

ABSTRACTS

NIRA SYMPOSIUM

July 7-8, 1982

PLENARY SESSION I

NIRA AND ITS ADVANCES TO DATE

Although Near Infrared Analysis (NIRA) as a technique can be traced back to the late 19th century, the first commercial instrumentation (Cary 14) was made available in the mid 1950's. Significant growth in the number of NIRA instruments used did not occur until the 1978 - 1982 period. During this time, the number of units utilized has grown at an annual compounded growth rate of well over sixty per cent. This phenomenal growth rate has been caused by: a) the enthusiasm and dedication, by leading researchers, of this technology; b) the financial resources of leading companies who have been convinced of the future market potential of NIRA; and c) by progressive users of the technology who have learned that NIRA methods, when applicable, can provide solutions more conveniently and more accurately than any other means of analysis.

The number of industries presently utilizing this technology are in excess of 75 and continue to accelerate rapidly. The number of NIRA instruments installed world-wide is estimated to exceed 5,000.

Howard Volin
Technicon Industrial Systems

MID INFRARED AND NEAR INFRARED REFLECTANCE; ADVANTAGES AND
DISADVANTAGES

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ABSTRACT

Near infrared reflectance spectrometry has the main advantage that the detectors which are used are both very sensitive and operate at room temperature. The instrumentation for NIR is therefore very simple and rugged. On the other hand, mid infrared detectors are less sensitive than PbS and many have to be cooled, so that more sophisticated instrumentation is needed. Most mid infrared reflectance spectra have been measured using an FT-IR spectrometer with mercury cadmium telluride detection. Calculations will be shown to demonstrate that the use of an interferometer does not significantly improve the sensitivity of NIR measurements but is essential for good mid infrared data.

Mid infrared reflectance should allow three types of sample to be studied which are not readily amenable to NIR analysis; (a) those with minor components absorbing in spectral regions where the major components do not have strong bands; (b) samples whose overtones and harmonics are too weak to permit near infrared detection; (c) samples which are too "black" for NIR analysis. Examples will be shown for which mid infrared analysis should be useful; these include the analysis of pharmaceutical compounds, both raw materials and final products, and coals.

There are several problems intrinsic to diffuse reflectance spectrometry which appear to be more serious for mid infrared than for near infrared spectrometry. These include the nonlinearity of plots of the reflectance metric, whether this be $-\log_{10}R$ or the Kubelka-Munk function, versus concentration, the effect of particle size and packing density, and the preparation of calibration standards for accurate quantitative analysis. Each of these factors will be discussed and their effect on mid infrared reflectance spectra will be illustrated with suitable examples.

PRINCIPLES OF REGRESSION TRANSFORMS:
PULLING THE RABBIT FROM THE HAT

Tomas Hirschfeld
Lawrence Livermore Laboratory, Livermore, CA

The empirical origin of NIRA, and the rapid pace of its experimental success, has left theory quite far behind. Even more behind is the level of general understanding of this theory, in which what little has been published has been much confused by the use of several separate sets of jargon.

In actual fact, a fairly simple explanation of the workings of NIRA is possible, and it can be done in (almost) plain English. From here the working of several different schemes of data reduction, with their advantages and limitations.

The properties of the NIRA data reduction will be discussed, with particular reference to their effect on instrumental and sampling requirements. The quality of the obtainable results follow from further examination of the procedure.

REGRESSIONS & PREDICTIONS - HOW TOAVOID PITFALLS

Drs. K. Luchter & H. Mark
TECHNICON INDUSTRIAL SYSTEMS

The spectroscopic technique of Near Infrared Reflectance Analysis (NIRA) has required the use of the correlation transform, a mathematical technique of multiple regression analysis in order to generate the empirical calibration required for the success of the technique. A fact that has long been appreciated by the statistician but is only recently coming to the attention of the practitioner of NIRA is that this technique contains pitfalls that may trap the unwary. Appreciation of these pitfalls, with the ability to identify them and the knowledge of how to cope with them are important factors in generating the best calibration that can be obtained from a given data set. The traditional statistics that are generated by most correlation transform programs are useful guides in determining the course of the mathematical analysis.

GENERAL SESSION I

FOOD/AGRICULTURE

GS.1
QUALITY MEASUREMENT IN THE
PROCESSING OF AGRICULTURAL PRODUCTS

D. Wetzel
Kansas State University

Quality measurement in the processing of agricultural products begins with selection of raw materials appropriate for the desired end use. In Kansas, where over 400 million bushels of hard red winter wheat are being harvested, pride is taken in the production and delivery of "bread quality" wheat. To assure such a marketing scheme based on quality, analysis of commodities as they arrive from the field is required. At later stages of commerce, processors in milling, malting, oil seed processing, feeding, and fermenting operations need quality measurements to provide their process with an appropriate grade of raw material at the most advantageous price. Long term product development involving genetic selection may also be enhanced by providing quality measurement of successive generations of various genetic crosses.

Each individual processing scheme has key points at which selected quality factors may be monitored, allowing yield and production throughput to be maximized while maintaining quality specifications. Examples from the grain and oil seed processing industries are given, showing how quality measurements before and during processing were used to predict resulting end product quality. Rapid analysis techniques for measuring quality factors provide feedback for process control at the production foreman level, allowing optimization of efficiency, quality, and profits.

PROTEIN DETERMINATION OF WHEAT IN TRADE BY NEAR

INFRARED REFLECTANCE SPECTROSCOPY

THE IRISH EXPERIENCE

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In an attempt to encourage the sowing of quality wheat by Irish farmers, the flour milling industry introduced a new standard for milling wheat prior to the 1981 harvest. This standard specified that only wheat which, in addition to meeting existing quality criteria, contained a minimum of 9.5 percent protein at 15 percent moisture would be acceptable for milling.

A project was set up with Technicon to check the transferability of calibrations, the variability of a particular grinder which is standard in Irish Flour Mills, and the subsequent performance of the machine over the harvest period. Using six InfraAlyzers and nine grinders a detailed study for protein and moisture was carried out. Satisfactory implementation of this technique will be described.

"MULTIPLE APPLICATIONS OF NIRA
IN THE CORN WET MILLING INDUSTRY"

Grain Processing Corporation has been using Near Infrared Reflectance for a period of 2½ years. During that time, Near Infrared has proved to be a valuable solution to many analytical problems that are common to the industry.

This paper will discuss the multiple uses of NIRA within a corn wet milling plant and point out the practical benefits derived from the virtual elimination of tedious, time consuming manual procedures.

Other applications, e.g. the analysis of liquid samples such as starch slurries, syrups and fermentation samples, offer much promise to the corn miller in maintaining better control over the wet milling process.

Steven J. Poock - Grain Processing Corp.
William Bell - Technicon

FIELD MONITORING OF NITROGEN IN PLANT TISSUE BY NIRA

R. Isaac
UNIVERSITY OF GEORGIA

A new and rapid analytical technique for the determination of nitrogen in corn leaf has been developed for use by farmers in Georgia. The method involves the use of microwave ovens drying of corn leaf samples which requires approximately 10 minutes grinding of the samples in a Wiley Mill to a 20 mesh size and subsequent analysis on a Technicon InfraAnalyzer 300.

The samples used to calibrate the instrument were collected over a period of two years from various locations in Georgia. Samples were collected covering a range of 2.20 to 4.00% nitrogen in the leaf tissue. Total number of samples used was 86 and included various states of growth (i.e., young leaves, leaf below the whorl and ear leaf).

The calibration data was developed using a Technicon InfraAnalyzer 400 Plus and samples were analyzed during the 1980 and 1981 season using conventional drying techniques. The technique was field tested this year using a Technicon InfraAnalyzer 300 utilizing data constants developed on the 400 Plus at each of the 8 wavelength values. The InfraAnalyzer 300 was placed in our extension office in Colquitt County with a microwave oven and a small Wiley Mill. Samples were analyzed over a period of 6 weeks during the critical early growing period for corn. Data received from this field service test indicated that NIR can be used very successfully as an analytical tool for the determination of nitrogen content in corn leaf tissues.

GENERAL SESSION II
DAIRY/MEAT

DEVELOPMENT OF NEAR INFRARED

DAIRY ANALYSIS SYSTEM

Drs. K. Luchter & H. Mark
TECHNICON INDUSTRIAL SYSTEMS

The practical and routine use of Near-Infrared Reflectance Analysis for Dairy Application has involved breakthroughs in all aspects of NIRA technology. State of the art advances in the hardware, high pressure homogenizer, transreflectance sample cell and maximized temperature stability for sample presentation and analysis, had to be matched by state of the art implementation of sophisticated mathematical data analysis, principle component analysis, evaluation of optical data for pressure and temperature effects, as well as a new way of treating samples.

These advances were required not only for initial calibration, but also for evaluating the effectiveness of the breakthroughs made.

APPLICATION OF NIRA TO DRY DAIRY PRODUCT ANALYSIS

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Proximate data from 82 nonfat dried milk samples were correlated with near-infrared reflectance (NIR) measurements. The best wavelengths for determining constituent concentrations were chosen from 19 pre-selected filters by using linear regression analysis.

The correlation coefficient (r) was 0.971 and the standard error of prediction (SEP) was 0.274 when the predicted values (from NIR measurements) using the 3 wavelengths selected for determining moisture content were compared with laboratory values; r and SEP were 0.961 and 0.099 when the predicted values using the 4 wavelengths selected for fat content were compared with laboratory results; 0.887 and 0.594 respectively using the 4 wavelengths selected for lactose content; 0.905 and 0.438 using the 8 wavelengths selected for protein (micro-Kjeldahl) content; and 0.911 and 0.509 using the 7 wavelengths selected for protein (dye binding). These data indicate that NIR can be used to estimate the moisture, fat, lactose and protein content of nonfat dry milk.

Rapid Composition Analysis for Processed Meats

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Iowa State University

Meat is composed primarily of three components: moisture, protein and fat. Fat percentage *is* the most variable but proteins affect emulsification, product yield, color and bind values. In the manufacturing of products like frankfurters, rapid determination of the chemical composition of meat raw materials is essential to formulate a 30% fat level which will form a stable emulsion during cooking. Near infrared analysis offers the capability of rapid component analysis. In addition, quality characteristics of color and bind value of raw materials may be determined on a batch basis. These capabilities then offer the processed meats manufacturer the ability to produce a more uniform, high quality and less expensive product.

USE OF NIRA IN THE QUALITY CONTROL LABORATORY

M. Nimtze
Valley Lea Dairies, Inc.

In a dairy processing plant, the InfraAnalyzer 400D offers rapid and accurate analyses of dairy components in products through all stages of production. It is capable of analyzing within minutes instead of hours, which enables immediate adjustments to the process for product uniformity and quality requirements. In an industry where products are bought and sold on component percentages, such as fats and oils, and with talks of a new refined pricing system, only a rapid, accurate monitoring system will help maintain bottom line profits.

PLENARY SESSION II

APPLICATION OF FACTOR ANALYSIS TO NIRA

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Mathematical methods in current use in NIRA involve selecting a few (<10) wavelengths for measurement requiring high signal-to-noise (SNR) (<100 $\mu\log$ (1/ reflectance)) and a high spectral resolution (<70 Å). Factor analysis has a potential advantage since it is more robust with respect to instrument noise and spectral resolution. This robustness stems from the use of many (10-1000) wavelengths for measurement.

We will review our work, previously presented in (1-3). There are two main results: first, that with high SNR, high resolution spectra of ground wheat, factor analysis gives results comparable to derivative and regression methods; second, that with mathematically degraded SNR or resolution, factor analysis gives better results. Preliminary studies on barley and cereal amino acids will also be described.

The kind of factor analysis implemented here is called principal component analysis, The method is described in (1), and we repeat that description here.

The matrix of a set of spectra (Y) is factored into a loading matrix (L) and a score matrix (S).

$${}_{nw}Y_{ns} = {}_{nw}L_{nc}S_{ns}$$

where nw = number of wavelengths, nc = number of components, and ns = number of samples. The columns of the loading matrix are orthogonal with Euclidean lengths equal to the eigenvalues of $({}_{ns}Y_{nw}^T Y_{ns})$ arranged in descending order. (T denotes matrix transpose.) The rows of the score matrix are orthonormal. (Geometrically, the loadings are artificial spectra which span the same space as the sample spectra with the nice feature that each loading takes out a maximum amount of spectral variance while being independent of preceding loadings.) The first few loadings are used to give

$${}_{nw}Y_{ns} = {}_{nw}L'_{nl}S'_{ns} + {}_{nw}E_{ns}$$

where nl = number of loadings used, E = error matrix, and (') denotes a submatrix. Protein content is multilinearly regressed against the scores, giving a calibration equation and a standard error of calibration. A set of scores (S') corresponding to a prediction set of samples (y) is obtained by the equation

$$({}_{L'}T_{L'})^{-1} {}_{L'}T_Y = S'$$

where (-1) denotes matrix inversion.

These are then used with the calibration equation to predict the protein content of the set of samples (y) giving a standard error of prediction (SEP).

REFERENCES:

1. Abstract No. 375, Principal Component Analysis Predicts Protein and Moisture Content From Near Infrared Spectra of Ground Wheat. Harald Martens and William R. Hruschka. In Abstracts 1982, Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy, March 8-13, Atlantic City, New Jersey.
2. Fractioning Barley Proteins by Computer Factor Analysis. Harald Martens and Knud Erik Back Knudsen. Presented at the 5th International Congress of Food Science and Technology, Kyoto, Japan, September 1978.
3. Factor Analysis of Chemical Mixtures. Non-negative Factor Solutions of Cereal Amino Acid Spectra. Harald Martens. Presented at the International Conference on Computers and Optimization in Analytical Chemistry, Amsterdam, Holland, April 1978.

FAST CORRELATION TRANSFORMS IN SCANNING NIRA

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Approximations to multi-linear regression mathematics such as those embodied in stepwise regression have proven invaluable in reducing the computation time necessary for finding correlations with NIRA filter instruments. As NIRA investigations move toward the use of scanning instruments, the increased number of observed spectral intervals will demand even faster methods of data treatment. It can be estimated that conventional NIRA algorithms applied to entire spectra would require computational times from hours to even days.

Scanning NIRA has another undesirable side effect besides increased computational time; it reduces the significance of the correlation coefficient (r value) as a measure of goodness of fit. This loss occurs because the large number of wavelength combinations which are tested increases the probability that random sample or spectral fluctuations will appear to correlate.

A technique will be presented which provides some degree of relief from these potential problems of scanning NIRA. This mathematical procedure, called row-reduction, results from the simple application of linear algebra to the regression equation. This linear algebra solution is more properly called a transform for reasons which will be shown. Computational time, the ability to avoid overfitting and compromises in accuracy produced by the new algorithm will be discussed.

NIRA INSTRUMENTATION-STATE-OF-THE-ART

Ed Stark
Technicon Industrial Systems

Near Infrared Reflectance Analysis (NIRA) instrumentation has developed from the early 1st generation analog instruments through 2nd generation microprocessor based systems. Several thousand units are in routine use in the field. Most of these units use narrow band interference filters to generate the required monochromatic light, although a limited number of 1st generation scanning monochromator units are in use, primarily in agricultural applications such as forage analysis.

The extension of NIRA to new applications in both food processing and other industries, for example chemicals and textiles, has increased the requirements for instrumental performance and flexibility. This need has led to the development of the second generation scanning monochromator based instrument, the InfraAlyzer 500.

This paper reviews the hardware and software requirements imposed by NIRA. The needs for research, methods development, and routine use are analyzed. The technology tradeoffs and the rationale of instrument design are discussed.

The design, performance and features of the InfraAlyzer 500 are described to illustrate the state-of-the-art of the most sophisticated and most versatile NIRA instrumentation. The 500S spectrophotometer discussion covers source optics, the monochromator, detection optics, sample presentation, signal processing, and the software features for stand alone operation.

Research and methods development require additional computational power and operator interaction. The InfraAlyzer data analysis system (IDAS) hardware and software are described.

NIRA: WHERE DO WE GO FROM HERE

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As NIRA Becomes more widespread, some discussion of its further possibilities seems warranted. Probably the most important growth area of NIRA is its steady expansion into the industrial analytical field. This not only has widened the field, creating economies of scale for the technology, but also has created new demands on the technique. The most important of these is a need for rapid methods development, which has led to a number of new experimental and data reduction procedures. Faster procedures have also been developed for methods evaluation. Other new procedures aid in qualitative interpretation of the chemical basis of measurable sample properties, and yet others may allow far simpler operating methods for dealing with spectroscopically simple samples.

The future evolution of the instrumentation will lead to even faster machines, and relaxed as well as more adaptable sampling. We have only begun to tap the growth potential of NIRA.

GENERAL SESSION III

FOOD PROCESSING

THE ADVANTAGES OF NIRA
FOR FOOD PROCESS CONTROL AND QUALITY ASSURANCE

G. Streeter
Kellogg Company

It is the desire of every quality control manager to have at his disposal a rapid, accurate means of analyzing the critical component that will exert the greatest influence on the quality and cost of his finished product. While no one type of equipment holds all the answers, NIRA is proven to be a valuable tool in many areas. In raw material acceptance, the accuracy and speed of NIRA allows a better balance between specification compliance, costs and good vendor relationships. In processing and shipping, NIRA allows a better balance between costs, quality and pounds produced because it allows more frequent monitoring and faster recognition of out-of-standard products. Additionally, NIRA technology is proving useful in making equipment and image adjustments and in shifting the responsibility for quality to those with the greatest opportunity for building in product quality. Could NIRA technology be a valuable tool for you?

FROM FLOUR QUALITY MEASUREMENTS TO BAKING QUALITY
MEASUREMENTS - ANOTHER EXTENSION OF NIRA TECHNOLOGY

The prediction of flour parameters such as protein, moisture and ash by NIRA is well documented and an established practice. The determination of baking quality parameters is much more difficult, since various laboratories may differ in their evaluations of quality. Therefore, good initial quality measurements may be difficult to obtain. No single parameter is independently responsible for baking quality. Protein content is important to baking quality but the quality of the protein present can only be predicted by monitoring flour absorption, dough mixing time, loaf volume of bread produced from that flour under standard conditions, and the dough handling characteristics of that flour. Fifty-two samples which varied in all the above parameters were used as a calibration set to predict baking quality. Samples were calibrated in both the dry flour, in flour-water doughs, and in slurries. A nineteen wavelength Technicon 400 NIRA instrument was utilized in this study. In each case (measuring mixing time, loaf volume, water absorption, and loaf volume corrected to constant protein content) the correlation coefficients increased when samples were measured in doughs instead of dry flours. The ramifications of these calibrations will be discussed.

Bernard L. Bruinsma
USDA-Manhattan, Kansas

THEORETICAL BASIS FOR THE ANALYSIS OF FATS & OILS BY NIRA

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Fats and oils are water insoluble substances which mainly consist of glyceryl esters of fatty acids, or triglycerides. Due to the incorporation of long chain fatty acid radicals which also contain reactive sites in the glyceride molecule, the chemical and physical properties of a fat are determined mainly by the properties of its component fatty acids. Natural edible crude oils/fats contain phospholipids, glycolipids and other unsaponifiable matters. During the processing of crude oils to obtain neutral oils for consumer consumption by the pretreatment with acid, base and aluminum oxide, many of these materials are removed. Neutral oil loss (NOL) occurs due to removal of acidic, basic and peroxidized oils and fats.

Measurements of oils/fats are important for several reasons. For instance, (i) fat content in meat is regulated by the U.S.D.A., (ii) fat analysis in dairy and oil measurements in vegetables and seed form the basis of all payment schemes.

The InfraAnalyzer, which utilizes the principle of NIRA measurement has become established as a simple, rapid and effective tool for the routine analysis of fats/oils from a wide variety of sample matrices. Potential applications of InfraAnalyzer for the measurement of oil/fat components will be discussed.

ANALYSIS OF HYDROGENATED SOYBEAN OIL BY NIRA PRELIMINARY REPORT

J. Bahl

Technicon Industrial Systems

Iodine Value (IV) and Solid Fat Index (SFI) are important analyses for controlling product quality and behavior of hydrogenated soybean oil. Preliminary development work on rapid analyses of both Iodine Value and Solid Fat Index by Near Infrared Reflectance Analysis will be discussed. Samples are pre-heated to 65°C in a dry air oven or circulating water bath, and 5ml. is injected into a 65°C liquid drawer for NIRA analysis. Results for both parameters are obtained in less than 90 seconds.

PREDICTING THE DEGREE OF GELATINIZATION
IN PROCESSED FOOD INGREDIENTS BY NIRA

J. Psotka
TECHNICON INDUSTRIAL SYSTEMS

The ability to accurately measure the amount of thermal processing which a food product has received has been a source of interest to food processors for many years. Estimation of degree of cook or degree of gelatinization has been made using chemical and physical measurements which are usually too time consuming or expensive to be of practical value for process control purposes. The use of NIRA has been shown to be a useful tool in estimating the degree of gelatinization in extruded cereal products based on correlation to physical tests. Current investigations are studying correlations to chemical and optical properties in flaked (rolled) cereal grains - specifically glucose availability and optical birefringence. This paper presents an overview of work currently in progress in the bases for the investigation.

GENERAL SESSION IV

INDUSTRIAL

QUANTITATIVE AND QUALITATIVE
ANALYSIS WITH NIRA

The InfraAlyzer 400 has been used to assay synthetic solutions of Diatrizoate Meglumine for both meglumine and meglumine diatrizoate content. Calibration of the instrument was performed using gravimetrically prepared solutions. Prediction models were selected from those chosen by an All Possible Regression procedure. Models for both meglumine and meglumine diatrizoate were developed, permitting the simultaneous determination of both components.

An approach to qualitative analysis using Near Infrared Reflectance Spectroscopy and Discriminant Analysis has been developed. Two sets of closely related compounds, one consisting of penicillins and the other of radiopaque contrast agents, were successfully distinguished from one another using this technique. Additional substances chosen at random were also subjected to the treatment and were successfully discriminated.

Near Infrared Reflectance Spectroscopy shows great promise as a rapid method of simultaneous multi-component analysis. Coupled with Discriminant Analysis, the technique is a powerful tool for identifying substances rapidly and objectively without the need for spectral interpretation.

J. Rose
E.R. Squibb

THE USE OF MODELING IN NIRA
METHODS DEVELOPMENT

J. Mardekian
Janssen Pharmaceutica

Each of the 19 filters in an InfraAnalyzer allows a reflectance measurement of the sample to be made at a specified wavelength. Based upon data generated from a calibration, one must choose an "optimum" subset of these 19 filters, which are specific for the particular constituent of interest to be utilized in subsequent sample predictions. This model selection process can be readily accomplished via two statistical software packages, Statistical Analysis System and BMDP Biomedical Computer Programs. These two, easy-to-use packages are available at most computer installations. The model selection techniques they offer will be discussed.

THE USE OF FOURIER TRANSFORMATIONS IN NIRA OF
TOBACCO AND OTHER AGRICULTURAL PRODUCTS

By: W. F. McClure, North Carolina State University
F. G. Giesbrecht
W. W. Weeks

We have demonstrated that trigonometric polynomials can be used to approximate visible and near infrared spectra of agricultural products which are obtained with dispersion-type instrumentation. Advantages of this technique include:

1. Reproduction of the spectra from as few as 50 pairs of Fourier coefficients.
2. Filtering of random noise without the loss of end points of the spectra.
3. Reduction of storage requirements both in the computer and on magnetic media.

The latter is extremely important where microcomputers are used to control the spectrophotometer, as well as process spectral data. We have also found that certain chemical constituents in agricultural products can be estimated from the magnitude of the Fourier coefficients. Furthermore, since most of the spectral information is at the low frequencies, the customary process of wavelength selection can be eliminated by simply choosing the first few coefficients. Consequently, the time required to compute a calibration equation is drastically reduced. Both theory and experimental data will be discussed.

WFM:ls

NIRA - POSSIBILITIES IN A CONTINUOUSPROCESS INDUSTRY

J.PETERS

DEVRO LIMITED, SCOTLAND

The normal business pressures to increase production efficiency and minimize costs sometimes appear far removed from the analytical R and D Laboratory. The considerations for the transfer of "Black Box" NIR instruments from laboratory to the environment associated with a continuous food processing factory will be presented.

The evaluation history of such an NIR instrument against classical wet chemical analysis and previously introduced rapid analytical techniques for protein, polyol and oil content will be described. The importance of solid sample preparation and instrument calibration will be highlighted.

The decision taking process of initial selection of analysis, staffing implications, accuracy and speed of analysis and consideration of some cost concepts will be outlined. The benefits in increased efficiency and product quality accruing from on the spot analysis are noted.

The opportunities for future NIR techniques for both solid and liquid samples, with possible "in line" processing will be mentioned.

"FAST OH NUMBER - DETERMINATION
FOR PROCESS CONTROL"

T.P. Byron
TECHNICON INDUSTRIAL SYSTEMS

Since its inception Near Infrared Reflectance Analysis has been traditionally used to investigate the chemical composition of grains and processed foods. It would be short sighted on our part to limit our investigation only to these areas.

During the chemical manufacturer of polyols, and more specifically polyethylene glycols, a control parameter that monitors the degree of polymerization is the "OH" number. The manual analysis for "OH" number is a timely and arduous procedure which may lag hours behind the actual production of product.

By employing the use of Near Infrared Reflectance Analysis, timely, accurate and precise analytical results for "OH" number and other constituents can be obtained and subsequently used as an effective process control tool.

PROGRAM CHANGE

THURSDAY. JULY 8TH

FOOD-PROCESSING

GS.10 CHANGED TO:

'REVIEW & CURRENT STATUS OF BAKING QUALITY
PARAMETERS RELATED TO NIRA'

D. WETZEL, KANSAS STATE UNIVERSITY

WELCOME TO TECHNICON'S 2ND ANNUAL NIRA SYMPOSIUM

ON WEDNESDAY NIGHT AT 5:00 PM THERE WILL BE A COCKTAIL PARTY IN THE TERRACE DINING ROOM AT TECHNICON.

ARRANGEMENTS HAVE BEEN MADE TO HAVE THE MARRIOTT BUS TAKE YOU TO TECHNICON, THE BUS IS SCHEDULED TO LEAVE FROM THE FRONT OF THE MARRIOTT AT 8:40 AM AND 8:55 AM, TRANSPORTATION WILL BE ARRANGED FOR YOUR RETURN.

DON'T FORGET TO MAKE ARRANGEMENTS FOR YOUR TRANSPORTATION BACK TO THE AIRPORT.

WE ARE LOOKING FORWARD TO AN EXCITING AND INFORMATIVE SYMPOSIUM!