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**Liquid Nitrogen Plant**  
**(Centre of Advanced Studies,  
Department of Physics  
and Astrophysics,  
University of Delhi)**

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by Y.N. Ivanov

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Mr. Y.N. Ivanov, Unesco consultant for the Liquid Nitrogen Plant from Sverdlovsk Oxygen Engineering Works No. 1, reached Delhi on 21 November 1967 for service in the Physics Department of Delhi University.

In Delhi University Mr. Ivanov had a meeting with Professor Majumdar who was at that time the Head of Physics Department. He started his work in Delhi University on 22 November 1967.

Mr. Ivanov's tasks consisted in the following:

- (1) To choose premises for the installation of the liquid nitrogen plant and to hand over to the chief engineer of the university Mr. Makhijani the necessary drawings for the construction work as well as the electrical work.
- (2) To check the condition of the equipment after its transportation and, if necessary, to carry out repairs.
- (3) To supervise the work of the construction of the foundations for all parts of the plant as well as channels for water, air and drainage communications.
- (4) To place the machines in the premises and to assemble the air, water and drainage systems.
- (5) To carry out the degreasing of the equipment, the inspection of the main parts of the plant, as well as the running in of the air compressor, the expander and the pump.
- (6) To carry out theoretical training of the working personnel.
- (7) To start the plant, to test it, as well as to teach the technical personnel the practical work at the plant.
- (8) To give instructions on safety rules to be observed during the running of the plant.

#### PREPARATORY WORK

During the first two weeks of Mr. Ivanov's work in Delhi University, the premises for the plant were chosen and the chief engineer of the university, Mr. Makhijani, was given all necessary drawings of the construction and electrical work. During this period a plan as to the location of the plant as well as of the illumination and the ventilation of the premises was finalized. The electrical engineer of the university, Mr. Tara Chand, was given drawings of the electrical installations of the plant. In one of the rooms the main machines of the plant: compressor, air separator group, air cleaner group, air drier group, expander, liquid pump and sodium tank should be installed and the other room was allotted for keeping the cylinder-filling manifold. The Head of Physics Department, Professor Majumdar, was given all the technical data of the plant. He was also informed as to the working personnel required - 6 technicians and one foreman.

### INSPECTION OF THE EQUIPMENT

The inspection of the state of the equipment after its transportation was completed on 10 December 1967. The condition of the equipment was found satisfactory with the exception of some slight damage to the paint.

### THEORETICAL TRAINING OF THE WORKING PERSONNEL

On 11 December 1967 Mr. Ivanov started the theoretical training of the technical staff consisting of 3 persons, delegated by the university, Mr. Madal Lal, Mr. Kalra and Mr. Datta. The aim of the theoretical training was to acquaint these technicians with the practical work of the plant, with the construction of its parts, with possible defects and the means of remedying them. The theoretical training programme also included acquainting the working personnel with the properties of nitrogen and oxygen and their use in industry, medicine and scientific experiments.

The theoretical training was completed on 12 February 1968 and an examination was held before a commission consisting of co-ordinator Prof. Klepikov, Dr. Chaudhury, Dr. Duggal and Mr. Ivanov. Each technician was given 4 questions, three of which referred to the equipment and the fourth to safety rules to be observed during the running of the plant. The Commission agreed that the technicians had an adequate training and all three could be allowed to work at the plant.

The following additional work was done from 11 December 1967 to 11 February 1968. Lists of lubricants, instruments, chemicals as well as short working instructions on the running of the Nitrogen Plant were prepared.

### BUILDING WORK

The building work started on 10 January 1968. The following works were on the agenda:

1. Building of foundations for
  - (a) Compressor and Electric Motor,
  - (b) Separator Group, Expander and Pump,
  - (c) Air cleaner Group,
  - (d) Air Drier Group
  - (e) Sodium tank.
2. Construction of under floor channels for gas, water and air communications.
3. Construction of an underground tank for waste solution from the cleaner group and of the water supply to the cooling system of the compressor.
4. Construction of the floor in the Nitrogen Plant room. All the building works were completed by 18 March 1968. Installation of the Machines of the Nitrogen Plant on their foundation and assembling of the air, water and drainage systems.

All machines were installed on their foundations and fixed there from 18 March 1968 until April 1968. The assembling work of the air, water and drainage systems was completed by 1 May 1968.

#### ELECTRICAL WORK

The supply of electric power to the control panel of the nitrogen plant as well as illumination and ventilation work was completed under the supervision of the University electrical engineer, Mr. Tara Chand, by 28 June 1968.

#### PREPARATION OF THE EQUIPMENT FOR WORK

Full checking of all equipment of the nitrogen plant was done from 26 June 1968 to 6 July 1968 which included the inspection of the conditions of cylinders, pistons, bearings and crankshafts of the compressor, the expander, the liquid oxygen pump and the lubricator.

On completion of the inspection, all the machines were run in, according to the instructions.

On 6 July 1968 the plant was started on trial with an aim to produce some liquid nitrogen and to check the working possibilities of all the machines.

The trial showed that all the machines were in working order and that the practical training of the technical staff could be started.

#### PRACTICAL TRAINING OF THE WORKING PERSONNEL

The practical training of the technical staff for the operation of the nitrogen plant started on 10 July 1968 and was completed on 3 August 1968.

During this period, the plant in its different regimes worked for 362 hours. The aim of the practical training of the operating personnel was to teach all the technicians to work at the nitrogen plant, to teach them to carry out on their own necessary repairs of various parts of the plant.

The training was carried out in three stages:

- (1) Acquaintance with the starting period of the plant and production of liquid nitrogen. Each technician performed this operation during 10 hours.
- (2) Running of the plant round the clock for 192 hours with the aim of acquainting all technicians with all the phases of nitrogen and oxygen production as well as of testing of plant and adjusting the regimes.
- (3) Inspection of the equipment on the conclusion of the work. The aim of the inspection was to check the condition of the equipment of the plant and its most important parts which had been working in difficult conditions.

The pistons of the fifth and sixth stages of the compressor, the bearings of the crankshaft and all the filters were checked. The condition of the reduction gears, lubricators, liquid oxygen pump and oil filter of the separator group was checked. The condition of all the parts of the plant was found satisfactory. When the inspection was over, the plant was started for 130 hours round the clock with the aim of a recapitulation of the knowledge of the technicians.

After the conclusion of the practical work, the whole technical staff took an examination before a commission consisting of the Unesco Co-ordinator, Professor Klepikov the Head of the Physics Department, Professor Auluck, Unesco expert, Mr. Ivanov, Dr. Chaudhury and Dr. Duggal. The Commission considered that the technicians were sufficiently trained to work independently.

#### INSTRUCTION IN SAFETY RULES

1. The whole technical staff consisting of 4 persons was acquainted with the safety rules to be observed during the running of the plant and the knowledge of these rules was checked in the examination.
2. The technical staff of the plant was acquainted with the methods of determining the presence of oil and acetylene in liquid air and oxygen.
3. The instructions on safety rules during the running of the plant as well as instruction on the inspection of the equipments were prepared.

#### PRESENT CONDITION OF NITROGEN PLANT

At present, all the regimes of the nitrogen plant are completely checked up. The production and the analysis of the products: liquid nitrogen, gaseous nitrogen and gaseous oxygen tally with the data given in the certificate of the plant.

The technical staff consisting of 4 persons, employed by the University, Mr. Madan Lal, Mr. Datta, Mr. Kalra and Mr. Tirath Ram, are fully trained to work at the plant and, if necessary, they are capable of training new technicians.

#### THE FOLLOWING ARRANGEMENTS MUST BE DONE

1. Fire-fighting equipment should be kept near the nitrogen plant. Not less than two fire-extinguishers of the CO<sub>2</sub> type should be kept in the room of the nitrogen plant.
2. Emergency lights using an accumulator should be provided in the premises of the nitrogen plant.

#### RECOMMENDATIONS CONCERNING THE WORK OF THE NITROGEN PLANT

1. All electrical equipment should be under the observation of the electrical engineer of the university.

2. A monthly plan for the work of the nitrogen plant should be worked out in conformity with the required quantity of liquid nitrogen.
3. All Dewar flasks should be repaired and new ones should be bought since the Dewar flasks at present in the Department are insufficient to contain a day's production of liquid nitrogen of the plant.
4. There should be an annual check-up of the knowledge of the technical staff by the foreman of the plant in the presence of the scientist in charge of the Holium Plant.
5. The inspection of the plant, especially degreasing of the Separator Group, should be carried out according to the instructions.

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(Y.N. Ivanov)

Centre of Advanced Study in Physics,  
Department of Physics and Astrophysics,  
University of Delhi, Delhi 7.

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