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15 June 1988
ENGLISH

BEIJING SPECIALITY GAS RESEARCH INSTITUTE (BSGRI)

DP/CPR/85/005/11-01

PEOPLE'S REPUBLIC OF CHINA

Fourth Status Report*

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Willard L. Ent
Chief Technical Adviser for UNIDO with BSGRI

Backstopping officer: M. Derrough, Industrial Operations Technology Division

United Nations Industrial Development Organization
Vienna

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ABSTRACT

This fourth status report of the CTA for Beijing Specialty Gas Research Institute describes a 14 day visit to monitor the activities of the institute and plan for future activities. The visit was followed by an expert group meeting in Vienna where many of the problems encountered in Beijing were able to be resolved. The report contains Job Descriptions for those experts still needed; an Annex (B) describing data gleaned from Study Tours; continuing problems with instrumentation procurement and utilization and the placement of six fellows in a graduate school in the United States.

INTRODUCTION

This report describes the activities of the Chief Technical Advisor during his fourth visit to Beijing, China to review and monitor the activities of Project DP/CPR/85/005; Beijing Specialty Gas Research Institute (BSGRI). The basic report has four sections: These are Job Descriptions; Instrumentation and Equipment; Study Tours and Fellowships.

These data have been reviewed with BSGRI personnel and they agree with the content herein, as presented.

Problems still exist with the placing of experts and instrumentation and equipment procurement.

JOB DESCRIPTIONS

There has been no major change in the Expert Requirements than those which were listed and described in the third status report of the CTA dated 4 January 1988. Those which are still required are listed below and their Job Descriptions are contained in Annex A of this Report. Recommended personnel are also listed as are comments about each resulting from reviews with Mr. Chen, Director of the Institute, and in Vienna with Mr. Sean Hand, Project Personnel. The numbering system below is the same as that in the Job Description section of the previous (January 1988) report:

1. #11.01; Chief Technical Advisor
   This report outlines the activities of the CTA during this most recent visit. A modified Job Description is contained in Annex A.

5. #11.05; Expert in the Utilization of Gases and Gas Mixtures for Food Ripening and Food Preservation.
   This expert is still required. During He Chen's (Project Director) visit in the United States on the last Study Tour, he had contacted an appropriate candidate. However that candidate had not been able to be located (or at least had not responded by May of 1988) to Mr. Hand's (UNIDO Recruitment) solicitations. That expert is still recommended and every effort should be made to recruit him. He is:

   Dr. Wang, Chien Yi, PhD.
   Research Horticulturist
   Horticulture Crops Marketing Laboratory
   Agriculture Research Center
   U.S. Dept of Agriculture
   Room 113, Bldg. 002
   BARC - West
   Beltsville, MD 20705

8. #11.08; Expert in Equation of State for Gaseous Computer Program.
   This expert is still required. During June of 1988 the CTA exerted considerable effort to coordinate the visit of Dr. McCarty to BSGRI. Problems were extant in procuring a Visa, travel arrangements, and just

about every facet of the requirements of this visit of the expert. It is understood that the expert did finally get to Beijing in July of 1988 and that he was able to accomplish the required objectives of the Job Description. The CTA would appreciate receiving a copy of the final report of the expert when it is received in Vienna.

9. #11.09; Expert in Standard and Calibration Gases.
This expert is also still needed. As in #11.05, Mr. Chen had "recruited" a potential candidate for this Job during his last Study Tour in the United States. That candidate is:

Mr. William Dorko
Office of Std. Physc. Mat'ls.
National Bureau of Standards
Room B 332, Bldg. 222
Gaithesburg, MD 20899

11. #11.11; Expert in Gas Blending and Analysis.
This expert is also still required. The proposed candidate (Mr. Lindenmoyer) needed some "proddino" by the CTA and by Mr. Hand; however, he has agreed to accept the post and is presently awaiting an invitation. It is currently understood that the Vapor Phase Chromatography Analytical Equipment has not been received as yet. (See section in this report on Instrumentation). Mr. Lindenmoyer's visit should be delayed until that apparatus is received and is operating.

INSTRUMENTATION AND EQUIPMENT

As was indicated in the previous (January 1988) report of the CTA, all of the instrumentation and equipment approved for the project document had been purchased and received or was on order.

This statement is not exactly true since many "glitches" in the process for ordering and receiving these equipment were discovered during the CTA's trip to BSGRI and subsequent meeting in Vienna.

Descriptions of specific problems follow:

1. Atomic Absorption Apparatus.
   This analytical equipment has been received and installed.

   The installation of the "clean room" to house the equipment was handled through "local" government engineering activities. The installation was not sufficient to attain the Class 100 which was required for this equipment. Modifications were made by BSGRI to attain the required cleanliness specification.

   Further, this equipment requires a water purifier system to supply ultrapure water for use in cleansing certain portions of the analyzer between analyses. This equipment was not procured as a part of the original equipment purchase, and some very expensive equipment has remained idle due to the lack of a very inexpensive accessory. Local purchasing documents and directives were misunderstood in this regard. The CTA attempted to correct the misunderstanding during his subsequent visit to Vienna and this problem should be resolved by now. A corrected authorization for field purchase was issued by Vienna in May and delivery of the water purified had been quoted at 60 days.

   There is one final problem with this equipment regarding sensitivity when operating in the computer mode. Perkin-Elmer (the supplier) is to correct this problem.

2. Software Package for Gaseous Equation of State.
   Repeated attempts were made by the CTA and BSGRI personnel to procure this piece of equipment needed in the computer center for determinig physical

constants of industrial and other gases. It was finally necessary for Dr. McCarty to take this software package with him to Beijing when he visited there as the expert in this project. During the CTA's subsequent visit to Vienna, it was learned that this item had been included as a part of another purchase order (as a description for items in another order) which were Gas Data and Safety Manuals). It is not known at this date if the computer software or the Gas Data and Safety Manuals have been ordered or received at BSGRI. The UNIDO Requisition is No. 86/3 and is dated 26 November 1986.

3. Vapor Phase Chromatrography Apparatus.
   The CTA had originally recommended an apparatus to be purchased with which he was familiar and would attain the sensitivity required for the proposed analyses. For some unknown reason, UNIDO purchasing decided to purchase a different apparatus. After so-doing, it was learned that the apparatus purchased by UNIDO would not accomplish the sensitivity requirements without expensive multi-head detector accessories which were purchased at a cost which caused this item to be over-budget. Further, the item was quite late in delivery. During the subsequent visit by the CTA to Vienna, a June 1988 delivery date was established (versus a promised date of March 1988). It has now been learned that there is a problem with the import license, and the item has still not been received in Beijing.

The foregoing represents the current status on all of the analytical equipment for BSGRI.

STUDY TOURS

No additional reports on the two Study Tours which were conducted for Institute personnel has been developed since the last (January 1988) CTA report.

Mr. Chen, Jinming, Director of the Institute has prepared a report on the development of the international specialty gas industry based on the two Study Tours in which he was involved. That report is of interest in that it describes the wealth of information on a particular industry which can be derived from Study Tours. The report is included as Annex B to this report. It is entitled, "A Commentary About the Development of International Specialty Gas". It is dated 30 April 1988.

FELLOWSHIPS

As reported in the last CTA Report (January 1988), the Institute and CDS were having trouble in placing Fellows for the Fall and Spring Semesters of 1988-1989 Scholastic Year.

Problems were encountered with eligibility, education background, English profficiency, and many other problems.

Since the major problem was English defficiency, CDS arranged for the six fellow candidates to take a "crash" English course at Beaver College during July of 1988. They then took their TOFEL tests, and all six candidates entered Lehigh University for the Fall Semester of 1988. CDS deserves credit and BSGRI's appreciation for solving the many problems associated with placing these fellows. The fellows and their disciplines are:

Ms. Chen, Zhifen and
Ms. Fan, Jinaren in Advanced Analytical Chemistry and Instrumentation Analysis.
Mr. Li, Wei;
Mr. Luo, Gang;
Mr. Meng, Wenzbi; and
Ms. Zheng, Ge in Advanced Chemical Engineering courses.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.01

POST TITLE: Chief Technical Advisor

DURATION: 1 Month

DATE(S) REQUIRED: October 1988 (15 Days)

DUTY STATION: Beijing, China and travel within the country.

PURPOSE OF PROJECT:

To establish a national specialty gas research and development centre at the Beijing Specialty Gas Research Institute (BSGRI) in order to enhance the national technical capability in manufacture, analysis, storage, transportation, safe handling and use, and applications technology related to specialty gases and with particular reference to their applications in electronics, medicine, food industry and environmental protection.

DUTIES: To accomplish the purposes of the project. More specifically:

1. To review the progress and status of the project.
2. To implement the revisions to the project as agreed in the TPR of December 1987 and during the visits to China and Vienna during May of 1988; particularly:
   a. Review the activities of experts scheduled for 1988.
   b. Assist in the preparation of the PPER for 1988.
   c. Assist where appropriate in the placement of Fellows.
   d. Review the operation of and acceptability of the equipment which has been provided by UNIDO.
3. Prepare a final report covering how all of the duties were accomplished.

JOB DESCRIPTION - 11.01 -2-

QUALIFICATIONS: High level scientist or engineer with extensive experience in the specialty gas industry including research and development work.

LANGUAGE: English

BACKGROUND INFORMATION:

1. The development of the Beijing Specialty Gas Research Institute is progressing very well.

2. BSGRI personnel are desirous to have the CTA continue to work with them.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.05

POST TITLE: Expert in the Utilization of Gases and Gas Mixtures for Food Ripening and Food Preservation.

DURATION: 1 month

DATE: October 1988

DUTY STATION: Beijing, China

PURPOSE:

1. To develop techniques for the ripening and preservation of foods using various gaseous atmospheres.
2. Establish analytical methods for measuring these gaseous atmospheres.
3. Establish analytical (biological) techniques for measuring the adequacy of the preservation and ripening techniques.

DUTIES: To accomplish the purposes of the project; more specifically:

1. Complete a medium range test (preservation) for two to three vegetable species.
2. Instruct in the techniques for producing preservation atmospheres in packages and containers.
3. Instruct in the techniques for utilizing ethylene and other gaseous atmospheres for ripening.
4. Deliver lectures or conduct symposia anent:
   a. Food preservation and ripening atmospheres.
   b. The economic benefits of utilizing gaseous preservation and ripening atmospheres.

JOB DESCRIPTION - 11.05 -2-

5. Prepare a final report covering how all of the duties were accomplished.

QUALIFICATIONS: High level scientist with extensive experience in food ripening and preservation gases and atmospheres including research and development work.

LANGUAGE: English

BACKGROUND INFORMATION:

1. Food preservation and ripening gases are not used in China since the economic value of these gaseous applications has not been studied or understood.

2. The Beijing City Government has requested BSGRI to investigate the potential for preserving vegetables using industrial or other gases.

3. Overabundance and shortages of certain vegetables and other foods exists in China causing waste at certain seasons and serious food shortages at other seasons.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.08

POST TITLE: Expert in Equation of State for Gases Computer Program.

DURATION: 21 days

DATE REQUIRED: October 1988

DUTY STATION: Beijing, China

PURPOSE OF PROJECT:

To develop a computer software program for the Pressure-Value-Temperature (PVT) Blending of Gas Mixtures.

DUTIES: Complete the purpose of the project, specifically:

1. Train BSGRI personnel in the use of the computer and the "Fluids-Pack" program.
2. Train BSGRI personnel in the use of a PVT gas mixture program for 3-component gas mixtures: specifically 4 Molar % CO_2, 0.7 Molar % Methane in Nitrogen; and 0.3 Molar % carbon monoxide, 20 Molar % oxygen in nitrogen.
3. Deliver lectures or conduct symposia on the development and use of the "Fluids-Pack" program.
4. Prepare a final report covering how the purpose of the project was accomplished.

QUALIFICATIONS: High level scientist with extensive experience in gaseous or fluid equation computer programs and in operation of computers.

LANGUAGE: English

BACKGROUND INFORMATION:

There are no "advanced" techniques for utilizing a computer and software for accomplishing the purpose of the project in China today.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.09

POST TITLE: Expert in Standard and Calibration Gases.

DURATION: 14 days.

DATE REQUIRED: October 1988

DUTY STATION: Beijing, China

PURPOSE OF PROJECT:

To establish a National Center for the production of primary and secondary calibration gas standards.

DUTIES: To accomplish the purpose of the project, more specifically:

1. Instruct BSGRI personnel in the method of preparation for primary gas standards.

2. Deliver lectures or conduct seminars on the analysis techniques for pure gases; and describe these techniques as they are practiced by the United States National Bureau of Standards.

3. Instruct BSGRI personnel in the proper treatment for gas cylinders used for calibration standards; and the testing methods used for determining gas mixture stability.

4. Explain the equipment and accessories necessary to produce primary standards.

5. Visit BSGRI's standards production facility and comment on the techniques used in producing these standards.

6. Prepare a final report covering how the purpose of the project was accomplished.

QUALIFICATIONS: High level scientist or engineer with extensive experience in establishment of primary gas standard centers.

LANGUAGE: English

BACKGROUND INFORMATION:

1. "National" calibration standards are required in China.

2. The National Institute of Metrology has requested that BSGRI develop these standards.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.11

POST TITLE: Expert in Gas Blending and Analysis.

DURATION: 21 days

DATE REQUIRED: October 1988

DUTY STATION: Beijing, China

PURPOSE OF PROJECT:

To enhance the gas blending and analysis capabilities at the Beijing Specialty Gas Research Institute.

DUTIES: To accomplish the purpose of the project; more specifically:

1. To instruct BSGRI personnel in the specialized gas analysis techniques for determining gas purities, impurities, and mixture analyses utilizing all of the normal analytical techniques; e.g.: gas chromatography, infrared spectrophotometry, atmoic absorption, ion mobility, etc.

2. Assist in the development of using a helium ionization equipped ultra-sensitive gas chromatograph for parts per billion impurity analyses.

3. Deliver lectures or conduct symposia in specialized gas blending and analysis systems.

4. Prepare a final report covering how the purpose of the project was accomplished.

QUALIFICATIONS: High level scientist or technologist with abundant experience in specialty gas blending and analysis.

LANGUAGE: English

BACKGROUND INFORMATION:

Beijing Specialty Gas Research Institute personnel need the assistance of an international expert in gas blending and analysis.

Annex B

UNITED NATIONS DEVELOPMENT PROGRAMME AID PROJECT "BEIJING SPECIALITY GAS RESEARCH AND DEVELOPMENT CENTER"

DP/CPR/85/005

A COMMENTARY ABOUT THE DEVELOPMENT OF INTERNATIONAL SPECIALITY GAS

CHEN JINMING

(PROJECT MANAGER)

BEIJING SPECIALITY GAS RESEARCH INSTITUTE

APR. 30,1988

Annex B
(1)

Based on the UNDP aid plan, under the arrangement of UNIDO, I,as the head of project delegation, had made a study tour to England, France, west Germany, USA, and Japan in 1986 and 1987 respectively. we called on 10 gas companies, 2 national research organizations and one comprehensive technical universities During the study tour, we investigated 17 speciality gas plants, 6 technical development center, we exchanged ideas broadly with 89 international gas experts about those interested problems. now, based on the informations and impressions of the two times investigation, I would like to make a summary about the present age developing trend and technical features of specialty gas as follows, however, these views are not so ripe, it is only a reference for designing project.

(1) Specialty gas is a very new gas kind which accomodates the world new technology revolution and developed on the foundation of industrial gases in sixties. from the concept generally acknowledged internationally, specialty gas consists 4 main kinds:

i) Various kind of high purity and super high purity mono-element gas
ii) Various kind of mixed gases which are precisely blended with poly-elements low concentrated gases
iii) Various kind of high purity gas transported and stored in liquid form
iv) Various kind of air products and other organic gases, inorganic gases, halogen carbon gases and isotopic gases

At present, in the international field, 267 knds of mono-element pure gases, 18 kinds of mixed gases, 330 special kinds, 2000 species and more than 3800 specifications were developed. As the basic chemical raw materials, the specialty gases are used in those important fields of national economy, such as :Metallurgy, Petrochemical industry, fabrics, Building materials. Cutting. welding, Medical and health work, Food preservation and environmental protection etc. It has widely application, especially after seventies, in accompanying the development of new technology, the specialty gases are becoming necessary type gas materials in micro electronic technology, Biological engineering, New energy source, Remote sensing laser, Fabric optics communication, Ocean engineering, Aerospace science and national defence demand.

Recently, the international specialty gas market is monopolized by 8 translational corporations. based on statistical informations of 1987, in according to the sales amount, those corporations can be arranged as follows:

i) France air liquid Co.
ii) BOC
iii) UCC of USA
iv) APCI of USA
v) ACGA of Sweden
vi) Messergreheim of Allied Germany
vii) Linde Co. of Allied Germany
viii) Japan oxygen Co.

The 8 companies stated above occupy more than 80% of the total sales amount of the international market. The technology situation of those 8 companies represents the technology level of developing trend of specialty gases.

(2) The specialty gas industry is a kind industry with highly accumulation of knowledge and technology. its development and research require very broad science knowldgeof physics, chemistry, machineries, electronics, engine ring physics and engineering chemistry. The technology of specialty gas is a strong comprehensive technology. From the

experiences of advanced countries, the development of specialty gas depends on the synthetic development level of high pressure technology, low temperature technology, vaccum technique, purification technique, measurement technique, precise manufacturing technology and automatic controlling technology etc, Since more than 20 years, the international specialty gas industry indicates that the specialty gas forms its own control systemwhich has its own features with clear division of labor and complete kinds. we consider that the system can be deducted to 8 aspects as following:

i) Gas separation technology
ii) Gas purification technology
iii) Gas blending technology
iv) Gas analysis technology
v) Gas storage and transportation technology
vi) Standard measurement technology
vii) Safety protection technology
ixi) Gas application technology

Since eighties, those world advanced countries have completed its starting period about those technologies. it has the clear target about the contrusctions, technology features and research orientations. Those laboratory equipments and technological process are completely day by day. therefore, the specialty gas technology after more than 20 years pregnent and foster enters a mature development period.

(3) The development of specialty gas depends on the perfection and consummation of international legislation. Specialty gas has manifestly different physical , chemical and biological properties to other industrial gases. In order to manage and safety application, under the control from government, it must establish severe standards and codes.

The technological legislation expressed mainly in the following two aspects:

i) Establish the severe standard transferring system

The specialty gas requires high severe inspection means in order to facilitate the product quality inspection and arbitration, to avoid theconfusion situation during applications, those developed countries established their complete transferring system. for intance, the Japanese government determines that the Tokyo industrial and measuring research Institute are responsible to offer first grade standard gas, the Chemical products association is reponsible for manufacturing the secojdary standard gas in using the first grade standard gas as reference material, the Manufacturng appraisal Institute of standard gas is responsible to manufacture the practical standard gases which are using the secondary grade standard as reference material transferred to different consumers. It constitutes a complete transferring net work for specialty gas standard. The American government determines the first grade standard gas which is prepared by the chemical analytical center of NBS. the government gives rights to those central laboratory of big gas companies which can be based on the first grade (primary) standard gas to manufacture the secondary standard gases and then those manufacturing factories produce the practical standard gases which are sold to the consumers. In Europe, there is established a union European standard material association which is responsible to determine the primary standard gas and transfer it to related government standard bureau or national experiment center. those factories utilize the primary standard gas to produce the pratical standard gas for approprite the consumer use.

From our understanding,The NBS of USA is the famous standard material research center with advanced equipments, excellant staff members and producing the complete set of various kind of specialty ga-

ses. it promotes so many fruitful research results, however, at present, there is still not to establish a world gas transferring system. but most governments acknowledge the standard gases prepared by NBS of USA as the base material,reference material, hence, an international standard transferring network around NBS of USA as the center is accepted practically by the international society.

ii) Workout various complete safety protective regulations

Most of the specialty gases have the characteristics of high pressure, low temperature,flammable, spontaneous combustion, explosive, suffocation, toxic and poisnous. therefore, the problem of safety and protection becomes very important in production and application. If there is any negligent to the safety and protection,may the crisis to machine or human body be happened, or to form public hazardous contamination to the environment. therefore, in comparison to the industrial gases, during the period of development of specialty gases, it needs the government legislation to protect and support. In dealing with this aspect, the different ordinances of USA are rather completion. at present, in USA, there are 6 organizations which are responsible to work out various safety and protection standards:

a. NIOSH is responsible to control industrial safety problems
b. OSHA is responsible specially to work out ordinances for avoiding poisnous gases which can give harm harzardous to human body and environment.
c. ACGIH is responsible to work out the lowest limit value of specialty gases
d. EPA is responsible to work out the exhaust standard of different kind of poisnous gases
e. DOT is responsible to work out those standards for transporting the specialty gases about the form of transportation, weight of loading, regulations in application, rescue measures etc.
f. CGA is responsible to work out a series of regulations about the materials, paint colour, size, bearing pressure, duration of application, maintenance etc. of various gas cylinders, and also offers safety, reliable code of design and calculating methods about the manufacture of various pressurized vessels.

All of those systems and measures give an important driving force for protecting and supporting the development of specialty gas industry of USA. recently, the other countries learn the legislation of USA, grasp firmly about the working out and issuing of safety legislation. it can be forseen,in accompaning the deeply progress of spacialty gas internationally, a general, unified international safety, protective rules and regulations will be finally worked out.

(4) The specialty gas is the baseic gas material of various new development technolgy. at present, the quantity, quality, species and new technology, new process of specialty gas are in continuously developed. the features of development can be summarized with two words, namely, "high" and "low".

In the respect of "high", it mainly expressed in:

i) High purity, high blending, high precision.

In the international field, the purity of mono-element gas goes higher and higher, the purity of Ar, H_2, He reaches 7N. the blending composition of mixed gas goes more and more. the max. components reach 30 elements,the analytical precision reaches 0.1-1%.

ii) High stability, high reliability, high quality.

Owing to adopt various advanced treating measure about the inner wall of gas cylinder, the quality of several semi-conductor ma-

terial gases and standard blending gases after stored 1-2 years are still reliable, it satisfies the various requirements of consumers.

iii) High automatic, high efficiency, high yield.

At present, in the international field, the process of gas separation, purification, blending, analysis and the system of selling and distribution adopt computer control program. put in reality of highly automatization. for example, the French air liquid Co., UCC and APCI of USA, Messergreheim of Allied Germany, Japan oxygen Co. etc. they do establish a fully automatic and semi-automatic computer technology of blending and cylinder management system. It highly increases the production efficiency and achieves excellent quality, high yield.

iv) High performance, high precision, high complete set.

Recently, various high effective thermal mass transfer tower developed. a batch of high selective power adsorbing agent, molecular sieve, gas separation membrane, high precision filtering medium are invented. Under the high precision controlling,technology,, owing to have high precision pipe fittings and valves, a complete sets of gas purifing, antitoxic and safety protective system are established. those new techniques promote strongly about the increasing of product quality.

In the respect of "low", it express in the following:

i) Low detection limit.

In accompaning the impurities content of high purity gases greatly decreasing, the analytical technology reaches super microquantity analysis period. The sensitivity of apparatus must be higher and higher. and the detection limit dropped lower and lower. the min. detection limit isppb degree.

ii) Low doping, low concentration.

Owing to the rapid progress of precise measurement and environmental protection achievements, it requires severe conditions about instrument calibration standard gases and environmental inspection standard gases. the doping composition of mixed gas is from ppm falled to ppb. the blending process level is increasing continuously. and the blending tolerance goes more lower.

iii) Low pollution. low exhaust.

In accompaning the transportation of gases to have a good means.the opportunities to be polluted in using high purity gas minimized greatly. in other aspects. the establishment of rules and regulations of specialty gas promotes the rapid progress of antitoxic technology. the exhaust standard of tail gas decreased daily. theharmful gases give rather low contamination to the environment.

iv) low cost. lowconsumption.

At present. the high pressure of air separation unit dropped to low pressure. in the same time. there is a new type air separation unit which uses the liquid natural gas as refrigeration source. hence. the nergy consumption goes down rapidly. In the other respect. various new technologies of adsorption. catalization are developed. those products devices are simple in equipment. low cost in manufacture. operation ease. higher degree in automatization. it decresease the proction cost rapidly. Since eighties, the features of "4 high" and "4 low" of specialty gases promote the whole gas business to be specialized in production. automatization in process. complete set in technology, series in products. Those big gas companies construct their specialized specialty gas com anies in the world. they adopt computer for realizing the process control, they prove to have a complete set technology about analysis, transportation, safety, standards andapplication. it achieves effectively the deep processing and serilization of polyspecies gases.

(5) The international developing new trend of specialty gases technology can be summarized as the following 7 targets:

i) Gas separation and purification technology

At present, the key points of research are focused in the following 4 areas:

a. Pressure variance adsorption technology(PSA)

This method was developed by UCC based on the patent of ESSO Co. it is used formerly in the purification of H_2,the product purity can reach 6N, but now, it expands its applications in various fields of gas separation, purification, etc. nowadays, UCC developed also another rapid pressure variance adsorption technology (RPSA) which has a pressure cycling period within 20 sec. through mono-bed. It can operate continuously, UCC now achieves their experiment in application, so that it will put into industrial production earlier.

b. Membrane separation technology

This technology is started in sixties. after seventies, in accompanying the development of high polymer materials, it gets to matur', owing to this technolgy which has obvious features of small equipment, low energy consumption, performance stability, low cost, operation convienient, therefore, it attracts the highly attention of various Co. in 1979, Monsanto Co. of USA adopted sulphone membrane to recover H_2, in 1985, Dow chemical Co. of USA adopted poly acetylene hydrocarbon membrane to separate out $H_2$from air successfully. in 1986, DuPont Co. of USA established an industrial device in using poly acrylamino membrane to recover H_2 from petroleum tail gas. at present, the main development trend of this technology are:

a) New type permeable membrane developed with hgih performance. in 1987, Japan O_2 Co. used cation permeable membrane to degrade O_2, N_2,THC, CO_2, and H_2O of H_2. it can obtain high purity H_2 of 6N.

b) The application field expands widely, the membrane separation technology has expanded from H_2 recovery to the sepaeation and purification of CH_4, air, O_2, N_2, H_2, CO_2 and steam.

c) As the membrane separation technology combined to a complete set with the traditional deep refrigeration technology and adsoption technology, the efficiency of separation increases rapidly. now, UCC of USA is just organizing their keytask team for researching this technology.

c. Laser purification technology

This technology is using the specialized wave length laser to excite the impurities which be eliminated after reacting and dissociation. At present, in the international field,they use ultra violet ray to dissociate the silane impurities successfully. it can reduce 50ppm AsH_3 and PH_3 in silane to less than 0.5ppm.

d. Gas terminal purification filtration technology

Owing to the rapid development of micro-electronic technology the requirements to various impurities, metalons and dust patticles are more severe. most gas quality can not satisfy such requirements, recently, the big gas companies developed the super purity, zero contamination, terminal purification system. which can be installed directlyin the gas stream terminal of the production process, so that it can achieve the purification for the gas products. that system has 3 functions of removing organic, inorganic impurities, of removing metal ions and filtering out the dust particles. at present, in the world, a purification device has already been developed which can eliminate the harmful impurities to ppb level, the high efficiency filter can filter 0.01 micro-meter dust particles.

ii) Gas blending technology

The research key points of gas blending technique are mainly focus ng on the following two aspects:

a. The high precision primary blending gas technique

It adopts high purity gas to prepare various primary standard gases. under the super purity environment in using super precision balance and gas cylinder which was specially treated. During eighties, this kind technique goes smoothly. the representation of this technology is NBS of USA and British O_2 Co.

b. Computer soft ware technology in using partial pressure method

The partial pressure method is the main means to prepare mixed gases, During the midst of seventies, those big gas companies developed the computer soft ware program which can correct the deviation between the ideal gas and real gas. based on this technique, as soon as the process requirements of blending gas were inputed to the computer, then through the data base, a complete blending program will be outputed including physical parameters of those composition gases, which gas can be mixed or not, blending scheme, what kind cylinders for filling, flow rate of filling gas, temperature, pressure, requirements of transportation and storage, protective regulations and other remarks etc. nowadays, in the world, themax. blending gas soft ware data base contains 1500 species of gas, more than 100,000 specifications. this kind new technology increase the blending precision greatly. it gurantees safety production, elevates the production efficiency and makes a revolutionary modification about blending gas.

iii) Gas analysis technology

At present, there are 3 items of the gas analysis technology in the forward position:

a. Programmable control with high automatic precise analytical and detection techniques. nowadays, in the central laboratory of big gas companies, all of the big scale precise instruments are linked in the computer net work, unmanned operation, automatic control, various analytical data can be automatically inputed to data base which may call out instantaneously. this kind high automatic modern detection technique is the newest trend occured in the analytical field.

b. Detection technique of metal particles in high purity gas. In the large integrated circuit, the electronic grade high purity gas used in the research and manufacture of semi-conductor requires the severe control and detection about the trace metal particles in the electronic grade high purity gases.the process is making the sample gas to liquid state by severe chemical treatment and then in the super purity room, use high precision atomic spectrometer to analyze the impurities, the main unconquered key points of that project are:

a) How do catch the trace metal impurities from the gas and make a precise sample?
b) How do separate the trace metal impurities with the base material effectively?
c) The problem of purification of reagent and cleaning treatment during the analytical process?
d) The detecting technique about the dust particle in higher purity gases.

The super large integrated circuit above 256K requires severe control about dust particles in process gas. Since the high terminal filtering system was developed, How do measure precisely about the quantity and particle size of metal dust particles in unit volume of high purity gas is a key problem now. generally, in the international field, they use two types precise counter of condensed nuclear type and laser type. detect the quantity of particles and size of particles in high purity gas separately. and then after comparison, offer the analytical data, but how do avoid the system pollution, ensure the reliability of detecting data and how do determine the relationship between the dust particles ontained in the instantaneous flow and the average dust content, those problems are still explored in world countries, there is not any conclusion yet.

iv) Gas transportation technique

In this field, there are two technical trends which must be paid attention:

a. The inner wall of gas cylinder treatment technique by means of isotopic ion spraying. in accompaning the development of high purity standard gas and electronic mixed gases, the traditional package utensils can not satisfy the stability and reliability of gas quality. during the end of seventies, big gas companies developed the inner wall treatment technique of gas cylinder by means of isotopic ion spraying. ie. after the gas cylinder to be treated in using the general method, make a layer oforganic coating on the inner wall of gas cylinder in order to cut off the contact between inner wall and composed gases. at present, the BOC,UCC French air liquid Co. and Japan oxygen Co.have already mastered this sophisticated technology.

b. High clean pipe installation technique. In order to ensure no pollution contaminated during the transportation, distribution and application of high purity electronic gases, a kind of high clean pipe installation technique was developed. ie. in the super clean room, use the 316L stainless steel inner wall polished pipe which may under the high purity Ar atmosphere condition connect the electroyte grinding fitting, regulator, filter etc. by means of automatic welding machine. in this case, it can ensure the high precision piping system to satisfy the requirement of different special conditions.

v) Safety protection technology

Recently, the most dominant progress in the safety field is the anti-toxic technology which becomes moreperfect, so many gases used in electronic industry are severe toxic, as AsH_3, B_2H_6, PH_3, SiH_4. the permissible concentration of those gases in theatomosphere are 0.05, 0.1, 0.3, and 5ppm respectively, therefore, the slag, waste gas produced in the process must take the anti-toxic treatment in due time. The French air liquid Co. and Japan oxygen Co. made system research about this problem. they manufacture several complete sets anti-toxic devices of dry type, wet type, thermal dissociation type and combustion type etc. it gives better effects for protecting thehuman life and avoiding the environment contamination.

vi) Gas application technology

Because the specialty gases have so many species and with complicated performances, therefore, the application problem is very protruding, recently, the application technology becomes from negative to positive, more plants use their dominant situation about specialty gases, they help users to research new technology, develop new process. in the same time, they makenew developments about those inherent fields, so that they will occupy the market and expand their application fiels. forinstance, in the gas developing department of France air liquid Co. they establish a micro-electronics technology and laser application research laboratory. In the research center of Japan oxygen Co. they established a semi-conductor research room which had developed out new type device for organo metal gasphase. this device modifies the original process, increasing the application efficiency, obtaining goodpraise from users. in the same time, it expands the application field about their products.

vii) Engineering design

In the engineering design, there are two new trends:

a. The computer aided design replaces the traditional design method. UCC of USA concentrated their soft ware experts, explored 5 years, they have now edited a complete set of soft ware design program Based on that, they can adjust the plant layout showed on the screen, until the satisfactory result is obtained, and then the printer will print out various process drawings, including spares drawings and components drawings, installations drawings, piping drawings, plant lay-

out and different side view of drawings , isotopic drawings etc. this kind of CAD will be sure lead to a new revolution in the engineering design field.

b. The modernized and standardized specialty gas factory has been formed gradually. because the specialty gases are deviated from industrial gases, therefore, the specialty gas attaches on the gas gas plant or gas separation plant. In the view of building construc-tionauxialiary activities, there exists some unreasonable plants, during eighties, based on the negative and positive experiences in developing specialty gas, the big gas companies explored a set of resonable, safety and reliable design code which gives more resonable design alternates among purification, blending analysis, storage and transportation, alarming, antitoxic, automatic inspection etc. at present, the Mitry-Mory specialty gas plant of French air liquid Co. the Chalon electronic gas plant near Lyons city and the Mie Ohyamada specialty gas plant of Japan oxygen Co. all of them reflects this kind sophiscated design thought. It can be said these factories are the fruital crystal which represent the present age technological development level of specialty gas. At the same time, several air separation units which produce high purity gas stride forward, fully automatic and unmanned operation.The Messergreheim Co of allied Germany established a super large scale air separation unit with a capacity of 100,000 cubic meter/hr. in Luhr industrial zone. the air separation unit of UCC in silicon valley are typical representative of modern air separation plant.

(6) The electronic industry is the present age main pillar of the development of specialty gases

At present, the micro electronic industry treated the integrated circuit as the core has already been the technological foundation ofinformationized society. Its technological level is the important target to measure the technological success of a modernized country and sophisticated degree of its industrialization, the electronic industry is its main pillar of industries.

In theinternational field , since sixties, the integrated circuit was developed, its progress is very rapid in the rate of decade change in this period, the selling income and product yield have doubled and endoubled annually. the price of integrated circuit decreases about 40%. During seventies, it is thehighly development period of large scale integrated circuit, the selling income average increasing rate is 20-30% and the price ofintegrated circuit decreased 25-30% the integrated degree increased four fold within three years. During eighties, thetotal selling income of international integrated circuit is USD 105×10^8, in 1982 USD 129×10^8 in 1983. in 1984 it rapidly increases to USD 209×10^8. the average annual increasing rate is above 90%. nowadays, the VLSI of 256K can be manufactured industrially in USA and Japan. the 1M-4M super large internated circuit has been researchod. In order to accomodate the rapid developing trend oflarge integrated circuit, those big gas comapnies have pay more attention to the manufacture of electronic gas products. In the sixties, there was a series products to satisfy the demand of medium-small integrated circuit production. in the seventies, the electronic high purity gases were produced for accomodating the large integrated circuit. during eighties the electronic high purity gases formed a complete system and continually to be developed more deeply and widely. from incomplete statistical data, nowadays in the world, there are 131 kinds o electronic high purity gases which occupy the total mono element high purity gas nearly 49%. because the micro electronic technology has the following features, as high precision, high integration,high reliability, microprocessing, micropower consumption, therefore it requires the electronic gas which must be high purity, high precision

and high reliability. it is understood that more than 80% ofthe technical results are developed for the requirement of micro electronic technology. In order to promote the rapid growth of micro electronic technology, it pushes the specialty business which has a leap so that the gas conrol technique reaches such high developinglevel, and also it strongly stimultes the relationship of supply to demend. based on the statistical data, sice, eighties, the liquid state gas produced in USA increased 4% annually, and the demand quantity increased 15% annually. in order to accommodate this kind requirement, several big gas comapnies of USA established factories in Silcon Valley of California and Silicon desert of Arizonia. from the incomplete statistics data, during the period of 1984-1985, the AirCo Co. established four high purity nitrogen separation unit. UCC established two new gas plants. APCI and French air liquid Co. established one gas plant respectively.From our understanding, only the APCI Co. has high purity N_2 transportation pipe net work about 25 miles long,the gas quantity supplied is 420 T/day, which can satisfy the demand of 45 integrated circuit plants. The development of electronic industry brings a vast market for specialty gases, and in the same time brings a large portion profit for the manufacturers, it promotes the specialty gas business going on a well cyclic developed stage.

(7) As a kind of new developing industry, the management of specialty gas industry absorb experiences from other industries to form its own specialized features, such as, fast information feedback, fast in technology development,fast in manufactureing product innovation, and high technology, high speed,high efficiency and also technology export, capital export, international monopolization etc.

At present, those big gas companies, in the management aspects generally adopt such guidlines: such as, integration of scientific research and production, integration of near future target and forward target, integration of high technology development and routine technologyinnovation. their informations must be feedback quick, management must be vivid, technology must be precise, products must be new, profit must be real. In the keen competition of international market, they keep forging ahead permanently. in order to promote the continuous progress of production and scientific research work. for example, in accomodating the rapid growth of micro electronic industry, those big companies use only10 years to carry out the third generation electronic products. in order to accomodate the world energy source crisis, big gas companies in Japan and USA make quick-ly orietation they developed specialty gas used in solar energy cell. the Japan oxygen Co. leaded by technology set up new market continuously. their business expands very swiftly within the 10 years from 1975 to 1984, their selling income increases 2.2 times, and the profit increases 1.5 times

Thepublic features of management in big gas companies are: precise equipments, small size machines, best quality and high efficiency. Since eighties, these big gas companies treat their new plants with vast money to adopt advanced technology, use computer for management, put in reality about computer control, reduce the staff members, so that in the max. limit to elevate the capital using rate and labour productivity. for example, the Chalon electronic gas plant of French air liquid Co. produced 35 kinds of electronic mixed gases and one kind electronic purity gas, but that plant has only 7 employees. the Messergrehim Co. of Allied Germany established a big air separation unit with the capacity 100,000 cubic meter/hr. in Rhur industrial zone, the plant has already been automated, it has only 4 employees. the specialty gas Co. of BOC is responsible for the production and

and selling activities of specialty gases to whole England, the total management person is 8. UCC of USA established in Silcon valley a high purity liquid N_2 air separation unit which is unmanned operation. the Mei Ohyamada specialty gas plant of Japan Oxygen Co. has a capital 20×10^8 Japanese yuan, it is one of themodern specialty gas plant of the present age , the employee is only 17 persons. from the example stated above, the specialty gas business which is capital integrated type and technology integrated type is now undertaking to simplify the organizations, modernizing the manufacturing means, well employ the employees in a high level.

The high technology and high accumulation will sure bring high monopolization, recently, the international specialty gas market has a trend to develop in the respects of district concentration and international monopolization. for example, the French market is mainly monopolized by French air liquid Co. the England market is shared by British Oxygen Co. and British air products Co. the allied Germany market is also shared by Messergrehim Co. and Linde Co. the USA market is shared by UCC, Matheson Co. APCI and AirCo Co. that means, at present, the international market is monopolized by those big gas companies of USA, England, Western Germany, Switzerland and Japan. Based on the insufficient statistical data, the fixed assets of specialty gas of Allied Germany, North America, Japan occupies more than 80% of the total world's specialty gas fixed asset, however, the specialty gas of Africa, south America, western Asia is still in void.

Recently, in the international field, theer is a new trend, ie. those big gas companies export their commodities simultaneously, they also take the technolgy export and capital export on the order of the day, for example, in 1982, the Japan oxygen Co. has estahlished a Japan-American oxygen and equipments technological company by his own capital and in 1982, it makes a joint venture with national iron works of Singapore to establish a Singapore national Oxygen Co. Ltd. in 1983, the Japan oxygen Co. and Ameli gas company cooperated to buy the Paihuangson specialty gas Co. which arranged as the second place in the American specialty gas business. in the same time, those gas companies in Europe and American take east Asia as their cockpit for capital investment. Recently, UCC of USA, APCI, BOC, French air liquid Co. all of them built factories or establish research organizations in Singapore, Taiwan, Phillipine, Malasia, Thailand, Hongkong, Japan and south Korea, in 1979. The APCI cooperated with China Zhong Hong industrial Co. located in Shekou district, GuangDong province to establish a joint venture plant for producing high purity N_2 and H_2 products for the GuangDong glass factory which use the floating method for production. this is the first joint venture plant in our gas industry, in 1986, the BOC negotiated with Shanghai Wusong factory, they obtained an agreement to develop specialty gas cooperately. At present, those foreign businessmen of USA, Japan, France, Allied Germany are contacting with us positively, to seek new route for technological trade coorperation. It can be forecasted, in accompaning the rapid development of China socialist construction,keep theopen policy goes smoothly, the prospect for making international cooperation about speciqlty gas is very brilliant, the east Asia district be sure an flourishing international base for researching and producing specialty gas forge ahead western Europe and North America.

(8) The specialty gas is a kind of new type gas material which faces a broad developing prospect, the main developing areas are:

1. Electronic industry

From the view of international developing trend, the nineties will be the developing period in depth of super large integrated circuit. It is estimated that before 1990, the 1M byte dynamic random store will put in industrial production, the 4M byte dynamic random store will be manufactured successfully, during the period of 1990-2000, 16M-64M super large integrated circuit store will be developed. The Min. line width of device will reach 0.5 micro meter. this means that the specialty gas used in complete set will not only increase in quantity, but also in quality to be renewed. The purity of product will increase to 7N-9N. The heavy metal and transcendental metal impurities in the high purity gas will be controlled in ppb degree. The max. diameter of dust particle will be limited below 0.05 micro meter. in facing the keen competition of electronic industry, those different gas companies must have a new break through in the gas detecting technique in one respect, and it will increase the quality, stabilize the process, decrease the cost in another respect, it must explore new theory, new concept to seek new material, new process and new route. so that it can promote the technology of specialty gas going to a new developing stage.

However, at present, the international economy is just under the adjustment construction, but it is estimated, the yield of large scale andsuper large scale integrated circuit will increase steadily according 10%-5% annually before the end of 20th century. in accompaning this, the yield of electronic gas will also enter to a sychronous and steady developing period and based on this foundation, it carries new break through and leap.

2. Food industry

In accompaning the development of world economy, the construction of human diet is facing scientific reasonable and rich in nutrition. In order to guranttee that persons will take reasonable food nutrition in different districts and different seasons, the food preserving storage technique is in rapid developing, Nowadays, there are 4 general methods for preserving the food:

a. Refrigeration method
This method is easily making the stored lost of weight, and the protein enzyme denatured. it is not an ideal method to keep food fresh.

b. Radiation method
This method is very complicate in the safety technique. Persons have apprehension to those food radiated, they are not easily to accept this method.

c. Chemical method
This method has not solve the problem that wether it has any damage to the food nutrition or is there any remaning poisnous material in the food.

d. Gas adjusting method
In practice, this method can remedy those shortinomings stated above in the other three methods, expecially, the fruit, vegetable presevering, it is the ideal method which has the following features:

i) It can guranttee the quality of fruit and vegetableto prolong the storage period.

ii) It can prevent the decomposition of chlorophyl of fruit and vegetable and preserve the colour.

iii) It can preserve the hardness of fruit and vegetable, reduce the dry consumption.

iv) It can hinder the after ripening process of fruit and vegetable, and reduce the nutrition consumption.

v) It can reduce the low temperature plant disease of fruit and vegetables, reduce the physiological damage and microorganism enchroach.

Based on our uhderstanding, during recent decades, the proportion of different countries in the world which adopt the method of gas adjusting for storing fruit and vegetables increased rapidly, for instance, England accounts 80%, Holland 10%, France 40%, Hungary 32%, USA 35-50%, Italy 35-50%. the stored quantity in using the gas adjusting method reaches 10,000 tons in abroad. The gas adjusting method needs a large amount of food grade N_2, CO_2 and different proportion of mixed gases It also needs different gas sealing means and detecting means to guranttee so that it is no doubt to open a new field for the application of specialty gases.

3. Medical treatment industry

Recently. in the field of medical science. and clinical examination. more specialty gases are used. at present. in the international field.it has already developed the specialty gas of pharmaopia degree. these are: O_2,N_2, He,NO_2, N_2O_5, ethylene oxide, synthetic air and their related mixed gases. for instance.mixed gases used for respiration. biological cultivation. blood analysis. lungs expanding. metabolismmeasuring. biological analysis. clinical operation anaesthetic. instrument sterilizing. bactericide etc.

In the application of specialty gases in medical field. it roughly can be generalized to 6 aspects: cure. anaesthetic. clinical operation. low temperature storage and utensils sterilization.

a. Diagnose

Let the patient to inhale mixed gases of O_2/N_2, O_2/H_2. synthetic gas/He, so that it can judge the functions of lungs whether it is normal or not. in the saline, dissolve Xe-133 and inject it to human body, through the analysis about exhaled gas , then it can judge the physiological situations of the lungs.

Let the patient inhale the H_2/O_2, CO_2/H_2O synthetic mixed gases for respiration and then measure the deviation between exhaled gas and standard value, so that it can give the logic judgment about certain illness.

b. Treatment

For example, in using the medical oxygen, it can modify and prevent the deficiency of O_2 in biological body, in curing the Malignant tumour, the application of O_2 can promote the treatment effect . as the trauma and Toxicosis happened to take emergency treatment, the using of O_2 is helping to increase the effectiveness of drugs. for treating the illness of Asthma by inhaling the O2/He mixed gas it can reduce the state of illness. in the deep diving, use O_2 20%+ H_2 80% mixed gas, it can prevent the happening of divi-ng illness. in using the 5%O_2+95%O_2 mixed gas, it can promote the respiration ability of infants. in using 10% CO_2+90% O_2 mixed gas, it can cure the brain capillary tube expanding disease. in using the liquid N_2 it can cure the Chronic arthritis and Rheumatism.

c. Anaesthetics

N_2O, cyclopropane, trichloro methane and ether etc. or liquid state steam can be used as anaesthetic agent especially, because of the stability of the physical, chemical property of N_2O, voluminous clinical operations proved that it has no obvious side actions to human organs, therefore, during recent years, it is widely used in the international medical field. for instance, Mixed gas of $30\%N_2O + 70\%O_2$ or $50\%N_2O + 50\%O_2$ can be used in dentistry analgesia, ophthalmology operation, no pain parturition of women. the mixed gas of $80\text{-}90\%N_2O + 25\%O_2$ can be used as the whole body anaesthetic agent in the big operation.

d. Clinical testing

So many kinds of specialty gases used in this field, for instance, in the fields of blood culture, microorganism cultivation, Biochemical analysis, serum measurement and urine analysis. Not only itself needs different kind specialty gas as background, but slso so many calibration standard gases for analytical detecting apparatus are needed. these gases are:O_2,N_2, H_2, He, Ar, Ar CH_4, C_3H_8, C_2H_2 etc.

e. Low temperature storage

Liquid He, liquid N_2 and dry ice can be used as low temperature cold source of different grades. At present , it has brought the initiative functions in the fieldd of serum storing, drugs preservation, sperm refrigeration, corpse and viscera protection in accompaning with the new development of organs transplanting techniques, however medical science and hereditary engineering, it is estimated that low temperature storage technique will sure have a brilliant perspect.

f. Instrument sterilizing

The sterilizing gas of oxyethylene is a new kind of high effciency and safety cold sterilizing agent which is made of C_2H_4O+ CO_2 or C_2H_4O +halohydrocarbons, it has the features of low operation temperature. great diffusion rate strong permeability, good sterilizing effect. it is widely used in the sterilizing of medical instrument, operation room, medical clothes, bed clothes.

Recently, certain countries utilize the features of sterilizing gases, ie. strong diffusion, strong permeability and combination the principles of pharmacology. they work out different medical mixed gases, so that it can shorten the physiological reacting period after the patient taking drugs, increase the drugs effect. It is foreseen, the medical scientific field is an important place of specialty gases.

4. Enviroment protection

In accompaning the development of modern industry, the contamination due to the drainage of industry givings is more and more severe. In Dec.1984, UCC of USA has an accident to leak out the poisnous gas of isocyanic methyl ester in the Bepain factory located in the central province of India. in 1986, Bernbelli nuclear power station of USSR has an accident of radiation pollution and in NOV,1986, the Basersdorf chemical factory has an accident of store explosion, volouminous sulfides, phosphides and mercury drained out. it gave much pollution to Rheine river. such accidents lead to strongly response. at present , the voice for maintenaning living balance, protecting atmosphere clean, purification of the living enviromment is more and louder, hence the environmental gas is developed under this conditions in according to the usage, environmental protection gas can be divided into 3 kinds:

a. Evironmental inspection standard gas

It also be divided to two kinds of atomspheric pollution inspection standard gas and district inspection standard gas, in order to control the atomospheric pollution, it must inspect these mixed gases blendly by NH_3, CO_2, Hcl, H_2S, CoS, SO_2, NO, NO_2, C_3H_8, C_6H_4 and phosgene, chloroethylene, sulfuranol. at present, the international experts have an unanimous idea that the main standards of atomospheric pollution inspection are 4 kinds, ie. Cl/N_2, SO_2/N_2, NO_x/N_2 and H_2/N_2 etc. the district inspecting standard gas is worked out to that different partial environment in which person are working these where may be occured theharmful elements in over and over dosage. for instance, those calibrating gases used in the alarming instrument of electroinc, petrochemical and chemical ibdustries.

b. Static contamination source inspecting standard gas

These are worked out in according to those harmful substances after detoxify for safety drainage. these kind environmental gas has more than 100 species and more than 1000 specifications in the world.

c. Dynamic contamination source inspecting standard gas

This isinstrument calibrating gas which is worked out for waste water drainge standard. as in airplanes, trains, ships, cars etc. at present, in the international field, there has already a series tail gas exhaust standard for vehicles. It is forecasted, in accompaning the development of modern industries, in accompaning that person pay more attention to the environmental protection, in accompaning those rules and regulations of environmental protection are perfect, the environmental protedtion gas will be also an important developing field of specialty gases.

(5) New type energy source

The problem of energy source is another severe problem that human faces. Owing to the sharp reduction of the traditional energy source storage of petroleum, coal, almost those industrialized countries are endeavour to economize energy source to drop in consumption and to seek new energy source reserve. The atomic energy and solar energy are the most available and inherent energy source for the world. In comparison the solar energy and atomic energy, the former has obviously the features of safety in using, simple in device, free of pollution, therefore the development and application of solar energy will be a great strategic target for solving the present age energy crisis. recently, the poly-crystalline silicon solar energy cell with high photo-eelectro converting tate has been normally input to the market. in the same time, the specialty gas material for producing poly-crystalline silicon, as methyl silane and selenmum methane has a big demand in the international market, based on statistical data, the field of Japanese solar cell was 7120KWP in 1982, it increased rapidly to 5580KWP in 1985 and in 1986 5860KWP. at present, the domestic electronic utensils , such as, calculator, semi-conductor, radio, clocks etc. almost adopt the solar energy as power. the speed for generalizing the new type energy is over the forecasting speed. USA is a big country in using solar energy. Recently, they establish a natioanl mangement system for generalizing solar energy cell, that is in the residential district, install the solar cell and satisfy the demand of different homes. In the same time, The government can buy or levy the spare electricity, by forecasting, after several years, the polysilicon solar cell will adduct and explosive development trend, at that time, the specialty gas used in methyl silane and silane for producing polysilicon crystallization material will be sure to a new level. we must highly pay attention to the big market of energy source.

From the above stated, specialty gas is a kind of new development industry which is very fully of hopefulness. In the development history of industrial gases, the metallurgy welding industry, chemical industry and iron industry, aerospace industry have made promotion to the development of industrial gas. we believe, in accompaning to the development of new technology, the specialty gas industry will sure promote an an open new field for specialty gas to create a new level, it will enter to a period of full blosom, full of viguor and full of life.

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