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JPRS L/8286

23 February 1979

USSR

TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 7/79)

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BIOCHEMISTRY

UDC: 681.2

INSTRUMENTS FOR THE STUDY OF BIOPOLYMERS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 12, 1978 pp 11-22

[Article by V. A. Pavlenko]

[Text] The presidium of the USSR Academy of Sciences [AS] considered the question of progress in fulfilling the plan of development of instruments for the study of biopolymers. A report was delivered by V. A. Pavlenko, doctor of engineering sciences, director of the Institute of Analytical Instrument Making.

Report of V. A. Pavlenko

The designing organizations of the USSR AS are developing various instruments which, according to the classification of the Council for Scientific Instrument Making under the Presidium of the USSR AS, are referable to about 25 directions of instrument making.

Instruments in virtually all of these directions are used in all areas of natural and engineering sciences. The vast majority of instruments is also used for biological studies, including the study of composition, structure and properties of biopolymers.

Intensive use of complex instruments began much later in biology than, for example, in chemistry. Evidently, this is attributable, on the one hand, to the status of research and, on the other hand, the lag in instrument building and impossibility of meeting the specific requirements of biological investigations without appropriate scientific research and experimental design work.

Steps were taken to expedite development of instrument production for biological research. As a result, in 1975-1977, enterprises under the Ministry of Instrument Making, Automation Equipment and Control Systems set up the production of instruments referable to 22 titles, and have produced 478 instruments. Production of 8 types of instruments has been set up in the AS, at the experimental plant (131 instruments were manufactured).

At the present time, high resolution EPR [electron paramagnetic resonance] and NMR [nuclear magnetic resonance] radiospectrometers, optical spectrometers, other optical instruments and microscopes, x-ray diffraction and roentgenospectral analysis instruments, electron, gamma resonance and mass spectrometers, instruments that use synchrotron radiation, electron microscopes and electronographs, liquid and gas chromatographs, electrochemical instruments, electrophoretic instruments, ultracentrifuges, sequencers ["sekvenator"] and synthesizers of proteins and peptides, calorimeters and thermal analysis instruments, automatic biochemical analyzers, special equipment for microbiology, physiology and cytology, laboratory equipment, instruments and devices of small-scale mechanization and automation are being used in biology.

Not all groups of instruments are used equally extensively, the degree of development of instruments and organization of series production thereof also are different.

In organizations under the Scientific and Technical Association of the USSR AS, the expenses incurred for development and production of instruments (mainly analytical) for chemistry and biology are growing constantly (Figure 1).

The interagency scientific and technical council for problems of molecular biology and molecular genetics, under the supervision of Acadmician Yu. A. Ovchinnikov, prepared the program "Micromethods in Protein Chemistry." The Institute of Bioorganic Chemistry imeni M. M. Shemyakin, Institute of Protein, Institute of Molecular Biology, Institute of High Molecular Compounds, Novosibirsk Institute of Organic Chemistry, Institute of Analytical Instrument Making and the design offices of the USSR AS participated in preparing this program.

The program provides for the execution of 13 methodological projects by scientific research institutes and development of 17 new, modern instruments for biochemical investigations.

Of the 17 instruments listed in the program, 12 must be developed at the Institute of Analytical Instrument Making and one each at the SKB [special design office] of Biological Instrument Making, Novosibirsk Institute of Organic Chemistry and Leningrad Opticomechanical Association; 2 instruments must be designed at the SKB of biophysical equipment.

Additional targets were included in the program at the instigation of the Institute of Analytical Instrument Making of the USSR AS: development of a device for connecting a liquid chromatograph to a mass spectrometer, designing an attachment with chemo-ionization for the current series-produced mass spectrometers, development of optical and membrane instruments, as well as automatic pipettes with regulated contents.

The new objectives caused substantial changes in the structure of work of the SKB of Analytical Instrument Making.

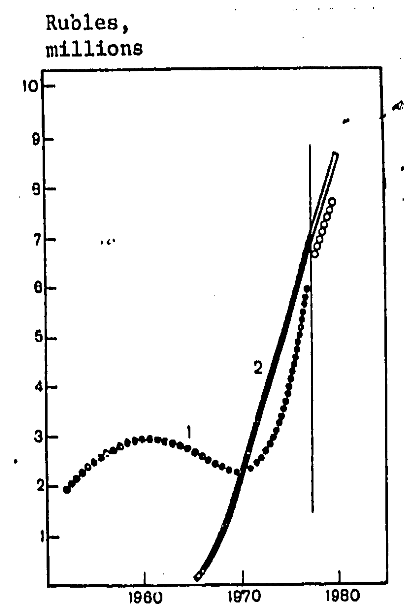

Figure 1.
Growth of expenses for development and production of instruments in organizations under the Scientific and Technical Assocation of USSR AS
1) instruments for chemical studies
2) instruments for biological "

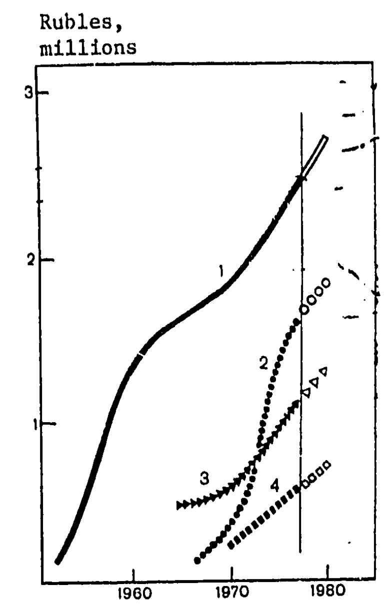

Figure 2.
Expenses for development and production of different types of instruments
1) mass spectrometers
2) chromatographs
3) radiospectrometers
4) data processing systems

There has been a significant increase in share and rate of development of work dealing with liquid chromatography (Figure 2). In this regard, there is an interesting forecast of development of some branches of scientific instrument making in the United States. The projected annual rate of growth in production of instruments, as listed in the Table, indicates that development of instrument making from chromatography is also ahead of development of other branches of instrument making.

It is difficult to discuss all groups of instruments used to study biopolymers, or even instruments developed for this purpose at the USSR AS. For this reason, we shall consider the most important directions of work within the framework of the "Micromethods in Protein Chemistry" program.

First, a few words about liquid chromatography instruments. As we have already stated, liquid chromatography is one of the important methods of studying biopolymers.

Rate of growth in instrument production in the United States, %

Types of instruments	1976/1975	1979/1976	Annual mean for 1976–79
Chromatographs:	11.9	44.7	14.0
gas	11.5	31.0	10.3
liquid	12.5	66.7	22.2
Instruments for spectral analysis:	9.5	21.3	7.1
spectrophotometers	10.2	21.0	7.0
spectrofluorometers	4.2	20.0	6.7
spectropolarimeters	5.3	50.0	16.7
Mass spectrometers	8.9	27.9	9.3
NMR spectrometers	7.8	24.6	8.2
Electron microscopes	8.9	27.5	9.2
Heat analyzers	7.9	36.8	12.3
X-ray equipment	11.0	31.6	10.5
Other equipment	6.0	17.6	5.9

The lag of liquid chromatography, as compared to gas chromatography, was due primarily to the absence of needed sorbents. It is only in the last few years, thanks to the work done at the Institute of Silicate Chemistry, USSR AS, did macropore glass appear, with controllable pore size, as well as porous silica gel, which was developed at Moscow University. However, even these sorbents are not being produced on an industrial scale.

Moreover, highly sensitive gages of concentrations of substances in liquid media--detector systems--are needed for the successful development of liquid chromatography. Optical measurement instruments serve as such systems: photometers, refractometers and spectrophotometers. For example, the autonomous refractometers produced by industry a few years ago had a sensitivity of only 10^{-4} refraction units with about a 1 mℓ size of optical nonflow-through cells. This by no means meets the demands of liquid chromatography.

In 1972, in developing liquid chromatographs for analysis of synthetic polymers, the refractometer sensitivity was raised to $2 \cdot 10^{-7}$ refraction units with optical cell size of 15 μℓ. As converted to proteins, these instruments had a sensitivity of 500 ng. This group of instruments includes the KhZh1304 liquid chromatograph developed in 1976. It is intended for analysis of a wide range of substances, including polymers. The sensitivity of this instrument is $1 \cdot 10^{-7}$ refraction units and that of the spectrophotometer, $4 \cdot 10^{-4}$ units of optical density. The size of the sample to be analyzed is 0.25 mℓ substance. This instrument permits analysis of proteins with a sensitivity of refractometric measurement of 240 ng, or $3 \cdot 10^{-12}$ mole of albumin.

Such features of the optical detectors, combined with an operating mode at a pressure of 200 atm, provide for high-speed analysis. Figure 3 illustrates the molecular and mass distribution of polystyrene standards which is obtained in 25 min.

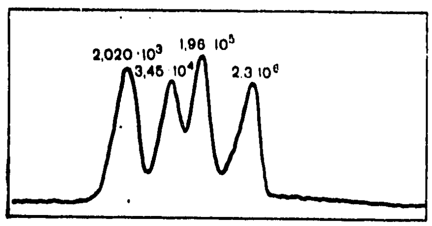

Figure 3.
Molecule and mass distribution of polystyrene standards, obtained on KhZh1304 chromatography (refractometer $\Delta n = 10^{-7}$, analysis time 25 min)

Development of microcolumn liquid chromatographs was an important step in development of liquid chromatography in application to analysis of biopolymers. In 1975, the Novosibirsk Institute of Organic Chemistry, Siberian Branch of the USSR AS, and the SKB of Analytical Instrument Making designed the KhZh1305 chromatograph, and in 1976 a functional model of the Ob' chromatography was built at the Novo-Novosibirsk Institute of Organic Chemistry. Capillary columns 0.5-1 mm in diameter are used in these instruments, and this made it possible to reduce the size of samples to 4 μℓ. This is the first time that such parameters were reached anywhere in the world.

It was necessary to develop special spectrophotometers for instruments in this group, with sensitivity of $4 \cdot 10^{-4}$ units of optical density, that operate in the range of 200 to 600 nm with 1 μℓ optical cells. Spectrophotometers of this type have no equal abroad. These instruments permit analysis of proteins with a sensitivity of about 15 ng sample, or $2 \cdot 10^{-13}$ mole of albumin.

A standardized set of microcolumn liquid chromatographs, unequaled abroad, has been developed and is being manufactured. It is based on unification of all units, blocks and parts, and it can replace five microcolumn liquid chromatographs for analysis of amino acids, PTH [phenylthiohydantoin] and DNS [dansyl] derivatives of amino acids, peptides and proteins.

The standardized set of chromatographs includes glass and metal columns of different length, syringe type pumps, devices for smooth change in composition and concentration of solutions (gradient devices). For the first time, a spectrophotometer, fluorometer for analysis of DNS-derivatives of amino acids and a highly sensitive laser refractometer have been included in this set.

The size of samp s used with this instrument is 1 μℓ. Spectrophotometric measurement with the new chromatograph is 3 times more sensitive that existing ones (5 ng protein, or $0.8 \cdot 10^{-13}$ mole albumin).

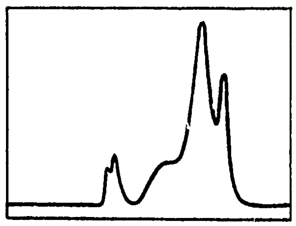

Figure 4.
Chromatograph of 2% urease solution obtained on a KhZh1307 chromatograph (analysis time, 12 min)

Work has also been completed on development of the highly efficient KhZh1307 liquid chromatograph. The columns of this instrument are 2.4 and 8 mm in diameter; macropore glass is used as sorbents. The instrument operates under pressure of 200 atm and permits rapid separation of proteins within 15-20 min, using samples of 1 μℓ. Figure 4 illustrates the chromatogram of urease, obtained on the KhZh1307 chromatograph in 12 min.

The KhZh2301 radiochromatograph, presently being developed, is of great interest. This instrument combines all types of chromatography: microcolumn, high pressure and preparative (using an additional photometric detector). A scintillation radiometric detector with flow-through cells serves as the base of the instrument. The original design of the detector, with the use of scintillating quartz, makes it possible to avoid mixing the samples with liquid scintillators, as is the case in foreign instruments. The sample is preserved in the preparative mode of operation, and this is particularly important in the synthesis of biopolymers. The sensitivity of the radiometric detector is at least $1 \cdot 10^{-6}$ Ci at the peak, when measuring a low-energy isotope (tritium).

The KhZh2301 chromatograph is an automatic instrument. In addition to data processing, the control computer provides for an optimum mode of gradient elution in the course of an analysis, according to the signals of the radiometric and photometric detectors, as well as correction of the previously set elution curve and control of microfraction collector.

Many design and technological problems were solved with the development of chromatographs: all-glass precision optical cells, aspherical mirrors, various stable pumps operating under pressure of 20-200 atm, batchers for a large number of samples measuring several microliters, various miniaturized devices (in particular, 200 atm valves, with the use of pair of leukosapphires--stainless steel, processes with high precision), manufacture of a radiometric detector of scintillating quartz, new materials have been used, etc.

Optical gage converters are of exceptional importance to liquid chromatography. At the initiative of the Council for Scientific Instrument Making and the Institute of Analytical Instrument Making, new types of refractometers are being developed at this institute: photometer-refractometer and fluorophotorefractometer. The new optical instruments are build in accordance with an original, patentable measuring system, based on measurement of the duration of an electric pulse proportionate to the angle of deflection of a flux of light. The angle of deflection is related to the index of light refraction by the liquid in the measuring cells of the instrument. The new system precludes the main flaws of refractometers build on the basis of the classical scheme, and it permits analysis of proteins with a sensitivity of 0.5 ng, or $5 \cdot 10^{-15}$ mole albumin. For the first time anywhere, it is possible to use one instrument, on the basis of one optical cell, to concurrently take measurements by the refractometric, photometric and fluorometric methods.

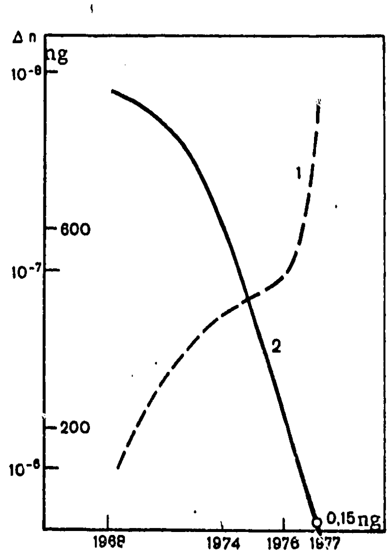

Figure 5.
Increase in sensitivity of chromatographs
1) according to "komprontatsiya" [typo for concentration?] of substances in liquid media
2) according to assay of protein in sample

The world's first laser refractometer, designed for liquid chromatography, was developed at the Institute of Analytical Instrument Making. This instrument, with an optical cell size of under 1 μℓ, permits bring the sensitivity of chromatographic assay of protein concentration to 0.1 ng, or $1 \cdot 10^{-15}$ mole albumin.

In conclusion of the survey of this group of instruments, it can be stated that their sensitivity has increased significantly in the last few years; for example, the sensitivity of optical detectors, in particular refractometers, has increased by a factor of 10^2, from 10^{-6} to 10^{-8} refraction units, while the sensitivity of chromatographic instruments increased by a factor of 10^4, according to amount of protein analyzed in a sample, and it now makes it possible to assay levels of up to 0.15 ng, or $2 \cdot 10^{-15}$ moles albumin (Figure 5).

Let us now consider another group of instruments. In 1970, the SKB of Analytical Instrument Making developed the first Soviet sequencer, an instrument designed to determine the sequence of amino acids in proteins. The instrument is on a par with foreign models of that time. However, neither our sequencer, nor analogous foreign instruments lived up to expectations. The American company, Beckman, which continued work in this field, produced a refined version of the sequencer, the Sequenso, in 1972, which has found broad use in the entire world; in particular, it is used in laboratories of the Institute of Bioorganic Chemistry, Institute of Protein and Moscow State University. We were faced with the task of developing a new Soviet sequencer for protein and peptides.

At present, a new instrument for determination of amino acid sequences has already been developed. The AP-02 sequencer is superior to foreign models in capabilities, and in particular it is better than the latest sequencer of Beckman Company. All stages of the process of protein degradation by the method of Edman can be conducted on it, including conversion of thiazolines into PTH derivatives of amino acids, as well as determination, for the first time in worldwide practice, of the amino acid sequence of proteins by the dansyl method, with yield of DNS derivatives of amino acids. The programmer in the instrument makes it possible to run all operations in any sequence and any combination, and provides for 100 cycles of degradation.

From the standpoint of technology, the all-glass revolving reactors for sequencers are of interest. Their inside surface is processed with a precision of up to 2 μm, and breakage during rotation of the reactor does not exceed 10 μm.

The complexity of objects such as biopolymers makes it necessary to conduct combined studies of their properties with the use of instruments with different operating principles. It is quite important for the experiment not to be interrupted by intermediate manual operations. In the new sequencer, successive separation of amino acids, proteins and peptides is automated. The use of the sequencer and liquid chromatograph together makes it possible to identify the separated amino acids.

It is known that mass spectrometry yields important information about the structure of molecules. Soviet scientific instrument making resources include some original instruments that combine mass spectrometry and gas chromatography techniques. Several years ago, the Institute of Chemical Physics and SKB of Analytical Instrument Making developed a chromato-effusion-mass spectrometer. This instrument is being produced in series. A chromato-effusiometric attachment, the commercial production of which has also been set up, is used in the new general purpose mass spectrometer set.

At the present time, investigation of biopolymers by methods of mass spectrometry involves complicated manual operations to prepare the sample: converting the substance to a volatile state. For this reason, it is very important to create an instrument complex that combines a liquid chromatograph and mass spectrometer.

The Institute of Chemical Physics, Institute of Bioorganic Chemistry and Institute of Analytical Instrument Making developed together an experimental connecting device. We hope that this device will be refined in the very near future and that use thereof will enrich substantially the instrumentation capabilities for studying biopolymers.

The use of a radio-frequency mass spectrometer is of interest to physiological investigations; it permits demonstration of gas components--oxygen, nitrogen and carbon dioxide--directly in blood and tissues of a live object.

Gas passes from blood into the mass spectrometer through a gas-permeable film made of synthetic rubber, stretched over a metal capillary that is inserted in the lumen of an injection needle. The gas samples constitute 0.1 μℓ/s, and accuracy of assay is 0.2 vol.%. The instrument operating speed makes it possible to determine the dynamics of change in concentration of gaseous components dissolved in blood.

The program entitled "Micromethods in Protein Chemistry" provided for the development of electrophoretic instruments, which are also very important to the study of biopolymers.

Four types of electrophoretic instruments were developed at one of the enterprises of the Ministry of Instrument Making, Automation Equipment and Control Systems. An instrument for capillary isotachophoresis, the operating principle of which is based on separation mixtures of substances according to motility of ions, was developed by the SKB of Analytical Instrument Making and is being produced in small batches.

However, with all the diversity of electrophoretic techniques and instruments, the situation is not good in this area of instrument making. Unfortunately, we must state that series production of electrophoretic instruments has not been set up by the USSR Ministry of Instrument Making, Automation Equipment and Control Systems.

The manufacture of ultracentrifuges has not been set up either. The SKB of Biophysical Equipment developed several models of preparative ultracentrifuges operating at 40,000, 50,000, 60,000 and even 65,000 r/min. These instruments are on a par with modern instrument making. But while the plan calls for the manufacture of 40 UTsPZ-47 ultracentrifuges operating at 50,000 r/min in 1978, it calls for only 3 of the more sophisticated preparative UTsP-65 ultracentrifuges operating at 65,000 r/min.

The UTsA-10 (60,000 r/min, 3 systems of optical detection, stabilization of temperature to 0.1°C and rate of up to 0.2%) and the UTsA-KM analytical centrifuge (68,000 r/min, 2 systems of optical absorption detection, stabilization of temperature to 0.05°C and rate to 0.1%) have been developed by the SKB of Biophysical Equipment. They are not inferior to foreign models in their specifications, but they are not yet in series production.

The Burevestnik Scientific and Industrial Association [NPO] is collaborating closely with the Institute of Crystallograph, USSR AS, in the field of x-ray equipment for the study of biological substances. In particular, they developed an original automatic 3-channel DAR-UMB difractometer, which operates 2-3 times faster than foreign models and yields very precise angular measurements for several years, and it is used to examine the structure of biological monocrystals. This instrument is in series production, and it is in use in the institutes of the USSR AS.

Through the joint efforts of the Burevestnik NPO and Institute of Crystallography, the DARK-2 automatic x-ray difractometer was developed, with a coordinate detector, also intended for examination of biological monocrystals. This instrument has 512 channels and permits simultaneous recording of hundreds of reflections, so that its productivity is 40-60 times higher than that of other difractometers. At the present time, series production thereof is being set up.

We cannot fail to discuss such an issue as laboratory instruments and equipment, means of mechanization and automation of laboratory work. We refer to small and, in most cases, simple laboratory equipment: all sorts of mixers, vibration instruments, shakers, drying devices, incubators, refrigerators, dishwashers and laboratory glassware.

The situation is the worst with respect to laboratory glassware and devices.

The USSR Ministry of Instrument Making, Automation Equipment and Control Systems developed numerous instruments, but not all of them by far are being manufactured. Even glass of the required grades is not being produced. Instrument making is experiencing exceptional difficulties with calibrated tubes and capillaries, for example, the SKB of Analytical Instrument Making is compelled to produce thousands of calibrated tubes for radiospectrometers. The required sets of tubes for fraction collectors are not being produced, etc.

The Ministry also developed glass columns for chromatographs; however, industrial production of these columns has not been set up. Nor are there enterprises that could fill the columns with appropriate sorbents and produce them in ready form.

Until recently, membrane instruments and dose-dispensing pipettes, urgently needed in biological studies, were wanting. These small and simple devices were imported.

At the present time, the SKB of Analytical Instrument Making has developed and is manufacturing sets of FM-01 membrane filters (about 200 per year) and synthetic membranes of different types with specific mesh sizes. These instruments are not inferior in quality to those manufactured by the Amikon firm, and they are several times less expensive. At the present time, fine-channel and fiber filters of the membrane type are being developed, and they are intended for purification, separation, concentration and desalination of biopolymers. Evidently, membrane chromatographs based on thin-channel multimembrane filters will be developed in the near future.

The SKB of Analytical Instrument Making and SKB of Biological Instrument Making have developed sets of pipettes to handle samples of 2 to 1000 μℓ. Production thereof is being set up at the present time.

It is necessary to prepare a clearcut nomenclature of laboratory instruments, equipment and means of automation and mechanization of laboratory work, as well as to prepare a plan for developing and learning to use them. The

USSR Ministry of Instrument Making, Automation Equipment and Control Systems should devote special attention to development of production of laboratory equipment and particularly glass goods.

In 3 years, the executors of the "Micromethods in Protein Chemistry" program have performed an enormous amount of work in the field of instrument making, and much of this work is original.

Implementation of the program stimulated development of instrument making, not only for the study of biopolymers, but for other branches of science, and it was instrumental in universalization of the instruments that were developed.

In the future, one should continue to develop goal-oriented programs for the main directions of research. Implementation of such programs could be particularly effective within the framework of the Scientific and Technical Association of the USSR AS.

Discussion of Report

Academician Yu. A. Ovchinnikov pointed to the great importance of instrument making to development of physicochemical biology. This branch of science is presently exercising an appreciable influence on medicine, agriculture and several branches of industry. In particular, breeding genetics and the microbiological industry are making wide use of methods of physicochemical biology.

Biologists are faced with the task of submitting the components of living matter to comprehensive analysis. Extremely refined and precise equipment is needed for this. Our instrument makers have made considerable strides in the last few years. For example, an extremely sensitive microspectrophotometer was developed, with a detector, for analysis of products of vital functions; a Soviet sequencer was also developed, which permits demonstration of amino acid sequences in protein within a very short time and using very small samples.

X-ray methods and electron microscopy are used to determine the spatial structure of substances. These methods make it possible to observe functioning molecules, to determine the coordinates of atoms in a molecule, etc. Such instruments have also been developed in our country.

The use of laser technology is quite promising for biological research.

A very important step has been taken: unique instruments have been developed, which are on a par with the best models in the world. Now we must set up series production of new equipment.

Academician A. M. Prokhorov observed that physicists also use instruments that have been developed at the Institute of Analytical Instrument Making for biology and, of course, they are developing their own equipment. However, on the whole, instrument making is somewhat behind at physics institutes. Physicists have an acute need for instruments to examine microprocesses, equipment for molecular epitaxy and scanning electron microscopes.

Recently, instruments needed for both physical and biological research began to be produced at the Institute of Radio Engineering and Electronics and Institute of Crystallography. The work of existing design offices should be so organized as to have them service more than their own branch of science.

Of course, academic institutions cannot implement production of all types of equipment. Considerable assistance on the part of the relevant ministries is needed by the Academy in the area of instrument making.

Academician B. K. Vaynshteyn discussed problems of x-ray equipment making: multichannel difractometers and two-dimensional detectors are being developed; the photographic method has been revived, and it requires appropriate apparatus; new instruments should not be available in a single sample, they must be produced in series.

V. L. Tal'roze, corresponding member of the USSR AS, stated that one of the tasks for scientists is to detect more quickly new trends in science and to implement them in their work. Quite often a new idea is referable to new equipment, with which one should become acquainted. It would be quite good to create a system of mobile information about new instruments, perhaps a small, periodically changed display at the presidium of the USSR AS. The second question is a management one. It is imperative for development of scientific instrument making to be backed up not only by different ministries, but by inclusion in the national economy plan, as an independent item in the plan.

As for instrument making in the Academy, first of all we need modern technology. It would be more expedient to purchase equipment with which we could build excellent instruments, than to purchase the instruments.

Academician A. A. Bayev observed that only a limited number of Academy institutes is equipped with the latest instruments. Most institutes that deal with biochemistry, molecular biology and organic chemistry do not have modern instruments. In order to change this situation, it is imperative to set up series production of instruments that have already been developed, to augment their reliability and expand production of small laboratory equipment (pipettes, dose-batchers, etc.) and preparative instruments. Modern equipment should be supplied not only to Moscow and Leningrad institutes, but to those of republic academies and scientific institutions of all cities in our country. Soviet instrument making should strive for total independence from foreign firms.

Academician M. A. Markov considers it expedient to try to organize the production of instruments in collaboration with foreign firms (according to Soviet projects) and to set up export of our instruments in the future.

Academician M. S. Gilyarov called the attention of the audience to problems of making instruments for general biology. There is no equipment in the laboratories for setting constant temperature and humidity conditions on a small scale, there are no instruments for transplantation work and microbiological cultures in chambers with aseptic flow of air; many other instruments, some of which are very necessary, are also wanting. The institutes that are not regular customers of the Institute of Analytical Instrument Making cannot get either spectrophotometers or mass spectrophotometers. The amount of modern instruments in several laboratories cannot provide for growth of science. It is imperative to set up series production of equipment.

A. P. Yurkevich (Department of Instrument Making for Radio Electronics, USSR State Committee for Science and Technology [GKNT]): The GKNT devotes much attention to problems of scientific instrument making' however, there are objective difficulties. Under the current Five-Year Plan, several instrument making plants will be built. In 1978, proposals must be prepared for organizing long-term collaboration with CEMA member nations in the field of instrument making. It would be desirable to set up a temporary commission under the aegis of the Academy of Sciences, with involvement of administrators of concerned ministries, in order to analyze the state of affairs in the field of scientific instrument making and to prepare the proposals.

Academician A. P. Aleksandrov, president of the USSR AS, in his summary of the discussion, stressed the importance of the intensive work in the field of instrument making, which is being pursued at the Academy of Sciences; he also observed that the situation is unsatisfactory with respect to production of scanning microscopes, spectrometers and certain other instruments. A. P. Aleksandrov expressed the opinion that the most interesting work in instrument making must be noted in special decisions of the presidium.

Decree

The presidium of the USSR Academy of Sciences adopted a decree, for the purpose of prompt fulfillment of the plan to develop instruments for the study of biopolymers and implement series production thereof, in which it voiced its approval of the performance of the Institute of Protein, Institute of Bioorganic Chemistry imeni M. M. Shemyakin, Institute of Molecular Biology, Institute of High Molecular Compounds of USSR AS, Novosibirsk Institute of Organic Chemistry in the Siberian Department of USSR AS, Institute of Physiology imeni A. A. Bogomolets of the Ukrainian AS, Institute of Atomic Energy imeni I. V. Kurchatov, Institute of Molecular Genetics of USSR AS, Institute of Crystallography imeni A. V. Shubnikov of USSR AS, SKB of Analytical Instrument Making, SKB of Biological Instrument Making, SKB of the Institute of Crystallography of USSR AS, in the area of developing new methods and instruments for the study of biopolymers, as well as the performance of the Scientific Council for the composite problem of "Biological membranes and application of the principles of their function in practice" under the USSR AS and Council for Scientific Instrument Making under the presidium of the USSR Academy of Sciences, for the coordination of the above-mentioned work.

The Scientific and Technical Association of the USSR AS, along with the Council for Scientific Instrument Making under the presidium of the USSR AS, were asked to prepare an appeal to the Ministry of Instrument Making, Automation Equipment and Control Systems to take immediate steps to set up series production of instruments for biological research, including liquid chromatographs, electrophoretic instruments, preparative and analytical centrifuges, x-ray analysys instruments and instruments of small laboratory mechanization and technology.

It was decided to submit a request to the State Committee of the USSR for Science and Technology to consider, together with the USSR AS, ministries and agencies, the plan for accelerated development of instrument making for scientific research in 1979-1985, and to ask the USSR Ministry of the Electronic Industry to provide microprocessors in the required amounts and assortment to instrument making organizations of the USSR AS.

The Scientific and Technological Association of the USSR AS was asked to organize regular exhibits of newly developed instruments for members of the presidium of the USSR AS.

In accordance with the decision of the presidium, the Scientific and Technological Association of the USSR AS and Council for Scientific Instrument Making under the presidium of the USSR AS must comprehensively develop the practice of working on instrument making for scientific research in collaboration with foreign instrument making organizations and firms.

The Council for Scientific Instrument Making under the presidium of the USSR AS was asked to consider the structure of the plan for development of new instruments, bearing in mind the inclusion of target-oriented programs in the plan, similar to the complex "Micromethods in Protein Chemistry" program, in other branches of science, along with the planning of development of sets of instruments based on a single physical principle.

The section for chemicotechnological and biological sciences under the presidium of the USSR AS, Council for Scientific Instrument Making under the presidium of the USSR AS and Scientific and Technological Association of the USSR AS were asked to expedite the creation of a temporary interagency commission for laboratory technology.

10,657
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INDUSTRIAL MICROBIOLOGY

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APPEAL FOR SUCCESSFUL COMPLETION OF THE STATE PLAN AND SOCIALIST PLEDGES

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1978 pp 1-2

[Article by V. N. Fedoryshin, Deputy Chief, All-Union Soyuzleskhimproduktsiya Industrial Association]

[Text] The laborers of our motherland have responded enthusiastically to the appeal made by the Communist Party to consolidate and develop the successes of 1977, the jubilee year. As Comrade L. I. Brezhnev noted in his speech to the December (1977) CC CPSU Plenum, 1977 was a very full year, important in political and economic respects: The new USSR Constitution was adopted, the 60th anniversary of the Great October Socialist Revolution was triumphantly commemorated, and our economy moved substantially forward.

Together with all Soviet people, workers of food chemical industry have made their contribution to the country's economic development. They successfully completed the plan for the second year of the five-year plan, and their socialist pledges. Products produced in excess of the plan sold for more than 6 million rubles. The profit plan was completed, and the labor productivity growth assignment was exceeded by 2.2 percent.

Wood chemical plants produced the prescribed assortment of products and managed to complete the plan for introduction of new equipment and production processes.

A number of wood chemical enterprises took winning places in the all-union socialist competition of enterprises and organizations of the Ministry of Pulp and Paper Industry. Thus the Orgsintez Industrial Association was awarded the perpetual Red Banner of the Ministry of Pulp and Paper Industry and the trade union central committee four times, the Syava Plant took second place for work in the first, second, and fourth quarters of 1977, the Dmitriyevka Plant took third place for the first and second quarters and second place for the third quarter, as well as the perpetual Red Banner of the Ministry of Pulp and Paper Industry and the trade union central committee for the fourth quarter, and the Neyvo-Rudyanka Plant took second place for the fourth quarter. Mention was made of the good work done by the collectives of the Asha, Barnaul , Lesosibirsk, and Tikhvin plants.

The competition among worker teams in the leading occupations in honor of the 60th anniversary of Great October assumed broad scope. The following teams won: Ye. G. Loginova's ethylacetate production team and N. A. Kondrat'yev's charcoal production team (the Asha Plant), A. I. Pestov's resin production team (the Barnaul Plant), Ye. B. Kolokolenkina's acetic acid production team (the Dmitriyevka Plant), and G. A. Andreyeva's resin production team (the Tikhvin Plant). Five hundred sixty of the best producers in the All-Union Soyuzleskhimproduktsiya Industrial Association were awarded the "1977 Socialist Competition Winner" badge.

Last year the new rosin extraction plants improved their work noticeably: The use level of output capacities and product quality increased, and the unit material consumption norms dropped.

However, there are also a number of shortcomings in the association's plants. Thus despite a decrease in production costs in all the enterprises as a whole, some of them permitted considerable overconsumption of raw materials, chemicals, and power (the Reshotinskiy, Novo-Mikhaylovskiy, Molomskiy, Asha, and Neyvo-Rudyanka plants and the Orgsintez Industrial Association).

Incomplete assimilation of planned output capacities, ineffective use of materials, growth in production outlays, a low level of mechanization of manual labor, deterioration of the quality of raw materials supplied to enterprises, and inadequate work in price forming are all in the end reducing the sector's profitability.

The production volume of brand A top and first grade rosin at enterprises such as the Reshotinskiy and Vologda plants and the Orgsintez Production Association continues to be low.

Collectives of plants in the All-Union Soyuzleskhimproduktsiya Industrial Association must achieve maximum assimilation of output capacity, a reduction in the unit consumption norms for raw materials, chemicals, and power, growth in product quality, and a decrease in losses in the third year of the five-year plan; this pertains mainly to the Zima, Lesosibirsk, Medvezh'yegorsk, Molomskiy, Novo-Mikhaylovskiy, Reshotinskiy, and Barnaul plants.

Considering the decisions of the December (1977) CC CPSU Plenum and the premises and conclusions in the speech given by Comrade L. I. Brezhnev at this plenum, every labor collective must mobilize its efforts to complete the following tasks: Completing and surpassing the 1978 state plan for economic and social development of the USSR, continually increasing production effectiveness and work quality, making sensible use of the created economic potential, accelerating scientific-technical progress in every possible way, intensifying production, raising labor productivity, and intensifying economization in behalf of a further rise in the welfare of the Soviet people.

The plan for development of wood chemical industry in 1978 foresees the further fullest possible satisfaction of the national economy's and population's demands for wood chemical products. Products worth more than 300 million rubles will have to be produced in 1978. The rosin extraction plants built in the Ninth Five-Year Plan will enjoy the greatest development in 1978. Production of clarified and modified extracted rosin will exceed 10,000 tons, which will be 26 percent more than in 1977. Solving the problem of refining extracted rosin, especially cedar rosin, is the main prerequisite for increasing the economic effectiveness of this production operation.

The plans call for production of about 87,000 tons of pine rosin, 100,000 tons of charcoal, 53,000 tons of butylacetate, and 42,500 tons of ethylacetate.

One of the important tasks facing the wood chemical enterprises is that of increasing the proportion of products in the top quality category. While last year production of goods bearing the State Seal of Quality totaled more than 61 million rubles for the association as a whole, in 1978 the association is to produce 75.5 million rubles worth of such products, which will be 24.9 percent of the total volume.

The Asha, Dmitriyevka, Amzya, Barnaul , and Tikhvin plants and the Orgsintez Industrial Association have a great deal of work to do in preparing for certification of products for the State Seal of Quality and in increasing their production volume. The managers of the Neyvo-Rudyanka, Syava, and Vologda plants, which are still not producing products bearing the State Seal of Quality, must mobilize the collectives to solve this problem.

One of the effective ways for upgrading the quality of products is to introduce an integrated product quality control system. This system will go into operation this year at the Dmitriyevka Plant and in the Orgsintez Industrial Association. All of the preparatory work is to be done with the assistance of the Central Scientific Research Institute of Wood Chemical Industry at the Neyvo-Rudyanka, Asha, Syava, Vologda, and Tikhvin plants in 1978 so that introduction of the integrated product quality control system could be started in 1979.

Jointly with the sector institute, the wood chemical enterprises must assimilate new production processes and organize production of new types of products of better quality. Thus the Neyvo-Rudyanka Plant will begin industrial production of clarified and modified extracted rosin, and the Orgsintez Industrial Association will begin production of glue made from modified clarified extracted rosin and a compound consisting of clarified extracted rosin and fatty acids to be used in soap-making. Industrial production of clarified extracted rosin will be organized at the Reshotinskiy Plant and a device intended for rectification of extracted turpentine with the goal of obtaining industrial fractions of turpene hydrocarbons

(α-pinene, Δ_3-carene, and dipentene) will be put into operation at the Medvezh'yegorsk Plant. Production of glue from cedar rosin intended for cardboard glueing will begin at the Novo-Mikhaylovskiy Plant. The Vetluga Plant is to work out the production processes and increase production of better-quality inhibitor.

The Syava Plant must introduce a production process for obtaining saponified wood resin for construction materials industry, and a casting binder. A second brand DAK activated charcoal production kiln will be put into operation.

The Molomskiy Plant must assimilate production of soluble resin for activated charcoal industry.

Experimental projects occupy a prominent place in the new equipment plan. Thus tests will begin on the following at the Asha Plant: A charcoal cooling and stablizing unit mounted on a vertical continuous-action retort, a new type of settling tank used to separate resin from pyroligneous distillate, an apparatus designed by the Moscow Institute of Chemical Machine Building to separate wood resin from steam and gas, and a cascade-type automatic regulation system (SAR) used in processes requiring esterification of acetic acid by ethanol.

The Orgsintez Industrial Association will test an extraction battery SAR and a continuous acetic acid butanol esterification process. The Dmitriyevka Plant will test a cascade-type SAR used in butylacetate neutralization and rectification processes. The Neyvo-Rudyanka Plant will obtain an experimental industrial lot of purified synthetic camphor intended for medical purposes. The Syava Plant is to test a method for final purification of biologically treated waste water and produce an experimental industrial lot of binding agents made from cold-hardened wood resin. The Lesosibirsk Plant must produce a unit intended for clarification and modification of extracted rosin.

The TsNILKhI [Central Scientific Research and Planning Institute of Wood Chemical Industry] is to play an important role in solving the problems facing wood chemical industry in the third year of the five-year plan. Enterprise workers await effective research from the scientists, the results of which will make it possible to improve the quality of rosin, extracted pine resin, and especially extracted cedar rosin. The institute must accelerate the work of obtaining new products from wood resin to replace those which no longer enjoy a sufficient demand. Jointly with the Orgsintez Industrial Association the TsNILKhI must finish its research on vaccum-cooking of rosin and submit recommendations to all rosin enterprises, which will make it possible to increase production of top quality and first grade brand A rosin.

Technical assistance from the sector institute has great significance to improving the work of the enterprises and their assimilation of planned output capacities. Thus this year the TsNILKhI must provide assistance in assimilating: Production of ethylacetate and industrial acetic acid at the Molomskiy Plant, a continuous acetic acid butanol esterification process and an automatic regulating system at the Dmitriyevka Plant, a process for obtaining clarified extracted rosin and clarified modified extracted rosin at the Reshotinskiy and Neyvo-Rudyanka plants, a process for producing glue out of modified clarified extracted rosin and larch balsam for chewing gum in the Orgsintez Industrial Association, and others.

The institute must submit recommendations to new rosin extracting plants on assimilating resinous substance extraction processes with the goal of achieving the interim planned output capacity approved by the Ministry of Pulp and Paper Industry.

In order that we can successfully complete the state plan, in addition to broadening the socialist competition even more we must promote an all-out movement of efficiency experts. In 1977, the economic impact enjoyed from utilizing inventions and efficiency proposals exceeded 1 million rubles. The most valuable ones included combustion of excess uncondensable gases from retorts in the drying kilns of the Asha Plant (economic impact--36,000 rubles) and turpentine washing in ball mixers at the Neyvo-Rudyanka Plant (economic impact--73,200 rubles).

In 1978 the sector's enterprises will have to implement specified measures to improve labor protection and safety foreseen by the appropriate integrated plans. Among these measures, mechanization of heavy physical labor, automation of production processes, introduction of hoisting and transport equipment, and mechanization of freight handling operations will have a prominent place.

The party teaches us that the fate of our plans rests with the people. Success is forged in the primary party organizations and labor collectives, and at the workplaces. It is the duty of the directors of the enterprises, the Orgsintez Industrial Association, and the TsNILKhI to organize the work in such a way as to ensure unconditional completion and overcompletion of the state plan and socialist pledges in the third year of the five-year plan.

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INDUSTRIAL MICROBIOLOGY

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ASSIMILATION OF A FLOTATION METHOD OF YEAST ISOLATION

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLONNOST' in Russian No 2, 1978 p 22

[Article by Engineer P. A. Smetanin, Bratsk Lumber Industry Complex]

[Text] The yeast shop of the Bratsk Lumber Industry Complex was put into operation in May 1967. The plan foresaw separating yeast from mash by a flotation method, followed by three-stage separation of the yeast suspension.

The flotation method was rejected because 3 days after *C. scottia* Tul-6 yeast was transferred from the pure culture department into industrial yeast-growing tanks outfitted with an airlift air distributing system, 40-50 percent of the yeast was substituted by incidental nonflotating forms.

Capitalizing on the partial capability yeast has for flotation and its concentration within the flotation tank, we attempted separate delivery of suspension and mash for separation. Thus mash from the flotation tanks underwent three-stage separation while the yeast suspension was delivered at a concentration of 70-80 gm/liter to the second and then to the third separation stage.

Due to inoperability of the yeast flotation unit all of the mash obtained in the yeast-growing apparatus was subjected to separation, for which purpose additional DSG-35 separators had to be installed.

Following the example of enterprises that had introduced the flotation method for isolating yeast from mash, in 1972 our shop raised the cuvettes in the yeast growing apparatus, which had a volume of 600 m^3, to different heights--1,500, 1,000, 700, and 300 mm from the bottom of the apparatus. As a result the possibility arose for using the flotation tanks as intended. It should be noted that an apparatus with a cuvette raised to a height of 300 mm above the bottom works more stably and with greater productivity than an innoculator in which the cuvette is located 1,500 mm above the bottom; yeast flotation, meanwhile, is identical in these apparatus.

When the flotation method was introduced, unexpectedly the stability of foam in the yeast-growing apparatus increased significantly, and consequently difficulties arose in quenching it during flotation in a two-stage 170 m^3 flotation tank. The chemical (light fractions from rectification of tallow oil) and mechanical foam quenchers ceased to provide the necessary degree of foam quenching.

Earlier, the yeast suspension was moved by gravity flow from the flotation tank through a hydraulic seal into the collecter. But after stable foam appeared the suspension began traveling periodically (in volleys), which resulted in overfilling of the collector and a significant loss of yeast.

The foam quenching problem was solved in the following way through the efforts of the shop efficiency experts. We began to quench foam in the housing of the centrifugal pump by a hydromechanical method. Together with chemical foam quencher, some of the yeast suspension and foam were returned by a pump from the lower part of the flotation tank to its tapered lid through a ring sprayer installed on the latter, and then into the working wheel of the mechanical foam quencher, which was replaced by a disk-type device.

To quench small foam bubbles in the housing of the centrifugal pump and achieve hydromechanical quenching in the yeast suspension collector, fluid was allowed to circulate in the latter.

In order to reduce losses of yeast combined with mash, the two-stage flotation tank, which had three sections in its first stage, was reconstructed as a single-stage tank with five sections. As a result the concentration of yeast in mash following the flotation tanks decreased by 1.5-2 times.

Introduction of the flotation method for isolating yeast from mash made it possible to substitute three-stage separation by two-stage separation. An economic impact totaling 60,000 rubles per year was achieved.

11004
CSO: 1870

INDUSTRIAL MICROBIOLOGY

COMPETITION FOR MILLIONTH TON OF NUTRIENT YEAST INITIATED

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1978 pp 29-30

[Text] In the beginning of January 1978 the collective of the Kirov Biochemical Plant appealed to all enterprises producing nutrient yeast, including those of pulp-and-paper and food industry, to initiate a socialist competition for early completion of the assignments planned for 3 years of the five-year plan, and for the honorary right to produce the millionth ton of nutrient yeast for agriculture in 1978. This patriotic initiative was soon approved at a joint session of the giverning boards of the Main Administration of Microbiological Industry and the Central Committee of the Chemical and Petrochemical Industry Workers Trade Union.

The Kirov Biochemical Plant is the flagship of the country's hydrolytic industry. Hard work, competent use of internal reserves, and assimilation of production capacities permitted the collective to produce 57,162 tons of nutrient yeast in 1977. Eight hundred tons of yeast and 5,000 tons of premixed combinations not foreseen by the assignment were produced in excess of the plan. Completing the annual plan ahead of schedule, on 21 December 1977, the Kirov workers gave the country an amount of extra products worth 800,000 rubles. In comparison with 1976, production and sales of commercial products increased by 30 percent, while labor productivity increased by 40 percent. Thus the entire growth in production was achieved owing to growth in labor productivity.

The plant completed its plan for introduction of new equipment and organizational-technical measures, which permitted the collective to make another significant step forward on the path of technical progress. Thus assimilation of the condensation-adsorption method for trapping exhaust gases from inverters made it possible to increase furforal production and reduce, by 90 percent, the quantity of toxic substances entering the environment; labor safety and effectiveness were increased as a result of the addition of remote control of hydrolysis; six hydrolyzing units have been converted to program control.

Kirov workers managed to significantly upgrade the excellence of production and make their labor more healthy. Installation of five semiautomatic packing machines in the yeast shop, for example, has dramatically reduced the dust concentration in the atmosphere; the specified measures of labor protection and safety were implemented completely in 1977.

The work indices of the Kirov Biochemical Plant were given a high assessment at a joint session of the governing boards of the Main Administration of Microbiological Industry and the presidium of the trade union's central committee in mid-January 1978. The Kirov workers were named the winners of the all-union socialist competition for greater production effectiveness and work quality on the basis of the results they achieved in 1977; they also won the competition for an honorable welcome to the 60th anniversary of Great October. The collective has been nominated for the perpetual Red Banner of the CC CPSU, the USSR Council of Ministers, the AUCCTU, and the Komsomol Central Committee.

This year the Kirov workers are once again examples of high consciousness. They have pledged to complete the 3 year assignment of the five-year plan by the first anniversary of the new USSR Constitution's adoption, to surpass the assignment for growth in labor productivity by 8.5 percent, to increase the output-capital ratio by 1.5 times over the 1975 level, raise nutrient yeast yield by 8 percent, and economize a significant quantity of materials, fuel, and power.

The laborers of many enterprises in the All-Union Soyuzgidrolizprom Industrial Association are following the example of the Kirov Biochemical Plant collective; since the very first months of 1978 they have been trying to achieve a good work rhythm and to complete the planned assignments and satisfy the socialist pledges.

In response to the letter from the CC CPSU, the USSR Council of Ministers, the AUCCTU, and the Komsomol Central Committee to party, soviet, business, trade union, and Komsomol organizations working in the Soviet Union, published on 14 January 1978, the labor collectives of hydrolytic industry have broadened the scope of the socialist competition for completion and overcompletion of the 1978 plan, and they have intensified their struggle to increase production effectiveness and work quality.

The socialist pledges adopted by workers of hydrolytic industry for 1978 include upgrading product quality, making fuller use of fixed productive capital, economizing materials, fuel, and power, assimilating productive capacities more quickly, introducing new equipment, and improving the work of scientific institutions and the planning and design organizations.

"Make 1978 a year of shock labor, new successes, and new victories": That is the slogan of the competitors.

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INDUSTRIAL MICROBIOLOGY

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EXPANDING PRODUCTION OF NUTRIENT YEAST IN PULP-AND-PAPER INDUSTRY

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 6, 1978 pp 1-3

[Article by V. I. Kropotov, USSR Gosplan]

> [Text] Workers of agricultural machine building, chemical, microbiological, meat and dairy, food, fishing, combined feed, and other sectors of industry must take the most active part in creation of a modern feed industry.
>
> From the decree of the July (1978) CC CPSU Plenum "On Further Development of USSR Agriculture"

As a result of constant improvements in the production of nutrient yeast, from year to year the enterprises of pulp-and-paper industry are increasing the rate of yeast production. Thus in 1977 yeast production attained 142,200 tons.

Analyzing the yeast production indices for the Ministry of Pulp and Paper Industry as a whole and in relation to individual enterprises in recent years (tables 1-3), we can note that the yield of yeast from 1 ton of sulfite pulp has stabilized in relation to both processes in which yeast and alcohol are obtained simultaneously and in those in which only yeast is produced.

In addition to an increase in yeast production at enterprises of the Ministry of Pulp and Paper Industry, a tendency toward a reduction in ethyl alcohol production has taken shape. This tendency will also persist in the future.

Among enterprises producing yeast and alcohol, the Svetogorsk, Kondopoga, and Arkhangel'sk pulp-and-paper combines and the Priozersk Pulp Plant achieved the highest yeast yields (33-35 kg per ton of pulp) in 1977. Low capacity of yeast production equipment was the cause of the low yeast yields in the Kotlas and Kamsk combines. As a consequence not all liquor sugars are consumed for yeast production, instead escaping partially into sulfite-yeast mash concentrates. The yeast yield has decreased significantly at the Sloksk Pulp and Paper Plant, where for 15 years the yield has been below 31 kg per ton of pulp, though attaining 34-35 kg in some years.

Table 1

(1) Год (2)	Производство целлюлозы (тыс. т) на предприятиях, вырабатывающих		(5) Выработано кормовых дрожжей, т	(6) Выход дрожжей на 1 т целлюлозы, кг	(7) Выработано этилового спирта, тыс. дал	(8) Выход спирта на 1 т целлюлозы, л
	(3) кормовые дрожжи*	(4) этиловый спирт**				
1970	2001,1	2041,3	45185	22,6	12772	62,6
1971	2021,5	2066,5	47306	23,4	12708	61,4
1972	2075,0	2117,0	51039	24,6	12626	59,8
1973	2157,0	2201,4	54416	25,2	12670	57,5
1974	2205,1	2219,8	57868	26,2	12647	56,3
1975	2234,9	2280,1	60740	26,6	13684	60,0
1976	2219,1	2265,1	61361	28,0	13169	58,1
1977	2125,1	2125,1	57813	27,3	12842	60,3

*Data on pulp production at enterprises producing yeast from sulfite liquor after acquisition of ethyl alcohol.
**The same, at enterprises concurrently producing alcohol and yeast, or alcohol alone (Makarov Combine).

Key:

1. Year
2. Pulp production (1,000 tons) at enterprises producing
3. Nutrient yeast
4. Ethyl alcohol
5. Nutrient yeast produced, tons
6. Yeast yield per ton of pulp, kg
7. Ethyl alcohol produced, 1,000 decaliters
8. Alcohol yield per ton of pulp, liters

The Tallin Combine achieved very high yeast yield per ton of pulp (95.1 kg). At the same time at the Kzyl-Orda Pulp Plant, which also gets yeast only from sulfite liquor, the yeast yield is only 29.2 kg, which is in turn significantly below the corresponding index for the Balakhna and Amursk combines (40.4 and 66.7 kg).

Table 2

(1) Год	(2) Производство целлюлозы на предприятиях, вырабатывающих только дрожжи, тыс. т	(3) Выработано кормовых дрожжей, т	(4) Выход дрожжей на 1 т целлюлозы, кг	(5) Производство дрожжей методом гидролиза древесины, т	(6) Общее производство дрожжей на предприятиях Минбумпрома (в том числе приведенное в табл. 1), т
1970	502,5	24153	48,1	2851	72189
1971	542,2	29652	54,6	2684	79702
1972	572,2	34315	60,0	2973	89126
1973	685,3	42705	62,4	8961	100112
1974	774,5	53071	68,4	13534	124403
1975	803,9	55846	69,3	17024	131921
1976	810,3	57580	70,7	16627	146632
1977	939,3	62184	66,3	22217	142194

Key:

1. Year
2. Pulp production at enterprises producing yeast only, 1,000 tons
3. Nutrient yeast produced, tons
4. Yeast yield per ton of pulp, kg
5. Yeast production by wood hydrolysis method, tons
6. Total yeast production at enterprises of the Ministry of Pulp and Paper Industry (including that shown in Table 1), tons

In addition to increasing the yeast production volume, we are also increasing yeast quality. While in 1975 the crude protein concentration averaged 45.4 percent for enterprises of the Ministry of Pulp and Paper Industry, by 1977 it increased to 46.9 percent. The quality of yeast improved especially at the Sloksk Pulp and Paper Plant, the Balakhna, Ingursk, and Tallin combines, and at the Syktyvkar Lumber Industry Complex.

The yeast production volume of the Ministry of Pulp and Paper Industry as a whole will continue to increase in future years. This growth is to occur mainly through fuller utilization of existing output capacities at the Syktyvkar Complex, the Kzyl-Orda Plant, and the Amursk Combine. In addition yeast production is also to be increased as a result of introduction of new large hydrolysis-yeast plants in the Ust'-Ilimsk and Bratsk lumber industry complexes and a new yeast shop being created at the Svetogorskiy Combine. The perspectives for increasing yeast production at most sulfite pulp plants are not very high because production of sulfite pulp is in a

Table 3

(1) Целлюлозно-бумажные предприятия	(2) Выработано в 1977 г.		(5) Выход дрожжей из 1 т целлюлозы, кг	(6) Получено дрожжей в пересчете на 100%-ный белок, т	(7) Содержание сырого протеина в дрожжах, %
	(3) целлюлозы, тыс. т	(4) дрожжей, т			
(8) I. Предприятия, вырабатывающие из щелоков дрожжи и этиловый спирт					
Светогорский комбинат (9)	84,4	2987	35,4	1249	41,8
Приозерский завод (10)	150,5	5230	34,7	2261	43,2
Сясьский комбинат (11)	133,6	3187	23,9	1343	42,1
Выборгский » (12)	56,7	1513	25,8	719	47,5
Окуловский » (13)	28,8	664	23,1	319	48,0
Кондопожский » (14)	113,3	3722	32,9	1721	46,2
ПО „Калининградбумпром" (15)	193,7	5149	26,6	2346	45,6
Советский завод (16)	124,8	3165	25,4	1361	43,0
Неманский » (17)	81,9	2353	28,7	1050	44,6
Архангельский комбинат (18)	220,0	7530	34,2	3304	43,9
Котласский » (19)	243,0	4356	17,0	2078	47,7
ПО „Сокольбумпром" (20)	119,7	3574	29,9	1611	45,1
Камский комбинат (21)	240,3	5131	21,4	2430	47,4
Соликамский » (22)	228,3	6148	28,2	2680	41,6
Поронайский » (23)	46,8	1309	28,0	616	47,1
Слокский завод (24)	56,4	1495	26,5	764	51,1
(25) Итого или в среднем	2125,1	57813	27,2	25852	44,7
(26) II. Предприятия, вырабатывающие из щелоков только дрожжи					
Балахнинский комбинат (27)	107,1	4322	40,4	2169	50,2
Туринский завод (30)	41,0	3312	80,8	1548	46,7
Кзыл-Ординский » (31)	49,6	1450	29,2	597	41,2
Амурский комбинат (32)	175,2	11685	66,7	5632	48,2
Ингурский » (32)	17,5	1301	74,3	651	50,0
Клайпедский завод (34)	53,2	3865	72,6	1717	44,4
Таллинский комбинат (35)	63,3	6020	95,1	3007	50,0
(25) Итого или в среднем	506,9	31955	63,0	15321	47,9
(36) III. Предприятия, вырабатывающие дрожжи из предгидролизатов					
Братский комплекс (37)	219,4	19669	89,6	9582	48,7
Байкальский комбинат (38)	213,0	10540	49,5	5079	48,2
(25) Итого или в среднем	423,4	30209	69,9	14661	48,5
(39) IV. Предприятия, вырабатывающие гидролизные дрожжи					
Сегежский комбинат (40)	—	2389	—	1040	43,5
Сыктывкарский комплекс (41)	—	19828	—	9855	49,7
(25) Итого или в среднем		22217	—	10895	49,0
Всего (42)	3064,4	142194	—	66729	46,9

Key:

1. Pulp-and-paper enterprises
2. 1977 production
3. Pulp, 1,000 tons
4. Yeast, tons
5. Yeast yield per ton of pulp, kg
6. Yeast yield corrected per 100% protein, tons
7. Concentration of crude protein in yeast, %
8. Enterprises producing yeast and ethyl alcohol from sulfite liquor
9. Svetogorsk Combine
10. Priozersk Plant
11. Syas'sk Combine
12. Vyborg Combine
13. Okulovka Combine
14. Kondopoga Combine
15. Kaliningradbumprom Industrial Association
16. Sovetskiy Plant
17. Nemanskiy Plant
18. Arkhangel'sk Combine
19. Kotlas Combine
20. Sokolbumprom Industrial Association
21. Kamsk Combine
22. Solikamsk Combine
23. Poronaysk Combine
24. Sloksk Plant
25. Total or average
26. Enterprises producing yeast only from sulfite liquor
27. Balakhna Combine
30. Turinsk Plant
31. Kzyl-Orda Plant
32. Amursk Combine
33. Ingursk Combine
34. Klaypeda Plant
35. Tallin Combine
36. Enterprises producing yeast from prehydrolysates
37. Bratsk Complex
38. Baykal'sk Combine
39. Enterprises producing hydrolytic yeast
40. Segezha Combine
41. Syktyvkar Complex
42. Total

stage of major technical changes involving not only improvements in the process, reduction of raw material and chemical consumption, and a decrease in contamination of waste water and in the quantity of exhausts and their toxicity, but also the use of qualitatively different wood as the raw material.

It should be noted that an increasingly greater number of enterprises are replacing the traditional calcium substrate by ammonium, sodium, and magnesium substrates in sulfite cooking. The existing system for processing sulfite liquor (ethyl alcohol--nuturient yeast--sulfite-yeast mash concentrates), the nutrient yeast--concentrates system is coming into more frequent use. The Balakhna Combine has converted to this system, while the Sloksk Plant and other enterprises are presently being converted. This conversion requires mandatory solution of the problem of growing yeast in concentrated mediums. This would considerably reduce the load on evaporating apparatus and decrease water consumption in production. Acquisition of yeast by this system would require lower productive capacities, and the quantity of waste water will decrease significantly. Consequently biochemical treatment of undiluted liquor and prehydrolysates containing 3 percent and more sugar will produce a large economic impact (lower outlays of materials, power, and so on).

Solving the problems of processing undiluted liquor and prehydrolysates, scientists and production specialists are selecting and breeding the highest-yield yeast cultures for these mediums. The Amursk Pulp and Cardboard Combine has achieved good results working with undiluted liquor obtained from the digestion of pulp on an ammonium substrate (with a reducing agent concentration of 2.8-3.2 percent). The enterprise's yeast plant is working with the initial *Candida scotii*, using a two-stage process. The yeast is grown in yeast-growing tanks with a volume of 600 m^3 employing a vibration-controlled air distribution system. The yeast is isolated from the suspension by the flotation method, and then it is thickened on separators. Before drying, the suspension is plasmolyzed. The experience of the Amursk Combine should be broadly disseminated among pulp-and-paper enterprises producing yeast.

The scientific research institutes have created and are now developing new methods of chemical wood processing, in which the spent liquor from the two-stage digestion method is to be used to produce yeast, using a magnesium-bisulfite substrate. Later, the oxygen-soda method, the oxidative ammonolysis method, and others are to be put to use.

With the goal of improving yeast quality and, in particular, increasing the crude protein concentration, jointly with the enterprises the scientific organizations are directing their efforts at selecting new high-yield, high-protein yeast culture strains. For this purpose they are studying the questions of using biostimulators as well as of supplying nutrients and microelements more sensibly and fully to the yeast.

Work done by the Leningrad Forestry Engineering Academy imeni S. M. Kirov has demonstrated that sulfite-yeast plants can produce up to 50,000 more tons of yeast by utilizing lactones. It is known that during sulfite digestion, up to 40 percent of the sugars are broken down, and almost half of this quantity participates in the oxidation-reduction reactions in which aldonic acids are formed. When sulfite liquor is prepared for biochemical treatment, yeast does not utilize aldonic acids, which basically remain in the form of lactones. By developing the appropriate conditions for their utilization and installing the additional apparatus, we can obtain good quality yeast.

The enterprises are devoting special attention to factors influencing yeast quality--production excellence, strict maintenance of prescribed production conditions, and prevention of bacterial contamination.

The possibilities for significantly increasing production of nutrient yeast and improving its quality are present at the pulp-and-paper enterprises. Realization of these possibilities will produce a tangible economic impact. Alteration of the yeast production procedures at some of the enterprises, exploration for highly productive yeast strains, modernization of the equipment, and other measures must be implemented with the active participation of the enterprise departments of scientific organization of labor in cooperation with scientific and planning institutes. Enterprise and association directors bear the responsibility for practical implementation of production modernization measures.

In his report "Further Development of USSR Agriculture" given at the July (1978) CC CPSU Plenum, L. I. Brezhnev attached important significance to the protein problem, due to the lack of which tremendous overconsumption of feed is occurring in livestock breeding. "Our chemists and workers of microbiological, pulp-and-paper, fishing, meat and dairy, food, medical, and a number of other sectors of industry must make their contribution to solving the protein problem," said CC CPSU General Secretary, Comrade L. I. Brezhnev. "The appropriate assignments are being set for them, and capital investments are being allocated to them."

By increasing its yeast production, pulp-and-paper industry can provide considerable assistance to agriculture in developing livestock breeding, increasing its production and, consequently, providing meat products to the population.

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TAPPING PINES WITH NUTRIENT YEAST INFUSION

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 6, 1978 pp 5-6

[Article by Cand Ag Sci Ya. G. Drochnev, Senior Engineer M. V. Perelyubskiy, and I. N. Selukov, Senior Scientist, Kirniilp]

[Text] Stimulants prepared out of wood chemical products from pulp-and-paper production have come into use in tree tapping in recent years. These reagents have an intense influence on resin discharge, but when they get into the resin the latter becomes difficult to process at rosin plants (1).

This is why there is special significance to seeking new stimulants that do not reduce the quality of the obtained product. The experience of the GDR and Poland is interesting in this regard; these countries make broad use of a new stimulant in pine tapping--a nutrient yeast extract (2). Introduction of yeast extract tapping has also begun in Bulgaria (3,4). The Kirniilp [Kirgiz SSR Scientific Research Institute of Lumber Industry] has studied the possibilities for using an aqueous infusion of dry nutrient yeast as a resin discharge stimulant. The results of this work are presented in this article.

The experiments were conducted at the Central Zonal Experimental Station (TsZOS) in Gor'kovskaya Oblast, at the Belorussian SSR Research Station (BelOP) in Brestskaya Oblast, at the Ural'sk Research Station (UOP) in Sverdlovskaya Oblast, and at the Siberian Zonal Experimental Station (SibZOS) in Irkutskaya Oblast. The research was conducted in mature pine stands typical of each region. Each experiment consisted of from two-fold to five-fold replications: The main experiments were conducted with 50-100 trees, and exploratory experiments were conducted with 10-30 trees. This ensured an observation accuracy of 95-97 percent in the first case and 90-94 percent in the second.

The infusion was prepared from dry nutrient yeast produced by pulp-and-paper combines, hydrolysis plants, and protein-vitamin concentrate (BVK) plants. Hot water at a temperature of 60-90° C was added to the yeast

(GOST 20083-74*) at a ratio of 50 grams per liter, after which the product was mixed and allowed to infuse for 2-3 days. After infusion, the solution was filtered through two layers of gauze. Enough stimulant was prepared to last not more than 14 days. The trees were tapped conventionally by (khaki) intended for work with mash. The results are shown in Table 1.

Table 1

(1) Место проведения опыта	(2) Выход живицы при подсочке с водным настоем кормовых дрожжей на КДП, % к подсочке					
	1976 г.		1977 г.		(3) средняя	
	(4) обычной	(5) с бражкой	обычной	с бражкой	обычной	с бражкой
БелОП (6)	140	95	148	100	144	97
ЦЗОС (7)	141	93	124	87	132	90
УОП (8)	129	93	135	98	132	96
СибЗОС (9)	149	93	161	98	155	96

Key:

1. Place of experiment
2. Resin yield from tapping with an aqueous nutrient yeast infusion per KDP, % of tapping with following methods
3. Average
4. Conventional
5. With mash
6. BelOP
7. TsZOS
8. UOP
9. SibZOS

As we can see from Table 1, an aqueous nutrient yeast infusion significantly intensifies resin discharge. On the average in 2 years of research, the yield of resin per (karrodetsimetr) (KDP) of (podnovka) was 32-55 percent larger with nutrient yeast tapping than with conventional tapping. These results agree with data obtained by the Latvian SSR Academy of Sciences Institute of Wood Chemistry in relation to yeast extract tapping (5).

Certain fluctuations can be observed in resin yield in different geographical regions, which is associated with weather and vegetation factors as well as with the use of yeast from different plants.

In 1976-1977 the Kirniilp tested aqueous infusions prepared from nutrient yeast produced by the Balakhna and Turinsk pulp-and-paper combines, the

Table 2

(1) Производство, вырабатывающее дрожжи	(2) Испытано вариантов кормовых дрожжей	(3) Выход живицы на КЗП при подсочке с настоем дрожжей, % к подсочке с бражкой		
		1976 г.	1977 г.	(4) средний
Пищевое (5)	2	117	97	107
Гидролизное (6)	5	96	97	98
Целлюлозно-бумажное (7)	2	93	91	92
Белково-витаминных концентратов (8)	2	86	74	80

Key:

1. Production operation producing yeast
2. Plant yeast variants tested
3. Resin yield per KDP when tapping with yeast infusion, % of tapping with mash
4. Average
5. Food
6. Hydrolysis
7. Pulp-and-paper
8. Protein-vitamin concentrates

Tavda, Kirov, Ivdel', Lobva, and Zima hydrolysis plants, the Kstovo and Ufa BVK plants, and the Tagil'sk and Talitsa yeast plants. The results are shown in Table 2, grouped in relation to type of production operation.

As we can see from Table 2, the best results were obtained with tapping using stimulants prepared from nutrient and hydrolysis yeast; yeast obtained from pulp-and-paper combines had a weaker influence on resin yield, while that from BVK plants had the weakest influence. Obviously the differences in degree of influence of the yeast infusion upon resin yield depend on many factors defining the unique features under which yeast is grown at these enterprises. In particular, the best results are obtained when we use nutrient yeast from plants processing conifer wood primarily. Yeast produced from raw material containing a large proportion of deciduous tree wood has a weaker influence on resin discharge.

We also established that the influence yeast has on resin discharge also depends on the temperature at which the yeast is dried at the plants. Resin yields obtained with the use of infusions of hydrolysis yeast dried at different temperatures were:

Yeast drying temperature, °C.....	130-140	160-170	200-300
Resin yield, % of that obtained with mash tapping	107	97	90

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The obtained results demonstrate the high stimulatory capability of yeast from hydrolysis production obtained at a drying temperature not greater than 140° C, and they permit us to recommend them for preparation of stimulant, and testing of the latter in industrial conditions.

Similarly as with sulfite-yeast mash, nutrient yeast infusion hardly alters the dynamics of resin flow observed with conventional tapping (Figure 1).

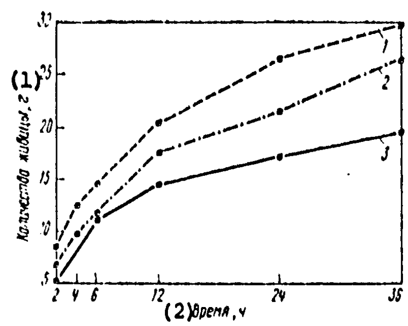

Figure 1. Dynamics of Resin Flow From Pines Tapped With: *1*--Sulfite-yeast mash; *2*--aqueous nutrient yeast infusion; *3*--conventional technique

Key:

1. Resin quantity, gm
2. Time, hours

Also of interest are data on changes in resin yield of trees tapped with aqueous nutrient yeast infusion depending on month of the season. Stimulant made from yeast as a rule has a stabler influence on resin discharge. It is less subjected to fluctuations from month to month than when mash tapping is employed (Figure 2). This can be explained basically by the relatively low effectiveness of yeast infusion at the beginning of the season in comparison with that of mash or other residues. During this time, the resin yield achieved with yeast tapping can be 15-25 percent lower, while in August-September it can significantly exceed the yields observed with mash tapping.

In order to increase the effectiveness of yeast stimulants, physiologically active compounds added to the yeast infusion were tested in exploratory experiments in 1977.

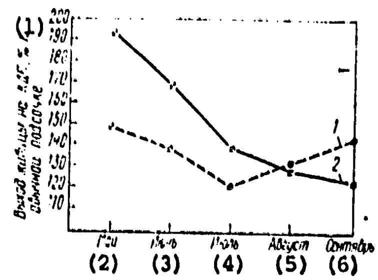

Figure 2. Resin Yield Depending on Season From Trees Tapped With: *1*--aqueous nutrient yeast infusion; *2*--sulfite-yeast mash

Key:

1. Resin yield per KDP, % of yield with conventional tapping
2. May
3. June
4. July
5. August
6. September

As we can see from Table 3, some additives (2M-4Kh, Kh-1, Urosulfan, birch sap) have a positive influence on the stimulatory capability of yeast infusion, increasing its effectiveness by 6-12 percent.

Table 3

Place of Experiment	Compound Added to Yeast Infusion	Resin Yield per KPD, % of that with yeast infusion tapping
TsZOS	Atrazin	99
	2M-4Kh	106
	M-1	102
TsZOS	2,4D	103
	Kh-1	106
UOP	Urosulfan	112
	Birch sap	108

Table 4

(1) Объединение	(2) Подсочка сосны с водным настоем дрожжей					
	(3) Количество карр, тыс. шт.	(4) Добыто живицы, т	(5) Средний выход живицы			
			(6) на карру		(7) на подновку	
			(8) г	(9) % к подсочке с бражкой	(8) г	(9) % к подсочке с бражкой
Иркутскхимлес (10)	230,2	232,55	1010,0	76	62,4	71
Свердхимлес (11)	143,1	159,65	1115,6	92	42,9	90
Горькхимлес (12)	418,1	330,7	805,0	93	35,1	89
Карелхимлес (13)	42,0	34,4	818,0	99	35,2	99
Итого или в среднем (14)	833,4	763,3	915,9	92	42,2	87

Key:

1. Association
2. Tapping pines with aqueous yeast infusion
3. Number of karri, 1,000
4. Resin obtained, tons
5. Average resin yield
6. Per karri
7. (Podnovka)
8. gm
9. % of that with mash tapping
10. Irkutskkhimles
11. Sverdkhimles
12. Gor'kkhimles
13. Karelkhimles
14. Total or average

Results obtained in experimental conditions made it possible to produce recommendations for broad industrial testing of yeast infusion tapping. These tests were performed in the 1977 season at a number of enterprises of the USSR Ministry of Timber and Wood Processing Industry (Table 4).

As we can see from Table 4, enterprises working with yeast infusion achieve relatively high technical-economic indices. Thus resin production for four associations was 763.3 tons, the resin yield per karri attained 915.9 gm, and the yield per podnovka was 42.2 gm, but on the average it was lower than with sulfite-yeast mash tapping. These indices vary in relation to individual enterprises, which is obviously associated with difficulties in assimilating the new production processes and organizing the tests. As a rule wherever a persistent effort was placed into introducing yeast infusion tapping, the best results were obtained. As an example the resin yield per podnovka in the Karelkhimles Association was 99 percent of that obtained with sulfite-yeast mash tapping. On the whole, the data of the production tests confirmed the experimental results.

To determine resin quality, samples were analyzed in the Central Scientific Research and Planning Institute of Wood Chemical Industry and processed in a laboratory rosin unit. In this case it was determined that resin obtained with nutrient yeast is hardly different at all in chemical composition from resin obtained without chemical influence.

Next an experimental 2.6-ton lot of resin was processed at the experimental plant of the Central Scientific Research and Planning Institute of Wood Chemical Industry (in 1977). The processing results confirmed the laboratory data. When settled turpentine was poured off, distinct separation of layers was observed; emulsification of the turpentine was not revealed. Rosin and turpentine obtained from this resin corresponded to GOST requirements.

A large lot of resin will be processed in 1978 to determine the effect nutrient yeast infusion tapping has on rosin quality.

BIBLIOGRAPHY

1. Polyakov, P. P., Radbil', B. A., Smirnova, Ye. B., and Chashchin, A. M., "Effect of Tapping Technique on Quality and Consumer Properties of Rosin," REF. INFORM. LESOKHIMIYA I PODSOCHKA, No 5, 1977, pp 11-12.

2. Stephan, G., "Die Gewinnung des Hartes der Kiefer," Leipzig, 1973.

3. "Effective Utilization of Bulgaria's Raw Material Base," REF. INFORM. LESOKHIMIYA I PODSOCHKA, No 9, 1977, pp 15-16.

4. Kostov, P., "Tree Tapping With the Help of Yeast Extract Biostimulant," GORSKO STOPANSTVO, No 8, 1977, p 30.

5. Kalnin'sh, A. Ya., and Tsakars, E. Ya., "Tapping Using Yeast Extract a$ the Stimulant," REF. INFORM. LESOKHIMIYA I PODSOCHKA, No 12, 1976, pp 7-8.

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ANDIZHAN HYDROLYSIS PLANT'S 25TH ANNIVERSARY

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 6, 1978 pp 13-15

[Article by N. I. Pavlova, P. S. Davydov, V. Ye. Oleynikov, and V. B. Shpannagel']

[Text] The Andizhan Hydrolysis Plant issued its first products in August 1953. In the quarter of a century since then the enterprise has become a major supplier of furfural and its derivatives, nutrient yeast, and hydrolytic lignin chemical processing products. The plant has achieved a high rate of production, especially of new types of products. Thus in comparison with 1976, in 1977 production of tetrahydrofurfuryl alcohol increased by 6 percent, production of nitrolignin increased by almost 14 percent, and the total commodity production volume increased by 450,000 rubles.

Production growth is resulting mainly from intensification of production on the basis of technological advances.

In furfural production, for example, a third vapor tapping line was placed into operation in 1977, making it possible to introduce new working conditions affording a possibility for increasing the time of furfural-containing vapor collection to 2.5 hours per cycle of the hydrolysis apparatus.

A system borrowed from the Georgiyevka Biochemical Plant for preparing sulfuric acid solution with which to wet cotton pods in a jet mixture was introduced. The need for laborious preparation of the solution in periodic-action tanks has been eliminated.

Following the example of the Fergana Chemical Plant, which produces furan compounds, chemically treated water is now fed into the residues of the principal furfural column, making it possible to partially neutralize the furfural-containing vapor and reduce consumption of soda ash in this process.

Six-section fractionating columns and coolers having a cooling surface of of 15 m^2 each in relation to the azeotropic mixture have been assembled and placed into operation.

Stainless steel screw conveyors of new design have been manufactured to obtain nitrolignin by a dry method. As a result of their use, production of nitrolignin and its derivatives has increased significantly, and discharge of nitrogen oxide into the atmosphere has been totally halted.

The economic impact enjoyed in 1977 from introducing these measures was 130,000 rubles.

The plant collective is celebrating its 25th anniversary in a time of reequipment of the principal production operations. A yeast growing apparatus with a decentralized air distribution system designed by the UkrNIISP has already been installed and placed into operation. This has made it possible to increase the yeast yield from the apparatus by 50 percent and free one tank for biological oxidation of yeast-free mash.

This year there are plans to replace the airlift air distribution systems by the UkrNIISP system in another yeast-growing apparatus.

The Kiev Technological Institute has provided us with the plans for an experimental column with a diameter of 1,400 mm and fishscale contact plates.

The column has already been manufactured and sent to the plant. Its use will permit us to increase the shop's productivity, improve overall quality, and reduce steam consumption.

Production of furfural derivatives is growing. A furfuryl alcohol shop with a capacity of 2,000 tons per year went into operation in 1976. The production procedures of this valuable product were worked out and its production was assimilated in 1977. Jointly with the All-Union Scientific Research Institute of Bioengineering, for several years we have been growing *Chlorella* in an experimental unit; *Chlorella* is distinguished by high adaptability to environmental conditions, valuable biochemical properties, and high yields. *Chlorella* has been fed to mulberry silkworm moths on an experimental basis. The first results have shown that the yield of the latter could be increased by 16-20 percent.

The plant collective is proud that it was a pioneer in qualified utilization of hydrolytic lignin. The plant's experimental shop has now assimilated industrial production of products such as nitrolignin (by wet and dry methods), sunil, igetan, APK, and LSU. Moreover it is producing experimental lots of OL-2 and BP-100 reagents, new drilling preparations, and other products.

The methods used for chemical processing of hydrolytic lignin at the plant can be subdivided into two groups: 1) Modification; 2) destruction coupled with utilization of total acquired products, without their separation.

Qualified utilization of lignin was initiated in 1961, when our collective began obtaining nitrolignin by the wet method jointly with the USSR Academy of Sciences Institute of Organic Chemistry (Prof N. N. Shorygina's laboratory). In 17 years the nitrolignin production operation has transformed from an experimental to an industrial operation. The output of this product has been increased by dozens of times. But the demand considerably exceeds our possibilities, since the shop's capacity does not permit production of more than 60 tons of this valuable product per month. In our search for a solution together with the Uzbek SSR Academy of Sciences Institute of Chemistry we developed a modified, so-called dry method for obtaining nitrolignin. It allowed us to significantly increase production while maintaining the same qualities of the product, and to raise the output to 600 tons per month at a very high profitability. Nitrolignin produced by the shop is exported to Pakistan, Vietnam, and other countries.

Today the plant cannot even partially satisfy the national economy's demand for this product. Its production must be expanded by utilizing the modern achievements of technology and chemical machine building.

Working together with the geology department of Patrice Lumumba University, the plant developed and introduced the procedure for obtaining sunil out of nitrolignin. Sunil has a number of advantages over nitrolignin. But because the former is a liquid product, and is not convenient to transport, jointly with the Moscow Institute of Petrochemical and Gas Industry imeni Gubkin the plant organized production of igetan, a new product having the form of a paste, but with the same properties. The plant produced 1,680 tons of igetan in 1977. But this could satisfy only a small part of the national economy's consumption. We must dramatically increase production of igetan on the basis of the latest technological achievements.

Since 1976, the plant has been working jointly with the lignin chemistry laboratory of the All-Union Scientific Research Institute of Hydrolysis Industry tc acquire APK (ammonium polycarbonic acids)--yeast, microorganism, and agricultural crop growth stimulants. The high effectiveness of APK was confirmed by many years of agricultural experimentation in different soil and climatic zones and with different crops.

APK was used as the basis for creating the procedures for obtaining bulk lignostimulatory organic fertilizer (LSU). Today the plant ships 200-300 tons of LSU per year to fill the orders of agricultural organizations, but once again this is only a very small part of agriculture's total demand. Unfortunately the existing semi-industrial unit cannot satisfy the growing demands of agriculture. LSU production must be expanded to a scale satisfying the demand.

The table below provides data on the output volumes of the principal products of our plant's experimental shop.

(1) Наименование продукции	(2) Выпуск продукции, т												
	(3) 7-я пятилетка (1961–1965 гг.)		(3) 8-я пятилетка (1966–1970 гг.)		(3) 9-я пятилетка (1971–1975 гг.)		(3) 10-я пятилетка						
							1976 г.		1977 г.		1978 г.	1979 г.	1980 г.
	план (4)	фактически (5)	план (4)	фактически (5)	план (4)	фактически (5)	план (4)	фактически (5)	план (4)	фактически (5)	план (4)	план (4)	план (4)
Нитролигнин общий (6)	2200	2785	9550	11730	19700	22600	5500	6813	6550	7733	6800	7000	8000
В том числе товарный (7)	1415	1420	4075	4210	11380	13818	3500	4150	4140	4604	4300	4500	4880
Сунил в пересчете на абс. сухой (8)	390	804	2990	3767	2200	1923	100	221	200	217	100	100	100
Игетан в пересчете на абс. сухой (9)	—	—	—	283	2950	4482	1100	1384	1250	1680	1400	1600	1800
АПК в пересчете на абс. сухой (10)	—	—	—	41,4	—	22	—	—	—	—	—	—	—
ЛСУ (11)	—	—	—	115	—	220	—	135	—	102	300	500	500
ОЛ-2 (спец. реагент) (12)	—	—	—	—	—	—	—	—	10	10	90	—	—
Реагент БП-100 (13)	—	—	—	—	—	—	—	—	—	5	100	—	—

Key:
1. Product
2. Product output, tons
3. Five-year plan
4. Planned
5. Actual
6. Total nitrolignin
7. To include salable
8. Sunil, corrected for absolutely dry weight
9. igetan, corrected for absolutely dry weight
10. APK, corrected for absolutely dry weight
11. LSU
12. OL-2 (special reagent)
13. BP-100 reagent

Presently the experimental shop is using 2,000-3,000 tons of absolutely dry lignin per year, which is only 12-15 percent of the total quantity available at the plant. All obtained lignin is to be processed in the future.

Despite the stiff requirements of the plan, work aimed at obtaining new lignin processing products is constantly going on in the experimental shop. Plant and shop colleagues are full members of all creative explorations. We recently received two inventor's certificates. Fourteen efficiency proposals have been submitted.

The collective of the experimental shop, which joined the socialist competition in honor of the 60th anniversary of Great October, has won first place in the plant five times and second twice. In June 1978 the workers of this shop completed the plan for 3 years of the five-year plan.

Celebrating the 25th anniversary of our plant, we must give proper credit to its mechanical service, without which it would have been impossible to complete even a single task posed to the collective.

The senior mechanic's section and shop mechanical services have completed a number of major projects in the last 3 years in cooperation with the plant's design office, as a result of which production of furfural and its derivatives, nutrient yeast, and lignin products has increased significantly. These projects include: Assembly and bracing of a yeast-growing apparatus with a decentralized air distribution system, and of a TV-175/1.6 turboblower; installation of a TsRM-12/75-800shch centrifugal sprayer in the yeast drier; reconstruction of flotation tanks in the yeast shop in cooperation with the All-Union Scientific Research Institute of Hydrolysis Industry; assembly of a main furfural column with a diameter of 2,200 mm; assembly of two six-section fractionating column batteries and two pipelines conveying furfural-containing vapors into reheaters; replacement of worn reheaters with a heat exchange surface area of 150 m^2, and assembly of two new reheater batteries; reconstruction of raw material wetting screw conveyors; replacement of the firebox and rear heating surfaces of three medium-pressure steam boilers (pressure--36 kg/cm^2, productivity--22 tons/hr); assembly of two metallic containers for fuel oil storage, each with a 1,000 m^2 volume.

The best people of the plant, who have earned government awards, were examples in the implementation of all organizational and technical measures. The collective is rightfully proud of Cavalier of the Order of the October Revolution tinsmith B. Abdullayev; Order of the Red Labor Banner recipients cooker V. P. Khvan, instrument controllers S. Ye. Malakhov and A. Rakhmatulina, and engineer D. M. Igoshin; Order of the "Badge of Honor" recipients director A. A. Pavlov, mechanic P. Mamirov, cooker Sh. Khashimov, and instrument controllers I. Dadakhanov and A. Ismanov; Order of Labor

Glory, 3d Degree recipients V. I. Doroshenko and G. I. Selina, workers in the furfural-hydrolysis shop; "For Labor Valor" medal recipients electrician A. I. Pletnev, engineer P. S. Davydov, and instrument controllers F. Churayev and R. T. Mullagaliyeva; "For Excellence in Labor" medal recipients instrument controllers V. A. Shchegoleva, S. A. Golikov, and R. Kirichenko, mechanic N. V. Romanov, foremen Ye. V. Podkhlebnoy and M. Irmatov, and electrician S. I. Pereyaslovets. The Presidium of the Uzbek SSR Supreme Soviet awarded honorary certificates to engineer P. S. Davydov and instrument controllers S. Ismanov and R. T. Mullagaliyeva.

Two and a half years of the 10th Five-Year Plan are now behind us. Our plant collective has successfully completed its current assignments in relation to the output of its prinicipal products. It is fully resolved to mark the 10th Five-Year Plan with highly productive, truly shock labor.

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INDUSTRIAL MICROBIOLOGY

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IMPROVING THE SYSTEM FOR CONTROLLING MAINTENANCE OF PRODUCTION CONDITIONS

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 6, 1978 pp 16-18

[Article by Engineer V. Ya. Ivanova, Tavda Hydrolysis Plant]

[Text] Much attention is being devoted at the Tavda Hydrolysis Plant to upgrading product quality and increasing labor indices in every production section and at every workplace.

Improvements in the equipment and production processes have played an important role in upgrading product quality. Thus inversion units, new settling tanks, vacuum coolers, and vacuum evaporators have been put into operation, and neutralysate aeration, a system for obtaining chemically pure rectified alcohol with a five-column apparatus, biological oxidation of mash following yeast separation, and other processes have been introduced.

But no improvements can achieve the required results if the parameters of the production processes are not strictly maintained. This is why a great responsibility lies with researchers working on concrete process control projects and shift foremen who monitor compliance with production conditions.

A system monitoring maintenance of production conditions has been in its introduction stage at the plant for 5 years. It is being improved more with every year: New forms of monitoring are being introduced, and the methods for transmitting monitoring results to controllers are being improved. A daily system for monitoring all stages of hydrolysis and yeast production operations has been introduced. This system is based on monitoring and measuring instrument record sheets and on laboratory analysis notes entered into the production logs. Since the integrated product quality control system has been introduced, the procedures for determining the quality of each laborer's work and the methods of error-free work have been formulated and are presently being introduced. In both the hydrolysis and the yeast production operations work quality is being evaluated on the basis of five coefficients, one of them being the coefficient of production process violation. In the hydrolysis production operation the violation coefficient is computed at all stages of the production process.

As an example in the cooking department, to permit computation of the production process violation coefficient we have singled out the main parameters of the hydrolysis conditions upon the maintenance of which the yield of reducing agents from the cooking stage and the quality of hydrolysate depend. Table 1 shows the norms for the production conditions.

Table 1

Process Parameter	Normal Conditions	Permissible Deviation	Information Source
Sulfuric acid dosage (a_1), liters	50	±5	Record sheet of instrument recording acid level in measuring gauge
Dosage of acid for percolation (a_2), liters	145	±10	"
Time of pressure increase (a_3), min	40	-5	Recording pressure gauge
Bleeding at excess pressure* (a_4), kg/cm^2	5	-1	"
Excess pressure in first 20 min of percolation (a_5), kg/cm^2	6-7	—	"
Excess pressure in hydrolysis apparatus during second half of percolation (a_6), kg/cm	12	-0.5	"
Weighing device readings every 20 min of cooking (a_7), tons	1 ton decrease	±1	Record sheet of recording weigher
Water consumption (a_8), m^3:			
for percolation and washing	55	±3	Water gauge record sheet
for loading	10	+2	"

*The process cannot be performed without bleeding.

The following formula is used in the computations:

$$K_v = \frac{a_1 + a_2 + a_3 + \ldots + a_n}{nc},$$

where K_v is the coefficient of production process violation, a-a_n are the numbers of production condition violations in relation to specific parameters, n is the number of parameters being monitored, and c is the number of cooking cycles per shift.

The work of the shift is said to be unsatisfactory when gross violations of the production conditions occur (double discharge into blow pit, entry of acid into hydrolysis apparatus without water, splash-over of hydrolysate entering the evaporator, increase of cooking pressure above 12 kg/cm^2, emergency situations arising at the fault of the cooker). In this case K_v is not computed and the overall work quality coefficient for the month is decreased by 0.5. When the conditions for feeding loading water are violated (below 10 and over 12 m^3), or when the acid feed rate is irregular the production process violation coefficient is increased by 0.1 for every violation. The work quality coefficient (K_v) for the month is decreased correspondingly by 0.1. Practice has shown that introduction of this monitoring method has made it possible to reduce the number of production process violations. Thus violations concerning the amount of water and acid delivered in the loading stage and concerning the rate at which acid is delivered for percolation have dropped to a minimum.

For 4 months of 1977 (since the time the new monitoring system was introduced) K_v was 0.15 for the cooking department, which is the main production section.

The best work quality indices were achieved by the team led by A. N. Izyumenko, a cavalier of the Order of Lenin and the Order of Labor Glory, 3d Degree. The RV [reducing agent?] yield following the cooking stage was 2,032 kg (1,900 kg was planned), 21,000 rubles were accumulated in the team's 1977 personal account, and $K_v = 0.135$. The K_v figures for other production sections were as follows:

Neutralization station	0.161
Settling unit	0.062
Cooling station	0.251
Fermentation department	0.160
Mash distillation department	0.130

The production process violation coefficient is computed in the yeast shop for workers in the principal occupations. They include the settling unit and heat exchange, pure yeast culture growing, biomass cultivation, and vaccum evaporation unit operators, the separator operator, the spray drier furnace fireman, the drier operator, and the yeast packer.

Table 2

Index	Number of Deviations	Standard Coefficient	Coefficient Computing Formula	Remarks
Violation of yeast-growing apparatus temperature conditions (required conditions--37-39°C)	C_1 (for the shift)	-0.01	$-0.01C_1$	Every deviation of data on the record sheet within a 1 hour interval increases K_v by 0.1. When temperature is above 40°C (K_v-1.0) the work of the shift is said to be unsatisfactory, and the month's K_w is decreased by 0.4
pH of medium in yeast-growing apparatus (less than 4.2 or above 4.5, for each case)	C_2 (total analyses for the shift)	-0.01	$-0.01C_2$	In cases of gross pH violations (below 3.8, above 5.0), K_v-1.0, and the month's K_w is decreased by 0.3
Yeast concentration in yeast-growing apparatus, ±5 gm/liter deviation from rated value	C_3 (for each analysis)	-0.01	$-0.01C_3$	In cases of gross violations (yeast concentration below 15 and above 30 gm/liter), K_v-1.0, and the month's K_w is decreased by 0.3
Residual RV concentration above 0.12 %	C_4 (total analyses for the shift	-0.01	$-0.01C_4$	In cases of gross violations (RV above 0.20%), K_v-1.0, and the month's K_w is decreased by 0.2
Residual P_2O_5 concentration below 0.069 and above 0.160 gm/liter	C_5 (for each analysis)	-0.02	$-0.02C_5$	In cases of gross violations (P_2O_5 less than 0.0 and above 0.2 gm/ /liter), K_v-1.0, and the month's K_w is decreased by 0.2

[Table continued on following page]

Table 2 [Continued]

Index	Number of Deviations	Standard Coefficient	Coefficient Computing Formula	Remarks
Nitrogen concentration in average sample of mash leaving flotation tank not less than 0.1 gm/liter	C_6 (for every 0.01 gm/liter below 0.1 gm//liter)	-0.02	$-0.02C_6$	Analysis of average shift sample
Loss of yeast from flotation tank above 2 gm/liter	C_7 (total analyses for the shift)	-0.02	$-0.02C_7$	Loss of yeast from flotation tank above 3 gm/liter is said to a gross violation, K_v-1.0. The shift's work is said to be unsatisfactory, and the month's K_w is decreased by 0.1
Oxidizability of waste water in yeast shop's drains not above 1,500 mg-O_2/liter	C_8 (for every 100 mg/liter excess)	-0.02	$-0.02C_8$	When oxidizability is above 1,600 mg-O_2/liter the violation coefficient is increased by 0.5 for the shift, and the month's K_w is decreased by 0.1 for every gross violation. When the average analysis is above 1,600 mg-O_2//liter, K_w is decreased by 0.3

Note: When the computed absolute value of K_v is 1.0, the work of the shift is said to be unsatisfactory. The following formula is used to compute K_v:

$$K_v = -(0{,}01C_1+0{,}01C_2+0{,}01C_3+0{,}01C_4+0{,}02C_5+0{,}02C_6+0{,}02C_7+0{,}02C_8).$$

A table demonstrating computation of K_v for the yeast-growing operator is presented as an example (Table 2).

The figures obtained for pH, yeast concentration, and residual RV obtained at the beginning of the shift are used in the computations for the previous shift; the figure determined for the residual P_2O_5 quantity is used in the computations for the following shift.

As a result of strict observance of the production conditions, in 1977 the yield of yeast from RV was 48.8 percent, 45 percent being planned. As a result of economizing materials and chemicals, the yeast producers accumulated 464,000 rubles in their personal account and 350 tons of nutrient yeast were produced in excess of the plan.

This work method is also being introduced into other production sections and into the shop repair teams.

Observance of production conditions and compliance with this work method are the main indices used in summarizing the results of the socialist competition between teams and shifts. These data are also the basis for awarding the "Best Worker in Occupation" title.

Much significance is attached at the plant to visual publicity on the results of monitoring strict compliance with production process conditions. "Quality Nooks" have been set up at the workplaces. Violations in production process conditions are discussed in daily 5-minute breaks and in work experience exchange schools.

The method for monitoring compliance with normal production conditions in all stages of the principal production operation has been introduced into the work of the process engineering division. The monitoring schedule is drawn up for the year and approved by the senior engineer. Remarks concerning violations and concrete proposals for improving the production process are recorded in a special shop production discipline violation log. The workers and shift foremen are made aware of these remarks. Correction of deficiencies stated in these remarks is monitored.

On Quality Day a complete analysis is made of the production discipline violations committed in the last month, and concrete proposals concerning elimination of the existing shortcomings are submitted.

Introduction and improvement of the production conditions monitoring system is promoting not only an increase in the yield of yeast and RV from the cooking stage and improvements in the quality of substrates and the end product, but it is also increasing the responsibility of every laborer for precise completion of his functions in the production operations. In the end, all of this improves the enterprise's technical-economic indices and promotes its rhythmic operation.

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NUTRIENT PROTEIN ACQUISITION IN CEMA COUNTRIES

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian, No 6, 1978 pp 25-27

[Article by Cand Tech Sci V. S. Minina, Cand Biol Sci M. Ya. Andrusenko and L. I. Ignat'yeva, and Cand Chem Sci E. G. Mirzanyanova, (ONTITEImikrobioprom) and (VNIIsintezbelok)]

[Text] Industrial production of nutrient protein by the method of microbiological synthesis has been given the most important role in recent years in supplying nutrient protein to animal husbandry. The reason for this is that microbiological synthesis permits us to process various forms of nondietary raw materials, wood and agricultural wastes in particular.

Nutrient yeast obtained by this method is a natural bioconcentrate because in addition to protein it contains a complex of vitamins and other biologically active compounds.

The first patents on continuous yeast growing processes making use of carbohydrate mediums were awarded in Germany, Hungary, and Denmark as long ago as in 1915-1920, but it was long before these methods enjoyed practical implementation.

Presently many countries are producing unicellular protein with carbohydrate substrates. The principal raw materials used are the wastes of wood processing industry and agricultural plant wastes, the polysaccharides of which are transformed by hydrolysis into sugars that can be assimilated by microorganisms; sulfite liquor and wastes from food processing, starch, winemaking, and alcohol production operations are also important.

The CEMA countries are devoting a great deal of attention to developing the methods for producing nutrient yeast with carbohydrate-containing mediums, orienting themselves on raw materials present in sufficient quantities in each of the countries. Because the demand for nutrient protein is not being fully satisfied by production operations within these countries, each year they are forced to import mill cake, grist, and milling bran (2.5-3 million tons) and fish meal (200,000-250,000 tons) from other countries.

Moreover they import large quantities of soy meal, synthetic amino acids, vitamins, nutrient antibiotics, and so on. This is why development of nutrient protein production is quite validly said to be one of the most urgent priority tasks (1).

Considering the urgency of solving the protein problem, we must concentrate our attention mainly on hastening mobilization of available reserves that can be utilized without special expense by practically all CEMA countries. One such reserve is growth in production of nutrient protein of microbial origin.

The Peoples Republic of Bulgaria--a country with well developed agriculture--possesses large quantities of agricultural wastes. Two hydrolysis-yeast plants built on the basis of Soviet plans have been operating in Bulgaria since 1964. *Candida* and *Trichosporon* yeasts are used as the producers. Nutrient protein production will increase by about 4.8 times during the Seventh Five-Year Plan. The capacities for producing nutrient yeast using wood waste and the wastes of agriculture and food and chemical industry will increase by several orders of magnitude (2). Future nutrient protein production in Bulgaria is characterized by the following figures: By 1985--150,000-200,000 tons; by 1990-2000--300,000-400,000 tons per year (3). Two facilities with an output capacity of 10,000-15,000 tons per year, producing nutrient yeast from the waste of sugar and alcohol production, are to be built during the Seventh Five-Year Plan (4). There are plans at the Sviloza Chemical Combine to obtain about 5,000 tons of yeast and 1,000 tons of furfural per year from aqueous prehydrolysates formed during pulp cooking, thus concurrently solving the problem of environmental protection (4).

The Hungarian Peoples Republic uses wastes from alcohol production to obtain nutrient yeast. Out of the total volume of nutrient yeast produced, 70 percent is obtained as biomass separated from fermented molasses, and 30 percent is grown on alcohol production wastes not containing alcohol and yeast.

In the first case, where alcohol is produced out of molasses in fermenters with a 1,000-1,200 m^3 capacity, the yeast concentration is 1.0-1.2 percent. The yeast is separated in separators produced by the Al'fa-Lavan' Company, and the biomass is washed, thickened to a 25-percent concentration, and dried in a drum drier. The dry yeast yield per 100 liters of alcohol produced is 12-16 kg, and the protein concentration of the end product is 45-50 percent. The cost of producing such yeast is low, since it is a byproduct of the principal--alcohol--production operation.

When *Candida* or *Torula* yeast is grown on molasses residues following alcohol production, nutrient salt must be added to this medium. A continuous cultivation method is being employed in fermenters of the French Soris Company. The yeast is separated in separators and dried in driers produced by the Niro Atomayzer Company. The protein concentration in the end product attains 50 percent. The volume of yeast produced with alcohol production wastes is limited by the output capacities of the alcohol plants, and it is not exhibiting any indications of a significant increase.

Nutrient yeast can also be obtained with the use of corn processing wastes, low-grade raw food materials not utilized in other production operations, and meat production wastes, animal fats in particular. The Central Scientific Research Institute of Food Industry in Budapest is conducting research on cultivation of yeast using plant and animal fats at laboratory and industrial scales (in 39 m^3 fermenters of the Fogel'bush Company). Its amino acid composition and biological value are typical of nutrient yeast (5). In this case 1-1.1 kg of nutrient yeast with a protein concentration of 45-50 percent are obtained from 1 kg of fat. Development of this method is creating the basis for fuller utilization of livestock products, since just in Hungary alone the quantity of wastes at slaughterhouses attains 40,000 tons per year (6).

Hungarian scientists have developed and patented a unique method for obtaining protein concentrates from the green parts of feed plants. The method, called "Vepeks," entails separation of protein from leaf sap under the influence of high temperature. A high protein yield is a merit of this method. For example up to 7 tons of protein can be obtained per year from one hectare of alfalfa (7). The Vepeks Kontraktorz Company, which was founded in the country's west, in the city of Tatabanya, has the purpose of disseminating this method for obtaining protein feed concentrate in Hungary and abroad. One plant working in Hungary produces protein concentrates from alfalfa and various grasses using this method. The protein product is sold abroad at soy prices (8).

Processing of cellulose-containing raw materials is presently not foreseen in Hungary, since this would require acquisition of expensive equipment and materials.

The German Democratic Republic does not possess large resources of carbohydrate-containing raw materials. Molasses, molasses residues, and sulfite liquor are used in yeast production. *C. utilis* yeast serves as the biomass producer. Fermentation apparatus at these plants is represented by Mammut, Val'dkhof, Friks, and Fogel'bush fermenters and spray apparatus. Vacuum evaporators and falling-film apparatus are used to evaporate the yeast suspension. The product is dried in roller units or in spray driers produced by the Niro Atomayzer Company.

The Republic of Cuba, which grows sugar cane, possesses large amounts of cellulose-containing wastes that are used for nutrient yeast production. There is a plant on the republic's territory producing *Torula* yeast using sugar cane molasses. Nutrient yeast is also grown with alcohol plant wastes. By 1980 another few plants producing yeast from molasses are to be built in Cuba. Plants purchased from the French Speyshem Company will be supplied with Lefransua-Merrilen fermenters, Al'fa-Laval' separators, Vegando evaporators, and Niro Atomayzer driers, while plants purchased from the French Schoyeller Blekman Company will be outfitted with Fogel'-bush fermenters, Al'fa-Laval' separators, and Angidro evaporators (9). Methods for acquiring nutrient yeast from the solid wastes of sugar production by hydrolysis and direct utilization of sugars are being studied. Commissioning of these plants in the future will make it possible to increase production of nutrient yeast from sugar cane processing wastes by more than 8 times.

Nutrient protein production reaches 20,000 tons per year in the Polish Peoples Republic (10). The bulk of this production consists of yeast obtained from alcohol distillery grains by a method developed by East German specialists. Starch and lignocellulose wastes, the reserves of which are large in the country, can become an important source of raw materials for Poland. The problem of obtaining biomass of some molds using cellulose and lignin has been studied. Solving the problem of decomposing lignin has important significance, since a lignin concentration greater than 5 percent makes it difficult for microflora to function in the stomach of ruminants. Wood wastes, which total 1 million tons per year in Poland, might become an important protein source.

Industrial waste water also serves as a specific substrate for biomass acquisition. Active sludge obtained from treatment of waste water from molasses residue fermentation in aerobic conditions has a protein content of 50-60 percent (10).

The Institute of Fermentation Industry is conducting research on the growing of yeast in sugar plant molasses. A productivity of 1.35 kg dry yeast per cubic meter of apparatus volume per hour has been achieved in the existing production conditions. The institute is also studying the problems of treating the waste water of this production operation together with domestic wastes with the end goal of acquiring active sludge. When this method is used, over 93 percent of the organic contaminants are removed from waste water (11). The sludge formed contains up to 50 percent protein, which can be used as animal feed.

The Socialist Republic of Romania is producing nutrient yeast from plant hydrolysates. Specialists at the Romanian Scientific Research and Planning Institute of Wood Processing Industry have developed a new method for producing nutrient yeast using the wastes of wood processing industry enterprises. The method has been tested successfully at a pilot plant. Eight wood processing combines are being outfitted with nutrient yeast-growing units employing the new production process; the output capacity of each of them is the to 1,500 tons per year (12).

Production of nutrient protein in the Czechoslovakian Socialist Republic exceeds 15,000 tons per year, which includes 7,000 tons obtained through sulfite liquor processing and 8,000 tons obtained from distillery grains of alcohol plants and citric acid production wastes. Sulfite liquor is believed to the best raw material source in Czechoslovakia; by processing it, the country could increase yeast production in the future to 50,000 tons per year. *C. utilis* and *C. lipolytica* cultures are used as the biomass producers (13).

The principal equipment (separators, driers, evaporators) used in yeast production is imported. Tests are presently being run on a Czechoslovakian drier with a productivity of 2.2 tons of evaporated moisture per hour, and on a fermentation apparatus employing mechanical mixing produced by the Czechoslovakian Khepos Company.

A cellulose production plant at which yeast production out of sulfite liquor will be organized is to be built in the city of Pacov.

Straw and wood chips are a potential raw material for nutrient yeast production in Czechoslovakia. The Liko Industrial Association is planning to produce nutrient yeast from wood processing wastes. The prices on wood chips and bark are very low in the country since only the shipping expenses are considered. By 1980 the annual quantity of these wastes will attain 1 million tons. A variant of microbiological wood-cellulose waste processing having nutrient yeast, alcohol, glutaminic acid, and others as the end products has been developed for the Slovik Plant in (Leopol'-dov).

Effective ways for hydrolyzing wastes and the methods for preparing them for direct feeding of animals are also being developed. Experimental feeding of filtered biological sludge having a protein concentration of 35-45 percent to animals for 5 years produced positive results (14). A method has been proposed for processing fine cellulose fibers unsuited for paper and cardboard production into nutrient yeast. The fibers are separated from waste water by filtration or settling, and they are subjected to fermentative hydrolysis with the help of the filtrate of liquid in which *Trichoderma viride*, a cellulase producer, had been cultured. The hydrolysates are used to grow *C. utilis* and *Cryptococcus aifluens* yeasts. Together with the substrate residue, the biomass is dehydrated and dried. The end product contains up to 20 percent protein (15).

A method for growing nutrient yeast in sugar beet processing wastes has been developed jointly with East German scientists. According to tentative estimates this method can produce 3.5-4 tons of protein from a hectare of sugar beets. Absence of waste water is an advantage of the method.

Hydrolysis industry in the Soviet Union is presently responsible for about 50 percent of the entire output of nurtrient yeast, which is being used successfully to intensify livestock production.

In the very near future, on the basis of specialization and concentration of production the livestock farms will be transformed into industrial enterprises producing meat, eggs, milk, and wool. Feed quality and the physiological completeness of the feed ration are acquiring decisive significance to maintaining high animal biological productivity. The quality of the feed ration can be raised to the required level only on the condition that nutrient yeast, vitamins, microelements, and other substances are introduced into the animal ration. Thus the main task of hydrolysis industry in the 10th Five-Year Plan continues to be to significantly increase the production volume, improve quality, and reduce production costs by introducing additional high-output plants outfitted with high-output machine units, and by intensifying production through extensive introduction of new equipment.

The prototypes of continuous-action apparatus for continuous one-stage and two-stage hydrolysis of plant raw material are to be tested in production conditions in the very near future; the productivity of this appartus is 12 tons of absolutely dry wood per hour. When compared with the periodic process, continuous hydrolysis in such apparatus can increase the concentration of the obtained sugars (by 2-2.5 times) and the size of the batches obtained, decrease consumption of steam, energy, and chemicals, and reduce production cost by 20-30 percent.

Such hydrolysis apparatus will be supplied to new high-output plants, and conversion of periodic-action apparatus to continuous operation will begin. This will make it possible to convert the entire sector to continuous hydrolysis within a short time and with lower capital outlays (16).

Fermenters characterized by intense mass exchange, multiple-body evaporators, highly productive driers, and other equipment will be installed at the hydrolysis plants, and hydrolysis industry's first automated production process control system (ASUTP) will be introduced at the Kirov Biochemical Plant.

As a result of improving yeast production, introducing high-yield strains, and implementing other measures, the average total protein concentration in yeast will increase to 55-60 percent, and the yeast yield from RV [reducing agent?] will attain 54 percent (16).

The bulk of the feed yeast is to be enriched with biologically active compounds (amino acids, vitamins, antibiotics, microelements) and supplied in the form of yeast additives.

Production of nutrient hydrolytic sugar (syrup), synthetic milk substitute, fructose-glucose syrups, and other substances is to be started.

We can conclude from this that the problem of satisfying animal husbandry's demand for nutrient protein is equally pressing to all CEMA countries.

Cooperation among specialists from the fraternal countries will make it possible to reveal new forms of raw material from which to produce nutrient protein, and to create the procedures for processing these raw materials with a consideration for the best experience of the CEMA countries and the achievements of world science and practice.

Future cooperation in this area may develop in the direction of production of amino acids, nutrient vitamins, antioxidants, and other feed additives, and it may include joint construction of production capacities necessary for satisfying the feed additive demand of the CEMA countries.

BIBLIOGRAPHY

1. Chanayda, E., "Cooperation Among CEMA Countries in Solving the Nutrient Protein Problem," MEZHDUNARODNYY SEL'SKOKHOZYAYSTVENNYY ZHURNAL, No 4, 1977, p 25.

2. Cherkezov, I., "The Feed Problem and the Perspectives of its Solution in Bulgaria," MEZHDUNARODNYY SEL'SKOKHOZYAYSTVENNYY ZHURNAL ,No 4, 1977, pp 30-34.

3. G"bev, A., Vasil'yev, A., and Stoychev, M., "Proyzvodstvo na prmyshlen edinoklet"chen protein (PEP) ot nekonventsialki surovinni iztochnitsi (bioinzheneren i tekhniko-ekonomicheski analiz)," Sofia, 1976.

4. Komitetski, V., "Increasing Production of Synthetic Protein Components," ZHIVOTNOVODSTVO, No 4, 1976, p 36.

5. Szecheniy, E., Simek, F., and Karpati, G., "Produkcja drozdzy pokarmowych na tluszczach zwierzecych i roslinnych," PRZEMYSL FERMENTACYINY I ROLNY, No 2, 1977, p 31.

6. BERLINER ZEITUNG, 7 January 1974.

7. Waskiewicz, A., and Szymanska, B., "Preparaty biaekowe z zielonych szesci roslin," PRZEMYSL FERMENTACYINY I ROLNY, No 2, 1977, p 19.

8. INDUSTRY UND HANDELS REVUE, No 51, 1976, p 632.

9. PRZEMYSL FERMENTACYINY I ROLNY, No 1, 1977, p 16.

10. Labendzinski, S., "Zajist ovani meme beznych surovin na vyroby krmne biomasy," KVASNY PRUMYSL, No 11, 1976, p 250.

11. PRACE INSTITUTOW I LABORATORIOW BADAWCZYCH PRZEMYSLY SPOZYWCZEGO, Vol 26, No 1, 1976, pp 25,43.

12. FUTTERHEFE AUS ABWASSERN. WASSERWIRTSCHAFT UND WASSERTECHNIK, Vol 26, No 5, 1976, p 168.

13. Patent No. 2288147 (Czechoslovakia). "Aerobic Microorganism Cultivation Method." Published 18 April 1976.

14. Abber, W., "Muhlberg Konferenz uber Perspektivische Richtungen in der Verwertung fester, flussiger und gasformiger Abfallstoff," ZELLSTOFF UND PAPIER, Vol 25, No 1, 1976, p 20.

15. Barta, J., "Die Verarbeitung des biologischen Schlammes zu Futtereiweib," PAPIR A CELULOZA, Vol 31, No 9, 1976, p 193.

16. Kozlov, A. I., and Epshteyn, Ya. V., "Hydrolysis Industry in the 10th Five-Year Plan," GIDROLIZNOYE PROIZVODSTVO, Vol 84, No 6, 1976, p 1.

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INPRODTORGMASH-78--EXHIBITION REPORT

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 6, 1978 pp 30-31

[Article by B. L. Smolyakov]

[Text] During the time that the July (1978) CC CPSU Plenum was in session, discussing the problems of agricultural development, Soviet machine builders displayed technical innovations for industrial food sectors, trade, and public food services at Sokol'niki Park in Moscow. The USSR had the largest exposition in the international Inprodtorgmash-78 Exhibition, in which the companies and associations of 23 countries participated. Its displays contained equipment for enterprises of breakbaking, sugar, dairy, oil, cheese, meat, and oil-and-fat industry.

Microbiological industry, which Comrade L. I. Brezhnev numbered in his report to the July CC CPSU Plenum among those specialized, independent, and large sectors which had not existed before, also demonstrated its potentials for producing goods for the public, and its contribution to solving the protein problem.

Visitors to the exhibition could acquaint themselves with a process for producing crystalline xylate, nutrient sorbitol, and mannitol, with a model of the B-50--a microorganism growing apparatus, with the apparatus and processes used in the production of pectolytic enzyme preparations, with a process for utilizing biomass when culturing pectolytic enzyme producers, and with the characteristics of products of microbiological industry--P-10Kh (pectofoyetidin), (amilorizin), (dekaren), G-10Kh amylosubtilin, (kormogrizin), (batsilikhin), (vitamitsin), vitamins B_2 and B_{12}, acidophilus, monocarbonic acid, nutrient yeast, etc. These products are enjoying a constantly increasing demand in meat, feed, canning, winemaking, brewing, baking, and starch-syrup production operations.

The CC CPSU and USSR Council of Ministers decree "On Further Development of the Production of Feed Additives, Plant Protection Resources, and Other Products of Microbiological Industry in 1978-1985," approved by the July (1978) CC CPSU Plenum, contains an elaborate program for raising production of nutrient protein, amino acid, premixes, enzyme preparations, nutrient antibiotics and vitamins, microbiological plant protection agents, and bacterial fertilizers in 1978-1985.

The Ministry of Machine Building for Light and Food Industry and Household Appliances, the enterprises of which provided the greater part of the exhibits in the Soviet section of the Inprodtorgmash-78 Exhibition, is numbered among the ministries ordered to manufacture the appropriate equipment for microbiological industry.

During the time of this exhibition specialists had the possibility for seeing models of highly productive machines and units characterized by high unit output capacity. Improved separators, driers--particularly those used to pulverize and dry baker's yeast, and evaporators used in sugar industry were of doubtless interest to workers of hydrolysis industry. Thus the VAG-3000 apparatus thickens sugar-containing juice, evaporating the water from it. It is unique in that it has an all-welded body with a built-in secondary steam separator. The obtained syrup is then cooked in a VAV-60 vacuum apparatus, which is distinguished by forced circulation of the product as it is cooking. Right next door the visitor can inspect the OGSh-321K-5 and FPN-1251-5 continuous-action automatic centrifuges intended for separation of sugar crystals from intercrystalline syrup within the centrifugal force field.

Soviet and foreign specialists were attracted by Soviet apparatus used to dry bulk products in a so-called vibration-induced fluidized bed. Intense mixing results from vibration of the grid and an ascending current of hot air. In the opinion of specialists, creation of devices (also making use of active hydrodynamic conditions) which would make use of the principle of spiraling a biphasal current is also a promising direction. One such drier, the Al-VGS, consists of a drying chamber, two ventilator-radiator stations, a pulverizer, cyclones, and exhaust fan, and a monitoring and control panel. There are four boxes one on top of the other in the drying chamber. The two pairs of boxes vibrate vertically in opposite phase, as a result of which full balance of the vibrating mass is achieved. The vibration frequency is 350 cycles per minute. How, for example, is yeast dried in them? After being pressed through a 2.5 mm diameter die, it is cut by a knife mechanism into individual granules which are then sent to the drier. The thickness of the layer during drying is 100 mm. The temperature of delivered air is maintained and the temperature of spent air is monitored automatically in each drying box. Such drying machine units, according to their designer--the All-Union Scientific Research and Experimental Design Institute of Food Machinery--are characterized by high effectiveness, and they are favorably distinguished by working reliability and simplicity of manufacture and operation.

Visitors of all sexes and ages--not only Soviet but also foreign, including some from faraway Australia, observed with interest the work of the Al-IIU unit, which produces protein-rich imitation roe, a new food product that was first developed in the USSR. This rival of sturgeon roe is made from milk protein, gelatin, and vegetable oil. It contains vitamins and micro-elements. It is very similar to sturgeon roe in appearance, nutritional value, and taste. All of the complex processes of the Al-IIU unit are fully mechanized and automated. This innovation was created by the USSR Academy of Sciences Institute of Elemento-Organic Compounds and the All-Union Scientific Research and Experimental Design Institute of Food Machinery. Some of the industrial imitation roe production units are operating at one of the Moscow enterprises.

Enterprises and organizations of 11 ministries and departments participated in the preparations for the Soviet exposition, and about 700 exhibits were displayed. Five CEMA countries (Bulgaria, GDR, Hungary, Poland, Czechoslovakia) and Yugoslavia took an active part in the exhibition. The exposition of the socialist countries was a clear demonstration of the fruitful result of scientific-technical cooperation among CEMA countries aimed at creating new equipment and production processes for the food sectors of industry, trade, and public food services. Cooperation is presently based on contracts with about 90 scientific research and planning-and-design organizations.

The displays sponsored by Austria, Australia, FRG, Great Britain, Denmark, Spain, Italy, Columbia, Liechtenstein, The Netherlands, Norway, USA, Finland, France, Sweden, and Japan were dominated by food dressing and packaging equipment, wrapping machines, filling machines, metering machines, driers, machinery and machine units for vegetable canning and food concentrate industry, and weighing instruments and devices.

Scientific symposiums were held, lectures and reports were given, and press conferences dedicated to the national days of the companies representing particular countries were held concurrently with the exhibition. Representatives from foreign companies and associations said that they viewed participation in the international review in Moscow as a new possibility for establishing and strenghthening scientific-technical and commercial ties in the spirit of the closing document of the All-Europe Conference in Helsinki.

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INDUSTRIAL MICROBIOLOGY

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CONTROL OF MICROBIOLOGICAL SYNTHESIS (SOVIET PATENT LITERATURE REVIEW)

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 1, 1978, pp 30-32

[Article by Engineers A. S. Fedorov and V. I. Boboshko, Institute of Automation, Kiev]

[Text] The main objective of microbiological synthesis is to acquire an end product with minimum expenditure of nutrients. This objective can be reached by creating production conditions which would promote maximum utilization of the components of the nutrient mixture and the largest yield of an end product having prescribed properties. These conditions can be created by means of biosynthesis control systems.

Control of biosynthesis boils down to maintaining the ratios and absolute values of nutrient concentrations necessary for development and reproduction of the microbe population, and to creating physicochemical conditions ensuring the best course of the process, oriented toward optimum acquisition of the end product.

The biosynthesis control systems currently being used in the sector are basically particular--that is, they are systems which regulate and stabilize individual parameters of the process: The rate at which the nutrient components are delivered into the apparatus and their volume; air intake for the purposes of aeration; the volume of culture medium in the apparatus; its temperature; the acidity of the medium in the apparatus.

Consequently the main indices of the process--the concentrations of biomass and nutrients in the apparatus--are not utilized in the control systems.

Such control of microbiological synthesis by indirect parameters is necessary because of the absence of reliable industrial sensing elements that could measure these principal parameters.

The effectiveness of control by indirect parameters decreases due to ignorance of the dependencies among important factors of the process, for example the intensity of mass exchange, gas exchange, the growth rate of microorganisms, and other controlling parameters. Reduction of the number of parameters being measured means a loss of information on factors having a significant influence on the process, and consequently it worsens the possibilities for keeping the process optimum.

Considering the little knowledge we have of the internal relationships of microbiological synthesis, the complexity of the synthetic process makes it difficult for us to choose the optimum control variant from the many possible methods of solving this problem.

This article discusses an attempt made to generalize developments published in the last 10 years in the USSR as inventions dealing with control of microbiological synthesis, developments which in the opinion of the authors offer the greatest practical interest. These developments are at the level of present development of science and technology.

The Institute of Physics of the Siberian Branch of the USSR Academy of Sciences has developed a microorganism culturing device (1) in which the culture fluid is maintained at a certain optical density with the goal of keeping the process continuous; this density is maintained by balancing the volume of fluid introduced into the cultivator and withdrawn from it.

The All-Union Scientific-Production and Planning-and-Design Association of Microbiological Industry has patented a number of methods and systems of automatic control of continuous microorganism growing processes.

Thus one of the methods (2) foresees maintaining an optimum level of air consumption for aeration depending on the quantity of carbon dioxide liberated, the latter being determined from the consumption of air for aeration and the concentration of carbon dioxide in the emerging gases.

Another method (3) involves regulation of delivery of the nutrient medium's components into the apparatus depending on the quantity of heat liberated, which is estimated from the distribution of the medium's temperature field.

Now that computer technology has recently been introduced, it has become possible to use complex integrated indices as control criteria. An example of this can be found in a method proposed by the same association, in which the rate of change of the economic coefficient of substrate utilization is used as the control criterion. The numerical value of this coefficient is the ratio of the quantity of biomass obtained to the mass of nutrients utilized within a certain time interval.

In this method (4), the concentration of the nutrient substrate delivered and consumption of air and mineral salt solution are regulated depending on change in the economic coefficient of substrate utilization, which is determined by comparing previous and subsequent (following certain intervals of time) computed economic coefficients. In our opinion this control method has the shortcoming that the inertia of the process is not considered in the computations of the principal index--the economic coefficient, which is used to control the process. The economic coefficient is computed on the basis of both input parameters (the concentration of RV [reducing agent?] at the input of the apparatus) and output parameters (the concentration of biomass and residual RV at the output). An economic coefficient computed on the basis of simultaneous measurements of input and output parameters cannot reflect the course of the process at the moment at which the parameters are being measured, since in most cases the practical lag of the process attains 4.5-5 hours.

Control can be effective only in the event that the time interval between control instructions is longer than the lag time. However, we believe such control to be not very effective, since the process may deviate significantly from optimum in the time interval between control instructions.

The All-Union Scientific-Production Association of Microbiological Industry has also proposed a system for automatic control of continuous microorganism cultivation (6), which makes use of the method described above to grow nutrient yeast. Another system for automatic control of continuous microorganism cultivation (5) developed by the same association foresees stabilization of water delivery and the temperature of the culture and nutrient mediums, regulation of the acidity and volume of medium in the apparatus, and regulation of substrate delivery depending on the respiratory coefficient and concentration of RV in the spent mash. The respiratory coefficient is determined from the concentration of dissolved oxygen and consumption of air for aeration with the help of a special logical unit.

In a third system for automatic control of continuous microorganism cultivation (7) patented by this association, the temperature of the yeast biomass and the volume and acidity of fluid in the apparatus are stabilized, and delivery of nutrient substrate into the apparatus depends on the respiratory coefficient, the concentration of dissolved oxygen in the fluid, residual RV, consumption of air for aeration, and substrate acidity.

The Institute of Automation (Kiev) has developed a system for automatic control of continuous microorganism cultivation (8) which foresees stabilization of consumption of air for aeration and nutrient substrate, temperature, and the acidity and volume of culture medium in the apparatus, regulation of the ratio between consumption of water for dilution and consumption of substrate, corrected in relation to the RV concentration in the substrate, and the time the biomass remains in the apparatus, and sampling of culture medium depending on the concentration of biomass in the yeast suspension and residual RV.

The institute has also proposed a system for controlling periodic microorganism biosysthesis (9) in which control of the principal parameters of the process--temperature, medium acidity, and consumption of air for aeration--is achieved with an adaptive model of the process, the algorithm of which is initially written into one of the system's blocks. The model's coefficients are tuned to the rate of the process.

Two systems for automatic control of qualitative indices in microorganism cultivation (10,11) created by the same institute permit control of quality parameters, for example the concentration of biosynthesis products in a bank of working apparatus using one analyzer-sensor and a recording instrument, and automatic determination of the end of biosynthesis (for example in the production of feed antibiotics) in each apparatus.

The All-Union Planning-and-Design and Scientific Research Institute of Automation of Food Industry has proposed a method (12) for automatic control of microorganism cultivation, in which consumption of aerating air, the rpm of the mixer, and pressure in the apparatus are stabilized, these indices simultaneously being corrected in relation to the difference in concentrations of carbon dioxide in delivered and spent air.

The All-Union Scientific Research Institute of Bioengineering has developed a device regulating microorganism cultivation (13); it regulates biomass concentration in the apparatus depending on microorganism growth rate by changing the substrate delivery rate.

V. N. Ostroumov and his colleagues have proposed a method of continuous microorganism cultivation (14) in which liquid hydrocarbons, for example paraffins and other components necessary for cultivation, mineral salts in particular, are delivered into the apparatus depending on the gas concentration in the culture medium; the latter is maintained constant throughout the entire cultivation time.

I. S. Ryvkina, et al. have patented a method for automatic control of continuous microorganism cultivation (15) foreseeing, with the goal of stabilizing the concentration of residual hydrocarbons and reducing fluctuations in the productivity of the apparatus, regulation of the consumption of hydrocarbons and water depending on biomass concentration.

The Groznyy branch of the Scientific Research and Planning Institute of Full Automation in Petroleum and Chemical Industry has developed a method for automatic control of aerobic microorganism cultivation (16) in which, with goal of intensifying the process, the delivery of air into the apparatus to aerate the medium is regulated with a consideration for the rate of change in the redox potential or with a consideration for the partial pressure of dissolved oxygen in the presence of a zero rate of change in the redox potential.

The colleagues of this same institute have proposed a method for automatic control of continuous fermentation in a battery of fermenters, in which the raw material-gas ratio in the first apparatus and temperature in subsequent units are regulated; in this case all regulated parameters are corrected on the basis of the amount of hydrogen measured in the fermentation gases of each apparatus.

The Institute of Biochemistry and Physiology of Microorganisms of the USSR Academy of Sciences has developed a method for controlling microorganism cultivation in thermostatic conditions (18), in which the biomass concentration is maintained at a prescribed level and the rate of delivery of nutrient medium is regulated depending on culture fluid temperature.

The Institute of Microbiology imeni Avgust Kirkhenshteyn has proposed a system for automatic control of microorganism cultivation (19) in which air delivery for aeration and the rpm of the mixer are regulated depending on the quantity of oxygen consumed for endogenous respiration of the culture and synthesis of the end product.

BIBLIOGRAPHY

1. Gitel'zon, I. I., et al., "Inventor's Certificate No 182870, 15 July 1963," BYULLETEN' IZOBRETENIY, No 12, 1966, p 79.

2. Odinokov, G. M., et al., "Inventor's Certificate No 334240, 13 April 1970," BYULLETEN' IZOBRETENIY, No 12, 1972, p 96.

3. Tokarev, B. I., and Loskutov, G. M., "Inventor's Certificate No 424875, 30 June 1972," BYULLETEN' IZOBRETENIY, No 15, 1974, p 86.

4. Odinokov, G. M., and Loskutov, G. M., "Inventor's Certificate No 507625, 10 June 1974," BYULLETEN' IZOBRETENIY, No 11, 1976, p 83.

5. Balashevich, I. I., Litvin, E. I., and Tokarev, B. I., "Inventor's Certificate No 412241, 20 December 1971," BYULLETEN' IZOBRETENIY, No 3, 1974, p 10.

6. Odinokov, G. M., and Loskutov, G. M., "Inventor's Certificate No 527472, 25 September 1974," BYULLETEN' IZOBRETENIY, No 3, 1976, p 83.

7. Litvin, E. I., et al., "Inventor's Certificate No 522228, 30 Ocrober 1974," BYULLETEN' IZOBRETENIY, No 27, 1976, p 82.

8. Govdya, Yu. D., et al., "Inventor's Certificate No 308060, 23 January 1969," BYULLETEN' IZOBRETENIY, No 21, 1971, p 89.

9. Zakharchenko, N. Ye., et al., "Inventor's Certificate No 488847, 18 December 1972," BYULLETEN' IZOBRETENIY, No 39, 1975, p 70.

10. Zakharchenko, N. Ye., et al., "Inventor's Certificate No 489784, 20 November 1973," BYULLETEN' IZOBRETENIY, No 40, 1975, p 64.

11. Zakharchenko, N. Ye., et al., "Inventor's Certificate No 489788, 16 January 1974," BYULLETEN' IZOBRETENIY, No 40, 1975, p 65.

12. Trinchuk, G. S., and Golger, L. I., "Inventor's Certificate No 355213, 24 November 1970," BYULLETEN' IZOBRETENIY, No 31, 1972, p 87.

13. Voronin, G. I., et al., "Inventor's Certificate No 365373, 31 July 1970," BYULLETEN' IZOBRETENIY, No 6, 1973, p 49.

14. Ostroumov, V. I., et al., "Inventor's Certificate No 390136, 30 August 1971," BYULLETEN' IZOBRETENIY, No 30, 1973, p 86.

15. Ryvkina, I. A., et al., "Inventor's Certificate No 469740, 10 July 1973," BYULLETEN' IZOBRETENIY, No 17, 1975, p 74.

16. Arzumanov, Ye. N., et al, "Inventor's Certificate No 502015, 9 April 1974," BYULLETEN' IZOBRETENIY, No 5, 1976, p 82.

17. Babayants, A. V. et al., "Inventor's Certificate No 311961, 27 March 1970," BYULLETEN' IZOBRETENIY, No 25, 1971, p 109.

18. Shkidchenko, A. N., "Inventor's Certificate No 506611, 20 December 1971," BYULLETEN' IZOBRETENIY, No 10, 1976, p 66.

19. Selga, S. E., et al., "Inventor's Certificate No 483426, 25 October 1973," BYULLETEN' IZOBRETENIY, No 33, 1975, p 84.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SYMPOSIUM ON BIOTECHNOLOGY AND BIOENGINEERING

Moscow MIKROBIOLOGIYA in Russian No 6, 1978 pp 1129-1132

[Article by M. Zh. Kristapsons and Yu. O. Yakobson]

[Text] In the last few years there has been significant development of research in the field of biotechnology and bioengineering. The decisions of the 25th CPSU Congress played a large part in development of such research; they put a number of important tasks to microbiologists. It became necessary to sum up the completed research and prepare programs for future work. The symposium that convened in Riga from 14 to 16 March 1978 dealt with this issues. The Scientific Council for Physiology and Biochemistry of Microorganisms, USSR AS [Academy of Sciences], Main Administration of the Microbiological Industry under the USSR Council of Ministers, All-Union Microbiological Society, in collaboration with the Latvian AS, were the instigators of these symposium. The practical organization of the symposium was assigned to the Institute of Microbiology imeni Avgust Kirkhenshteyn, Latvian AS, and Latvian Republic Department of the All-Union Microbiological Society.

More than 500 specialists participated in the symposium: representatives of institutions of the USSR and Union republic AS's, Glavmikrobioprom [Main Administration for the Microbiological Industry], USSR Ministry of the Medical Industry, USSR Ministry of the Food Industry and other agencies and VUZ's, as well as scientists from the German Democratic Republic, Polish People's Republic and Czechoslovak Socialist Republic.

The Latvian SSR was represented by specialists who work at 11 scientific research institutions, VUZ's and scientific-production associations. Specialists from the Uzvar feed producing kolkhoz (Bauskiy Rayon, Latvian SSR) also participated in the symposium; at this kolkhoz, an experimental shop was built for commercial production of protein and vitamin enriched feed, and a problem laboratory was opened in collaboration with the Institute of Microbiology imeni A. Kirkhenshteyn.

A. A. Drizul, Academician of the USSR AS and vice-president of the USSR AS, delivered the opening remarks at the symposium. The following also delivered some brief greetings: Prof I. L. Rabotnova, on behalf of the problem council for physiology and biochemistry of microorganisms, USSR AMS, and the presidium of VMO [All-Union Microbiological Society]; Prof E. Galas, on behalf of the delegation of scientists from the Polish People's republic, who stressed in particular the importance of active collaboration among specialists of CEMA member countries to solve theoretical and practical problems in the field of biotechnology and bioengineering.

Several keynote and survey papers were delivered: "Problems of Technological and Bioengineering Science as Related to Development of the Microbiological Industry" (A. N. Garpov, Glavmikrobioprogm under the USSR Council of Ministers), "Problems of Economics of Microbiological Synthesis" (M. P. Morozov, USSR Gosplan). Prof N. Ringfayl, head of the scientific delegation from GDR and corresponding member of the GDR AS, in his paper entitled "Synthesis of Microbial Protein by Unicellular Organisms and Technical Back-Up of This Process," discussed comprehensively the possible technological solutions from the standpoint of combining data on physiology of producer microorganisms, optimum cultivation conditions and equipment for the process.

In his paper, entitled "Some Theoretical Prerequisites for Developing Fermentation Equipment," Prof P. I. Nikolayev described and substantiated the principles of engineering aspects of fermenters developed at the Moscow Institute of Chemical Machine Building, and he used the systems approach to analyze the chief factors affecting the efficacy of fermentation equipment.

Prof V. Sikita (CSSR), in a paper entitled "Continuous Cultivation of Microorganisms," demonstrated the potential of the continuous method for the study of theoretical problems of physiology, biochemistry and genetics; he stressed the practical importance of the method for accumulation of highly productive mutants in the producer population. The producer of acylases used as one of the examples.

Academician M. Ye. Beker of the Latvian AS discussed development of the main directions of microbiological research and microbiological production in that republic, which were the prerequisite for intensive development of investigations in the field of biotechnology and bioengineering, in his paper entitled "Development of Biotechnology and Bioengineering in Latvian SSR"; he also reported the main results of developing diverse technological processes, finding new forms of raw material, designing fermentation equipment for different purposes and development of automated regulation, inspection and control systems for microbiological processes developed by specialists of this republic, including the Institute of Microbiology imeni A. Kirkhenshteyn, Latvian AS, in collaboration with many institutions of the nation.

A total of 40 survey papers were delivered and about 120 display reports were discussed at two plenary sessions, as well as meetings of three sections ("Processes of Fermenation," "Media and Products of Microbial Synthesis," "Equipment and Management"). In addition, summaries of submitted topics, including about 350 titles ("Biotechnology and Bioengineering," in 3 volumes, Izdatel'stvo "Zinatne," Riga, 1978) were brought to the attention of the participants.

It should be noted that the visual [display] reports prompted particularly lively discussion, and this form of symposium work was highly praised by the participants.

Various factors of basic importance to optimization of fermentation processes were discussed in the section entitled "Fermentation Processes." The symposium participants observed that the the data obtained in laboratory experiments on physiology, biochemistry and genetics of producers of biologically active substances are obviously not precise enough to make use of the potential capabilities of a producer in the presence of specific technology and equipment.

Investigation of thermodynamics of the fermentation process (B. Heinrits, F. Glombits, GDR) and use of the balance method of estimating the proportion of base raw material, intermediate and end products in the biological reaction mixture as related to a specific technological process, as well as recording the kinetic characteristics of metabolite synthesis, are very important.

Comprehensive knowledge of activity of various enzymatic systems, as related to the intensity of the process (A. M. Bezborodov, M. P. Ruklisha), investigation of bioenergetic mechanisms of metabolism of microorganisms (Yu. E. Shvinka) make it possible to increase significantly the effectiveness of the biosynthetic process. Serious attention must be given to the study of the regulatory role of carbon dioxide in cultivation of microorganisms (A. D. Gologob, Ye. R. Davydov).

Comprehensive analysis has been made of mass transfer and scaling in extrapolating the results of laboratory processes to semi-industrial and industrial conditions, and attention was given to the significance of stirring (Ye. S. Bylinkin,a L. D. Shtoffer). In this section, due attention was also devoted to processes of continuous cultivation of microorganisms in order to obtain biomass and secondary products, both in the case of inhibited growth (I. L. Rabotnova) and from the standpoint of resistance and microevolution of a population, which is also governed by the main laws of evolution under artificial continuous cultivation conditions (N. S. Pechurkin).

Foam production plays a dual role under various fermentation conditions, depending on physicochemical properties of fermentation media and specific equipment used, and wise restriction of this phenomenon requires special approaches (M. Zh. Kirstapsons, M. K. Yakobsone). It should be noted that these problems are also being investigated intensively at the Institute of Microbiology imeni A. Kirkhenshteyn, under the supervision of Academicians M. Ye. Beker and U. E. Viyestur.

In the section on "Media and Products of Microbial Synthesis," attention was focused primarily on discussion of the suitability of various forms of raw material for microbial synthesis of secondary products (N. V. Glushchenko, M. Ye. Beker and others). There was detailed discussion of the question of new types of raw material for biosynthesis of lysine (G. K. Liyepin'sh and others).

Among the various forms of waste and by-products of other industries, attention was called to the use of whey for cultivation of microorganisms (M. V. Zalashko). In the general opinion of participants at this section, raw material of which there is an abundant supply--products of photosynthesis, waste and by-products of various industrial and agricultural enterprises, chemical precursors, minerals and atmospheric gases--should be used to influence biosynthesis of biologically active substances.

At this section, much attention was given to questions of immobilization of live cells and isolated cell components, which can now be classified in an independent direction, engineering enzymology.

There was discussion of immobilization of lysozymes on collagen (E. Galas, Poland), preparation of solid carriers of the cellulos type for immobilization (I. Avgustin, CSSR), physicochemical properties and enzymatic activity of immobilized lipase, as compared to the unadulterated product (R. Yu. Are et al.).

The question of choice of technique and metabolite purification depends on the nature of the substrate that is being developed and the product obtained, so that there was discussion of the general principles that must be taken into consideration. No doubt, some methods, including ultrafiltration, may have several advantages (R. Yu. Are). Physicochemical products of the "concentrate" type depend not only on the type of raw material, but production technology; for this reason, special attention should be given to the study of correlation between the properties of such products and technology of production thereof (Ya. Ya. Laukevits and others). At this section, there was also discussion of problems of disintegration of microorganisms in various disintegrator systems (B. A. Fikhte), special methods of dehydration for preservation of viable cells (M. Ye. Beker), as well as problems related to purification and sterilization of air (G. L. Motina), and a few others.

In the section on "Equipment and Management [or control]," attention was mainly concentrated on problems and specific results pertaining to the development of complex fermentation lines, various instruments for inspection, control and automation of the fermentation process with a hook-up to a computer.

In most cases, the submitted data were the result of generalization of considerable experimental and semi-industrial material, as well as production knowhow, and in many cases comparable products were evaluated on the basis of the systems analytic approach. Some original data were reported on automatic regulation of cell mass synthesis (D. Poland et al., GDR); there was discussion of bioengineering and machine-building aspects of designing large fermentation apparatus (A. Prokop et al., CSSR), problems of development of fermenters for optimum management of the process of microbiological synthesis over a maximum range of variable parameters, and equipping them with automatic devices for inspection and control of the process by the producing plant (U. E. Viyestur), comparative data on technological apparatus for sterile processes (V. A. Osen'kina et al.), data on various devices for cultivation of bakers' yeast (G. G. Gandzyuk, A. I. Sokolenko), development of modern technological lines varying in capability for the production of enzymes and enzymatic preparations (K. A. Kalunyants, L. I. Golger). There was a report on development of original, selective electrodes (Yu. Yu. Kulis, E. V. Rallis), and a method was proposed for examining bioengineering operations with the use of computers (K. G. Fedoseyev, A. A. Kampe-Nemm).

It should be noted that an entire set of engineering systems for cultivation of microorganisms, with which the symposium participants could become acquainted, in part, by visiting the biotechnological complex of the Institute of Microbiology imeni A. Kirkhenshteyn, Latvian AS, was brought to the attention of the symposium participants by this institute, in the papers, display reports and special publications for the symposium. The technical specifications of these systems are reflected in a special brochure ("Technical Systems of Cultivating Microorganisms," Zinatne, Riga, 1978, 32 pages).

Many speakers also touched upon economic problems of microbiological synthesis in their papers dealing with fermentation processes, choice of raw material, methods of isolating and purifying end products and developing apparatus. However, economic problems were discussed the most vividly in the paper of V. P. Zamakh, general director of the Biokhimreaktiv [Biochemical Reagents] Scientific and Industrial Association, which was entitled "Technological and Economic Aspects of Production of Biochemical Reagents and Products in the USSR," in which he demonstrated the complexity of organizing production, as related to the volume of production of each specific type of product. The speaker offered several specific suggestions on organizing and backing up such production, as well as organizing collaboration between a scientific team and industrial enterprises.

On the last day of the symposium, a film, entitled "Irreplaceable Lysine" (Riga Motion Picture Studio) was screened for the participants; it dealt with creation and industrial use of a microbiological method of producing a lysine feed concentrate at the Livany Experimental Biochemical Plant of Glavmikrobioprom in Latvian SSR.

At the final plenary session, the accomplishments of the symposium were summed up, the most important problems to be submitted to comprehensive investigation were outlined, and a joint decision was elaborated. It was stressed that biotechnology and bioengineering are of exceptional scientific and practical importance as the key element that links microbiological science with practical use of microorganisms in various branches of the national economy, and first of all with regard to cultivation of microorganisms for biosynthesis of secondary metabolites.

Prompt evaluation of biotechnological and bioengineering aspects could be largely instrumental in specifying the types of laboratory investigations and thereby expedite development of processes and introduction thereof to industry. It was stressed that in solving purely biotechnological and bioengineering problems, considerably more attention should be given to environmental protection. In this respect, of exceptional importance are the directives of the 25th CPSU Congress pertaining to development of waste-free production and closed-cycle production. It can be noted that some advances have been made in the area of developing waste-free production by the staff of the Experimental Biochemical Plant of the Latvian AS, under the supervision of its director, A. A. Lurinya, Hero of Socialist Labor, and chief engineer R. Ya. Karklinya, Honored Industrial Worker of Latvian SSR and corresponding member of the Latvian AS.

It can also be noted that some microbiological products of the "concentrate" type can be well-used for regulating microbiological processes in soil, in particular for accelerating degradation and elimination of chemical pollutants and recycling the material in mining industry dumps, as well as products for stimulating plant grown in establishing green belts in the region of industrial buildings where there is a high degree of pollution of atmospheric air.

The symposium participants observed that the time is ripe to single out biotechnology and bioengineering as independent scientific specialties.

It was shown at the symposium that many problems of biotechnology and bioengineering are complex; they are being worked on at different scientific and industrial institutes, many VUZ's, as well as planning institutes and specialized design offices; many problems are being resolved directly under industrial conditions.

Various branches of industry are concerned with the results of this research and these projects: microbiological, chemical pharmaceutical, medical, food, agriculture, as well as such branches as oil production and oil refining, as well as the enrichment [processing?] industry. However, finalization and industrial application of many investigations are being delayed (some types of fermenters, automatic control devices, apparatus for cell disintegration and others). For this reason, it would be expedient to coordinate this work within the framework of a specialized interagency council, under the supervision of the State Committee for Science and Technology of the USSR Council of Ministers.

In the course of the discussion, it became apparent that different specialists interpret differently the content of such concepts as "biotechnology," "bioengineering," and "biotechnical"; there is also disagreement on terminology.

The participants unanimously concluded that it is time to seriously tackle problems of terminology, and for this reason the USSR AS should be asked to establish a special commission to systematize existing terms and develop new ones in the field of biotechnology and bioengineering.

The opinion was voiced that there is an urgent need for special biotechnological and bioengineering periodicals, as well as the desirability of publishing the proceedings of this symposium. In addition, it was noted that it would be expedient to organize such symposiums regularly, at least once every 203 years.

The symposium participants were pleased with the announcement of Prof M. Ringfayl that the GDR AS and GDR Biological Society propose that the second symposium of socialist countries on biotechnology and bioengineering be held in November 1980, in Leipzig.

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PUBLICATIONS

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OPTIMIZATION OF MAN-MACHINE SYSTEM DESCRIBED IN NEW BOOK

Moscow UPRAVLYAYEMOST' MASHIN (The Controllability of Machines) in Russian 1977 signed to press 15 Jul 77 pp 3-8, 279-280

/Foreword, introduction and table of contents from book by Nikolay Vladimirovich Adamovich, Izdatel'stvo "Mashinostroyeniye", 9,500 copies, 280 pages/

/Text/ Foreword

In the vast field of modern engineering psychology research the development of methods of recording the energy expenditures of the body of the man-operator on the processing of controlling a machine occupies a very modest place. Proper attention is not being devoted to questions of limiting the energy load on the body in the practice of planning the work place of the man-operator when determining his work posture, developing new systems of control and information, determining the feasible limits of the automation of the functions of control and so on.

Meanwhile experimental data attest that the correlation of the required and proposed energy expenditures of the body during the process of controlling a machine cannot but have a decisive influence on the quality and reliability of the performance of the functions of control. In general from the technical point of view the neglect of questions of the power supply of any unit of an operating system is inadmissible, since a deficiency of supply entails the rejection of this unit, no matter how perfect it might by functionally. The human body, of course, is not a technical unit, but in its activity on the control of a machine ..."the contraction of muscles, the stepping up of the work of the nervous system,... the increase of attention, of precision--everything requires additional, as compared with the state of rest, expenditures of energy resources" /26/. These energy resources are expended by the body from its own, very limited source of power supply, therefore it is logical to assume that there is an energy limit of the loading of the man-operator with functions of control and that exceeding it entails the nonperformance of functions.

In this case the question arises: how to convince the designer that the actions, which he has planned, of the man-operator on the control of a machine are within the limits not only of the functional, but also of the energy potentials of man and, consequently, will be performed with the required reliability? In order to answer this question there is needed, apparently, the development of a method of the calculation and direct recording of the energy expenditures during the processing of controlling a machine, which in addition to the existing methods of organizing the functional activity of the man-operator would make it possible to regulate this activity with respect to energy.

The theoretical part of this book was developed on the assumption that the indicated energy limit of the loading of the man-operator with functions of control exists, a limit which is quite close and often is unintentionally overstepped by designers due to the lack of the appropriate manuals. In the book the method of approaching the designing of the man-machine system, which provides for the minimization of the energy expenditures of the body of the man-operator on actions on controlling a machine, is substantiated, and examples of the practical application of the methods to problems of designing the work place of the man-operator are described.

The order of exposition, which was adopted in the book, corresponds to the methodological approach of the author to the solution of problems of this sort over many years, beginning with the first postwar years, when the idea of the method was formulated as applied to problems of aircraft building [2]. The experience gained at the time confirmed the effectiveness of the method, while the use of the concept of information, which was introduced by N. Wiener in 1948 [5], made it possible to extend it to general machine building. Regardless of the methodology chosen by the author, the experimental materials and empirical data cited in the book can also be of independent interest.

It is impossible, of course, to count on the exhaustive completeness of all the particular theoretical assumptions of the book. The questions of the development of methods of the quantitative definition of the obtained criteria on the basis of the recording of both the general energy expenditures of the body of the man-operator and those on the functioning of its individual organs and systems are the most complicated and are subject to further study. According to existing notions, the majority of these energy expenditures are connected with physical movements [13, 20], while the nerve and brain activity, which constitutes, as a rule, the basis of the activity of the man-operator, is not energy-consuming and therefore is not governed by energy expenditures. Such a notion does not accord with the data to the effect that there passes through the brain more than 20 percent of the blood which supplies it with oxygen [26], and with well-known cases of appreciable general fatigue following great nerve and brain strains: the fatigue of a pilot after an instrument flight (as compared with a visual flight), an engineer after a crucial conference or, say, a student after taking an examination.

The very fact of the lower energy consumption of nerve and brain activity as compared with physical activity does not give grounds to assert that the amount and quality of this activity do not depend on the energy resources of the brain and the appropriate systems of the body. The development of methods of estimating and regulating the energy expenditures of the body as applied to all types of activity of the man-operator is one of the central problems of engineering psychology.

However, in any theoretically complicated technical problem (and in this case it is a matter precisely of the technical problem of adapting the machine to man) an approximate solution can be found by means of simplifying it on the condition of the preservation of the essence of the problem. In this case the essence of the problem can be reduced to the limitation of the energy strain on the body as a whole and on its systems from the condition of the preservation of certain functional data of the man-operator, while the essence of simplification can be reduced to the adoption of a conventional model of the energetics of the body which uniformly expends energy on the operation of the appropriate organs, like fluid from communicating vessels. The system of criteria, which was elaborated on the basis of such assumptions, made it possible to substantiate the requirements of the optimization of the work place of the man-operator, which satisfy the qualitative appraisals by operators of the ease of control of a machine.

The methodological approach to the solution of the problems of designing aircraft cockpits, which is based on the obtained requirements, made it possible to make a number of result-producing studies and to build equipment models which are quite ideal as to ease of use during a flight (some of them are described in the book). This methodological approach is being successfully used in the further development of equipment. Therefore, regardless of the degree of theoretical validity of this approach at present, its use in other sectors of machine building is feasible.

In the book the practical experience of the appraisals and designing of the work place of the man-operator is systematized for the purpose of helping the designer to create the maximum conveniences in the control of equipment, and the crew of an airplane, the driver of a motor vehicle, the worker at a works and in general the person dealing with equipment to facilitate the control of this equipment and to increase labor safety and productivity.

In connection with the great amount and diversity of the research, the materials of which were used in preparing the book, it is impossible to list all the participants in this research. The performance of such operations as the development of new systems of control and indication, the search for new forms of the interior of the cockpit, the study of the dynamics and systems of automatic aircraft equipment and so on has always been governed by the creative efforts of many specialists, from the technician to the skilled engineer and test pilot. The author expresses his gratitude to all the participants in this research for many years of joint fruitful work.

The author expresses thanks to Honored Figure of Science and Technology, Doctor of Technical Sciences Professor V. S. Vedrov; Honored

Figure of Science and Technology, Doctor of Technical Sciences Professor M. A. Tayts, and to the readers: Honored Test Pilot of the USSR, Hero of the Soviet Union, Doctor of Technical Sciences M. L. Gallay, and Candidate of Medical Sciences V. A. Popov for a number of valuable remarks and advice, which they made when reviewing the manuscript.

Introduction

The designing problem of adapting a machine to control by man becomes more complicated with the development of technology and at present has assumed the form of the "man-machine problem," which urgently requires solution. Does this mean that before this problem did not exist?

Every machine is above all a tool of labor, while the appearance of the first tools of labor was connected with the beginning of the labor activity of man and his formation as a thinking being. The aspiration to adapt the tool of labor to his hands and to make it easy to use, and to develop in himself the appropriate labor skills accompanied man from the first steps of civilization. Moreover, the process of the "mutual adaptation" of man and the tool of labor together with the aspiration of man to invent new tools constituted the basis of the increase of labor productivity--the basis of the development of civilization itself. It can be asserted, consequently, that the "man-machine problem" was incorporated in the basis of the formation of man himself and arose at the same time as his appearance on earth.

Why did this problem not arise earlier with such urgency?

The losses of production due to the poor "mutual adaptability" of man and machine depend on the level of development of technology and labor productivity. With the growth of technology and labor productivity the price of an error of man in interaction with a machine, which is expressed in absolute losses of production, increases. For example, the consequences of an error in the piloting of a passenger plane of 30 years ago with 20 passengers on board and of a modern liner seating 200-400 are incommensurable. Consequently, the observed increase of interest in the problem of optimizing the man-machine system and the search for its solution are not accidental, but are the natural result of the development of technology and the increase of labor productivity throughout the world.

That is the situation with the man-machine problem right now. What are the prospects of its development in the future?

The solution of this problem, which in itself is not simple, is complicated by the fact that a synthesis of the data of the psychophysiology of man, on the one hand, and the design and tactics of the operation of the machine, on the other, is required. In other words, the organization of research work at the meeting point of psychophysiology and the two fields of technology is required /17/. The experience of organizing such work shows that it is an extremely complicated matter to overcome the unique "barrier of occupational incompatibility," which arises here, and to organize the result-producing cooperation of specialists of such different specializations.

The delay in the solution of the man-machine problem served as a pretext for the attempts to "bypass" this solution by means of the complete automation of the cycle of operation of the machine and the exclusion of man from it. For the designer of a machine this means is always tempting because he limits the designing to a group of technical problems which yield to calculation or modeling and is completely freed from the need to guess, what surprises the unknown "blank spaces" of psychophysiology can give and whom of the most competent specialists on these matters he should believe more. In connection with this direction in technology two questions arise which are of decisive importance in formulating the man-machine problem:

To what extent are the attempts at the complete automation of the man-machine system justifiable and universal?

How do you solve the man-machine problem, if it does not appear possible to avoid this solution by complete automation?

If the technology of the future will make it possible to exclude man from the cycle of operation of a machine, right now it is expedient to aim the efforts not at the solution of the man-machine problem, but at the development of automatic equipment which eliminates this question from the agenda. If there are areas of technology, in which complete automation in principle is impossible, it is necessary to find this solution by developing a scientific method of the optimization of the man-machine system.

In this book the man-machine system is examined in a conventionally simplified form, as a system of organized influence on the environment, which formed spontaneously in the struggle for existence and led to the appearance on earth of man, who controls the system. In such an examination, man outside the system is inconceivable, while the further evolution of the system is the material basis of the development of civilization.

This evolution is represented in the form of the improvement of the system in two directions:

the increase of the functional possibilities of the machine as the executor of the control signals received from man,

the attribution to the machine of a set of properties which guarantee the utilization by man of its functional possibilities and are united with the concept of the /controllability/ /in italics/ of the machine.

The former, technical, direction rests only on technical achievements. The latter is governed by the synthesis of the data of technology and psychophysiology.

An attempt is made in the book to elaborate theoretically the latter direction on the basis of the consideration of the influence of the energy expenditures of the body on its functional potentials.

Contents

Part Two

Optimization of the Work Place of the Man-Operator

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