, bioethanol has become a promising fuel as an environmentally friendly alternative for fossil fuels. Second generation bioethanol production i.e. using agricultural waste as a feedstock for C5 converting yeasts, is particularly promising since it does not compete with food production. In fact, both the food and fuel industries may exist in a symbiotic fashion to yield maximum benefit from agricultural resources.

Worldwide, many research groups and companies spend significant time and money on research dedicated to improving enzymes for feedstock pretreatment, improving yeast strains and optimizing process conditions for the production of bioethanol. The most important engineering parameters for bioethanol fuel production are the rate of conversion and the total ethanol yield from a feedstock.

A number of methods exist to monitor conversion rates and yields during alcoholic fermentations. Ethanol concentrations in fermentation broths may be measured on-line with alcohol-specific sensors, or alternatively, samples can be taken for off-line GC or HPLC analyses. Taking offline samples is, however, time and resource consuming. Additionally, ethanol sensors have known reliability issues, reduced accuracy and frequently require calibration.

An alternative approach to follow conversion rates is to monitor the amount of carbon dioxide that evolves from the fermentation broth. Metabolically, ethanol and carbon dioxide are stoichiometrically coupled under anaerobic conditions with little growth. Therefore accurate and automated monitoring of the amount of carbon dioxide produced during fermentation results in a reliable presentation of metabolic yeast dynamics.
“The AFM is of special interest for any process involving ethanol production.”

HANS VAN DIJKEN PH.D., PROFESSOR | INDUSTRIAL BIOTECHNOLOGY | DELFT UNIVERSITY OF TECHNOLOGY

“As a yeast scientist I am involved in a lot of studies on alcoholic fermentation. So you can imagine that this Alcohol Fermentation Monitor is of much interest to me. It can be used for the production of alcohol such as beer brewing and wine making. Especially interesting is its application for the production of the second-generation bioethanol, that is production of alcohol from plant waste. The fermentation liquid in this particular case is very, very viscous and therefore this machine contains exceptionally strong magnets.”

Professor Van Dijken’s scientific contributions include the valorization of fundamental research in industrial projects, such as the production of organic acids, amino acids and alcohols by yeast. | www.tnw.tudelft.nl
The Alcohol Fermentation Monitor (AFM)

Easy, Quick and Accurate
The AFM, developed by HaloteC Instruments in the Netherlands, is a dependable laboratory instrument or monitoring metabolic activity of six alcoholic fermentations simultaneously.

Because standard Schott Duran™ 250ml or 500 ml laboratory flasks are used, the system is much easier to operate and clean than standard, commercially available fermenter systems. New experiments can quickly be started at any time. Moreover, the AFM is equipped with very strong magnetic stirrers, able to handle viscous media such as lignocellulose hydrolysates.

Conversion rates and yields can accurately be measured as a function of feedstock, yeast strains or other process conditions such as medium temperature.
“The AFM is ideal for studying enzymes and micro organisms for development of the biomass to ethanol process.”

FRANK LAUMEN, M.SC. | SENIOR SCIENTIST
DSM WHITE BIOTECHNOLOGY

“At DSM White Biotechnology we are using the AFM to develop the biomass to ethanol process. We are using it to test enzymes, to test micro organisms and to actually perform process development. The AFM helps us to perform a series of simultaneous experiments while measuring kinetics in time.”

DSM creates innovative products and services in life sciences and materials sciences, contributing to the quality of life. | www.dsm.com
The Alcohol Fermentation Monitor (AFM)

Modern and Straightforward Control Software
The AFM system is fully controlled with user-friendly PC software running on Microsoft Windows XP Pro™, using Microsoft Excel™ for generating advanced reports. The AFM control software allows for convenient storage of experimental data and easy data comparison. Moreover, performance indicators can be calculated automatically for large sets of experiments. The AFM control software is password protected, all user actions are logged and stored automatically and data is stored in encrypted form (21-CFR Part 11). Medium temperature is controlled well within 0.1°C of set point.

Temperature programs may also be entered in time schedules for each individual fermentor flask. The software is intuitively designed with a “no need for a manual” approach.

The entire operation of the AFM can be mastered within 10 minutes, even by untrained staff.
“Iogen uses the AFM continually during the fermentation design process for its ethanol facility.”

DR. IR. JAN-MAARTEN GEERTMAN
STAFF SCIENTIST, IOGEN CORPORATION

“Iogen has been using the AFM for more than a year now. We use it to measure fermentation rates, screen different yeast strains for performance, and to measure kinetics. It is a quick and efficient tool and we are very satisfied with the performance.”

Iogen is a leading biotechnology firm specializing in cellulosic ethanol - a fully renewable, advanced biofuel. Iogen also develops, manufactures and markets enzymes used to modify and improve the processing of natural fibers within the textile, animal feed, and pulp and paper industries.

www.iogen.ca
Many satisfied users involved in biomass to ethanol conversion processes describe the AFM not only as the perfect screening machine for general research on anaerobic yeast fermentations, but also as a powerful, time saving tool for plant design and process optimization.

A very accurate characterization of the fermentation quality can be obtained, without the need for highly trained or specialized laboratory staff, which is an important, money saving feature.

A selection of satisfied users

• Bird Engineering, Schiedam, The Netherlands
• DSM White Biotechnology, Delft, The Netherlands
• Iogen Corporation, Ottawa, Ontario, Canada
• Royal Nedalco, Bergen op Zoom, The Netherlands
• Carlsberg Research Laboratory, Copenhagen, Denmark
• DSM Nutritional Products, Belvidere, NJ, United States of America
“The AFM embodies the missing link between shake flask experiments and large scale fermentations.”

TOM ELINK SCHUURMAN, B.SC.
SCIENTIST, BIRD ENGINEERING

“We as Bird engineering were involved in the development process of the AFM. For us as a company, the AFM limits the amount of time needed for the development of new processes. The AFM enables us to measure on a small scale and is thus the missing link between shake flask experiments and large scale fermentations.”

Bird Engineering specializes in consultancy, contract research and engineering in the area of fermentation technology.

www.birdengineering.nl
The AFM - Easy, Quick and Accurate

- Very user friendly laboratory device for monitoring anaerobic, metabolic yeast activity for alcohol production
- Six independent yeast fermentations can be carried out simultaneously
- Standard 250 or 500 ml Schott Duran™ flasks
- Stirrer speeds and temperatures can be set or time programmed for each fermenter flask individually
- Accurate comparison of conversion rates and yields under different conditions such as temperature, strain type, carbon source or nutrients
- Much easier to operate and clean than standard fermenter systems
- Fully controlled with user-friendly PC control and data analysis software
- Automatic generation of advanced reports containing all measured data, data analysis tables and corresponding graphs
- Very strong magnetic stirrers, able to handle very viscous media
- Proven value for research and QA purposes in all fields of yeast research and (bio)ethanol production

Typical applications of the AFM system include
- Measure conversion rates and yields of lignocellulose hydrolysates into biofuels
- Test and compare different yeast strains or different feedstock/substrates
- Quality control of regular/commercial yeast
- Quality control of traditional feedstock (such as molasses)
- Conversion of wort into beer
- Conversion of grape juice into wine
- Alcohol tolerance and toxicity studies
- Industrial and academic research on yeast and potable alcohol/bio-ethanol/bio-butanol production
Specifications

Number of fermentor flasks: 6 (250ml or 500ml Scott Duran™)
Machine size (L x H x W cm): 76 x 66 x 30
Weight: approximately 75 kg
Wetted parts materials: Stainless Steel, Delrin™, Gylon™
Power supply: 115 - 230 VAC, 50/60 Hz
Maximum power consumption: 500 W
Certification: CE
Measuring range: several ranges between 0 and 3 mmol/min.
Measuring inaccuracy: < 1%
Medium temperature range: (10 °C *) ambient - 85 °C
Medium temperature control: < 0.1 °C after calibration
Controls on enclosure: illuminated power on/off switch only
Indicators on enclosure: 3 status LEDs per channel
Ports per fermentor flask: 1 x sample, 1 x off-gas
PC communication: USB-A cable

* not standard

Since 1998 HaloteC instruments has developed and produced many innovative, fully automated measuring systems and process equipment for the life sciences industry. HaloteC maintains a large network of specialists in various fields, ranging from electrical, software and mechanical engineers to biochemical engineers and scientists. By combining a broad range of knowledge and skills, a satisfactory, if not the best, solution to any technical challenge is always found. HaloteC is at the forefront of developing new, high tech solutions for challenges encountered in the dynamic world of industrial biotechnology.