MANDERSTAM`S ENVIRONMENTAL EXPERIENCE

The Manderstam Group, their staff and associates have many years of international experience in all forms of waste material and refuse collection, waste and effluent treatment re-cycling and disposal. We are registered with the World Health Organisation, and Food and Agricultural Organisation, in the fields of sewage, waste and refuse collection, treatment, re-cycling and disposal. We are independent of the British Government and of plant and process manufacturers.

Our experience includes marketing, economic planning, materials handling, engineering and feasibility studies, and the design and construction of pulverising and process plants, refuse disposal schemes, effluent and sewage treatment, composting and incineration, gas scrubbing, treatment, venting and flaring.

In the following pages we set out a number of projects for which we have been responsible and which we trust give good examples of our capabilities.

(A) SPECIFIC EXPERIENCE

The following projects have been selected to indicate the Group's breadth of experience in the municipal refuse and processing industry. All the projects included technical and economic analysis of refuse collection, transfer and economic site location.

LIBYA
Tripoli and Benghazi composting plants:

(1) The Tripoli plant is designed to receive, handle and treat up to 1500 tonnes per day of municipal refuse and garbage and to produce a compost material suitable for agriculture.

(2) The ferrous metal content is removed from the fees, passed through a roasting furnace, baled and carted to the local iron smelting factory.

(3) Reject materials from the compost production lines are passed to a reject incinerator and the inert ash carted to a tip site.

(4) The Benghazi plant is similar to that at Tripoli but designed to treat up to 1400 tonnes per day of refuse.

(5) The Group was retained as the Consultant to the GNOI to carry out complete feasibility studies, process design, tender document preparation and to provide assistance during the tender adjudication of the many tenders received for these two prestigious schemes. All the studies included technical and economic analyses of refuse collection transfer and location of the plants.

(6) Both plants have been constructed on a turnkey fixed priced contract by Peabody GCI International of Nanterre France.

(7) The Benghazi plant was commissioned in 1980 and has been operational ever since.

The Tripoli plant was not commissioned and was left for a number of years due to a contractual dispute between the Contractor and the Municipality. Both these parties have appointed the Group as an independent third party to act as the technical arbitrator and also to advise on the steps necessary to put the plant back into operation and to advise on its operation.

Municipality of Beida Composting Plant:

(1) The Beida Plant has been designed to receive, handle and treat 120 tonnes per day of municipal refuse and garbage with a minimal amount of manual handling.

(2) The major product will be a humus type material suitable for agricultural use in this semi-arid country.

(3) Ferrous material is removed from the process line and baled but at present there is no available market for recovered or rejected materials and these will continue to be tipped after incineration to produce an inert and stable fill material.

(4) Manderstam personnel were retained as the Consultant to the Municipality of Beida to carry out a feasibility study and process design, prepare tender documents, assist in the adjudication of tenders received, supervise the manufacture of main plant items, and carry out complete site supervision of the appointed Contractor. All the studies included technical and economic analyses of refuse collection transfer and location of the plants.

A number of other installations with which we have been involved are:

(1) Design of refuse composting plant with British .Jeffery Diamond Limited. Complete refuse preparation and admixture with sewage sludge for open bed composting, using forced deration. Completely automatic compost bed laying, turning and pick up to screening and storage.

(2) Refuse pulverisation plant in Stockholm, Sweden. Modifications to plant with screening and sewage sludge admixture for future composting plant.

(3) Design of 1000 tonnes per day refuse composting plant in Krakow, Poland.

(4) Design of refuse preparation and composting plant for West Sussex County Council. Rotary drum composting and possibility of Refuse Derived Fuel Plant.

(5) Pulverisation plant at Seamer, Scarborough for North Yorkshire County Council.

(6) Refuse handling and treatment prior to incineration at Poder Hall, Edinburgh.

(7) Design of refuse pulverisation plant for Banff and Buchan, Scotland.

A further selection of projects executed in connection with the refuse and sewage treatment industries is as follows:

(1) Feasibility study into all methods of refuse disposal including tipping, pulverisation, composting and incineration for the Stanley Urban District Council in the UK. The study examined all methods of refuse disposal from a technical and economic viewpoint and recommendations were made on the most suitable process and choice of sites.

(2) Feasibility report on the treatment of refuse from the city of Cairo, Egypt, forthe General Organisation for industrialisation involving the disposal and treatment of

up to 2500 tonnes per day of refuse. Detailed studies were made of the refuse, its collection and disposal including composting processes.

(3) Detailed design and supervision of execution of a refuse pulverisation plant in Malta.

(4) Report on detailed design and supervision of execution of a composting plant at Annaba in Algeria.

(5) Study, report and supervision of the initiation of composting process for material from an existing refuse plant in Antofagasta, Chile.

(6) Feasibility study, detailed design, and tender documentation, for a water supply to the Municipality of Agedabia Project, Libya.

(7) Local investigations into the characteristics and quantities of refuse and into the circumstances relevant for its treatment and disposal have been conducted in many towns such as Accra, Bangkok, Bermuda, Cairo, Hong Kong, Jakarta, Karachi, Liege, Madrid, Malta and Rawalpindi. Preliminary studies were also undertaken in Alexandria, Beirut, Bagota, Caracas, Dacca, Havana, Jamaica, Montevideo, New Delhi and Patras.

(8) Review of existing refuse disposal arrangements in Cairo, Columbo, Bangkok, Kuala Lumpur, Singapore, Jakarta, Saigon, Perth, Adelaide, Melbourne, Canberra, Brisbane, Sydney, Auckland, Mexico City, Bogota, Johnson City, Atlanta, and Washington. Discussion of findings with officials of World Health Organisation, locally and in Geneva Headquarters.

(9) Study for design of domestic sewage treatment works extensions for the Spenborough Borough Council, Spenborough, Yorkshire, England, and for an industrialised sewage treatment works with high proportion of chemical waste far the Blaby Rural District Council of England.

(10) Study and design of Water Pollution Control Worksforthe County Borough of Teeside, England, for the treatment of foul sewage from the domestic and industrial areas of Billingham.

(11) Trade effluent surveys have been carried out for various manufacturing and processing plants in the UK such as malting and brewery waste for Paine and Company Limited, abattoir waste for Huntsman Meats Limited, dairy effluent for Bridge Farm Dairies Limited at Mildenhall, Suffolk.

(12) Study and design of process for the treatment of a domestic and industrial effluents involving extensions to the existing Pollution Control Works of the Borough of Rugby, England.

(13) An incinerator for the safe disposal of domestic and industrial refuse was designed forthe Wallon-Braban district, Belgium. The heat generated was used to generate electricity for supply to the national grid.

(14) We were retained to advise a subsidiary of George Wimpey & Co involved in the disposal of hazardous wastes, including low flash point hydrocarbons and solvents, toxic chlorinated solvents, paint residues, fertiliser waste products, pesticide residues etc.

(B) EXAMPLES OF OUR EXPERIENCE IN INDUSTRIAL TREATMENT AND EFFLUENTS

A selection of projects dealing with the wastes from specific industrial plants include:

(1) Polypropylene Extraction and Purification Plants at Plaju. Sumatra. Indonesia

A large hydrocarbon processing plant gives rise to a variety of potential pollutants - hydrocarbon vapours to the atmosphere, dust from propylene polymer escaping from conveyors and storage silos, alcohol dissolved in water escaping into the drainage network and disposal of spent catalysts. Because of the dense population of these areas of Indonesia, special care was taken at both the design and construction supervision stages to recover materials for recycling, to minimise effluents and reduce losses to a minimum.

(2) Treatment of Refinery By-Products. Palembang. Sumatra. Indonesia

We were retained by the Indonesian National Oil and Gas Company (PERTAMINA) as Consultants to advise on the development of refinery products, natural gas and hydrocarbon by-products.

Detailed design work included handling and treatment systems for noxious and pollutant materials, as eg:

Design and construction of hydrogen sulphide, mercaptans and carbonyl sulphide removal plant from refinery product stream;

Design and erection of an incinerator system for the disposal of refinery and petrochemical wastes;

Separation plant for treatment of effluent containing high BOD contaminants before discharging purified water to an inland water system.

(3) The Vegetable Oil Industries in Algeria. Afghanistan. Fernando P0. Mali and Pakistan

Norms for admissible pollutant levels were established and suitable equipment specified to keep emissions within these limits. Special attention was given in each case to the process water and cooling water systems, to minimise demand on fresh water resources by extensive use of recycled water wherever possible. Effluent treatment recovered the residues of vegetable oils, soap, fatty acids and derivatives.

(4) Cotton Processing and Cotton Seed Oil Industrial Redevelopment. Egypt

In connection with a major rehabilitation programme of Egypt's principal export-orientated industry, sewage treatment plants were installed at Shirbeen, Zagazig, ltay-el-Barud and Beni Suef. A second phase of environmental improvements called for similar sewage treatment schemes at Aboutig, Dairut, Kafr-el-Dawar, Kafr-el-Zayat, Minia, Mit Yazid and Zifta in the Nile Delta and Upper Egypt.

(5) Wastewater Treatment. Steelmill. Cileyon. Java. Indonesia

In addition to potable water provision, treatment, storage and distribution to the township of Kota Baja (population 25,000) in Western Java, Manderstam designed and supervised construction of the cooling systems and wastewater treatment for the Cilegon Steelworks of PT. Krakatau, a 250,000 tonne/year bar and section mill.

Suspended solid and millscale are removed in a series of flumes, settling tanks and thickeners, cooled and corrected to neutral pH, enabling the water to be recycled thus reducing the make-up demand to a basic 300 m /hour.

(6) Petroleum Refinery. Skopie. Yugoslavia

A comprehensive environmental impact study was made to establish the effects of water, air, noise pollution and visual intrusion from the complex onto the locality near Skopje, during both construction and operational phases of new plants. Allowable pollutant levels were established in relation to accepted levels in advanced industrial countries of Western Europe. The results of the survey were instrumental in selecting the detailed siting of the refinery by Organsko Hemijska Industrija.

(7) Off-shore Oil Production Platform Construction - UK

An environmental impact study was carried out for the Scottish Development Department of sites proposed for the manufacture of concrete oil-production platforms at Drumbuie, Loch Carron, covering the physical environment, infrastructure, social and economic effects of the development. Comparative studies were made at nine possible construction sites in Loch Carron to determine their relative advantages in terms of the operational variables. Members of Manderstam staff appeared as expert witnesses at a subsequent Public Enquiry.

An identical environmental impact study was carried out for the Scottish Development Department for sites near Ullapool on Loch Broom.

(8) Location Study for Potentially Polluting Industries -Merseyside. UK

Selection of sites for potentially polluting industries. A large number of sites were categorised and those suitable for industries producing various types of pollution (eg. noise, dust, chemicals etc.) identified. Several alternative sites for a sulphuric acid plant were also recommended.

(9) Planning of Secondary Industries. ,Jubail. Saudi Arabia

Manderstam were retained by the principal consultants for the Jubail Industrial Development to plan the choice, sizing and siting of secondary industries in relation to the potential of industrial development in the Region and available resources.

Great care has been taken with the siting of derivative industries using the basic output of a primary plant, to minimise loss of material in transfer and ultimate production of disposable reject material. Cooling and process water have been minimised by use of seawater systems devised to suit climatic conditions and tidal regimes. As a number of the plants produce highly toxic, corrosive or explosive intermediates environmental and safety considerations had to be taken into account.

(10) Inshore Oil Production - UK

A full appreciation was made of the environmental implication of developing the Beatrice Oil Field in the Moray Firth area. A detailed oil-spill risk analysis was carried out in relation to the siting of pipelines to shore with the provision for on-shore loading of tankers from a terminal, against the alternative of using an off-shore dedicated storage tanker with off-shore transfers to ocean-going tankers.

(11) Environmental Monitoring of Off-Shore Oil/Gas Production - UK

Some of the tasks undertaken by our resident environmentalists included benthic, water column and mollusc sampling; walking the beaches and pipeline route; visiting rigs and production platforms, boarding and observing incoming tankers in order to check conditions and crew performance; investigating and reporting oil-landings, seepages, spills and slicks; investigating any problems arising from tainted fish; meeting representatives of local pressure groups; etc.

In addition oceanographic studies were undertaken for the monitoring of currents, and shore-line sites sampled for vegetation and hydro-carbon analysis. A special study was made of the inshore fishing industry and selected seabed areas.

A monitoring brief of the area covered by the study, using full-time residential staff, was continued for a year to establish a bench mark of natural variations in the littoral zone against which the effects of off-shore oil field development and operation could be compared.

(12) Prediction of Environmental Effects of New Industrial Developments on an Existing Industrialised Region - UK

An environmental impact study was carried out in the Teeside area of the United Kingdom to predict the effect of a new steel plant on the region which already had old established industries including one of the largest fertiliser complexes in Europe, a large petrochemical complex, oil refineries, coke oven and steel complexes and a wide variety of smaller industries. The additive effects of the new plant on particulate (dust) fall out, ground level concentrations of gaseous SO_2, NO, and fluorine emissions, water-borne effluents, noise, traffic, etc, were predicted. A mathematical technique was developed in conjunction with aerial false colour infra red aerial photographs to predict the effect on ground level plant foliage of the increased pollution levels over distances of up to thirty miles from the industrial centre.

(13) Environmental Conditions - Cereal Factory - UK

An analysis was carried out in relation to human response and tolerance to vibrations set up by plant and machinery in the working area. Vibrational measurements were taken. The effect on the structure was determined and recommendations made as to safe working limits.

(14) Re-use of Old Industrial Facilities and Land - UK

A survey was made of a petrochemical plant which had been making a wide range of speciality chemicals for over a hundred years. The land and plant uses were determined, existing drainage systems traced, inspected and recorded, remedial action specified, a new land use scheme developed and a detailed plan for development prepared, including non-industrial options.

(15) Hazard Studyfor Off-Shore Operations - UK

A study was carried out on hazardous operations (HAZOP) for off-shore (North Sea) conditions relating to crude oil/gas production for BP.

(16) Pollution Risk Assessment - Ireland

A study was carried out to estimate costs arising from four scenarios of catastrophic loss of hydrocarbons at Whitegate Refinery, County Cork, due to:-

a) Release of contents of crude tanker moored at the terminal due to fire, explosion or collision;

b) Out of control fire on largest crude oil storage tank causing other tanks to fail;

c) Ship colliding with jetty and shearing pipelines carrying crude and refined petroleum;

d) Unconfined vapour cloud explosion due to LPG leakage over tank farm.

Clean up costs for the various scenarios were estimated up to US $27 million

(17) Athens Air Pollution Alleviation Programme - Greece

A team was provided to the Greek Government to monitor and advise on the Athens air pollution alleviation programme, funded by the EEC, including specification of work to be carried out by contractors on meteorology, industrial pollution, vehicle emission, pollution from domestic central heating and the effect on local flora and fauna.

Technical and environmental studies were carried out.

Follow-up monitoring of contractors' works and results was carried out.

(18) Environmental Protection of a Gas/Oil Separation Plant. Qatar

The project included the conceptual design for fire water pumping and distribution together with a deluge system at a gas/oil stripping plant in a remote location at Fahahil. Process flow and instrumentation diagrams of the process system, the fire system, pumping capacities, supply/demand balance, plot plans, equipment duty specifications and details of paving, slopes, channels, kerbs, etc, were provided together with an appraisal of the electrical power supplies, alarm

system interfaces, BCF systems, etc, together with detailed construction specifications and drawings.

(19) Environmental Protection of a Crude Oil Tank Farm - Qatar

Design, specification, preparation of tender, documents, installation supervision and commissioning of ring mains, electrically driven fire pumps, hydrant, automatic spray systems, heat detectors, automatic isolation systems, alarms, BCF extinguishing systems on each tank, foam pourers, portable fire extinguishers, drainage, access roads and routes at Umm Said Tank Farm and metering station. All work was carried out to NFPA Codes of Practice, and to API, ASME, ASIM and BS Codes.

(20) Locating Source of Pollution from Oil Fields and Recommending Remedial Action - Nigeria

As a result of several deaths and widespread illness in villages bordering the rivers and coasts around Port Harcourt and adjacent to crude petroleum production wells at Bonny, we were retained to study the sources of the pollution resulting in contaminated drinking water. Recommendations were made to prevent further contamination and to establish safe drinking water sources. Draft legislation was drawn up to control the activities of foreign oil companies.

(21) Study on Cationic Oyestuff after Treatment - China

An existing plant in Shanghai produces 1500 tons/year of 30 different cationic dyestuffs of international quality. Most processes used are intermittent (batch) with low labour efficiency, and poor control due to lack of instrumentation. Production equipment is out-dated and waste treatment poor so that effluent water does not reach acceptable discharge standards. The study was made to allow advice to be given on improved process control using automatic systems and computer control to improve process monitoring, to specify highly efficient equipment for after treatment (including separation, pulverisation, mixing and drying)and effective waste water treatment.

(22) Advice on Production of Ciprofloxacin and Ouinolone Chemicals - China

A study was made to determine the best new technology and to identify the equipment needed to produce 3 tons/annum of ciprofloxacin and other quinolones, together with the specification of other ancillary plant and equipment, buildings, laboratories, testing facilities, etc, suitable for products for domestic use and for export products. The new facilities are required to be incorporated

into the existing pharmaceutical factory at Xian. Recommendations were made for improved environmental protection including water treatment plant.

(23) Leather Chemicals Production - China

The existing factory in Nankai cannot meet the higher demand for quality of finished leathers and cannot keep pace with the increasing number of different kinds of leathers. We were required to advise on the world market for leather finishing chemicals and to specify the technology required to allow the factory to manufacture a modern range of finishing agents including emulsions, perfluoro-acrylate resin and other agents, together with the environmental protection procedures and plant such a plant needs.

(24) Improving Performances of Existing Factories Producing Enzymes -China

The study investigated the possibilities of expansion of production at factories in Shanghai, Wuxi andTianjin engaged in enzyme production and highlighted the constraints. Estimates were made of the cost of expanding the plants and updating the technology used. Energy savings were investigated together with down-stream processing, recovery plants and environmental protection measures.

(25) Improving Citric Acid Production - China

The study recommended ways to increase production of citric acid at Bengbu No 2 Plant while at the same time upgrading the technology used. Investigations were made into continuous operations and into the effects of changing feedstocks. Improved environmental protection measures were recommended including modern water treatment systems.

(26) Improving Lactic Acid and Citric Acid Production - China

The study recommended ways to increase production at Bengbu No 1 Plant from 3000 t/y to 5000 t/y while at the same time upgrading the technology used. In particular it was desired to change from the present batch system to continuous operation. The study also considered the difference in processing which may arise from the use of sweet potato as the raw material, Improved environmental protection measures were recommended including improved water treatment facilities.

(27) Improving Nitric Acid Production Efficiency - China

A survey of the existing manufacturing plant at Lanzhou was carried out with particular reference to catalyst performance and losses, absorption efficiency, acid strength and tail gas (NO,) emission. Air pollution from oxides of nitrogen was particularly bad.

A report was submitted giving steps to be taken to improve these aspects of nitric acid production technology and the costs and benefits which would arise from such a rehabilitation programme, both to process economics and environmental impact.

(C) SPECIFIC EXAMPLES OF OUR EXPERIENCE IN ENVIRONMENTAL IMPACT STUDIES

	Project	Client	Follow-Up
1	Loch Carron	Scottish Office	Public Inquiry
2	Loch Broom	Scottish Office	Public Inquiry
3	Teeside	Local Authority	Public Meeting
4	Manchester Airport	Airport Authority	Public Inquiry
5	Moray Firth	MESA Petroleum	Public Inquiry
6	Skopje, Yugoslavia	Local Authority	Public Inquiry
7	Merseyside	Local Authority	Public Inquiry
8	Irving	Local Authority	Public Inquiry
9	Cork	Sigma Biotechnology	On going

(d) Specific Examples of Our Experience as Expert Witnesses in Environmentally Sensitive Actions

	Subject	Client
1	Flixborough disaster caused by unconfined vapour explosion (leak)	NCB/Stamicarbon
2	Failure of Hydro-desulphuriser	Wimpey Waste Management
3	Failure of Catalyst Loading Device	ARCO
4	Disposal of Hazardous Waste	Landstar Limited
5	Environmental impact of wrongly constructed pipeline across and off Bartragh Island, Donegal	Owner of Bartragh Island
6	Umm Said NGL disaster caused unconfined vapour explosion (leak)	Qatar Petroleum Producing Authority by

Planning of Secondary Industries, Jubail, Saudi Arabia Area Population 0.5 Million

Manderstam and Partners were retained by the principal consultants for the Jubail Industrial Development to plan the choice, sizing and siting of secondary industries in relation to the potential of industrial development in the Region and available resources.

Great care has been taken with the siting of derivative industries using the basic output of a primary plant, to minimise loss of material in transfer and ultimate production of disposable reject material. Cooling and process water have been minimised by use of seawater systems devised to suit climatic conditions and tidal regimes. A number of the proposed plants produce highly toxic, corrosive or explosive intermediates and safety corridvations had to be taken into account.

Mesa Oil, Inverness (UK). Area Populations 2.5 Million

A full appreciation of the environmental implications of developing the Beatrice Oil Field in the Moray Firth area. A detailed oil-spill risk analysis was carried out in relation to the siting of pipelines to shore and the provision for on-shore loading of tankers from a terminal.

Some of the tasks undertaken by the residential environmentalists included benthic, water column and mollusc sampling, meeting local representatives, walking the beaches and pipeline route, visiting rigs and production platforms, boarding and observing incoming tankers in order to check conditions and crew performance, investigating and reporting oil-landings, seepages, spills and slicks, investigating any problems arising from debris, investigating any reported problems arising from tainted fish etc.

In addition oceanographic studies were undertaken for the monitoring of currents, and shore-line sites sampled for vegetation and hydro-carbon analysis. A special study was made of the inshore fishing industry and selected seabed areas.

The firm is continuing a monitoring brief of the area covered by the study, using full-time residential staff.

Recovery of Potash from the Dead Sea -
The Arab Potash Company, Jordan — Cost US$ 37,000,000

PVC production in the U.K. - project planning -
Albright & Wilson/Petrofina Group — Cost US$l00,000,000

Pre-project Study of Animal Feeding production plants -
Ministry of Finance, Moroccan Government

Plant for the production of Tartaric Acid -
Borax Consolidated Ltd., Spain

Plant for the production of Gluten -
Nutrex Ltd., U.K. Cost US$ 5,000,000

Vegetable oil plant -
Turyag S.A., Turkey Cost US$ 5,700,000

Plant for production of Chemical Cellulose -
Indian Rayon Corporation, India Cost US$ 4,100,000

The processing of Pyrrhotite Cinders -
Maroc-Chimie (Moroccan Government), Morocco
Ferro-nickel production Complex -
FENI, Skopje, Yugoslavia Cost US$256,000,000

Re-organisation of the Steel Industry in Greece -
Ministry of Co-ordination, Athens
Study of LPG recovery and distribution facilities Pertamina, Indonesia

Survey of Development Policy for exports -
Government of Thailand.
Project under the auspices of Colombo Plan.
Still in hand.

Survey of Agricultural Production - Indonesia
Ministry of Agriculture, Jakarta

Ammonia and Fertiliser Production Study -Government of Brunei

Nitrogenous fertiliser production planning - Nigerian Government

Volta River Project - Fertiliser Study, U.N.O.

Ammonium Sulphate Fertiliser Production - CEPSA, Spain

Phosphate Fertiliser Plant - Lebanon Chemical Company, Beirut

ALLOWED CONCENTRATIONS OF WASTE MATERIALS IN THE AIR AND IN THE WATER ACCORDING TO JUGOSLAV NORMS

IN THE AIR	**Max per unit**	**Max per unit**
sulphur dioxide	0.5 mg/ m^3 air	0.15 mg/ m^3 air
smoke	0.15 mg/ m^3 air	0.05 mg/ m^3 air
nitrogen dioxide	0.085 mg/ m^3 air	0.085 mg/ m^3 air
carbonic monoxide	3.0 mg/ m^3 air	1.0 mg/ m^3 air
carbons	0.125 mg/m^3 air	-
ash	up to	300.0 mg/m^2

II **IN THE WATER**

BRO (biologically required oxygen)		25.0	mg/lit
CRO (chemically required oxygen)		50.0	mg/lit
Suspended materials		15.0	mg/lit
Dissolvent oxygen		4.0	mg/lit
pH		6.8- 8.5	
Phenoles	max	0.02	mg/lit
Petroleum		0.3	mg/lit