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ACTION PLANS FOR REDUCING ENVIRONMENTAL HAZARDS FROM INDUSTRY

DP/ROM/91/002

ROMANIA

Technical report: Findings and recommendations*

Prepared for the Government of Romania
by the United Nations Industrial Development Organization,
acting as cooperating agency for the United Nations Development Programme

Based on the work of O. Prof. Dr. M. Grasserbauer, consultant on industrial pollution monitoring and control

Backstopping officer: B. Sugavenam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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1. Introduction:

The Government of Rumania had submitted a proposal for the above named project to be carried out in cooperation with UNIDO under UNDP funding. The purpose of the mission was to discuss the proposal with Rumanian institutions involved, to evaluate and - if necessary - adjust it, to check the feasibility of performing the proposed work and to advise Rumanian colleagues in technical and organizational matters.

In order to achieve this task the following institutions were visited and extensive discussions held with representatives of these institutions:

i) Research Institute of Soil Science and Agrochemistry, Bukarest
(Director Prof. Dr. C.I. Rauta)

ii) Research and Engineering Institute for Environment [ICIM]
(Scientific Director Dr. V. Rojanschi and coworkers)

iii) The Research and Design Institute for Waste Water Treatment (ICPEAR), Bukarest
(Ms. Toader Felicia Adrian, Chief, Department of Operative Research)

iv) Industrial Complex at Onesti
(Dipl.Eng. G. Niculescu [Technical Director, CHIMCOMPLEX S.A.], Ing. S. Albu [Director of Technical Products, Rafineria Onesti), the (technical) director of the rubber plant, and Eng. T. Mihai [Chief of environmental protection department, Petrochemical Works])

v) The Ministry of Environment, Bukarest
(State Secretary Ioan Jelev)

vi) The UNDP office in Bukarest
(Mr. O. Jannone)

The visits were arranged by Mr. V. Alexandrescu, International Relations Office of the Ministry of Environment, who was the designated national coordinator of the proposed project and who presented the proposal for the organization of the project (annex 1). The essential visits and discussions were done jointly with the representative of UNIDO.

2. Findings:

2.1 General impression:

Rumania is in a state of drastic change with accompanying instabilities and uncertainties at many levels. This may have an effect on the performance of the project. A strong and clear local organization for the project must be found, cooperation between all partners involved must be ensured and the required assistance of the government must be provided to achieve a successful

completion of the project. It was found that several open questions remain, which should be cleared immediately. The most severe are:

- Responsibility and authority of local coordinator
- Cooperation between the main partners in the project (e.g. ICIM and the Institute of Water Research)
- Guarantee of financial and other support by the Ministry of Environment

2.2 Scope of the project:

In view of the difficult situation in Rumania, the necessity for extensive training, the lack of infrastructure etc. the ambitious project submitted by the Rumanian authorities has to be substantially modified, particularly by concentration of the investigations on one industrial area. An industrial complex which is typical for Rumania in respect to environmental pollution and the technical standards was chosen:

- The Onesti complex containing a chemical factory, a rubber production plant and an oil refinery, and
- The Bacau energy plant operating with lignite of high sulfur content

The major items of the revised project as recommended by the consultant and as agreed upon with Rumanian authorities are given under item 3 (Recommendations).

2.3 Specific impressions and findings:

i) Research Institute of Soil Science and Agrochemistry:

The head of the institute, Prof. Rauta, has international experience and connections and showed great interest in cooperation. It seemed that the major expertise on soil contamination in Rumania is gathered in this institute. Examinations have been performed in many industrial areas leading to a rough soil pollution cataster (annex 2). More detailed investigations have been hampered also by lack of modern analytical equipment. As basic techniques AAS and GC are available. Improvement of the analytical capabilities of this institute, mainly by the Rumanian Government, is recommended as well as integration into this project.

ii) Research and Engineering Institute for Environment:

The scientific head of the institute, Dr. Rojanschi, showed great interest in the project and clearly expressed that he was willing to accept the major responsibility for the analytical

investigations of air and water pollution, including the operation of the mobile laboratory. The institute has experience in water analysis and processing and in air pollution monitoring (annex 3). It publishes also a journal (Mediul Inconjurator) which contains important articles and data concerning environmental issues.

The laboratories visited (those for water analysis) are in relatively good shape, but lack of new equipment is also a severe problem. The institute however has a variety of analytical techniques at its disposal (annex 4) which qualify it to act as the core laboratory for the proposed project. This organizational decision would also have the advantage that a central Rumanian environmental laboratory is upgraded with equipment and expertise and it could offer improved services to the Ministry, industry and the provincial laboratories and authorities. This type of structure has proved successful in Western countries too.

In the talks with Dr. Rojanschi and coworkers it was clearly expressed that for a successful implementation of the project, it is necessary

- to provide new laboratory equipment (annex 5).
- to provide funds for maintenance of modern equipment bought from Western countries.
- to provide an adequate car - at best a Volkswagen van, for which service is available in Bukarest.
- to provide reagents and mobile laboratory.
- to support the institute in every manner necessary concerning implementation and performance of the project.

This position is strongly supported by the consultant since only if the adequate measures are taken the project will achieve its goal. The difficulties for efficient and successful work in Rumania are enormous today. Lack of trivial things hinders progress - e.g. the lack of gasoline, scientific literature, heating, failure in electricity. This project is going to be implemented under extremely difficult situations - thus every possible and foreseeable measures have to be taken to allow a fairly smooth performance.

iii) Waste Water Treatment Institute (ICPEAR):

The Institute is located near a water work station and the Chief, Dept. of Operative Research explained the work carried out by the Institute. They keep close links with industrial complexes around the country and monitor chemical influents and effluents in waste water. They maintain a data bank and assist in trouble shooting exercises. The laboratory is housed in an old building damaged by earthquake and the staff carry out T.L.C., G.C. Volumetric, and T.O.C. analyses. According to the Institute most of the industrial complexes do not meet Rumanian standards in effluent limitations.

Full participation of ICPEAR in the project is essential for proper planning in cleaning up of industrial waste water pollution of the past, present and the future.

iv) Onesti Industrial complex:

The Onesti Industrial complex operating since 1961 is a huge assembly of various chemical plants (producing e.g. chlorine, organic solvents, acetylene, vinyl chloride, PVC, i-propanol and other alcohols, calcium chloride, soda, linear alkyl benzenes, amines, pesticides, organo-phosphorous compounds, cyanic acid, aluminium chloride, sodium hydroxide etc.), a rubber production plant (based on butadiene and isoprene) and an oil refinery. Production of some chemicals is several hundred thousand tons per year. 4600 people are employed in the chemical plant, 1200 people in the refinery processing 5 million tons of crude oil per year (sulfurous and non-sulfurous). The "rubber" plant produces 200000 tons of rubber and 20000 tons of polystyrol per year.

The general impression of the industrial site and facilities can be summarized in following points:

- There is a very strong air pollution (smell, visible emissions).
- There is a huge problem concerning industrial waste treatment.
- There is a substantial suspection of pollution of river water, ground water and soil with chemicals.
- Technology looks old-fashioned, maintenance is poor and many objects give a desolate impression (e.g. practically all metal pipes etc. are highly corroded).

Some photographs (annex 6) illustrate this situation.

There are however programs and plans to improve technology (e.g. a replacement of the present mercury-electrolysis process for chlorine production by a membrane process is already decided), but the necessary renewal of the whole complex will be a task for many years to come. The strong environmental pollution is one driving force for implementation of new technologies. Environmental pollution although recognized and measured in some parameters by the industrial laboratory itself is insufficiently characterized. There is no systematic assessment of pollution, no source allocation data, no impact data of air pollution. Ground and river water analysis seem to have been neglected, or at least carried out insufficiently. Waste water analysis is carried out at several places (for pH, TOC, petrol, phenol, Cl^-, S^{2-}), but waste water treatment is nearly (practically) broken down due to

- mechanical problems with aerators (motors burning down due to overheating).
- broken installations in the biological processing step.
- contamination and plugging of plants by synthetic rubber effluents.

The whole waste water treatment system is in urgent need of renewal, preferable applying modern technologies of waste water treatment.

Due to the problems in the waste water treatment wet sludge is deposited in landfills near the factories. These are filled up now and flow over at heavy rains. Contamination of soil, river and ground water is consequently occurring.

A special problem is the open deposit of soot from acetylene production which is burned periodically. Soot and particles are transported into the environment by wind over kilometers.

Air pollution effects on the environment have been reported up to 20 kilometers distance - e.g. damage of forests due to acid deposition. Frequent complaints of the population and an increase in diseases - allergies, respiratory problems, eye irritations have been reported. Soil pollution from underground petroleum pipes has been established by visual observation (oil films on river at low water levels).

Due to this very bad environmental situation a thorough assessment of environmental pollution and of the existing technologies (for production and waste management) seem urgent.

The environmental assessment should be based on a systematic measurement of air pollution performed preferably during one year in order to incorporate episodes of very high pollution (smog) and seasonal changes. These measurements are the basis for

- identification of specific emission sources (processes).

- assessment of environmental impact and risk.

The components to be analyzed should include the fundamental substances regulated by laws or national standards:

> SO_2/SO_3, CO, NO_x, total organic hydrocarbons, total suspended particulate matter (TSP) including its content of toxic metals, and chemical substances typical for the emission situation of the industrial complex: HCl, HF, Cl_2, NH_3, amines, HCN, phenol, phosgen, Hg etc.

Basic data can be obtained from immission measurements performed by the industrial complex itself and should be used for comparative purposes.

The air pollution measurements must include meteorological parameters like temperature, wind direction and speed, barometric pressure, relative humidity.

Several sampling sites inside and outside the complex must be selected and periodically monitored in order to obtain representative values for air pollution and enable source allocation.

For water analysis the river and ground water should be characterized for hazardous substances originating from effluents. These should include phenol, heavy metals (Hg, Cd ...), hydrocarbons, cresol, pesticides etc. Sampling should be performed also at characteristic and representative times over one year with particular observation of changes in the chemical production, waste management etc.

Soil analysis should be performed for major pollutants in a few places where contamination is suspected. In view of the limited funding and frame of this project, soil analysis does have mainly a supplementary but important rule.

Future plans:

The chemical complex has allotted 12 billion Lei from their own funds to modify their secondary waste water treatment station (019 station) mainly for inorganics. The petroleum refinery located in the same area has a committment to clean up the ground water contamination due to leaks in the underground oil pipe system.

Replacement of mercury electrolysis methods by membrane technology for the production of chlorine is already planned at a cost of US$ 60 million from external credit facilities.

Thorough investigation of process modernization and closing up of old obsolete technologies are already in the planning stage and with the shortage of raw materials and many export markets disappearing, an overall strategy for the country's requirements and the production capacity should be determined for an environmentally and financially sustainable development.

3. Recommendations:

3.1 Scope of the project:

i) Assessment of environmental pollution in Onesti-Bacau area, including identification of pollution sources.

ii) Assessment of existing process technologies in respect to their environmental impact and possibilities of technological improvements: power plant in Bacau, chemical and rubber plant and oil refinery in Onesti.

iii) Assessment of waste water treatment system in the Onesti complex and proposal of technological upgrading.

iv) Assist in developing medium/long term strategy and in taking legislative measures for cleaning up of industrial pollution acquired from past heritage and plan an environmentally suseptible industrial development.

3.2 Organization of the project:

i) Major responsibility with the Research and Engineering Institute for Environment. ICIM should cooperate with the Institute of Water Research concerning aspects of water pollution and waste water treatment and with the Research Institute of Soil Science and Agrochemistry concerning aspects of soil contamination.

ICIM must nominate a responsible project leader and identify specialists for the various topics to be investigated.

ii) Responsibility for coordination of all relevant Rumanian authorities and institutions with the Ministry of Environment who should give the necessary executive power to the project coordinator.

iii) Consult local specialists who have vast experience with ONESTI and other complexes for any advice on technical coordination matters.

3.3 Investments:

i) Mobile laboratory for:

- Continuous air pollution measurements (NO_x, SO_2/SO_3, CO, total hydrocarbons)
- Sampling air-borne particulate matter with filters
- Measurement of meteorological parameters (temperature, wind speed and direction, relative humidity, air pressure)
- Sampling of water and soil
- On-site measurements of water for pH, conductivity, fluoride, chloride and other elements with ion selective electrodes and photometry.

The mobile laboratory should be housed in a suitable truck (preferably VW van) and include the necessary glassware and other supplies.

The mobile laboratory should be operated by ICIM who will take over the full responsibility of its proper operation and maintenance. It should also be available for the cooperative research partners in agreement with ICIM.

ii) Analytical laboratory equipment for performing the necessary analysis in the laboratories (ICIM, Institute for Water Research, Institute for Soil Science). The list provided by ICIM is enclosed, but certainly needs updating after the start of the project.

iii) Reagents necessary to perform the project. A (partial) list has been submitted by ICIM.

iv) Supply of spare parts - possibly through special UNDP funds.

v) Basic operating costs (fuel etc.) and chemicals, glassware etc. available in Rumania should be covered by the Ministry of Environment - as it was agreed upon by the State Secretary I. Jelev.

3.4 Training:

The following training for Rumanian experts actually involved in major functions in the project should be provided:

- Air pollution measurements and their evaluation: 2 mts
- Water pollution measurements and their evaluation: 2 mts
- Others:

Study tours for Rumanian scientists - including research directors - should be arranged to create international contacts and gain international experience.

3.5 Consulting from foreign experts:

- Industrial pollution measurements and source allocation
- Assessment of existing technologies in respect to environmental pollution
- Assessment of risks and impact of pollution
- Industrial waste water processing
- Economic assessment of environmental pollution effects
- Others:

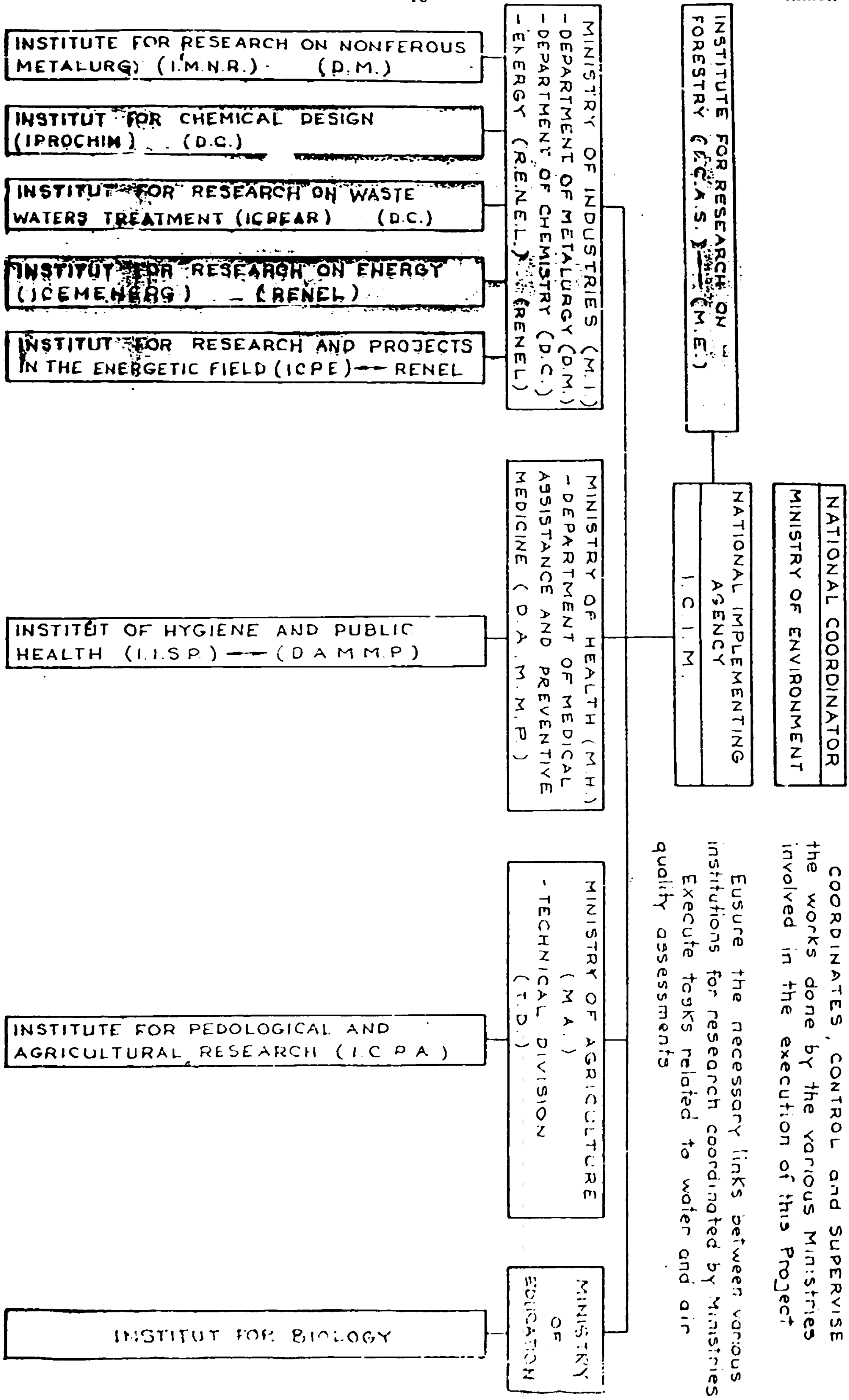
3.6 Impact of the project:

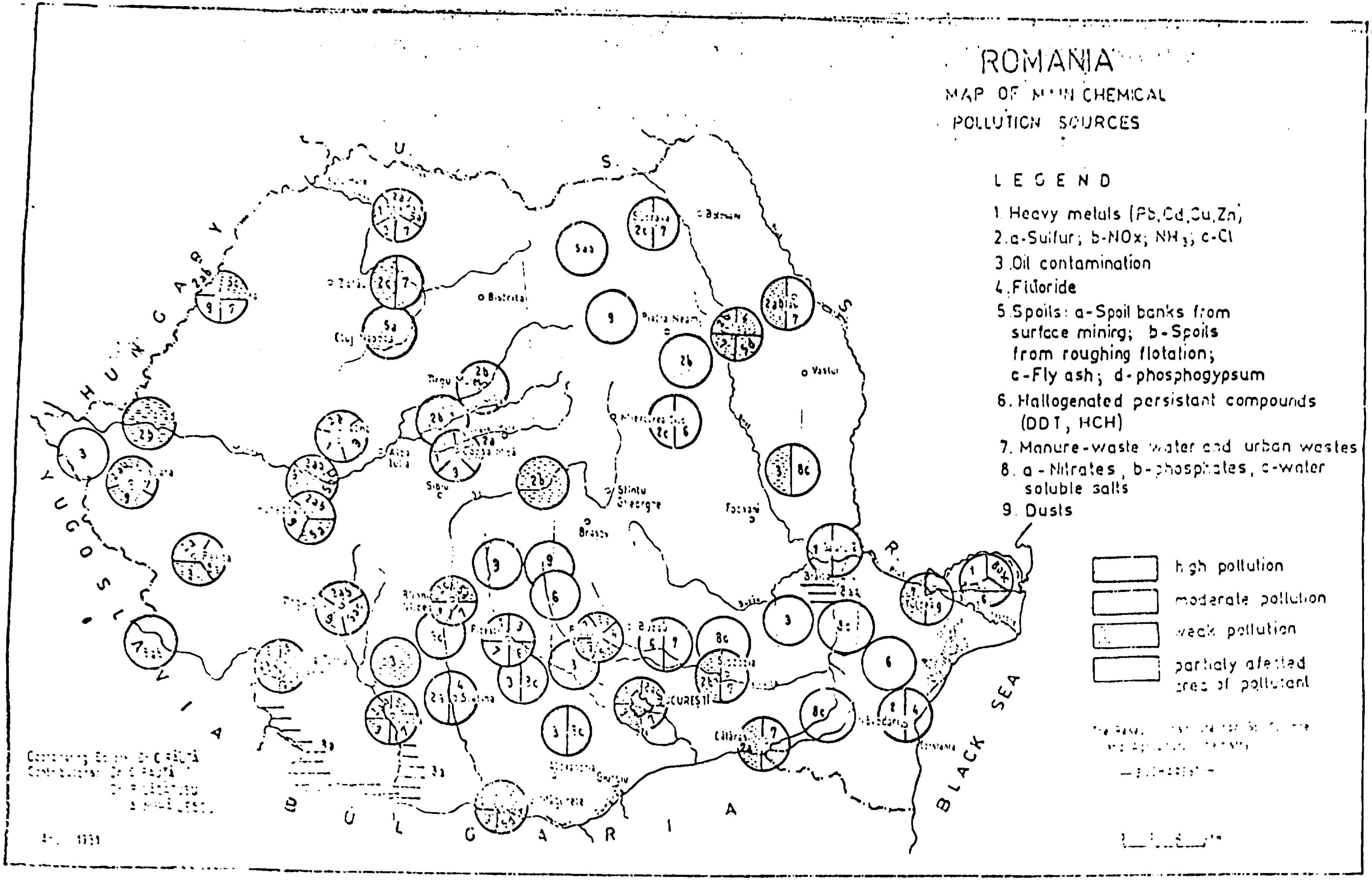
i) Upgrading of Rumanian potential for assessment of environmental pollution, extension of measurements to other industrial (and urban) areas possible.

ii) Assessment of current technologies with suggestions for improvement.

iii) Provision of sound data about environmental impact of industrial complexes as a basis for retechnologization programs, particularly for obtaining further funds (e.g. EC, World Bank).

iv) "Internationalization" of Rumanian environmental science and technology.


NATIONAL COORDINATOR
MINISTRY OF ENVIRONMENT
COORDINATES, CONTROL and SUPERVISE the works done by the various Ministries involved in the execution of this Project
NATIONAL IMPLEMENTING AGENCY
I.C.I.M.
Eusure the necessary links between various institutions for research coordinated by Ministries
Execute tasks related to water and air quality assessments
INSTITUTE FOR RESEARCH ON FORESTRY (I.C.A.S.) — (M.E.)
MINISTRY OF INDUSTRIES (M.I.)
-DEPARTMENT OF METALURGY (D.M.)
-DEPARTMENT OF CHEMISTRY (D.C.)
-ENERGY (R.E.N.E.L.) (RENEL)
INSTITUTE FOR RESEARCH ON NONFEROUS METALURGY (I.M.N.R.) (D.M.)
INSTITUT FOR CHEMICAL DESIGN (IPROCHIM) (D.C.)
INSTITUT FOR RESEARCH ON WASTE WATERS TREATMENT (ICPEAR) (D.C.)
INSTITUT FOR RESEARCH ON ENERGY (ICEMENERG) — (RENEL)
INSTITUT FOR RESEARCH AND PROJECTS IN THE ENERGETIC FIELD (ICPE) — RENEL
MINISTRY OF HEALTH (M.H.)
-DEPARTMENT OF MEDICAL ASSISTANCE AND PREVENTIVE MEDICINE (D.A.M.M.P.)
INSTITUT OF HYGIENE AND PUBLIC HEALTH (I.I.S.P.) — (D.A.M.M.P.)
MINISTRY OF AGRICULTURE (M.A.)
-TECHNICAL DIVISION (T.D.)
INSTITUTE FOR PEDOLOGICAL AND AGRICULTURAL RESEARCH (I.C.P.A.)
MINISTRY OF EDUCATION
INSTITUT FOR BIOLOGY


ROMANIA
MAP OF MAIN CHEMICAL
POLLUTION SOURCES
LEGEND
1. Heavy metals (Pb, Cd, Cu, Zn)
2. a-Sulfur; b-NOx; NH3; c-Cl
3. Oil contamination
4. Fluoride
5. Spoils: a-Spoil banks from surface mining; b-Spoils from roughing flotation; c-Fly ash; d-phosphogypsum
6. Hallogenated persistant compounds (DDT, HCH)
7. Manure-waste water and urban wastes
8. a-Nitrates, b-phosphates, c-water soluble salts
9. Dusts
high pollution
moderate pollution
weak pollution
partialy afected area of pollutant
HUNGARY
U.S.S.R.
YUGOSLAVIA
BULGARIA
BLACK SEA
Bistrita
Piatra Neamt
Vaslui
Sibiu
Brasov
Focsani
Calarasi
Tulcea
BUCURESTI

FIELDS OF ACTIVITY IN THE ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE

environmental ecology and monitoring division	technologies and menagement division	environmental engineering division	environment investigation facilities division
WATER QUALITY MONITORING AND MENAGEMENT	DRINKING AND INDUSTRIAL WATER TREATMENT TECHNOLOGIES	HYDRAULICS	MODELLING AND EXPERIMENTAL INSTALLATIONS
AIR QUALITY MONITORING AND MENAGEMENT	WASTE WATER RECOVERY TECHNOLOGIES	HYDROTECHNIKAL BUILDING SCHEMES	COMPUTATION AND AUTOMATIC CONTROL OF EXPERIMENTAL INSTALLATION
WATER ECOLOGY	TECHNOLOGY OF WASTE CIRCULATION AND SOIL ECOLOGY	HYDRAULIC STRUCTURES AND IMPACT SIMULATION	ELECTRONICS AND FACILITIES FOR RECORDING THE ENVIRONMENT PARAMETRES
WATER AND ENVIRONMENT ECONOMY	TECHNOLOGIES AND ECOLOGICAL IMPACT	URBAN ENGINEERING AND ECOLOGY	MEASUREMENT AND CONTROL DEVICES FOR THE ENVIRONMENT CHARACTERISTICS
ENVIRONMENT RADIO ACTIVITY			LABORATORY TECHNOLOGIES

Annex 3

Annex 4

ICIM Apparatus Endowment

• Laboratory supplies

Name of apparatus	Made in	Year	Running
Atomic Absorbtion Spectrofotometer	USA	1972	in order
AA Spectrofotometer 2900	Pye Unicam GB	1976	work out
Gas chromatograph 900-OMS 63	USA	1972	out of order
Spekol Spectrocolorimeter	East Germ	1971-1982	in order
Spectrofotometer recorder	East Germ	1975	in order
Spectrofotometer M 2380	USA	1980	in order
UV Spectrofotometer	Pye Unicam GB	1974	in order
Dissolved O_2 analyser (handheld)	USA	1971	in order
Conductometers (2) OK-102	Hungary	1973	in order
Different Recorders			in order
Oscilloscope "Tesla"	Checkoslov.	1975	in order
Mini Computer printer	Romania	1988-1990	in order
Derivatographs (2)	Hungary	1986	in order
Flamefotometer	Romania	1988	in order
Flamefotometer	Germany	1980	in order
Viscositymeter	East Germ	1974	in order
Calibration pumps	Germ,Polony	1973-1978	in order
Laboratory centrifuges	East Germ	1973-1975	in order
Ozone analyser AO 325-2R	USA	1981	in order
Coresimeter	East Germ	1986	in order
Viscositymeter Höpler	East Germ	1973	in order
Spekord Spectrofotometer	East Germ	1978	in order
Different microscopes	Romania	1971-1990	in order
Technicon Analyser	West Germ	1974	in order
AA Spectrofotometer 90	GB	1971	work out
TOC Analyser	USA	1974	in order
BOD Analyser	USA Voith	1972	

• Geotechnical Instruments

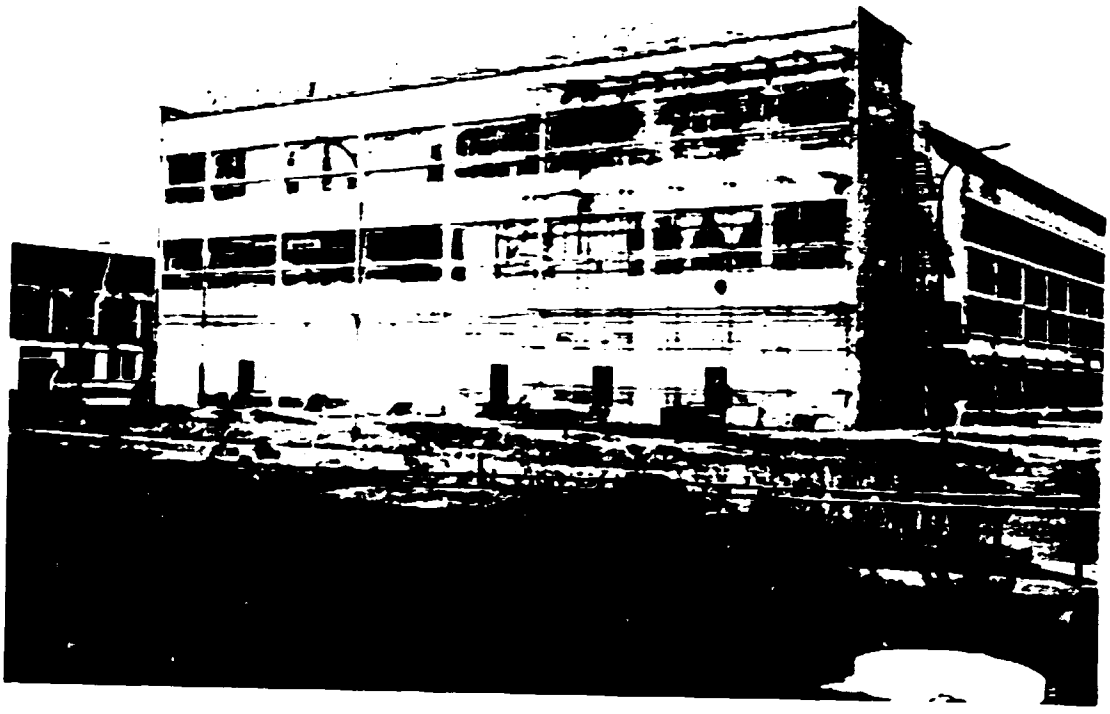
Annex 5

Tentative List of Non-expendable equipment

		Estimated Cost ($)
1.	Portable system for air quality NO_x ; SO_2 ; CO; CO_2 and O_2 immission measurements a) Sampling probe b) Pre-conditioning unit c) Patterns unit d) CO, CO_2, O_2 analyzer e) SO_2 and NO_x analyzer f) Hydrocarbon analyzer g) Sampling of airborne dust	125,000
2.	Portable equipment for water quality measurement - 4 pcs. a) Photometer SQ 118 Merk b) Thermoreactor TR 205-Merk c) Spectrograde reagents	6,000
3.	pH meter, conductometer Col parmer - SUA; Portable Electrodess	
4.	Ionometer Orion Portable 2 pieces Probes, accessories, reference samples	
5.	Different lamps for elements; electrodes (Beckmann), pipette tips Syringes Photometer Cells Chemicals	Not available
6.	Suitable vehicle for mobile laboratory	

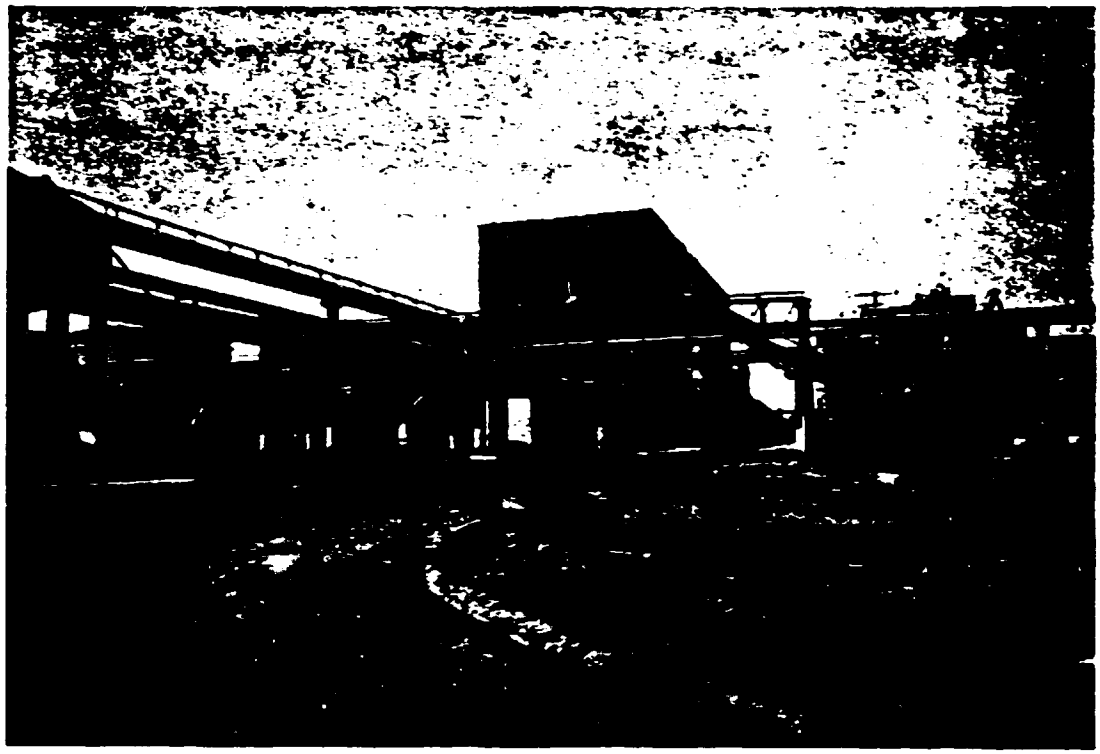
Annex 6

The Onesti Industrial Complex



The entrance of the chemical factory

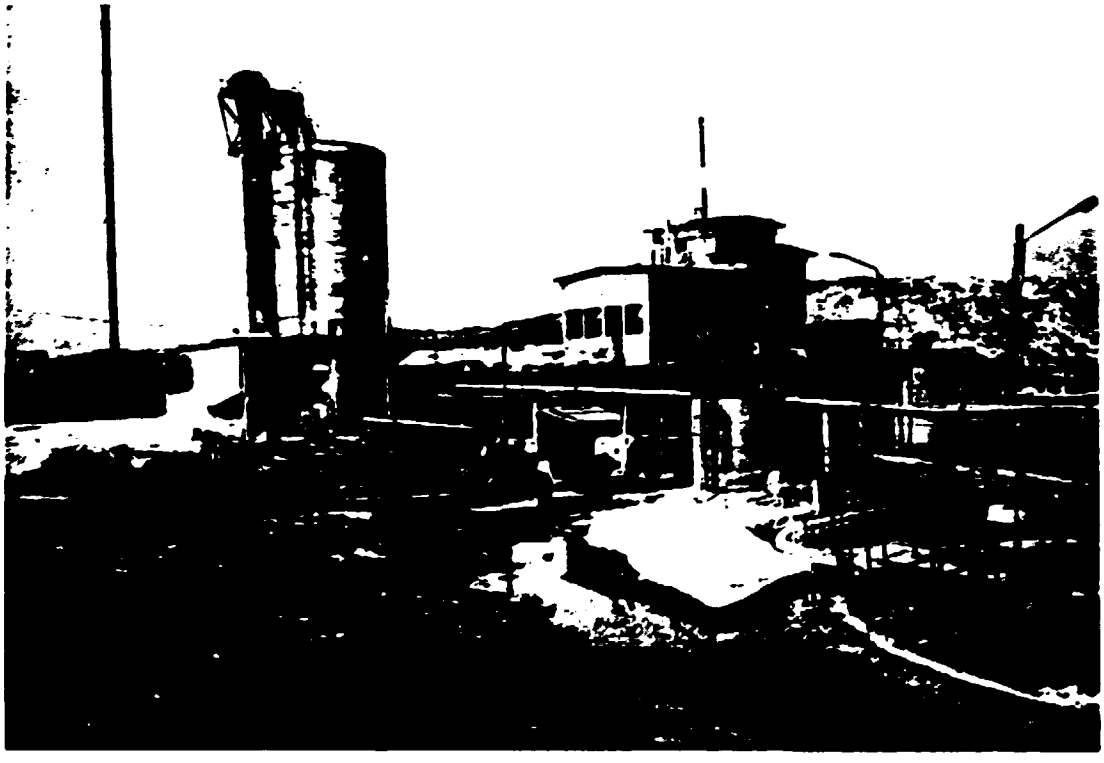
A view of the plants



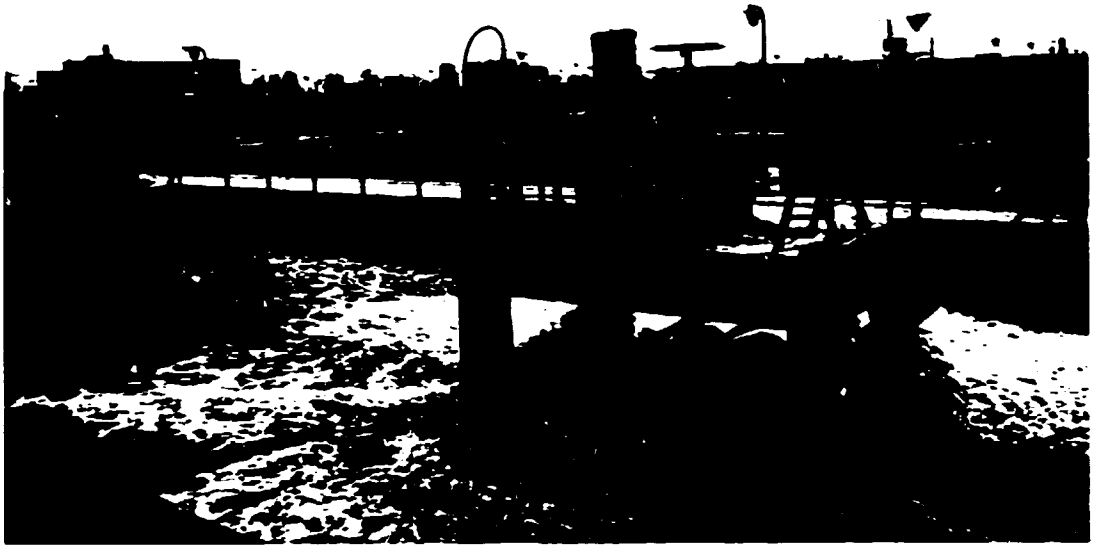
Inside the chemical plant

Details from inside the chemical plant

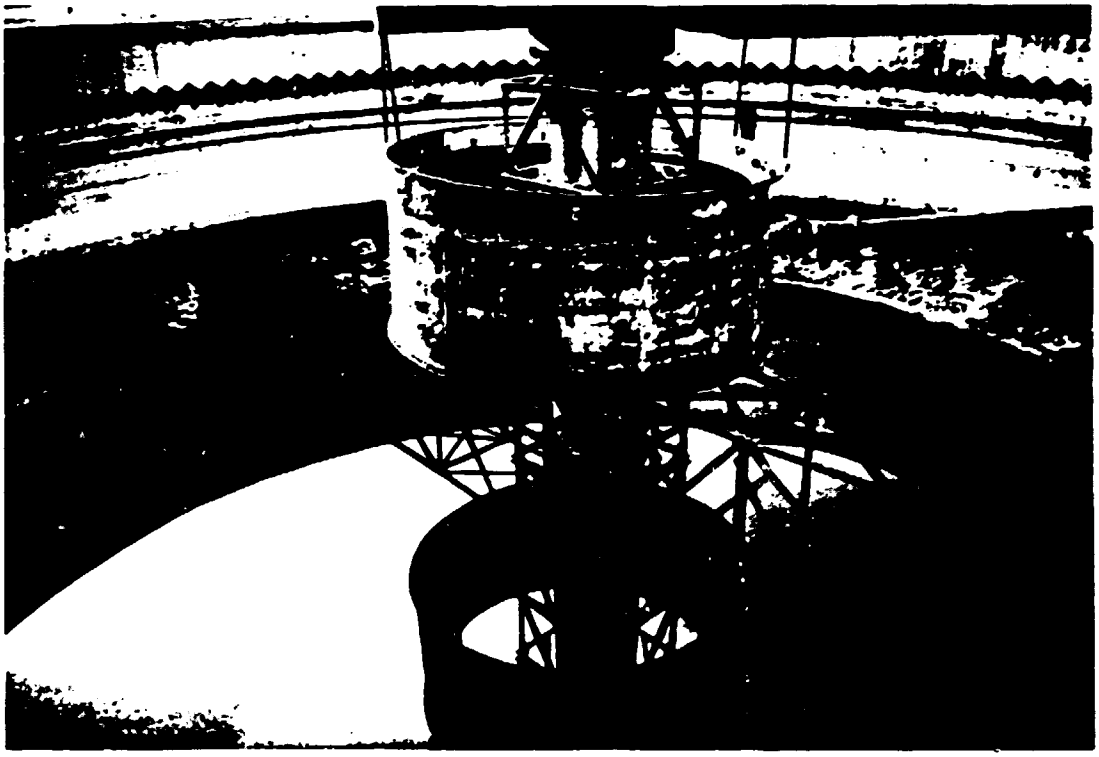
A typical road inside the complex



Chemical water treatment plant



Water treatment plant with aerators out of use due to burnt motor



Biological water treatment plant out of use due to broken parts

Open land fill site

Open carbon deposit from acetylene production (for burning carbon)

UNIDO COMMENTS

During the short assignment the expert was able to meet many government departments, UNDP officials and also visit a factory complex, so as to recommend necessary action to implement the project in a most efficient and in an economically acceptable way under the presently existing conditions and budgetary limits.

The expert himself is very much involved in operating mobile laboratories to monitor environment pollution in Austria, his recommendations and linking the project with his institution would pave the way for a smooth implementation of the project. In addition, UNIDO has identified a few more institutions in Europe which could provide the necessary training for the project counterparts in selected areas. This way the project would lay the foundation for the Rumanian Government for a methodical approach to deal with the industrial pollution acquired from the past heritage.