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HAZARDOUS WASTE MANAGEMENT IN POST-WAR KUWAIT

TK/KUW/91/001

STATE OF KUWAIT

Technical report: A brief review*

Prepared for the Government of the State of Kuwait
by the United Nations Industrial Development Organization

Based on the work of Dr. K. Puskas,
UNIDO consultant

Backstopping officers: G. Ramsay, Chemical Industries Branch,
and M. Daniel, Environment Co-ordination Unit

* This document has not been edited.

Introduction

The project was initiated and prepared by the United Nations Industrial Development Organization (UNIDO) as a part of the UN Interagency Plan of Action for the ROPME (Regional Organization for the Protection of the Marine Environment) Region.

The immediate objective is "to make a preliminary assessment of the situation in Kuwait in the aftermath of the recent hostilities, regarding the risk of release of hazardous chemicals from damaged industrial plants and to outline subsequent project(s) to fully quantify this problem and to recommend solutions for this and for the disposal of hazardous wastes generated in the future from new factories".

The project activities in Kuwait were prepared and coordinated by Dr Badria Al-Awadhi (ROPME) and Dr Makram Gerges (UNEP). Due to their effort and fruitful cooperation smooth and effective execution of the project was ensured.

Miss Shaha Sabfi Al-Kandari Head of Pollution Control Section of the Environmental Protection Center in Shuaiba Area Authority was my counterpart. Her active cooperation is highly appreciated, and contributed significantly to the project results.

The extent of the damage to factories in Kuwait was reviewed to make a preliminary estimate of the risk this involves for the release of hazardous chemicals to the environment. The major industries, industrial areas, oil fields and the responsible authorities and institutions were visited and interviewed to obtain reliable information. The data were evaluated and the industrial sectors with the greatest risk potential were determined.

Industries and institutions visited and persons contacted are as follows:

- * Shuaiba Area Authority
 - Abdul Aziz Al-Ahmad, Deputy Director for Area Development and Planning
 - Abdulla Al-Ajmi, Department Manager of the Wastewater and Solid Waste Projects;
- * Shuaiba Area Authority, Environmental Protection Center
 - Miss Shaha Sabfi Al-Kandari, Head of the Pollution Control Section;

- * Petrochemical Industries Co.
 - Hamad Al-Mishwat, Operations Manager, Salt and Chlorine Plants,
 - Anwar Salarah, Operations Manager, Fertilizer Plant (Plant A and B)
 - Ms Saud Al-Munies, R and D Group Leader;
- * Kuwait National Petroleum Co.
Shuaiba Refinery
 - Riyadh I. Al-Saleh, Refinery Manager;
- * Power and Water Desalination Stations
(North and East) Shuaiba
 - Naser Al-Gilalab, Director;
- * Kuwait National Petroleum Co.
Mina Ahmadi, Mina Abdullah Refineries
 - Ramsi Nusiden, Department Manager for Environmental Affairs;
- * Kuwait Oil Company, K.S.C.
 - Shabib N. Al-Ajmi, Supdt, Fire and Safety Division;
- * Bechtel Petroleum, Chemical and Industrial Co.
 - Samir A. Malaty, Manager, Process Planning and Evaluation;
- * Environmental Protection Council (EPC)
 - Ibrahim Hady, Director
 - Dr Mahmood J. Abdulraheem, Deputy Director;
- * Kuwait Institute for Scientific Research
 - Dr Jassem Bishara, Division Director
 - Ms Saud Al-Hooty, Department Manager;
- * Ministry of Commerce
 - Department Manager of the Industrial Development Department (contacted by telephone).
- * Magwa, Burgan, Waffra oil fields, gathering stations;
- * Sabhan Industrial Area;
- * Shuwaik Industrial Area;
- * Used catalyst storage;
- * New Mina Abdullah Industrial Area;

Preliminary assessment of the risk of the hazardous chemicals released from damaged industrial plants

General structure of the industrial activity in Kuwait

Three huge refineries, petrochemical industries, operations on the oil fields, four power stations and desalination plants represent Kuwait's major industrial activities. In addition several medium and small size organic and inorganic, light, food industries exist in Kuwait.

The industries are located in the following industrial areas:

- The Shuaiba Industrial Area located 50 km South of Kuwait City is the largest and most important industrial area comprising the refineries, petrochemical industries, organic and inorganic industries and power stations.

- The Sabhan Industrial Area adjacent to the airport is rapidly developing, with refreshment, food, pharmaceutical, light metal, wood, plastic etc. industries and warehouses.

- The Shuwaik Industrial Area located between the residential areas with car repairing workshops, refreshment, food, light metal etc. industries, storages and a power station.

- The Sagghaja Industrial Area located about 60 km West of Kuwait City in the desert area comprises mainly farms and food processing industries.

- The Al-Zoor Power Station and the Getty Refinery are located near the Saudi border in the vicinity of the Waffra oil field.

- The Doha Power and Desalination Station is situated on the western side of Kuwait Bay.

Assessment of the damages of the industries

The damages of the industries were studied and evaluated in regard of the release of hazardous chemicals.

In Shuaiba Industrial Area, the damage of the major industries, refineries and petrochemical industries is not significant. Units containing hazardous chemicals (catalysts, acids etc.) are intact. The hazardous chemicals were properly stored and/or consumed by emergency operation during the invasion. Some oily materials were released from the broken pipes or tanks and through the industrial wastewater drainage

system into the shallow inshore water, but significant pollution was not observed. Some air pollution was generated by coke plant fires in the Mina Abdullah Refinery during the crisis.

The damages of the medium and small industries located in the Shuaiba Central and the Western Mina Abdullah Area are more significant. Several industries were looted and set on fire causing a potential hazard. Raw and auxiliary materials, various chemicals could have been mishandled, poured out from their containers and spread on the ground and yard. The liquid chemicals and solids dissolved or transported by liquids can penetrate into the soil contaminating the soil and/or the ground water or/and flow into the area drainage system (industrial or municipal) contaminating the inshore shallow seawater and/or the wastewater treatment system (when rehabilitated). Solid hazardous chemicals remaining on the surface can also be collected and disposed of into pits for general waste landfill or into the desert without knowing their danger. The inadequate handling of such materials can cause latent pollution which will be realized as a multiplied contamination at a later time.

As per the results of the preliminary assessment, only some chemicals from some industries signify potential hazard, but the exact quantification and qualification of the hazardous materials can be carried out only by a comprehensive investigation of each industry and plant.

The above described damages and risk caused by chemicals released are typical also for industries located in the Sabhan and Shuwaik industrial areas.

About 60-80 industries, plants should be inspected in the three (Shuaiba, Sabhan, Shuwaik) industrial areas to ensure safe disposal of the damaged chemicals. The urgency of this task should be emphasised since the cleaning operation has already started with some chemicals already dumped off.

Industries located in Sagghaja Industrial Area were almost entirely destroyed during the invasion in ground battles and by air attacks. Since the industries located in this area are agricultural and food processing industries, the major pollution is the 3-4 million chicken carcasses, and other degrading organic materials, but the risk of hazardous chemicals released is not significant.

The major damages of the power and desalination stations are the fourteen destroyed transformers at the Shuaiba Power station and mainly fuel tanks at the Doha Power station. The fate of the transformer oil and other oily materials released from the damaged units of the power stations near the coastline in the region of the water intake points should be investigated.

Information for the preliminary assessment about the potential pollution derived from the destroyed Al-Zoor Refinery was not available, since this plant is operated in cooperation with Saudi Arabia and therefore it is not controlled entirely by the Kuwait National Petroleum Co. (KNPC), but in comparison with the Shuaiba refinery complex, whose capacity is about 1,000,000 barrels/day, the Al-Zoor refinery's capacity is only about 40,000 barrels/day and the potential hazard caused by plant damages could also be in the same ratio.

The used catalysts from all the Kuwaiti refineries and petrochemical industries are stored in a desert area South of the New Mina-Abdullah Industrial Area. The used catalyst storage was properly designed and constructed. The storage area is covered with concrete, fenced and equipped with proper drainage system to collect the run-off water and accidental spillages. The ground water table is around 40 m deep in the area. As designed, the used catalysts are stored in sealed drums.

Due to the war activities in the region, some drums were broken and turned over, but the exact situation could not be defined since part of the storage area has been covered by sand dunes and the inspection was possible only from the nearby road, since the area is still not cleared up from war explosives.

The exact evaluation of the potential pollution should be carried out urgently and necessary remedial measures taken to avoid any risk of the soil and ground waters being polluted by seepage in the rainy season or airborne pollution of the adjacent areas by wind-blown catalyst powder or direct poisoning of the desert animals.

The visit to the oil fields with the destroyed gathering stations, damaged and burning oil wells, widely polluted by oil spills and pools, airborne hydrocarbons convinced also myself, that this is the most significant pollution caused by the Iraqi aggression in Kuwait.

The major types of hydrocarbon pollution on the desert soil are as follows:

- Large or smaller pools and spills of crude oil in various sizes (in some cases 4-8 acres) accumulated around the damaged wells.

- Contaminated bottom layers of the oil spills and pools. After pumping off the bulk of the oil, oily sludge and an oil contaminated soil layer remains in the area. The depth of the oil contaminated layer is not more than 10-15 cm.

- Desert area contaminated by airborne sooty ash and hydrocarbon droplets forming a sticky, continuous layer (less than 1 cm thick) which covers not only the soil but the desert plants as well.

- Desert area contaminated by airborne solid particles generated from the smoke of the burning wells with a maximum thickness of 0.5 cm.

The extent of the contaminated areas should be mapped and the priorities for their cleaning determined.

Recommendations for short-term actions to avoid risk of hazardous wastes released during the crisis

- 1.a Quantify and qualify the hazardous materials released from the small and medium industries in the Shuaiba, Sabhan and Shuwaik Industrial areas during the crisis.
 - b Determine the potential pollution priorities and actions to be taken to avoid further pollution caused by their
 - uncontrolled disposal into municipal solid waste dumping sites or sewers until now,
 - improper storage on plant yards and grounds.
 - c Study the possible use of the SIA's used catalyst storage for interim storage of the hazardous chemicals.
 - d Take urgent remedial measures to ensure their controlled and safe disposal.
- 2.a Carry out exact evaluation of the damages of used catalyst storage located in the Shuaiba Industrial Area.
 - b Take urgent remedial measures -as discussed with the responsible party- to clean up the area and replace the damaged drums to avoid the risk of soil and ground water contamination and poisoning of desert life.
- 3.a Determine the pollution caused by oily materials released near the coastline from damaged units of the power stations.
 - b Take urgent remedial measures to eliminate and avoid any further pollution.

- 4.a Determine the extent and the location of the polluted desert areas. Determine the quantity and quality of the hydrocarbon deposits generated from the damaged and burning oil wells and destroyed gathering stations. Determine the treatment priority.
 - b Pump off the bulk of oil from the oil pools and spills, as soon as possible.
 - c Select proper treatment technology to remove the various types of hydrocarbon deposits. The onsite treatment of oily deposits by enhanced biodegradation and photo oxidation can be the most suggested technology based on preliminary evaluation of the available treatment technologies and the character of the pollutants.
 - d Prepare the large scale implementation of the treatment process.
5. Collect relevant information and evaluate the potential pollution at the destroyed Al-Zoor Refinery. Determine the necessary actions to avoid further pollution.

**Recommendations for large scale projects for
handling of hazardous wastes in Kuwait**

1. Treatment of the oily waste deposits caused by the Iraqi aggression in the Kuwaiti desert. (e.g. as proposals by the Kuwait Institute for Scientific Research, KISR).
2. Treatment of oily sludges generated from the oil industry and oil mining (Research program is in progress).
3. Establishment of the central solid waste (hazardous and non-hazardous) handling plant for the Shuaiba Industrial Area. (This project had been started, but was interrupted by the crisis.)
4. Feasibility study on using the central solid waste handling plant of the Shuaiba Industrial Area for handling hazardous wastes generated from other industrial areas in Kuwait.
5. Establishment of a used catalyst reuse or recovery plant. (Feasibility study is already available)
6. Determination and implementation of an effective waste management system for hazardous waste handling, taking into consideration the post-war situation in Kuwait.

APPENDIXES

APPENDIX I
Shuaiba Industrial Area

The Shuaiba Industrial Area (SIA) is the largest industrial complex in Kuwait, comprising Kuwait's three hugest refineries (Shuaiba Refinery, Mina Abdullah Refinery, Mina Ahmadi Refinery), the Petrochemical Industries Co., two power and water desalination stations (Shuaiba North and South Station) and medium and smaller industries located in the Eastern Sector (Shuaiba Industrial Area) and in the Western Sector (Western Mina Abdullah Industrial Area).

The Shuaiba Area Authority (SAA) is responsible for:

- the planing and development and the projects constructed thereon and their requirements for services and public utilities;
- the environmental protection, pollution control and monitoring, wastewater and solid waste handling, treatment and disposal;
- the approval of setting up industrial enterprises and structures;
- the development of the area socially and economically.

As a result of SAA's activity:

- a system is developed and implemented for continous monitoring of the air and shallow inshore water pollution;
- the establishment of a central wastewater treatment plant (for industrial and municipal wastewater) is in progress;
- the solid and semisolid handling and disposal plant is already designed, and the site is selected for its establishment;
- a properly designed and constructed temporary storage for the used catalysts already operates;
- guidelines and regulations are prepared for water and air pollution, wastewater and solid waste handling.

The industries located in the area, their products and materials used for the production are listed in Table 1.1. The hazardous wastes generated in the SIA during ordinary industrial operation are summerized in Table 1.2.

Information and data gained from the interviews, reports were evaluated and the following should be emphasised for the program to be prepared for the hazardous chemicals released during the crisis:

1 Harmful chemicals were not released at the three refineries, Petrochemical Industries Co. Future actions are not needed.

2 The fate of the transformer oil and other oily materials released during the crisis at the Shuaiba Power Stations should be investigated and necessary measures taken.

3 A preliminary list can be determined for the industries, where further investigation is needed for quantification and characterization of the pollution caused by the chemicals released. They are as follows:

- Packaging and Plastic Industries Co.
- Dresser (Kuwait) Co.
- The National Industries Co.
Kuwait Asbestos and Plastic Industries
- Kuwait Insulating Material Manufacturing Co.
- Kuwait Chemical Manufacturing Co.
- Gulf Glass Manufacturing Co.
- Kuwait Lube Oil Co.

The investigation should be extended to the damages of the plants, amounts and character of the chemicals released, mishandling of the raw materials, auxiliary materials and products, onsite pollution, pollution of the area drainage system, potential pollution caused by inadequate disposal of the chemicals released or damaged during the crisis.

Table 1.1. Raw materials and products of the industries in the Shuaiba Industrial Area

Industries	Raw materials	Products
1 Shuaiba South Power and Water Production Station; Shuaiba North Power and Water Production Station	Sea water, Natural gas, Oil, Liquid chlorine, Sodium tripolyphosphate, Lignin sulfonate, Acid inhibitor, Hydrochloric acid, Caustic soda, Hydrazine, Organic antifoam, Morpholine.	Electricity, Distilled water.
2 Shuaiba Refinery Mina Abdulla Refinery Mina Ahmadi Refinery	Crude oil, Natural gas, Fresh water, Chemicals and additives.	Various refined light and heavy products Propane, Butane, Sulphur.
3 Petrochemical Industries Co. Fertilizer Division Salt and Chlorine Unit	Natural gas, Raw water, Sulphur, Salt, Chemicals.	Ammonia, Urea, Sulphuric acid, Salt, Liquid caustic soda, Pressurized nitrogen, Distilled water.
4 Kuwait Industrial Gases Corp.	Air, Nitrogen, Oil, Hydrogen.	Oxygen, Caustic soda, Argon, Activated aluminum, Silica gel.
5 KREMENCO	Steel plaster, Rolled steel; Welding rods, Acelyne, Oxygen, Argon, Nitrogen.	Types of iron, steel frame works, Heat exchangers.

	<i>Industries</i>	<i>Raw materials</i>	<i>Products</i>
6	Packaging and Plastic Industries Co.	Polypropylene (low and high density), Thinner, Ink, Master batch.	Polypropylene, Bags, Rolls, Sheets.
7	Refrigeration and Oxygen Co. Ltd.	Air, Oil, Caustic soda, Activated aluminum, Silica gel.	Oxygen, Nitrogen, Air.
8	Dresser (Kuwait) Co.	Baryte, Bentonite.	Barytes, Bentonite, Oilfaze, Detergent, Surfactant, Lignosulphonate.
9	Shuaiba Paper Products Co.	Cellulose pulp, Paper, Starch, glue, Ink.	Oilferent, Sorts of paper bags.
10	Kuwait Cement Company	Ordinary portland cement, clinker, White cement, Gypsum, Paperbags.	Grey and white cement.
11	The National Industries Co. Lime Products Factory	Limestone, Silica sand, Olibic sand.	Lime bricks, Hydrated lime, Quick-lime.
12	The National Industries Co. Kuwait Asbestos and Plastic Industries	Asbestos, Cement, Water, PVC powder, Additives.	Asbestos products, P.V.C. pipes and fittings.
13	Kirby Building Systems, Kuwait	Mild steel, Red oxide primer, Xylene thinner, Wood, Paper, Fibre glass insulation.	Various iron and steel works.

Industries	Raw materials	Products
14 Real Estate Con. and Fabrications Co.	Aggregates, gravel, Sand, Cement, Water, Steel, Plasticizers.	Precast and prestressed concrete products.
15 Kuwait Precast System Co.	Aggregates, gravel, Cement, Sand, Steels, Plasticizers.	Precast elements, Ready-mix concrete.
16 Kuwait Insulating Material Manufacturing Co.	Sand, Dolomite, Limestone, Rasorite, Sodium carbonate, Barium carbonate, Sodium sulphate, Phenol, Mulrex oil, Paraformaldehyde, Barium octahydrate, Sulphuric acid, Urea, Ammonia, Feldspar, Ammonium sulphate.	Fibre glass insulators.
17 Gulf Paper Manufacturing Co.	Wood pulp, Waste paper, Water, Starch, Alum, Resin.	Paper rolls, sheets.
18 Al-Rabiah International Contacting Co.	Aggergates, gravel, Sand, Cement, Water, Steel, Plasticizers.	Precast and prestressed concrete.

	<i>Industries</i>	<i>Raw materials</i>	<i>Products</i>
19	Kuwait Gypsum Manufacturing and Trading Co.	Gypsum, Cardboard, Starch, Additives.	Gypsum powder, Gypsum walls.
20	National Automotive Manufacturing and Trading Co.	Trunk parts, Paints, Oil, Wax.	Trunks.
21	Kuwait Chemical Manufacturing Co.	Maleic anhydride, Propylene glycol, Diethylene glycol, Soya bean oil, Phtalic anhydride, Linseed oil, Xylene, White spirit, Styrene, Vinly acetate, Glycerol, Pentaenyth, Butyl acrylate, Vinly versatate.	Alkyd. resins, Polyester resins, Polyvinly and Aceytate resins.
22	Gulf Glass Manufacturing Co.	Sand, Limestone, Soda ash, Alumina, Sodium sulphate, Gullet, Water.	Glass bottles.
23	Kuwait Lube Oil Co.	Oils with various viscosity, Additives.	Different engine lube oils.
24	United Fisheries of Kuwait Company	Shrimp, Fish.	Shrimp, Fish.

**Table 1.2. Hazardous waste generated in the SIA
during ordinary industrial operation**

1 Solid wastes

Used catalysts
Oily sand and clay
Molecular sieves
Charcoal/Silica gel
Fibre glass insulation

2 Semisolid wastes

Crude oil suspension
Oil sludge
Asbestos suspension
Used oil/lubrication
Bitumen
Leaded sludge
Glass wool sludge
Chemicals and additives

APPENDIX II
Sabhan and Shuwaik
Industrial Areas

The Ministry of Commerce has the responsibility for the Sabhan and Shuwaik Industrial Areas. Area authorities do not exist in these industrial areas. The assessment of the war-damages is in progress for both areas, and the clean up activities have already started.

Summarized information on the damages is not available, therefore the individual industries should be visited for exact assessment of the risk of the hazardous chemicals released.

Based on the visits to the industrial areas and some of the typical industries, it can be assumed that detailed investigation is necessary for about sixty industries. Since the Sabhan area is more typical for the industrial activity, preliminary assessment of the damages for some typical industries visited in the Sabhan area are as follows:

Out of the inspected thirty-three industries fifteen industries were looted or burned out:

<i>Industry</i>	<i>Status</i>
Kuwait Food Company S.A.K. Americana	Looted
Kuwait Cotton Production for Trade Industry	Partially looted
Kuwait Catering Co.	Looted
The Kuwaiti Danish Dairy Company	Badly burned out Looted
Kuwait Biscuit and Food Products Manufacturing Co.	Looted
Arab European Aluminium Co.	Looted
Middle East Manufacturing Co. K.S.C.	Mishandled chemicals Looted
Kuwait Aluminium Extrusion Co. W.LL	Looted
Y.R. Al-Adasani Enterprise Plastic Pipes and Fitting Factory	Mishandled chemicals
Burgan Brick and Tiles Ind.	Looted
International Prefabricated Houses Co.	Looted

Ahlia Chemicals W.LL

Looted

Al-Ahlia Plastic Co.

Looted

The Plastics Co.

Partially looted

The above industries should be inspected to determine the risk of the hazardous chemicals released.

APPENDIX III
Onsite Biological Treatment of the
Oily Waste Deposits Caused by the Iraqi
Aggression in the Kuwaiti Desert

The Kuwait Institute for Scientific Research (KISR) Biotechnology Department in cooperation with the Petroleum Department prepared a proposal for onsite biological treatment of the oily waste deposits in the Kuwaiti desert.

It is highly suggested to take into consideration KISR's proposal for cleaning up the desert areas and find out the possible ways to cooperate with KISR.

The onsite treatment of oily deposits in an adaptation of the widely practiced land farming of oily wastes. The contaminated soil surface is irrigated and fertilized with chemical fertilizers and ploughed also for aeration by well known agricultural methods. Therefore the natural biodegradation process and the decomposition through photooxidation can be sped up and the treatment time minimized. The activity of the indigenous aerobic soil organisms responsible for oil degradation is enhanced by this technology.

As a result of the preliminary evaluation of the possible methods for the treatment of the oily deposits, it is found that the onsite biological treatment is the most appropriate technology, since it can be implemented immediately and it is very cost effective and the removal of the contaminated soil from the surface is not needed. By implementation of the onsite biological treatment, the hazardous oil deposits can be eliminated without causing any secondary pollution (e.g., air pollution at incineration) and moreover the hazardous wastes can be converted to useful materials, which increases the organic content of the sandy soils, therefore the water holding capacity of the soil will be greater and better the water conservation. The improved soil quality also results in soil stabilization affect against wind and water erosion.

Scientific results -gained from KISR projects- are ready for the immediate large scale implementation of the onsite treatment of oily deposits in Kuwait. The research results proved, that the Kuwaiti climate and soil composition is very advantageous for the effective bio process and photooxidation.