

**Sustaining quality by control of industrial discharges***Derek Harrington and Dr Karim Alibhai, UK*

THIS PAPER SUMMARISES the progress of an ongoing project carried out by Taylor Binnie and Partners (TBP) (a joint venture of two UK consulting engineers, ACER Consultants and Binnie and Partners), on behalf of the European Investment Bank (EIB), the Cairo Wastewater Organisation (CWO) and the General Organisation for Sanitary Drainage (GOSD) for the protection of this enormous investment.

The project has focused on the study, management and control of industrial discharges, for the Shoubra el Kheima district of Cairo, that:

- (i) Exceed existing legal requirements,
- (ii) Damage the sewer fabric,
- (iii) Produce hazardous conditions within the sewer network,
- (iv) Produce odour or accumulate debris within the sewers,
- (v) Interfere with biological treatment processes,
- (vi) Compromise the efficient reuse of the treated effluent and sludge.

The benefits accruing from the implementation of an effective effluent control programme include:

- Protection of the environment and public health,
- Maximising the use of water resources,
- Improvements in sewer capacity,
- Reduction in sewer maintenance,
- Improvement in river drainage quality,
- Reduction in costs to industry.

Work undertaken by CWO and GOSD over the last decade has involved the design and construction of an extensive sewerage network and six major treatment

plants to serve Greater Cairo and Helwan. This study area covers approximately 875 square kilometres and serves a population of about 15 million people. These plants are already significantly reducing pollution levels within Cairo and are providing the potential for effluent and sludge reuse in agriculture. The total treatment capacity of these plants is 3,280,000 m³/day.

Like all major urban areas, Greater Cairo and Helwan have locations which may be wholly industrial, commercial, residential or mixed. Some districts are also centres for specific types of industry, such as the tanneries, which can cause significant problems in the sewer systems and treatment works and therefore need to be monitored and controlled. An extensive literature review was carried out to ascertain progress to date on industrial effluent control initiatives and to establish baseline data for the Cairo Project. The conclusions of this review were that:

- Information on quality and quantity of industrial effluent is sparse,
- Industry is reluctant to control its pollution,
- Access to sampling locations is often refused,
- High levels of toxic materials may be discharged to the sewers,
- Legislative controls although in place are not implemented,
- A comprehensive database of polluting industries does not exist.

The first step in the development of an industrial database for the Project area was the preparation of a comprehensive list of industries. A number of sources of information were identified. However, much of the

Table 1. Average water consumption, effluent volumes and polluting loads for industry throughout Egypt (Source GOFI)

information was available only as the address, telephone and industrial activity with little or no data on effluent flows, concentrations and loads. However information that was useful is summarised in tables 1 and 2.

The Food and Chemical industries discharge the greatest volume of effluent and the Oil and Soap industries were the most polluting with respect to organic material. Oil/grease and solids were noted as a general pollutant from all industries. In a more detailed study in the Shoubra el Kheima area the NRC found that the textiles and metal industries constitute 83% of the total manufacturing base and were by far the most polluting. The above review confirmed the need for; better Co-ordination between the government organisations responsible for monitoring of industrial pollution and the production of a single master database of polluting industries.

Industrial pollution may be microbiological, physical, organic or inorganic and hence, a wide range of parameters needs to be monitored. To ensure that sampling costs do not escalate it is normal to tailor the number of samples and types of analysis to particular industries. Table 3 shows the range of analyses used to quantify particular effluents on a routine bases.

A review of the existing legislation in comparison with standards in other countries shows that the standards for some parameters including suspended solids, BOD and some heavy metals are too severe. One example is a BOD value of 400 mg/l which may be less than some strong wholly domestic sewages. With the development of the new extended sewerage system and the construction of treatment works capable of treating most industrial effluents, a review of the discharge standards was recommended and this was later implemented.

One of the key elements of an industrial effluent monitoring programme is the establishment of fully reliable laboratory with trained staff and appropriate equipment and resources. As part of the study, 21 laboratory facilities in Cairo were reviewed. As a result of this review, a recommendation was made that the existing GOSD laboratory at Heliopolis should be used for monitoring industrial effluent, following major refurbishment. It was also recommended that some analyses could be contracted out at suitable laboratories.

A pilot sampling and analytical programme was included in the study in order to provide representative data to gauge the nature and extent of the overall problem associated with effluent quality. Within the short time available a limited sampling programme was completed involving 51 samples mainly from industrial locations. The pilot sampling and analysis programme quantified, to a limited degree, the problems experienced in the operation and maintenance of the Cairo sewerage system.

The analysis of sewage samples from four GOSD pumping stations indicated that the high concentrations of pollutants were diluted to acceptable levels within the sewerage system. However, with regard to effluent and sludge reuse, it is considered necessary to further evaluate the metals content in the final effluent and sludge.

Several of the factories have installed treatment facilities although some are not always in operation. The introduction of an ongoing effective monitoring programme may persuade these factories to utilise their treatment works on a regular basis.

It was therefore concluded that construction of simple treatment facilities at 40% of the pilot sampling locations

**Table 2. Effluent characteristics from industries sampled by NRC (Greater Cairo)
(All results in mg/l except pH and flow) Source: NRC**

Table 3. Industrial monitoring - appropriate determinands

would significantly improve effluent quality. Appropriate facilities include neutralisation, sedimentation and/or oil and grease traps.

The data gathered during the Study was used to develop a database. Some 50 publications were obtained and reviewed for this purpose, producing more than four thousand records for input to the database. All reliable analytical results, including those obtained during the pilot sampling programme were also loaded onto the database.

Implementation (phase 1) - 1993

An Implementation Group was instituted under the auspices of the Ministry of Housing with representatives from private and public industrial organisations, GOSD, the Cairo Wastewater Organisation and the Egyptian Environmental Affairs Agency. The terms of reference of the Group were to recommend changes to Law 93, develop an Industrial Effluent Control Agency and raise public awareness of the problem of industrial wastewater

pollution. Law 93 was first enacted in 1962 and was considered inappropriate for the current situation. As a consequence, an International review was carried out and changes recommended. The summary of the review and the recommended changes are shown in Table 4.

Implementation (phase 11) 1994

As a result of the success of the Implementation Group in addressing the various issues EIB commissioned further technical assistance during 1994. One of the many recommendations of the Group was to implement a control programme at one particular District in Cairo to show industrialists what can be achieved. Shoubra el Kheima was chosen and EIB agreed to fund a pilot programme. Shoubra el Eheim is centrally located in Cairo and is bounded by the Nile to the west and the Ismailia Canal to the east. It has a population of about one million and is a mix of urban development, agriculture and industry. TBP were asked to appraise the location and recommend a programme of implementation.

The 'way forward'

To develop the initiative TBP recommended that there was a need to carry out the following tasks:

- Inform industry on how best to tackle the problem of industrial pollution and to make them aware of the statutory requirements.
- Update the database by continued sampling and including data from other Agencies.
- Carry out a selection of industrial audits to ascertain treatment options including 'good housekeeping'.
- Categorise those industries requiring treatment prior to discharge to sewer.
- Identify technical and financial initiatives required to implement the desired changes.

Implementation (phase III) 12/94 - 5/95

The Phase III Implementation Programme has been divided into two distinct parts. The first has been the identification of priority industries and the choice factories for audit. The second is the carrying out of the audits and the development of the possible subsequent loan/grant arrangements for construction of the Treatment Plants at individual factories.

The identification of priority industries had the following elements:

- Reviewing and updating the database to include EEAA, GOFI, Federation of Egyptian Industries (FEI), and the GOSD data.
- The introduction of a short intensive sampling programme of selected industries.
- The categorisation of priority action industries.
- The selection of criteria and the setting of 'bench marks' for the priority industries.
- The choosing of factories for audit followed by a short appraisal visit to assess suitability.

Priority industries were chosen by a review from four important industrial sectors that were finally chosen which were the textile, food, chemical and metal industries. Table 5 is a summary of the selected criteria and was used in 'broad terms' to aid the selection of appropriate factories.

'Bench Marks' have been derived for particular industries and are, in essence, a set of expectations and goals. These will become part of the audit protocol document and include the following objectives:

- Many of which are simple 'good housekeeping' initiatives.
- Effluent discharge wherever practicable to the sewer.

Table 4. Proposed guidelines for Greater Cairo for industrial discharges into sewers

Table 5. Criteria for the possible selection of factories for audit

- Emphasis on 'in situ' treatment of wastewater for water reuse at the factory.
- The reduction in water use.
- The development of source management control.
- Improvement in water use efficiency, including the separation of contaminated/uncontaminated wastewater.
- Construction of bunds and retaining walls to reduce accidental spills.
- For particular industries standard wastewater values have been obtained and typical treatment options will be appraised.
- For textiles these include balancing, fibre separation, cooling, sulphide removal, flocculation and settlement.

A total of 10 factories have been chosen for audit and these are representative of the type of ownership and industrial sector in the Shoubra District. It is expected that the industrial audits will identify the extent of pollution and the remedial solutions for particular industries. To encourage industrialists to embrace the audits it is hoped that financial savings can be recommended by both reducing water consumption and reducing wastage at source. The final objective will be to produce a wastewater which does not exceed the requirements of Law 93 for discharge to the sewer. It is proposed to carry these out during May to June 1995. If successful, it is hoped that the results will be emulated by other industries. The aim will be the development of an efficient control programme, adequately resourced both financially and technically.