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**CORROSION PROTECTION IN CHEMICAL PLANTS AND OTHER
INDUSTRIAL INSTALLATIONS**

BP/CUB/74/002,

CUBA.

Technical report

- 4 APR 1978

Prepared for the Government of Cuba by the
United Nations Industrial Development Organisation,
executing agency for the United Nations Development Programme

Based on the work of E. Ghisai, corrosion expert

United Nations Industrial Development Organisation
Vienna

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Explanatory notes

The following abbreviations are used in this document:

ASTM American Society for Testing and Materials

CIQ Chemical Research Centre (Centro de Investigaciones Químicas)

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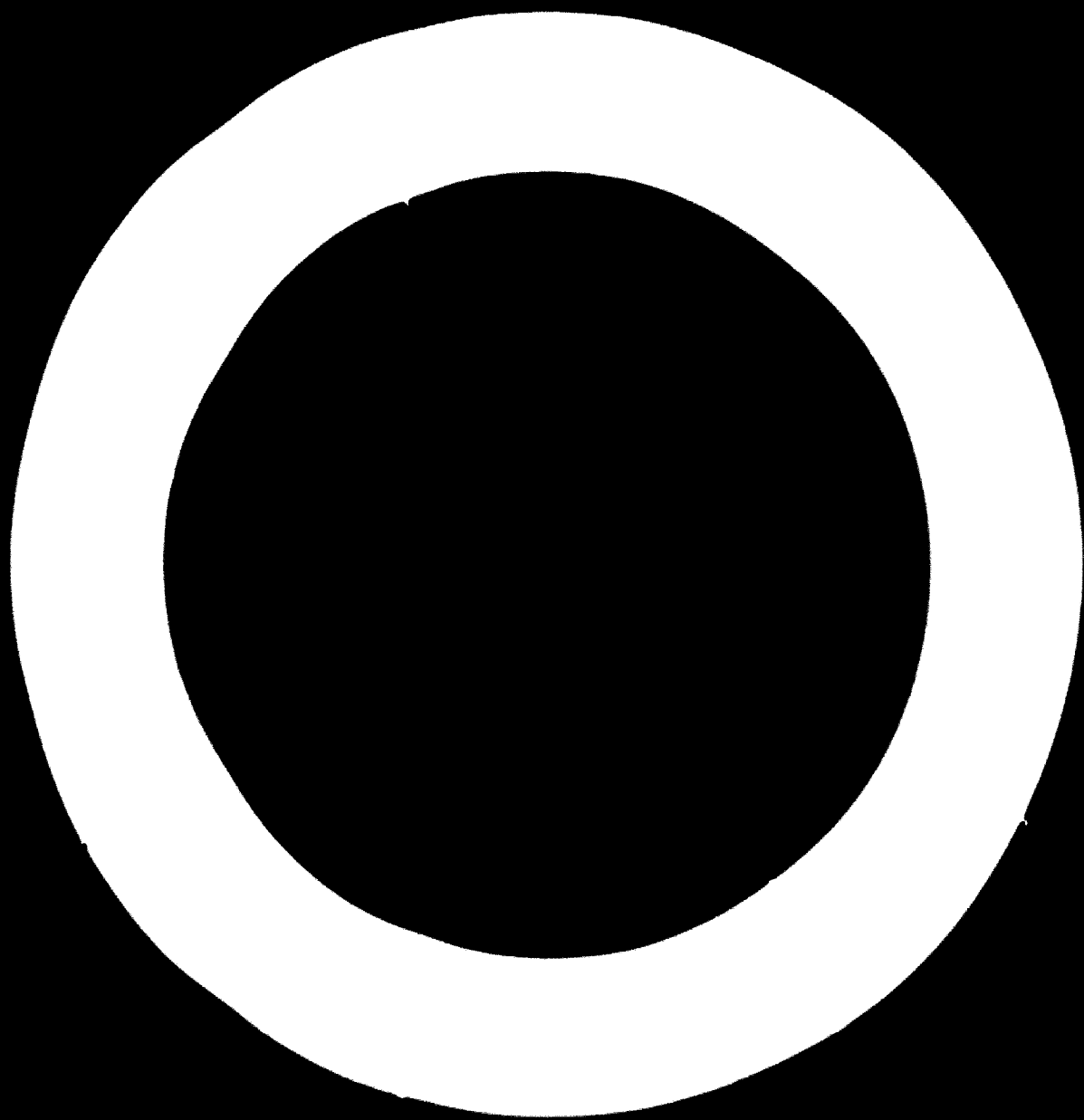
ABSTRACT

As part of the ongoing project "Corrosion protection in chemical plants and other industrial installations" (DP/CUB/74/002) that is being carried out by the United Nations Industrial Development Organisation (UNIDO) as executing agency for the United Nations Development Programme (UNDP) and in response to a request from the Government of Cuba, an expert in corrosion protection was sent on a two-month mission to Cuba. The mission extended from March 1977 to May 1977. The expert was attached to the Chemical Research Centre (Centro de Investigaciones Químicas - CIQ) within the Ministry of Chemical Industry.

This mission was a follow-up to the mission the expert carried out in 1975.^{1/} The expert observed work at CIQ and, together with personnel of the CIQ Painting Department, visited chemical plants.

The expert concluded that the original objective of the project, namely, to establish the technical capability for studying and applying corrosion protection, had been achieved to a large extent.

^{1/} See DP/ID/SER.A/32.



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INTRODUCTION

As part of the ongoing project "Corrosion protection in chemical plants and other industrial installations" (DP/CUB/74/002) that is being carried out by the United Nations Industrial Development Organisation (UNIDO) as executing agency for the United Nations Development Programme (UNDP) and in response to a request from the Government of Cuba, an expert in corrosion protection was sent on a two-month mission to Cuba. The mission extended from March 1977 to May 1977. The expert was attached to the Chemical Research Centre (Centro de Investigaciones Químicas - CIQ) within the Ministry of Chemical Industry.

Since 1970, the Department of Corrosion of CIQ has been providing advice to chemical plants on corrosion problems. In 1977, the Department was divided into a Department of Painting and a Department of Corrosion.

This mission was a follow-up to the mission the expert carried out in 1975.^{1/} The expert observed work at CIQ and, together with personnel of the CIQ Painting Department, visited chemical plants.

The expert concluded that the original objective of the project, namely, to establish the technical capability for studying and applying corrosion protection, had been achieved to a large extent. He found that Cuba's technical capacity to deal with corrosion had been enlarged considerably during the last two years. Many corrosion engineers had been engaged and were working in plants that had no such staff in 1975. He observed that the engineers turned to CIQ for advice.

^{1/} See DP/ID/SER.A/32.

I. FINDINGS

General

The painting standards the expert prepared in Cuba in 1975 are under review and will be adopted in the near future. The sand-blasting section set up in Cuba in 1975 is working satisfactorily with the compressed air available at the plant but at present is still a mini unit.

After the mobile diesel compressor becomes available, the CIQ staff who have already been trained can transport it to factories for on-the-job demonstration, with the goal of training plant personnel in faster methods of surface preparation.

A new outdoor exposure station is being set up at Guanabo in addition to the small one at Viriato beach that belongs to the Institute of Oceanology of the Academy of Sciences and was set up in 1969. The tropical-marine atmospheric exposure station for the evaluation of the durability of protective coatings as recommended in October 1975 had to be abandoned because of lack of funds and failure to obtain permission to use the land for this purpose.

The Department of Painting at the Chemical Research Centre

The Department of Painting was formed in January 1977 when it was separated from the Department of Corrosion. It now consists of five units:

- Evaluation
- Formulation
- Application
- Sand-blasting
- Metal spraying

The total number of personnel is 18 in all five units, but the sand-blasting and metal-spraying units are not functioning because:

(a) The electrical compressor with which sand-blasting was being done in 1975 is out of order and the mobile diesel unit provided by UNIDO has not yet arrived. The hopper for the sand-blasting has not been fabricated yet;

(b) The electrical connections for metal spraying for 440 volts has not been available since mid-1975. Plastic spraying is, however, being carried out and studied.

The first three units mentioned above are working smoothly with each unit housed in a separate room with its equipment. On the whole the units are well organized, each unit having its own supervisor who is adequately qualified.

A mini-exposure station is housed on top of the terrace at the Centre and serves as a guide for paints and waxes formulated in the department. Primers, zinc-rich paints, enamels, bitumens and waxes are being studied. A relative humidity exposure bench with samples has also been installed. A wet-dry bulb unit is also housed here.

Surface preparation panels are also being exposed and studied.

Of the two fellows awarded grants by UNIDO one is already at work and the second candidate will be leaving for Madrid in the first week of April.

The Department has established a good working relationship with industrial establishments throughout Cuba and is cultivating it diligently.

Factory visits

The expert revisited the factories he had visited on his earlier mission and reviewed the recommendations made in 1975. His findings are summarized below. A working scheme to check and follow up reports every three months has been established. Additional work as called for has also been implemented.

Tónica Cubana, pulp and paper plant at Cárdenas

This plant received reports and visits regularly from CIQ. Panels have been set up for exposure study exactly as recommended in October 1975.

The total conveyor system will be replaced by early 1978, and even the bagasse storage flooring recommendation of 1975 will not be necessary, since bagasse will be carried automatically by conveyors and not by fork-lifts anymore.

No true severe corrosion problem exists at this plant; the control panels set up are in good condition.

Fertiliser plant at Cienfuegos

The expert undertook a detailed inspection of this plant together with staff of the Department of Inspection and Maintenance and CIQ engineers during the plant shutdown.

The major problem was the erosion of the bituminous coating of the interior of the cooling-water lines.

On visual inspection of the 48-inch intake section along its total length it was observed that the pipe was originally coated with a hot aluminium spray that had been overcoated with a hard bituminous paint. Since it is a direct intake and does not incorporate filter beds, heavy deposits of fouling organisms - marine organisms such as barnacles - settle in the layer of silt deposits. The barnacles then grow and force their way through the silt until they are firmly attached to the paint. These interior spaces, so easy to descale and protect during construction, are relatively difficult to work in. The best method of removal would be to use brass or aluminium scrapers and carefully scrape the barnacles off without damaging the bituminous paint coating.

The aluminium coating was completely intact and even the bituminous coating was in good condition. An air line delivering compressed fresh air can be provided and run near to the area where the descaling is in progress. Two teams of six men each should enter and scrape the surfaces for short periods of two hours alternately, until the areas have an inspection.

Since the method is time-consuming and difficult, the workers could be offered an incentive to undertake the job. The 24-inch pipeline above ground was inspected, and it was observed that specifically the problem was the same along long running lengths.

However, at bends, T connections and elbows, the erosion had removed both the bituminous coating and the aluminium as well. Here the expert recommended sand-blasting of the affected areas and coating the same with four coats of an epoxy coal tar hard coating to a thickness of 200 microns after a primer coat of zinc-rich epoxy - thickness of 50 microns.

On surfaces where the bituminous coating has eroded and worn off, a touch-up coat can be given with the same bituminous coat of paint as used three years ago.

The most important point is to remove as far as possible all deposits from the interior surfaces before painting and to carry out a detailed inspection, keeping in mind the hazard of fumes and the safety of the workers.

Electro Gufico, chemical plant at Sagua

This plant was visited with two representatives of CIQ. The expert found it encouraging that the staff of the Department of Corrosion Maintenance and Painting had been expanded to 15 and that compressed air points with standard couplings were being placed at key spots all around the plant to operate the pneumatic chipping hammers, at present the best method used here for surface preparation. The plant personnel have been well trained in the execution of correct methods of surface preparation and application of paints. A record is kept on inspection and maintenance.

The expert stated that he would dispatch direct from India two copies of the International Organisation for Standardisation (ISO) the Swedish Standard, "Rustgrades for steel surfaces and preparation grades prior to protective coating" for evaluation and guidance during maintenance. He recommended that on arrival of the portable diesel compressor, CIQ demonstrate its use to the plant technicians and engineers so that eventually they would fabricate their own unit.

He also recommended that the hypochlorite storage concrete tank that had been painted with epoxy paint as he had recommended in 1975 be overcoated with two coats of epoxy clear lacquer, since unfortunately they had as their final coat a red epoxy whose pigment was leaching and colouring the hypochlorite stored therein. This would seal off the pigment contamination.

The perchloro-vinyl paints imported from the Union of Soviet Socialist Republics, which were being used on surfaces, should be replaced by chlorinated rubber paints, which are manufactured in sufficient quantities in Cuba and which give a very thick and strong protective coating in areas exposed to heavy corrosion and lesser surface preparation is needed. This plant should standardise on this coating and also bituminous coatings with an admixture of mica for their needs.

The expert inspected the 18-inch pipes that had been coated with a bituminous paint to protect the surfaces from underground corrosion and found the coating too thin for this purpose. He recommended that a fine silica sand be mixed with the next bituminous coat, which should be applied before the pipes are laid underground to a thickness of 150 microns.

All aluminium corrugated sheets should be treated with an etch primer prior to overcoating with a zinc chromate primer and finally overcoated with chlorinated rubber paint. Since this procedure was not followed in the old aluminium sulphate plant, the paint skin has broken down in areas where the paint was not bonded well with the sheets.

The maintenance at the chlorine plant is a very good example of correct maintenance. The repair of steel structures, which prolongs the life of the trusses and roof, is carried out efficiently. Proper methods of surface preparation, inspection and painting with chlorinated rubber paints are used. The maintenance department should be especially commended for its work.

Cuba Nitro fertilizer plant at Matanzas

The expert discussed the recommendations he made in 1975 with two corrosion engineers of the plant who wanted a clarification on the specifications, since a maintenance painting programme was to begin in a few days. The expert had recommended a bituminous paint for the structure of the conveyors, i.e. for the underside metal parts, channels etc., and a coal tar epoxy for the main supporting structures, such as columns. The painting was to be carried out by the end of April 1977.

The engineers at Cuba Nitro were anxious to know the approximate number of man-days that would be required for surface preparation and painting in each unit, and the expert reviewed the situation in each and assessed the requirements.

At present only 6 painters are employed in maintenance, but 14 are required as a minimum. During the shutdown approximately 20 painters and one supervisor would be adequate to complete each unit in about one month.

In this plant the maintenance painting should have been carried out in early 1976. However, due to various factors it had been shelved. Now immediate action should be taken, since "deep pitting" corrosion has set in.

Rayonera, rayon plant at Matanzas

The expert reviewed the recommendations he made in 1975 with two senior engineers from CIQ.

In the sulphuric acid plant the leakages and overflow of acid that is causing corrosion should be controlled to save the paint films. Since heat-resistant paints containing silicones are not available at this moment in Cuba, the areas (chimneys, hot lines tanks etc.) should be painted from time to time to save all ferrous surfaces.

Panels exposed by CIQ on the racks were examined and found in good order. They also revealed that no bituminous or aluminium paints could be used here for exterior purposes.

The solventless epoxy metal panels prepared by CIQ and hung in the fan chamber for studying this type of paint film (tested for 3 months) were in good order. Results will be studied further as recommended by the expert.

A new sodium sulphate recovery plant is being constructed here costing 1.5 million pesos by a Japanese firm. The civil engineering will be executed by Rayonera. The area for the plant had been cleared, compacted and laid out. Water had been encountered in the subsil which contained sulphates. The expert recommended that a pit trench 18 inches deep and 12 inches wide be excavated around the periphery of the area into which calcimine could be sprayed from time to time (every month).

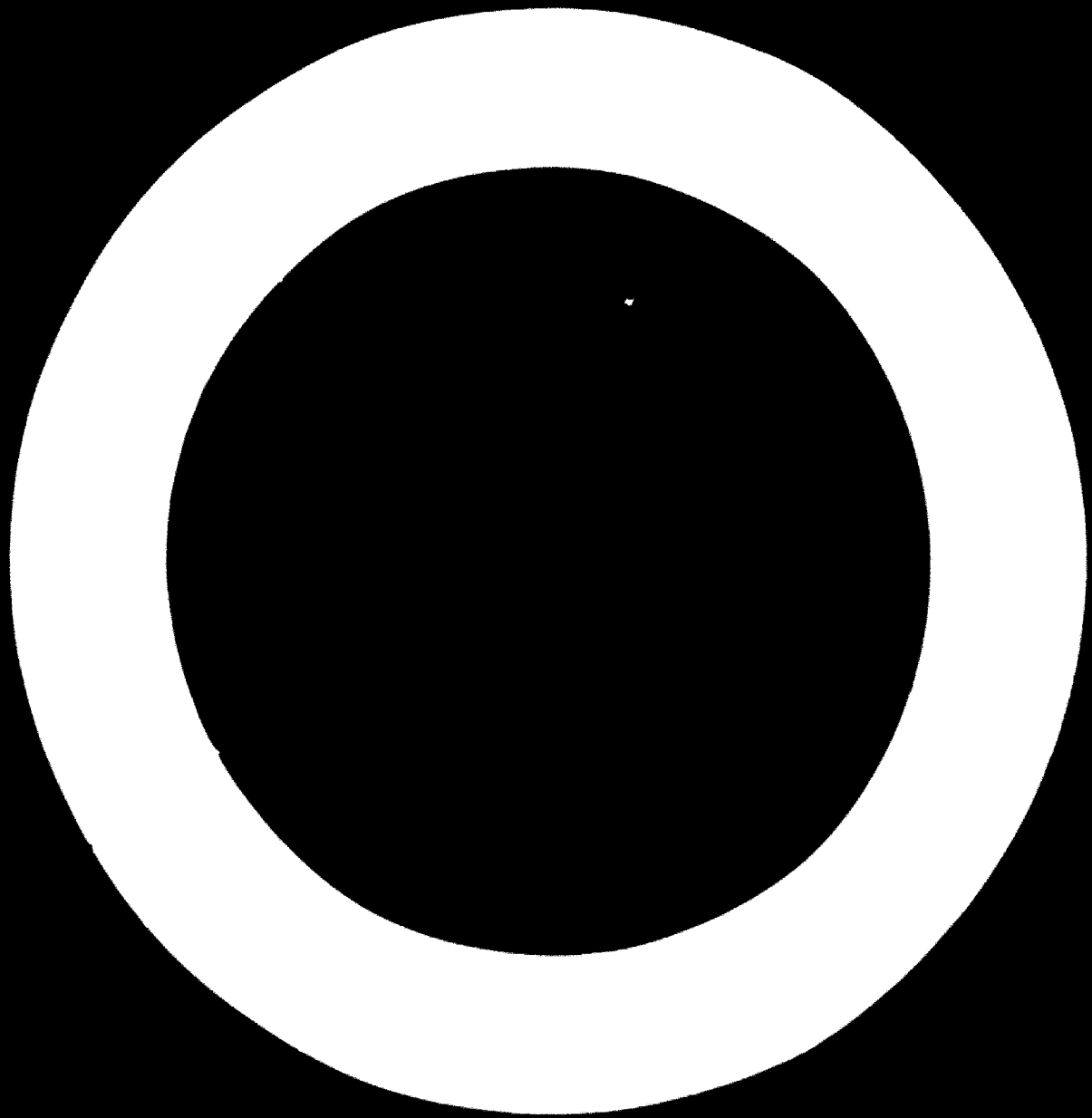
II. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

After a detailed review of the activities at the Chemical Research Centre since 1975, the expert is of the view that the division of the Department of Corrosion into a Department of Corrosion and a Department of Painting has been very successful. New products for painting and priming have been developed. Surface preparation and cleaning methods, an integral step in the process of protection of manufacture of metal structures and equipment, are chosen with greater care.

Recommendations

1. UNIDO should continue to support the project in 1978.
2. The Painting Department should be expanded with UNIDO aid to meet present plant needs.
3. UNIDO should be asked to provide additional equipment to facilitate studies and research.
4. Development of new sophisticated industrial coatings for the chemical industry that has recently been started should continue.
5. The new exposure station at Gannabo beach should be developed.
6. Sand-blasting equipment should be used in industrial installations.



Annex I

JOB DESCRIPTION

- Post title: Corrosion expert (dealing with general subjects on corrosion protection)
- Duty station: Havana, Cuba, with trips within the country
- Duration: Six months
- Date required: March 1977
- Duties: The expert will be expected:
- (1) To assist in planning applied research, both current and future, carried out by the Chemical Research Centre, on corrosion problems in chemical plants and other industrial installations;
 - (2) To provide advice through the Chemical Research Centre concerning protection against corrosion in the following chemical plants and industrial installations:
 - Nitrogen fertilizer plants
 - Basic chemical plants (salt, sulphuric acid, chlorine, caustic soda etc.)
 - Mineral processing plants (nickel, copper etc.)
 - Sugar mills and their auxiliary installations
 - Plants and installations in the light industries
 - Food-processing plants and installations (breweries, dairy products etc.)
 - Maritime transport (merchant marine and fishing fleet)
 - Enterprises importing iron goods
 - (3) To study the results obtained from investigation of those chemical plants and industrial installations in respect of the coatings and materials used for corrosion protection;
 - (4) To select suitable methods of testing corrosion.
- Language: Spanish desirable, English acceptable
- Qualifications: University degree in chemical engineering or chemical technology with extensive experience in corrosion protection

ANNEX II

SALT-WATER SPRAY EQUIPMENT

Salt-water spray equipment (Constant Level Acetic Acid Salt Spray Testing Apparatus, E.W. 11 65 A type, manufactured by W. Canning and Co. Ltd, Birmingham, United Kingdom), was delivered by UNIDO to the Centre in October 1976. It was installed during the first week of January 1977.

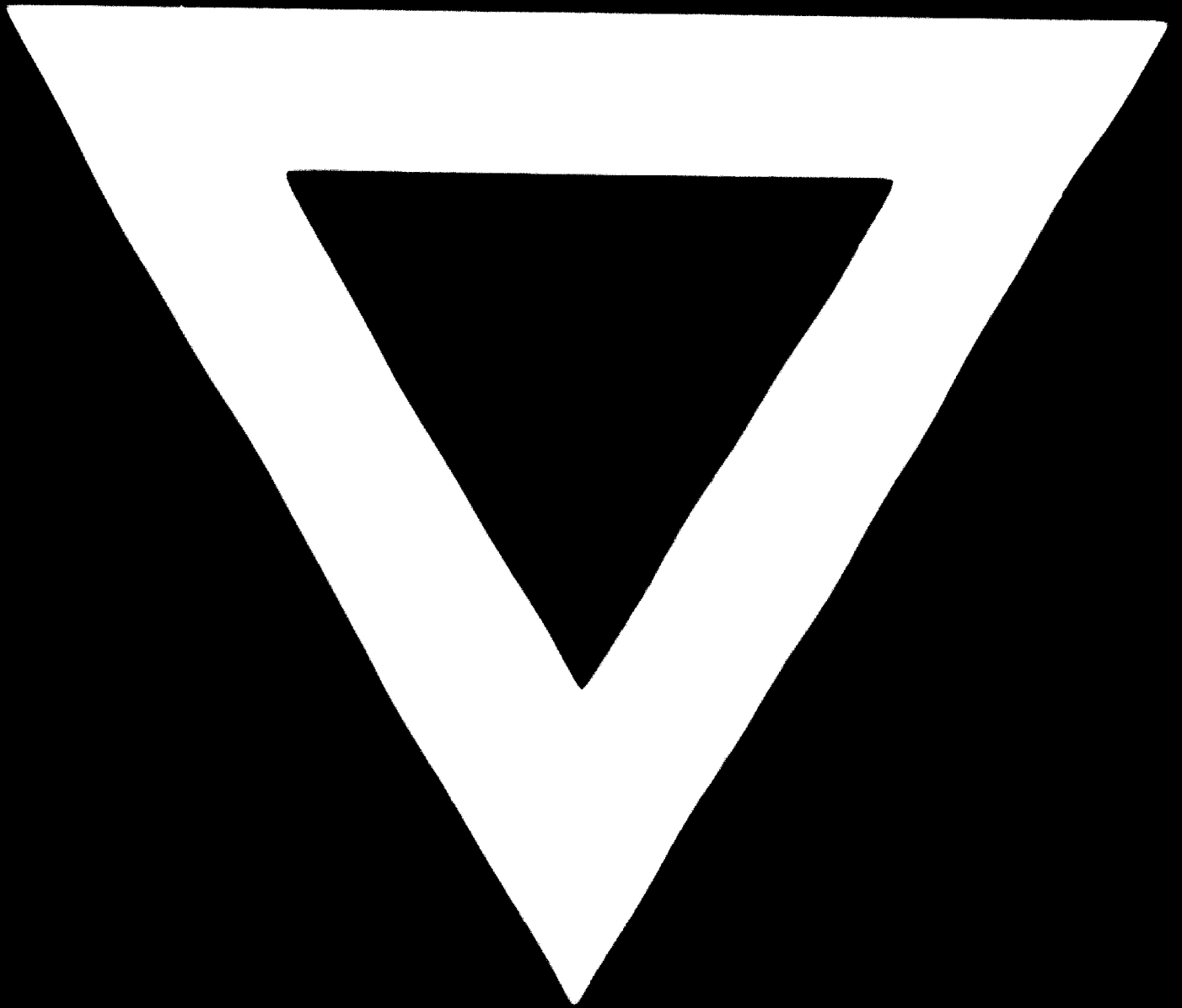
A trial run was made on this unit during March after obtaining the test specimens and the salt and distilled water required for a short run. CIQ found that in 3 days 48 litres of salt solution was consumed or 2.5 kg of salt or NaCl pure for analysis. Distilled water was also readily available.

The expert was requested to help ascertain the exact requirements of the salt spray equipment. On referring to the ASTM Standard for the Acetic Acid-Salt Spray (FOG) Testing B 287 - 62 (reapproved 1968) it was established that the unit should be put into operation immediately by obtaining regular salt and testing to see that it does not contain more than 200 ppm of total solids free of nickel and copper and on a dry basis not more than 0.1% of sodium iodide and 0.3% of total impurities; the amount required per day would be approximately 0.64 kg and the Centre could manufacture its own requirements in the laboratory.

The expert recommended that the compressed air line that is at present delivering traces of oil be cut at a section and two goose necks be installed, one as a water draw-off with a nipple at the bottom and the other with a detachable nipple approximately 2 feet long packed with asbestos fibre.



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