

Challenges of Treatment & Reuse of Industrial Wastewater in Developing Countries – Case of Kuwait

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KISR



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Introduction

- In contrast to developed countries who have accumulated adequate technical and managerial skills needed for adequate management of industrial wastewaters, developing countries face great difficulties in treatment and disposal of industrial wastewaters.
- Challenges faced by developing countries can be attributed to one or more of the following reasons:
 - Absence of adequate policies and legislations
 - No enforceable regulations of industrial discharges
 - Lower priority for management of industrial discharges

Introduction Conti.

- Lack of appropriate treatment and disposal facilities
 - 70% of industrial wastewater is dumped untreated.
- Lack of technical and organizational experiences
 - Most developing countries do not have good experience in design, monitoring and maintenance of wastewater treatment and reuse systems.
- Limited financial resources
 - Most developing countries can not afford building adequate sanitation facilities.

Introduction Conti.

- Unplanned and scattered industries
 - In developing countries, industries are often scattered around big cities.
- Rapid population growth, urbanization and industrialization
 - 90% of world population will be in developing countries by 2050
 - Most developing countries strive for fast economic growth and associated industrialization



Introduction Conti.

- This presentation is about the management of industrial wastewater in one of the Gulf countries, Kuwait where some of the mentioned drawbacks for proper management of industrial wastewaters exist.



KISR Study

- Kuwait Institute for Scientific Research (KISR) has completed a 18-month study that aimed at:
 - Development of a base-line information source of quality of wastewater generated in municipal and industrial sources in Kuwait.
 - Review of existing regulations in Kuwait for reclaimed water.
 - Development of a scheme for wastewater quality control and monitoring in Kuwait

KISR Study Conti.

- To achieve the study objectives, the following has been done:
 - Collection of published and unpublished data about wastewater quality in Kuwait
 - Surveying and collection of water samples from households, industries, commercial buildings, rainfalls-runoff and irrigation drainage water.
 - Laboratory analysis of the collected samples
 - Reviewing of Kuwait regulation for wastewater reuse
 - Suggestion of a scheme for monitoring and control of wastewater quality in Kuwait
- Here only the part related to the management of industrial wastewater will be presented.

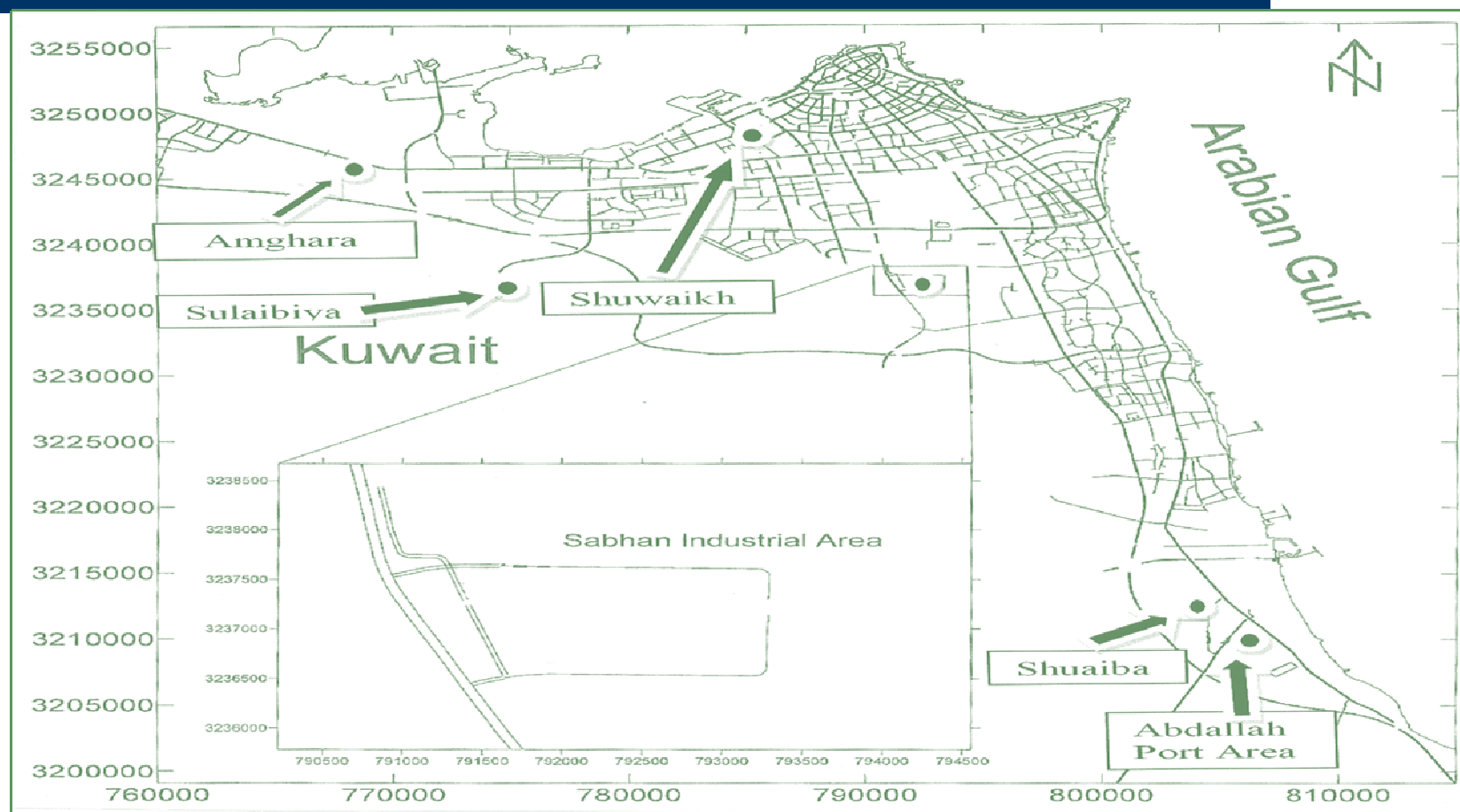


Studied Industries

- Wastewater samples were collected from 36 industrial sites.
- Few Industries were planned to be sampled, but samples could not be collected due to insignificant flow of wastewater. These factories include manufacturing plastic, concrete, quarrying, animal food, leather and equipments.

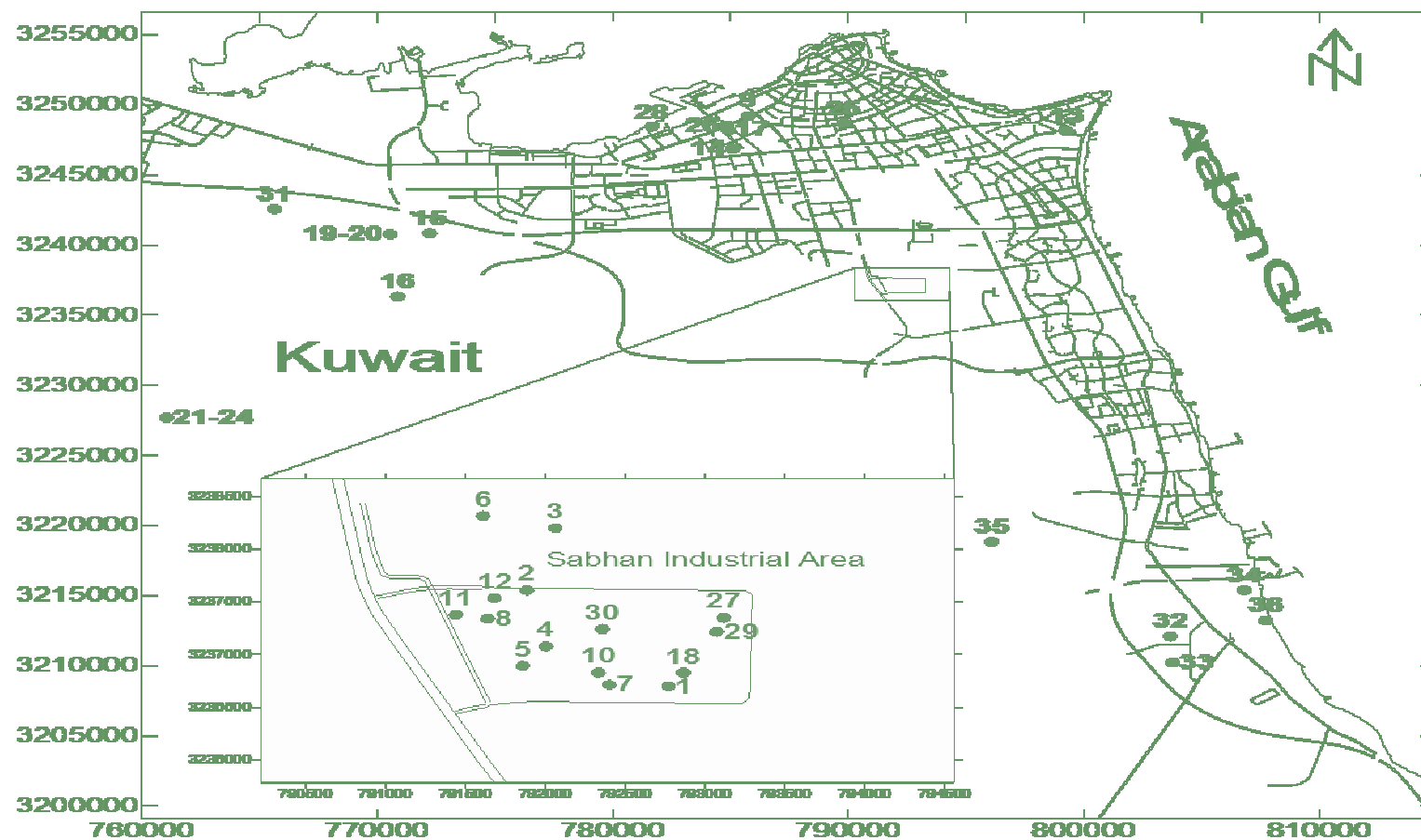


Kuwait Main Industrial Areas





Location of Studied Industries





Studied industries

- Meat processing
- Detergent manufacturing
- Bakery,
- Dairy farms (cow, sheep, and chicken farms)
- Dairy product processing factories,
- Soft drinks,
- Metal products,
- Car wash facilities,
- Slaughter houses,
- Cannery,
- Laundry
- Paper manufacturing,



Studied industries Conti.

- Photo & film processing
- Textile manufacturing
- Pesticides manufacturing
- Glass production
- Fertilizers manufacturing
- Petroleum & gas production facilities
- Petroleum & refinery processing.



Measured Quality Parameters

- Quality parameters measured at field included: pH, EC, DO.
- Quality parameters measured at labs included: TOC, BOD5, COD, TSS, TVS, TDS, NH4, TKN, TN, PO4, alkalinity, sulfide, Na, Ca, Mg, K, Cl, Hg, Zn, Cu, Fe, Cr, Ag, Cd, Pb, Cn, As, TC, and FC.



Quality of Generated Industrial Wastewater Conti.

Pollutant Exceeding Kuwait Standards	Industrial Process
Organic Load (BOD, COD) Average COD > 8,000 mg/l	Shampoo manufacturing, Meat & food processing, Cake & bakery production, Juice & milk factories, Detergent manufacturing, Cannery production, Dairy farms, film processing, Carpet industry, Pesticide manufacturing, Fertilizers manufacturing.
Solids (Settleable, SS, TS) Average TSS > 900 mg/l	Cake & bakery production, Flour mills & Bakery, Dairy processing, Car washing, Detergent manufacturing, Food processing, Slaughter houses, Paper manufacturing, Building materials



Quality of Generated Industrial Wastewater Conti.

Pollutant in Excess	Industrial Process
Biological Contaminants (TC, FC, Salmonella, Coliphage, Virus) Average Total Coliform > 10^7	Dairy farms, Dairy production processes, Slaughter houses, laundry, Cake and bakery production.
Surfactants Average Surfactants > 54,000 mg/l	Paper industry, Carpet industry, Textile industry, Shampoo manufacturing, Detergent manufacturing, Slaughter houses, Meat processing



Quality of Generated Industrial Wastewater Conti.

Pollutant in Excess	Industrial Process
Heavy metals (e.g. Zn, Cu, Hg, Cd) Occasionally Zn > 2.0 mg/l	Shampoo production, Juice & milk factories, Aluminum extrusion, Oil & gas facilities.
Other toxic chemicals (e.g. phenol) Average Phenol > 5.0 mg/l	Refinery processing, Aluminum extrusion, Petrochemical industries.



Industries with excess pollution loads Conti.

- A wide variety of pollutants
- Pollution level depends the type of industry
- Most of the industrial wastewater discharges need pretreatment before reaching public sewers or water bodies.
- Implementation of the regulations that controls industrial discharges to public sewers or waters in Kuwait is urgently needed.



Regulation of industrial Wastewater Discharges in Kuwait

- In Kuwait there are two standards proposed by Kuwait Environmental Public Authority (KEPA) for regulating the discharges of industrial wastewaters into public sewers or to the sea:
 - KEPA standards for industrial discharges to waters in Kuwait.
 - KEPA proposed standards for industrial discharges to public sewers.



KEPA Standards for Industrial Discharges to Waters in Kuwait

Parameter	Standard	Parameter	Standard
Color	Free of pollutants	Aluminum, mg/l	5
pH	6 to 8	Arsenic, mg/l	0.1
Temperature, °C	10	Barium, mg/l	2
BOD, mg/l	30	Boron, mg/l	0.75
COD, mg/l	200	Beryllium, mg/l	0.1
Oil & Grease, mg/l	5	Cadmium, mg/l	0.01
TSS, mg/l	10	Cyanide, mg/l	0.1
TDS, mg/l	1,500	Total Chromium, mg/l	0.2
PO ₄ , mg/l	2	Nickel, mg/l	0.2
NH ₄ , mg/l	3	Mercury, mg/l	0.001
NO ₃ , mg/l	30	Cobalt, mg/l	0.2
TKN, mg/l	5	Iron, mg/l	5
Total N, mg/l	30	Antimony, mg/l	1.0
Total Phenol, mg/l	1	Copper, mg/l	0.2
F, mg/l	25	Manganese, mg/l	0.2
S, mg/l	0.5	Zinc, mg/l	2.0
Residual Cl ₂ , mg/l	0.5	Lead, mg/l	0.5
DO, mg/l	>2	Lithium, mg/l	2.5
Turbidity, NTU	30	Molybdenum, mg/l	0.01
Hydrocarbons, mg/l	5	Vanadium, mg/l	0.1
Floatables, mg/l	none	Silver, mg/l	0.1
Total Coli, MPN/100 ml	1,000	Pesticides, mg/l	0.2



KEPA proposed standards for industrial discharges to public sewers

Parameter	Standard	Parameter	Standard
BOD	500	Cu	0.5
COD	750	Pb	0.5
TSS	300	Hg	0.002
EOG	30	Ni	0.2
FOG	20	Ag	4
Tar and Tar Oil	0	Zn	2
SO4	1,000	Total Coli, MPN/100 ml	1,000
H2S	10	Fecal Coli, MPN/100 ml	100
CN	0.1	Parasite Eggs, #/l	0
As	0.1	Worm parasites, #/l	0
Cd	0.1		



Regulation of industrial Wastewater Discharges in Kuwait Conti.

- KEPA standards do not include important parameters like alkalinity, acidity, phenol, pesticide, Br and surfactants.
- It was felt that the regulations need review.
- Effective enforcement of the standards should be based on monitoring, surprise samplings, and quality assurance programs.



Status of Industrial Wastewater Treatment & Reuse in Kuwait

- There is no documented study about the status of treatment and reuse of industrial wastewaters in Kuwait.
- Some (few) industries use package treatment units as pre-treatment steps.
- Very few industries, like the Petroleum Industry Company (PIC), have their own treatment plant.
- Significant number of the industries do not have even a pre-treatment unit and therefore dumped or discharged untreated to public sewers or the environment.



Status of Industrial Wastewater Treatment & Reuse in Kuwait Conti.

- Limited number of industries, like some tile and concrete factories, reuse some of the generated wastewater within the industrial process.



Selection of industrial Wastewater Treatment and Reuse Technologies for Kuwait and Similar Conditions

- Pretreatment is needed before discharging to public sewers.
 - Suitable unit operations or processes
 - A wide variety of package commercial units can do the job.
- Small-scale central treatment plants for certain groups of industries:
 - Precise selection of industrial wastewaters that can be treated in one place.
 - Preference should be given for anaerobic treatment technologies which are more appropriate for treatment of high loads of industrial wastewaters discharges

Selection of industrial Wastewater Treatment and Reuse Technologies for Kuwait and Similar Conditions Conti.

- Treatment of selected groups of industrial wastewaters at existing municipal plants
 - Characterization of industrial discharged wastewater
 - Strict implementation of the regulation regarding pretreatment
- Reallocation, if possible, of some industries in order to make treatment and disposal of industrial wastewater technically and economical feasible



Future Prospects of Industrial Wastewater Treatment & Reuse in Kuwait

- With a dedicated efforts, definitely the status of industrial wastewater management in Kuwait can be improved significantly.
- All managerial aspects related to industrial wastewater treatment and reuse need to be improved and strengthened:
 - Issuance of more realistic and enforceable regulations
 - Strict Implementation of the regulations through monitoring and surprise visits
 - Encouragement of waste minimization of through processes modification
 - Encouragement of the recovery of valuable materials and on-site recycle and reuse of generated wastewater
 - Designation of especial industrial zones for certain industries

Future Prospects of Industrial Wastewater Treatment & Reuse in Kuwait Conti.

- Giving guidance and help in selecting appropriate and sustainable technologies: package units for onsite treatment, preferably anaerobic systems for off-site treatment systems
- Inclusion of the aspects of management of industrial wastewaters in all strategic urbanization plans.
- Increase of the public awareness of the environmental effects of industrial wastewaters.



Thank You
