CHAPTER 5

OBSERVATIONS AND CONCLUDING REMARKS

Traditional systems have provided drinking water to Indian villages and towns over centuries. Even today, thousands of villages and numerous towns depend on them for domestic water supply. Traditional systems also play an important role in areas where groundwater is saline or polluted due to human activities. The pattern of urbanization in the post-Independence period has also contributed to water scarcity. Traditionally, settlements developed near the water sources. Presently, water has to be piped from distance sources to supply mushrooming satellite towns. Wastage of water and energy resources and unnecessary pumping operations are very common. When the distance source became inadequate, efforts are made to locate yet another distance source. If the source is a dam or reservoir, the people around it do not tolerate the "export" of water to other region. If the supply is pumped groundwater, which causes the water table to fall, local people resent it strongly. Increasing cases of taps going dry creates a situation desperate enough for people to revive the old system of collection of rainwater storage in homes, water harvesting in small check dams, ground water recharging and find-out other alternatives.

"Traditional water harvesting systems were good in the past, for smaller population groups. Traditional systems were specific response to ecology and culture in which they had evolved. These systems emphasize ecological conservation in contrast to environmental overuse of modern systems. Traditional systems had benefited from collective human experience since time immemorial and in that lies their biggest strength."[1]

"The most striking feature of traditional water harvesting system was, the people had the right to construct and manage them. Legal changes in 1975 took away the jurisdiction of individuals and village communities over all water sources and placed it with the government. Currently, water rights are an extremely controversial issue. Disputes over surface waters often result in litigation and violence. State invariably claims monopoly over all significant streams even though groundwater is by and large free for any one to grab and destroy. Holistic domestic water policy is absolutely essential as a part of the management of a region. Traditional water-harvesting systems may not be sufficient for today's needs. As such, a healthy mix of the small and traditional, along with the large and modern is needed."[2]

High sense of water management and sanitation is demonstrated by the provision of bath in every dwelling house of Harrappa, Mohenjo-daro and Lothal. At Lothal – a Harrappan Port Town, about 85 Km from Ahmedabad and about 150 Km from Bhavnagar, most of the houses had baths measuring 8 ft. X 6 ft., more spacious than those in the Mohenjo-daro and Harrappa. The wastewater from the baths flowed into small brick-lined sump or soakage jars through runnels. These jars had a hole in the base to allow liquid waste to soak into ground while solid matter was regularly cleaned to prevent overflowing of sewage into streets. Masons have shown their maximum skill in building drains, sumps inspection chambers water chutes and cesspools. Even the small lanes were served with underground brick-built drains, and excellent drainage system. A row of twelve baths, each separately connected by a runnel with public drain is seen in the Acropolis. Photographs and sketches of Lothal related to this study are given in the annexure.

Wastewater reclamation and reuse have rightful place in the integrated management of water resources. Today, it is proven fact that good wastewater treatment systems or water purification processes exist to provide water of almost any quality desired. The effective integration of fresh water and reclaimed wastewater is required for effective and efficient use of available water for human consumption, industrial applications, agricultural uses and recreational requirements. Whether wastewater reuse can be implemented or not depends on,

-Public health considerations,

-Reclamation techniques,

-Economical considerations,

-Potential use for reclaimed wastewater,

-Public acceptance,

-Planning in reclamation and reuse,

-Efficient management of water sources and other local issues.

Agricultural use of reclaimed sewage has largest use potential and it is an accepted, and well-practiced phenomena throughout the world. There is minimum chance of adverse public opinion in agricultural use of reclaimed wastewater. Agricultural use of reclaimed sewage is safe considering microbiological aspects of sewage recycle. The second larges possible use of reclaimed sewage could be industrial application. If an industry can use reclaimed wastewater for some of its requirements, water saved for these applications can be made available for public use. Madras Refinery – Madras is using reclaimed sewage for industrial application for last ten years, and Rastriya Chemicals and Fertilizers (R C F) – Trombay is using reclaimed sewage of Mumbai for last three years. Both the plants are based on Reverse Osmosis technology.

The R C F plant for reclamation of sewage is using sewage from Ghatkopar Municipal Sewage Disposal Plant – Mumbai. The details of Sewage Reclamation Plant of R C F are as under[3].

Company	Rastriya Chemicals and Fertilizers (RCF) - Trombay
Titla of Project	"SUJAL"
Aim of project	To ensure uninterrupted supply of process water to support production (Boiler)
Input	Sewage water from
Source	B M C Ghatkopar Municipal Sewage Plant
Input Quality	C O D 300 ppm Hardness 180 p.p.m.
Input Volume	Five Million Gallons per Day
Output Quality	C O D 10 p.p.m. maximum. Hardness 2 p.p.m. maximum
Output Volume	Three Million Gallons per Day
Process	Reverse Osmosis
Main Equipments	

Treatment / Equalization tank, 18000 M^3 capacity
32 hrs stay time
50 H P aerators X 12 nos.

Clarifier 5000 M3 X 3
6 hrs stay time

High-Rate Clarifier (HRC)
3 hrs stay time

Rapid Sand Gravity Filter
2500M3 X 6 nos.

Chemical Dosing

Chlorine at 2 Kg /hr

Other chemicals by metering pump

Dual Media Filter (DMF)

3 nos.

Reverse Osmosis

Feed rate 162 M^3 / hr

R O Recovery (Efficiency) 85 % average

R O out-put 145 M^3 / hr

Final Storage Tank

Capacity 10,000 M^3, equipped with spray fountains to increase D O.

Cost of Treatment

Chemicals Rs. 2 / M^3

Chlorine, Polyelectrolyte, Alum, NaOH, H_2SO_4.

Rs. 17 / M^3 including power and manpower.

(June 2000)

Benefits of System

(1) Assured supply of water to RCF - 3MGPD

(2) Reduction of Blow-down from process plant (Boiler) due to better quality of water

(3)Saving of 3 MGPD fresh (potable) water for Grater Bombay Municipal Corporation

(4) Reduction in cost of disposal of 3.5 MGPD Sewage for Grater Bombay Municipal Corporation.

Know-how from Aquatech - U S A

Project Execution Batliboy Environment Engineering Limited (BEEL)

Project Cost Rs 40 Crores.

The Madras Refinery plant for reclamation of sewage is using sewage from Madras Municipal Sewage Disposal Plant – Madras. Central Salt and Marine Chemicals Research Institute – Bhavnagar, supplied the know-how and design of the plant. The details of Sewage Reclamation Plant of Madras Refinery are as under[4].

Company Madras Refineries Limited – Madras.

Aim of project To ensure uninterrupted supply of process water to support production (Low Pressure Boiler)

Input Source Secondary Treated Sewage water from METROWATER plant at Kodungaiyur of Municipal Sewage Plant

Input Quality C O D 300 p.p.m. Secondary Treated Sewage
Hardness 500 p.p.m.
T D S 2000 p.p.m.

Input Volume 11365 M^3 per Day

Output Quality C O D 5 p.p.m. maximum.
Hardness 100 p.p.m. maximum
T D S 400 p.p.m. maximum.

Output Volume 9565 M^3 per Day

Process Reverse Osmosis

Main Equipments

Treatment / Equalization tank,
24 hrs stay time
mechanical surface aerators

Secondary Clarifier

6 hrs stay time

Hydro-Treator

Removal of temporary hardness and phosphates

Pressure Sand Filter

Ammonia Stripper

Carbonation Tower

To remove lime.

Calcium carbonate clarifier

Reverse Osmosis

Feed rate 118 M^3 / hr X 4

R O Recovery (Efficiency) 85 % average

R O out-put 100 M^3 / hr X 4

Final Storage Tank

Cost of Treatment

Chemicals Rs. 10.5 / M^3

Chlorine, Polyelectrolyte, Ferric alum, $Ca(OH)_2$, H_2SO_4. CO_2

Rs. 21 / M^3 including power and manpower.

(October 1996)

Benefits of System

(1) Assured supply of water to refinery

(2) Reduction of Blow-down from process plant (Boiler) due to better quality of water

(3) Saving of fresh water for Municipal Corporation

C. S. I. R. Laboratory, Central Salt and Marine Chemicals Research Institute - Bhavnagar, developed R O Membranes for this project.

Project Execution Hindustan Dorr-Oliver Limited.
Project Cost   Rs 19.5 Crores. (1991)

Nirma Industries - Bhavnagar, Manufacturing soda ash, detergents and soap is using reclaimed seawater for their production plant. Input water is of about 35000 p.p.m. TDS. It is operating at the rate of 450 M^3 / hr of output water. Thermax India Limited executed the project costing about Rs 70 Crore. The cost of product water of TDS below 250 p.p.m. inclusive of power and manpower is about Rs 17 / M^3 ,according to Nirma Officers.

All these examples prove that it is possible to treat any water to any desired quality. The operations for large-scale reclamation are technically feasible and quite economical. All these units are using water, believed to be waste - non-usable before few years, as their source of water supply today. It is now time to think for such technically feasible and economical and ecological solution for the water supply to the industries and public.

Biotechnology has featured in human endeavor since pre-historic times. Making of curds, wines, Idely, Dhokla, and many Indian traditional dishes or converting animal refuse into compost are examples of the use of biotechnology by pre-scientific man. We did not use the term biotechnology for all these activities until much letter.

Classically, biotechnology was even more closely associated with sanitary engineering than it was with many other branches of human endeavor. Septic tanks, activated sludge process, anaerobic fermentation units, compost pits etc made use of biotechnology without formally acknowledging it.

Biodegradable organics are the most common water pollutants. Sewage are generated wherever human beings dwell, requiring process to convert the organic pollutants in those wastes to 'Harmless', 'Inorganic' or substances such as Carbon dioxide and Nitrogen. One more dimension to this challenge is the development of wastewater treatment technology appropriate for urban and rural localities. Emerging technology of using aquatic macrophyts – especially common weeds – that enable cost effective treatment of biodegradable wastewaters, assumes greater significance and promise.

The realization that aquatic plants can improve water quality must have come about several centuries ago, with the observation that wastewaters flowing out of channels infested with the vascular plants, such as water hyacinth, seem to be clearer than the wastewaters entering such channels. However scientific studies to employ aquatic plants in water purification began only during the 1970s.

There were occasional publications on the subject earlier, including pioneering and significant contribution from India. The studies that caught the imagination of environmental engineers all over the world, and gave major support to R & D on macrophyte based water treatment systems came to light during mid 1970s [5-14]. The scientific work in this field was from Germany, The Netherlands and U S A. In India Prof. Abbasi S A and Dr. Ramasami E V, both working with Center for Pollution Control and Energy Technology, Pondicherry University has contributed in this field to great extent. This technology can be thought off for treatment plants of industrial wastewater and sewage for small and medium size cities like Bhavnagar. Production of large quantity of fodder for animals will be an added advantage of this type of system,

Water supply to the public of Bhavnagar is 120 Lit. per person per day in normal days. It is much less in hot summer days, when it is required the most, and even smaller in the years of shortfall of rain. Public depend upon secondary ground water sources, which is high in salt and hardness, for their additional needs. This is reflected in quality and quantity of sewage.

Public of Bhavnagar deserves for good quality and larger quantity of water for domestic use. This can be supplied only by using technical solutions, as water cannot be manufactured of desired quality in desired quantity. Use of reclaimed water for Industrial Applications can, for example, save large quantities, that can be made available to the public. Water required for watering the trees on the roads and playgrounds, and non-drinking public uses can be satisfied by treated wastewater.

Studies made in this research work indicate that the sewage of Bhavnagar city is practically free from effluents of any chemical industry or toxic compounds in large quantities. Sewage can be classified as "strong", because public is getting much less water for domestic consumption, and depends upon secondary sources for their additional requirements. The secondary source in most cases is ground water, and it is temporary hard water, containing impurities of bicarbonates.

Treatment types studied during this research work indicates that effective secondary treatment, that is activated sludge process in combination with some polishing treatment can give good quality water for other than domestic use. At present about 250 farmers are using untreated sewage from final disposal plant for agricultural applications. Most of them are producing fodder for milking animals, mainly Jowar and Kadab. They are facing problems of salinity to some extent. White patches of salt deposits can be seen in some part of the land, but no disease of heavy infestation of pest is observed in the fields for last few years. Perhaps Lime Treatment as polishing treatment can increase calcium content of the sewage to bring down S A R in tolerable limits for the application of sewage for agriculture. More studies are required to be made in this direction.

A problem associated with the treatment and disposal of sewage is treatment and disposal of sludge. The sludge resulting from sewage treatment operations and processes is usually in the form of thick liquid or semisolid liquid. Typically it contains 0.25 % to 12 % of solids, depending on operations and processes of sewage treatment and other public utility factors. Sludge is by far the largest in volume of the constituents removed by treatment. Processing and disposal of sludge is perhaps the most complex problem for sanitary systems, because,

(1) It is composed of the substances responsible for the offensive character of untreated sewage;

(2) The portion of sludge produced from biological treatment is composed of organic matter and it will decompose and became offensive;

(3) Only small part of sludge is solid matter.

Many of the constituents of sludge, including nutrients, are important in considering the ultimate disposal of the sludge, and liquids removed from the sludge during processing. The fertilizer value based on the content of Nitrogen, Phosphorous and Potash, of sludge is to be used as a soil conditioner. Especially if the sludge contains appreciable amounts of grease and skimming, a heat balance can be made and it should be used for combustion processes. Detailed studies on this subject may help to understand the sewage in better manner for its treatability and reuse, and many things about sanitation habits of the public.

Traditional habits, education, religion, food habits, business activities, economic status, civil traditions, and many more things of human and social activities can affect the water consumption quantitatively and qualitatively, and in turn quality and quantity of sewage. Public health and sanitation in this respect may be a very interesting study.