Engineering News

A Quarterly Journal of the Pakistan Engineering Congress

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46th YEAR OF PUBLICATION

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EDITORIALLY SPEAKING

June is the month when Environment Day is celebrated globally every year on 5th day commemorating Stockholm Conference of 1972, where it was decided that environment concerns be highlighted nationally and internationally to make the public aware of environment problems and to win their support for pressing governments to formulate and execute protection programmes. To some extent the goal of spreading awareness has been achieved but the celebration remains an annual ritual to a large extent.

This years' theme was "Wanted Seas and Oceans Dead or Alive" not an easily comprehended topic, whose simplified version would be that water bodies, particularly the oceans, should be handled and utilized in a manner that ensures continuous benefits to the communities around and the global population in general. This cannot be achieved if dumping of liquid and solid wastes into the seas and oceans goes on un-abated. Spillage of oil through accidents, clearing of ships in the sea and off shore drilling operations form major sources of pollution. Not only that, the industrial countries are aggravating quality of oceans through air emissions caused by air lines and shipping lines and dumping of wastes. Millions of tons of wastes is entering the seas and causing eutrophication thus altering the natural biological activities and creating imbalance in their capacity to absorb the environmental heat and permit the penetration of light vital for sustaining the life cycle of sea. Much of the damage is being done by this resourceful western countries by allowing over fishing. Communities around the sea shores have to be cautious and bear responsibility in controlling the fish harvesting ; for that matter all types of activities detrimental to sustainable utilization of available resources. This shall not absolve the main-landers whose activities release countless tons of pollution to sea through rivers and estuaries besides the heavy silt load resulting from cutting of trees and exposing mountain slopes to the vagaries of weather.

Pakistan proportionally has a short sea-shore but intensity of pollution is enormously high. However, there is a light at the end of tunnel because federal and provincial governments have shown concern over the pollution caused by the untreated discharge from urban areas and industrial clusters. Investigation programs are getting accelerated attention. Pakistan has also gone a long way in adopting a national conservation strategy and by establishing legal institutions, national environmental quality standards with the creation of environmental agencies. What is yet to be done is a strong application of those laws and standards. The application of laws is squarely dependent upon development of appropriate technology for the treatment of effluent and emissions. However, sight should not be lost for minimization in generation of pollution to which every individual can contribute. The consequential results for not adopting anti-pollution measures are horrible. The dead seas and oceans are synonymous to the death of the planet and the life on it.

WELCOME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering Congress approved Membership of the following new members in to the Congress fold. The Engineering News congratulates all of them and welcomes to PEC

Members admitted on 7-8-2004

1 Engr. Muhammad Mushtaq Chaudhry
2 Engr. Islam ud Din Ghauri
3 Engr. Dr. Muhammad siddique
4 Engr. Muhammad Mumtaz Ahmad Khan
5 Engr. Prof. Dr. S. E. Benjamin
6 Engr. Shahid Mahmood
7 Engr. Muhammad Tauseef Hassan
8 Engr. Waheed-uz-Zama
9 Engr. Prof. Dr. Aziz Akbar
10 Engr. Dr. Ahmad Hadi Shaikh
11 Engr. Liaquat Ali Khan
12 Engr. Muhammad Mohsin Ismail
13 Engr. Imtiaz Hussain
14 Engr. Abdul Majeed
15 Engr. Eajaz Ahmed Bhatti
16 Engr. Farooq Ahmed Shaikh
17 Engr. S. Khawar Hussain
18 Engr. Muhammad Ashaar Naseem
19 Engr. Muhammad Rana Manzar Ali
20 Engr. Anjum Saeed
21 Engr. Sarfaraz Ali Abdi
22 Engr. Muhammad Khan
23 Engr. Adnan Ali
24 Engr. Mahmood Ali
25 Engr. Muhammad Rizwan Shafi
26 Engr. Usman Rafiq Jutt
27 Engr. Ibrahim Rahim Mian
28 Engr. Muhammad Tauseef Arshad
29 Engr. Imtiaz Ahmad
30 Engr. Muhammad Shahid Qamar
31 Engr. Shahzad Javaid Awan
32 Engr. Muhammad Arshad
33 Engr. Rifaqat Ali Shah
34 Engr. Muhammad Younas
35 Engr. Muhammad Baber Ikram
36 Engr. Shahzad Bashir
37 Engr. Ahmad Hussain
38 Engr. Abdul Aziz Anjum
39 Engr. Nadeem Baber
40 Engr. Khalil-ur-Rehman
41 Engr. Ammara Nusrat
42 Engr. Faiza Mahmood
43 Engr. Farooq Azim Cheema
44 Engr. Muhammad Yaqoob Farooqi
45 Engr. Ijaz Hussain Shah
46 Engr. Mohsin Siddique
47 Engr. Yasar Hayat
48 Engr. Abrar ahmad Sayal
49 Engr. Ali Nawaz Khan
50 Engr. Arshad Mahmood Baig
51 Engr. Khurram Khalid
52 Engr. Adnan Abdul Ghaffar Rana
53 Engr. Muhammad Sohail Saleem
54 Engr. Muhammad Munawar Zaman
55 Engr. Muhammad Abbas
56 Engr. Qurat-ul-Ain
57 Engr. Mirza Muhammad Ahmad Sarwar Baig
58 Engr. Muhammad Arshad
59 Engr. Murtaza Ali
60 Engr. Lt. Col (R) Khalid Mahmood
61 Engr. Hafeez Ahmad
62 Engr. Syed Ghulam Mustafa Shah
63 Engr. Imtiaz-ul-Haque
64 Engr. Muhammad Mahboob Khan
65 Engr. Muhammad Aslam Mughal
66 Engr. Nazeer Ahmed Chaudhry
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68 Engr. Hafiz Waheed-ul-Hasan
69 Engr. Ghulam Murtaza
70 Engr. Zia-ud-Din Satti
71 Engr. Usman Haider Shaikh
72 Engr. Muhammad Younis Mughal
73 Engr. Muhammad Haroon Naseer
74 Engr. Abdul Rashid
75 Engr. Ahmad Pervez Khan
76 Engr. Tahir Javed
77 Engr. Qamar ul Mannan
78 Engr. Syed Ali Hasan
79 Engr. Shafqat Saeed
80 Engr. Imtiaz Ali
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82 Engr. Humayun Rashid
83 Engr. Muhammad Saeed Chaudhry
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88 Engr. Abid Raza Syed
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92 Engr. Ghazanfar Ali Khan
93 Engr. Muhammad Asif
94 Engr. Khurram Zafar
95 Engr. Shoaib Qazi
96 Engr. Waqas Akram
97 Engr. Imran Ali

ADDRESS OF WELCOME

By

Engr. Rana Muhammad Saeed Ahmad Khan*

On the occasion of World Environment Day – 2004

I heartily express my gratitude to the Honorable Minister for Environment of the Punjab for gracing this occasion with his presence. I also welcome the distinguished guests who have gathered here this morning at the inaugural session of the "World Environment Day" which has been organized jointly by Pakistan Engineering Congress, Institute of Engineers Pakistan and Environ Monitor.

I am grateful for providing me the opportunity to be with you and to address this august body of engineers and environmentalists, all those who are deeply concerned with the protection and preservation of the environment.

Ladies and Gentlemen :

The United Nations Conference on the Human Environment convened in Stockholm in 1972, brought into focus the general realization that different physical components of the environment have limited assimilative and carrying capacities and that pollution control measures must be instituted to safeguard the environment and quality of human life. More important has been the growing realization that natural environmental resources on which man depends are not limitless. The need for conservation of these resources demands positive and realistic planning that balances human needs against the potential usage, which the environment has in store for them. The planet earth has the capacity to meet our needs but not greeds.

Increasing pollution of the air, land and water are now matters of concern for everyone. Deterioration of the quality of the environment has brought this generation to an awareness that its own health and well being as well as the fate of future generations depends on actions taken now to avert a possible environmental catastrophe. Rapid changes due to human actions are occurring in the chemical and physical composition of the atmosphere of our globe. Expected climate changes will affect all ecosystems and societies on our planet in Pakistan.

I would like to draw your attention to the recent spreading of gastroenteritis in Hyderabad due to supply of contaminated water from Indus River having poisonous industrial effluent. This resulted in the death of over two dozens people – a serious tragedy. Thousands of people had been affected and hundreds of them had been hospitalized. The untreated waters are also disposed of into water bodies in Punjab. I can quote a few such examples of badly polluted streams, Hudiara Nallah near Lahore, Barian Wala Drain in Sheikhupura and Paharang Drain in Faisalabad. The people using this water downstream are potentially open to pollution hazard. God forbid any such occurance might happen in Punjab.

I feel sorry to mention here that the programme, started 17 years ago in Punjab after the creation of Environment Protection Agency (EPA), for implementation of the provisions of Pakistan Environmental Protection Ordinance 1983, could not achieve the desired result due to absence of political will.

The theme of World Environment Day 2004 – "Wanted Seas and Oceans : Dead or Alive?" addresses the fact that human kind can no longer view the world's seas as a convenient

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* President Pakistan Engineering Congress.

dumping ground for our waste, or as an unlimited source of plenty. The effluents and wastes of Karachi metropolis are being allowed to flow in to the sea which has lost its original character. Karachi is one of the most polluted coasts of the world. It is no more alive and the marine life is almost extinct. At the same time huge expenditure is incurred to undertake dredging operation for the removal of sediment load from the bottom of the sea.

As reported by the United Nations, the facts are clear. The World's seas and oceans are becoming increasingly tainted by untreated waste water, oil spillage, industrial effluent and silt form inadequately managed watersheds. Nitrogen overload from fertilizers across the globe and the marine litter is killing upto a million seabirds, mammals and turtles each year. With more than 40 percent of the human population already living within 60 kilometers of coast line, and the population still growing. Resultantly, the problems are likely to increase. Moreover, despite the enhanced access to fishing areas and intensity of commercial fishing operations, total global catch is declining. World wide fish are being harvested faster than they can reproduce.

Ladies and Gentlemen : we have assembled here today to remind ourselves about the fast approaching environmental crisis and the urgency of taking appropriate measures. I sincerely hope that this seminar on World Environment Day will discuss valuable ideas and recommendations to be presented by the participants realizing the importance of the matter and come forward with their active support for the cause of environmental protection.

I hope that at the end of this seminar, you will have established some understanding on how we can cooperate better locally and help in solving the global environmental problems. Though created by a few countries of the world, these problems effect us all the world over and innovative suggestions by learned engineers for solutions of these problems will go a long way in assuring a better tomorrow for every one.

At the end, I once again thank you Sir, for sparing your valuable time to inaugurate the Seminar. I am also grateful to the guests for attending the inaugural session of the seminar.

Thank you all for your kind attention.

PAKISTAN PAINDABAD

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ATTENTION

Members are requested to keep the editorial board posted regarding the important events of member's career and life e.g. posting, transfer, promotion and transition to next life for publishing in the journal. Any means of communication available to the informer may be used but make sure the identity of the person and news reported is correct. Also expect your reactions to the contents of the journal by way of letters to the Editor.

Editorial Board

NESPAK makes progress

Locally :

Awarded :

- Upgrading of Feasibility Study on Hill Torrents Management Plan in CRBC Area.
- KESC Up-gradation Project.
- Consultancy for Flyover at Hino Chowk.
- Sabakzai Dam Project Balochistan
- Lahore Ring Road Project.
- Jinnah Hydro Power Project.
- Design of professional studies block at G. C. University, Faisalabad.

In progress :

- KKH landside studies.
- Work at Mirani Dam in full swing.

Wins :

- Design Competition National Bank Building, Islamabad.

Appointed :

- As consultant for Taxtile City Project.

Signs :

- Consultancy agreement with Balochistan University of Information Technology Management Sciences (BUITMS).

AND ABROAD

- Work starts on Torkam Jalalabad road.
- Complete assessment study for Herat Canals.
- Studies for Recharge Dam in Wadi Ghulagi, Sultanate of Oman.
- Buraidah Water Feeder Line Project, Saudi Arabia nearing completion.
- Three health sector and three education sector projects in Afghanistan.
- Feasibility study for rehabilitation of Nawar Bridge of Hesarak Nangahar province Afghanistan.
- Pakistan Embassy, Katmandu awarded to NESPAK.

- Dr. Amjad Pervez Sheikh has taken over as new NESPAK M. D.

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CONTRACT AGREEMENT FOR MANGLA DAM RAISING PROJECT SIGNED

Lahore, June 28, 2004 : WAPDA inked a Rs. 13.793 billion contract agreement with CWE Joint Venture led by a Chinese Company. China International Water and Electric Corporation for the construction of main works of Mangla Dam raising with a completion period of 39 months here at WAPDA House.

Muhammad Amin, Member (Water) of Water and Power Development Authority and Wang Shaofeng, Vice President of Chinese firm, CWE signed the contract agreement on behalf of respective organizations. The Commercial Counselor of China in Pakistan, WAPDA Chairman Tariq Hamid, Member (Power) Khalid Anwar, Member (Finance) Imtiaz Anjum, high officials of WAPDA and consultants representatives were also present on this occasion.

CWE Joint Venture was the lowest bidder amongst the six contractors who submitted the bids for the works in March this year. The local contractors in CWE Joint Venture include Descon Engineering, Sardar M. Ashraf D. Baluch, Inter-construct, Gammon Pakistan and Sachal Engineering Works.

WAPDA Chairman Tariq Hamid said on the occasion that such a huge project was being executed in Pakistan after a long time. He expressed the confidence that the project would be completed within the stipulated time and allocated funds.

The major components of Mangla Dam raising works comprise raising of the dam and main spillway head works besides constructing a control weir upstream of the emergency spillway.

On completion of the project in 2007, the average annual water availability for irrigation releases would increase by 2.88 million acre feet (3,550 MCM). It is pertinent to mention here that the power generating facilities of the dam were designed for raised Mangla Dam conditions. Hence, additional energy will also be produced without making any alteration or addition in the power generating units. The average annual energy output is estimated to increase by about 12% of the present energy production. It is believed that the raising project will generate employment opportunities and give a fillip to socio-economic activities.

The Mangla Dam Raising project is one of the mega projects of Vision 2025 Programme for water resources and hydropower development. This programme, on implementation, would provide additional water storage and hydel power to the system, essentially required to cope with food and energy requirement of the increasing population of Pakistan and to ultimately achieve sustained economic development.



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AIR POLLUTION IN LAHORE

By

Engr. Shabir Ahmad Qureshi*

Pakistan at present faces an array of environmental problems, particularly in the urban centers, largely attributable to water and air pollution. A study conducted by the World Bank about eight years ago revealed that the country was losing annually over U. S. $ one billion as a result of pollution.

Of particular importance in Pakistan is the extraordinary growth of gaseous and particulate matter emissions. This problem is largely confined to urban areas and industrial centers and due to large amounts of vehicular, domestic and industrial emissions, air quality has been severely degraded. Of even greater concern is the increasing trend of atmospheric degradation increasing and deteriorating rapidly air quality standards. In an effort to curb this problem, the Government of Pakistan and its subsidiary agencies and institutions have collaborated to control the discharge and emission of pollution. In particular, Pakistan has developed National Environmental Quality Standards, which are relevant to acceptable levels of emissions from industrial, domestic and vehicular sources of pollution. In addition, a number of ordinances have also been promulgated, which fortify the governmental control over air pollution and provide a basic regime for governing bodies and agencies to enforce these provisions cooperatively and effectively. However, inadequate formulation of enabling rules and regulations has remained a handicap in effective pollution control measures by the Environment Protection Agencies.

The study conducted by the World Bank in 1995 indicated that Pakistan is spending over U. S. $ 360 million per annum to meet the cost of additional health care and covering the loss of productive man-hours due the sickness directly attributable to air pollution. By now, this figure could well have exceeded a billion U. S. $ per annum due to increase in population and increase of air pollution due to industrial activity and vehicular traffic. The above figure does not include the social and emotional costs. Punjab, being the most populous province, is footing the major portion of this huge bill.

Any investment for combating air pollution would, therefore, give a manifold return and be amply justified. Any amount spent on popular. Using cleaner technologies would be worth while to reap huge benefits.

Quoting Late Mr. Richard Nixon, the American President from his New Year's address to the nation, that *"the 1970s absolutely must be the years when America pays its debt to the past by reclaiming the purity of its air, its waters and living environment. It is literally now or never".* The resulting commitment of both the American Government and the public showed a turn-around in the environment culminating in cleaner air and pollution free processes in the USA, which is now largely free of smoke emitting chimneys and resulting smog.

We are faced with a similar situation but with a marked difference - the constraint of financial resources and with the pressing need for industrial development - and that is where the role of our engineers and scientists gains importance. We must assist the government in finding affordable solutions to air pollution control problems and facilitate it to strike a viable balance between allocations for development and industrialization versus environment protection.

Although waste disposal problems have been with us ever since our independence, they

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* M.Sc. Civil Engg. Director, Environment Protection Agency Govt. of the Punjab.

did not pose a threat to our survival till a couple of decades ago. It is largely the tremendous increase in our population which makes the issue so critical, necessitating control in both population and pollution in health. Not only is the population rising at a high rate, but so are the demands for vehicles and industrial products sources of waste and pollution.

As a case study, the City of Lahore, which is the provincial metropolis, has been selected. Lahore is the second most populous and industrial city in north east of Pakistan having population of about 5.1 million in 1998 with growth rate of 3.32%. (Bureau of Statistics, Government of Pakistan). It encompasses an area of about 450 sq. km. Geographically, the city lies on 35°-33' N Latitude and 74°-05' East Longitude and its height from the mean sea level is 215 m.

Its climate is hot in the summer and mildly cold in the winter. The average maximum temperature during the summer months is 40° C which can occasionally shoot up to 48° C. The average minimum summer temperature fluctuates around 25° C and 5° C. The winter months observe inversion at lower level of the atmosphere. Lahore is hit by the north-easterly monsoon in the summer and the south-westerly monsoons in the winter. The summer months, namely May and June, are usually dry with some windstorm activities. During these months, atmosphere is also occasionally hazy. The relative humidity of the city ranges from 20% in dry summer season upto the saturation point during monsoon season. In the winter, the temperature drop results in fog and smog problems in the urban areas due to-low-humidity. Low relative humidity, high temperature and thin vegetation cover, combine to raise the background particulate matter into the atmosphere of the city. Due to its peculiar climate and geographical features, large amount of dust enters the air and there is dire need to set the national PM 10 standards to a comparatively higher level. The standards of suspended particulate matter set by the western countries and WHO would be extremely difficult to achieve in view of our climatic conditions.

Vehicular emissions represent biggest source of air pollution in Punjab and reflect the rapid growth in the use of vehicles. Motor vehicle emissions account for about 90 percent of the total emissions of hydrocarbons, aldehydes, and CO. Other emissions include lead, SO_2, and oxides of nitrogen. The distinctive feature of the urban vehicular population is two and three-wheeled vehicles (motorcycles and auto rickshaws), mostly driven by two-stroke engines, which are multiplying as popular mode of transport. It has been estimated that in the Punjab there are about 1.4 million vehicles on the road. The total vehicle pool in the Punjab has increased at the rate of 11.54 percent per year over the past seven years.

The motor fleet in Lahore city comprising 719,000 vehicles i.e. more than 50% of the total vehicles in the Punjab, is responsible for damaging the ambient air quality by discharging noxious gases such as CO, hydrocarbons, oxides of nitrogen, and SO_2. During the last year (2003), the average load of CO in air has been reported as 123 thousand tons, hydrocarbons 29 thousand tons, nitrogen oxides 14.5 thousand tons, SO_2 1.3 tons, and aldehydes 209 tons. The motor exhaust also had a relatively small share of 2 thousand tons of particulate matter during the last year. Environment Protection Department, Punjab is regularly monitoring the ambient air quality in Lahore. (Table -1) On the basis of this study, status of ambient air pollution in Lahore is depicted us. (*the table added at the end.*)

Sources of Air pollution in the City

The main sources of air pollution were identified as under:

1. Unpaved and dusty roads
2. Motor vehicles exhaust
3. Littering of Solid waste

4. Burning of Municipal Solid Waste
5. Fuel combustion for domestic and commercial purposes
6. Emission form Industrial processes in the city

Other Reasons of Air Pollution in the City

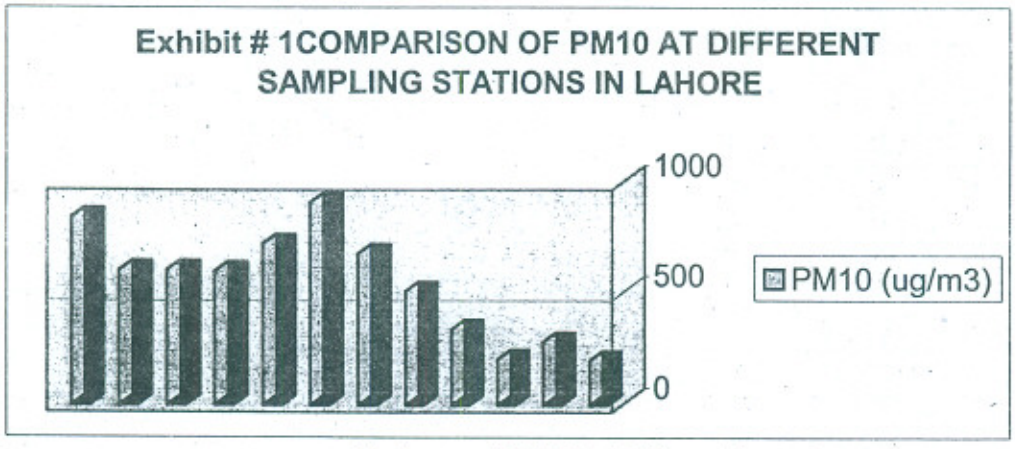
Punjab has semi arid and dry climate conditions with low vegetation cover. Due to this reason, back ground level of suspended particles is higher than the tropical or sub-tropical regions other factors relating to status of in the our suspended particles are ;

- Peak is observed usually at night, from 6 PM to 10 PM which is due accumulation of particles during day-time activities which thins out by late night.
- Poor maintenance of the public transport, for example rickshaws, vans, old and diesel vehicles, add to the PM 10 level.
- Poor maintenance of vehicles with two stroke engines.
- High traffic volume on roads of Lahore.
- Absence of Hydrocarbon standards in NEQS of motor vehicle emission.

Air Pollution in Lahore

1. <u>High PM10 At Road crossings and Commercial areas.</u>

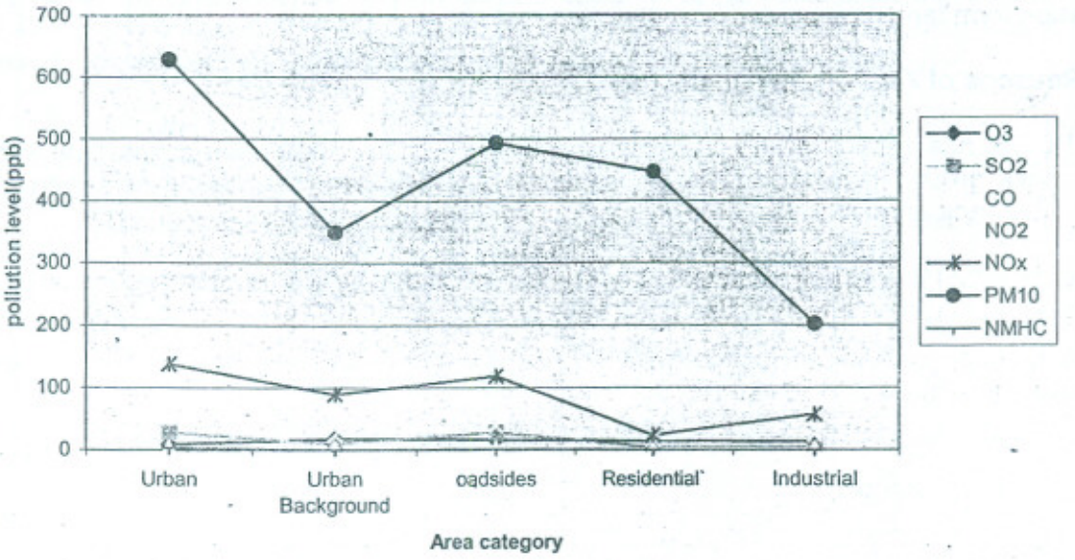
Table I shows that PM10 level in Lahore varied from 353 to 1123 ug/m3 as recorded from 1996 – 2003 at different road crossings. The residential areas in Defense Housing Society and Upper Mall have very low PM 10 concentration in air. Only 210 ug/m3 was measured at Saden Shah Upper Mall, and 198 ug/m3 at E-Block Defense Housing Society, Lahore. The results show that Defense Housing Society is a bit better than the Upper Mall residential colony. In Upper Mall residential society measurement was made in the month of June while in Defence, it was measured in September. The variances of meteorological conditions, can influence the degree of dispersion of air verticals.



Variance of PM10 at Different Locations

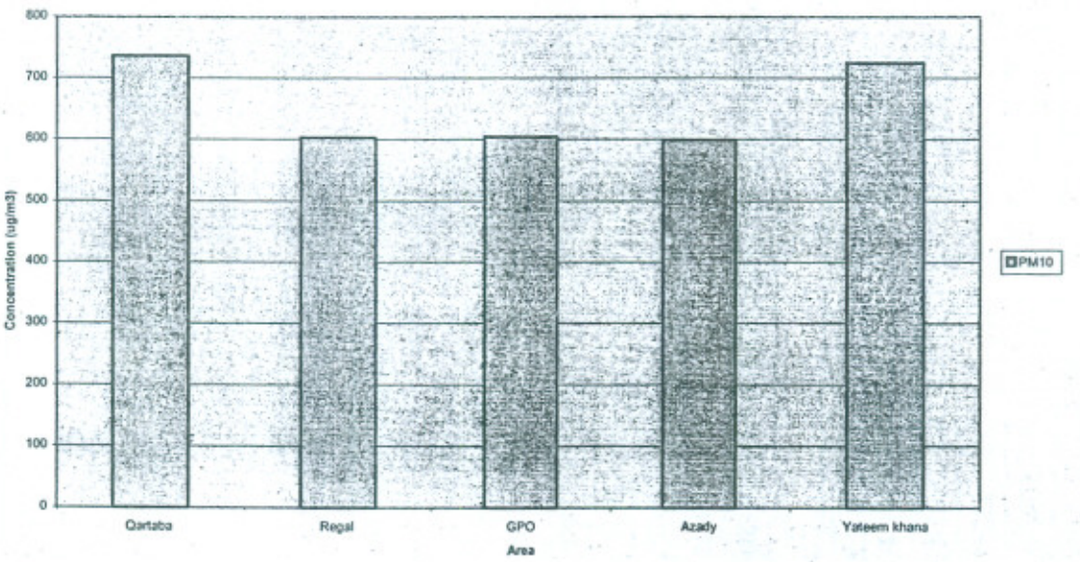
The total sites in Lahore were divided into five categories. The data obtained during the study period was averaged for each category and compared in Exhibit # 2. It was concluded that urban areas, where there are commercial markets along with busy roads, have high PM 10 (up to 628ug/m3) while the lowest PM 10 was measured in industrial areas. Suburban and urban areas have PM I0 in the order of 447 and 350 ug/m3 respectively, while the road crossings and roadsides had 494 ug/m3 during the study period. The trend is reflected below:

Exhibit # 2 State of air quality in Different areas in Lahore.



The average concentration of PM 10 during the study period was made with respect to busy road crossings and it is concluded that the Qartaba Chowk had an average of730 ug/m3 while Yateem Khan Chowk had 715 ug/m3. Regal, Azadi Chowk and GPO had about 600 ug/m3 concentration of PM I0. The facts are presented graphically in Exhibit # 3.

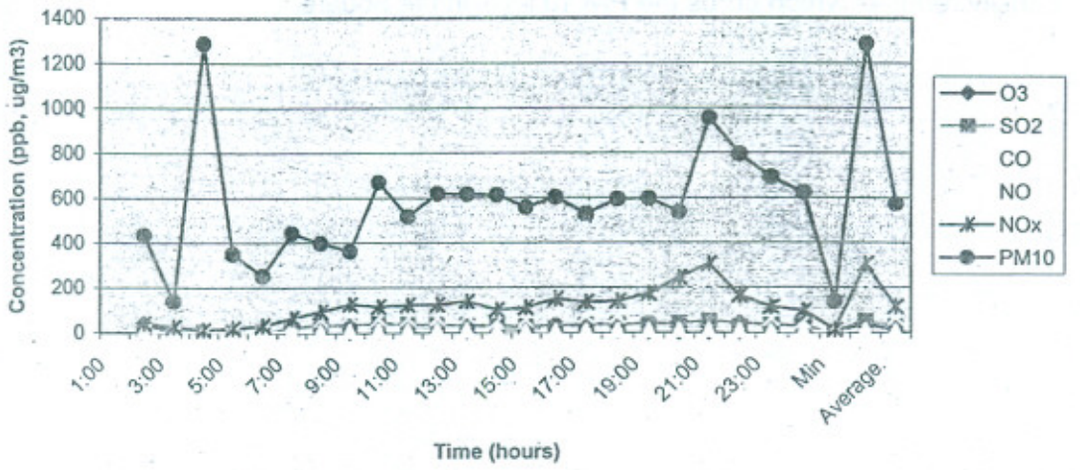
Exhibit # 3 Levels of PM10 at Different Road crossings of Lahore.



DAILY POLLUTION OF PM IO IN LAHORE

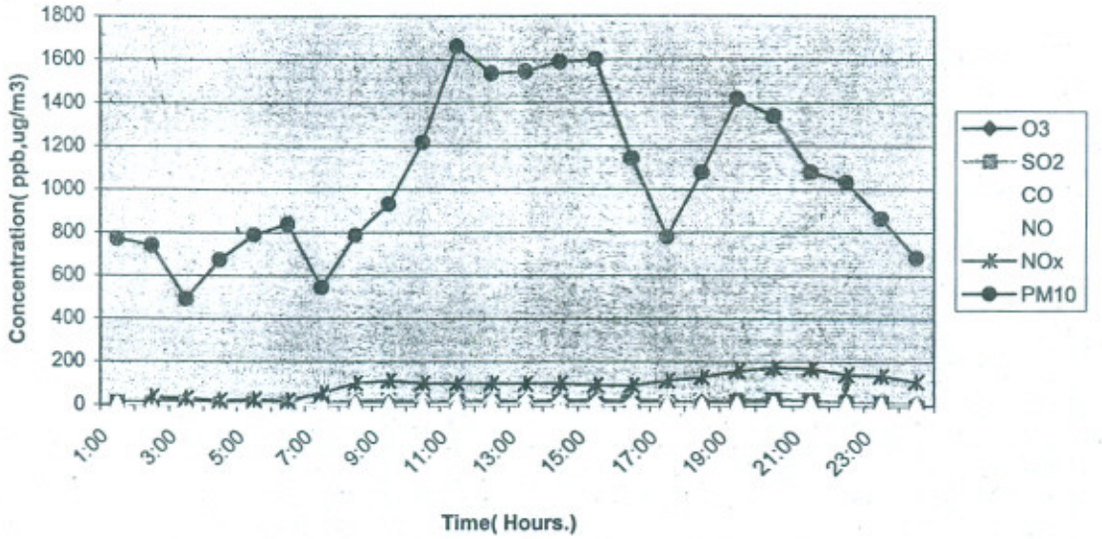
The data shows that there are two peaks of air pollution in the monitored sites. One peak is observed in the morning when people go to the offices and other at evening from 5.00 to 9.00 PM. At both times peak traffic rush hours are seen. Therefore, it is concluded that air pollution in the busy Chowk is solely due to high traffic flow. The graphical presentation of the results obtained at Faisal Chowk show the highest PMI0 from 9.00 to 11.00 PM. Mall road is a shopping market and people come there in the evening making the high traffic density which gives rise to high PM10 concentration.

Status Of Air Polluion at Faisal Chowk, Lahore.



Qartaba Chowk, which is the burriest intersection and links many side roads to the main Ferozepur Road, was monitored frequently during the study period. The PM10 concentration ranged from 413 ug/m3 to 1048 ug/m3. The average concentration during this period was found to be 843 ug/m3. The traffic density varies from 70-80 vehicles/min and begins to increase from 8.00 am to reach the peak level at 1.00 PM. The second highest spell of the vehicles comes out at the 2100 hrs. On 10-04-2000, the highest number of vehicles counted was 2097/hour. Average PM10 concentration was found five times more than the International Standards. The trend shows that there is a close relation of the Suspended Particulate matter and traffic flow in the busy crossings of Lahore. The heavy traffic volume passing through the crossing and high background dispersion level at night results in high level PM 10 around Mozang Chungi. The trend is exhibited more explicity in the graph below:

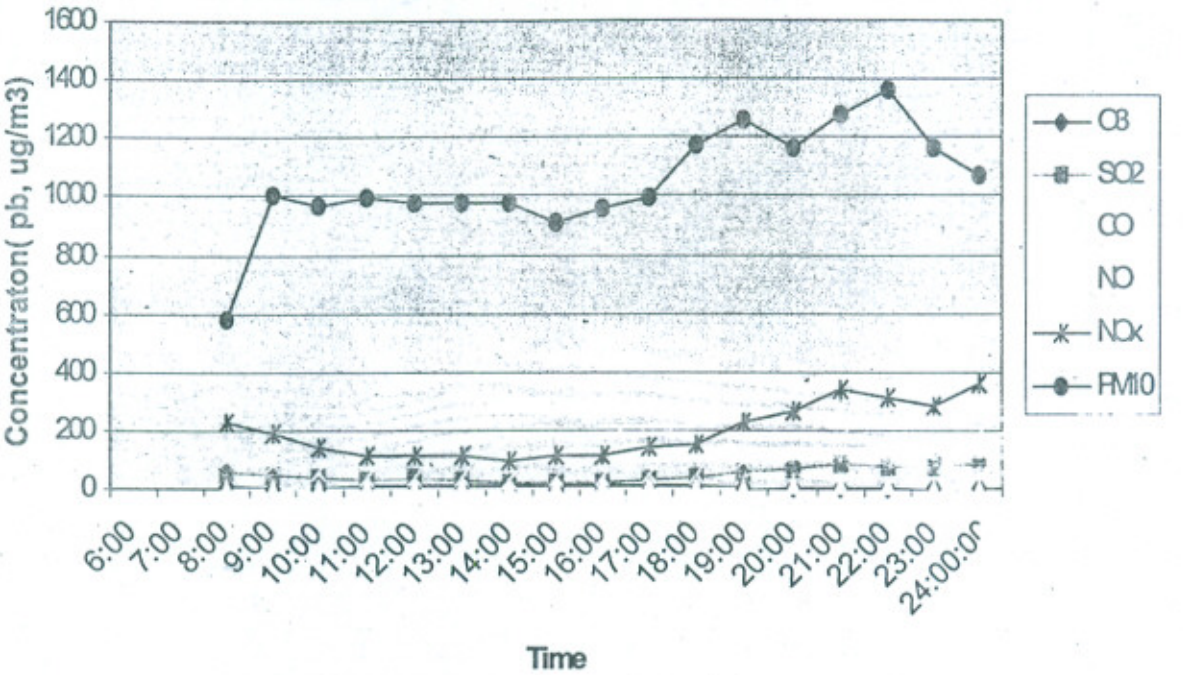
Exhibit# 5 Diurnal Variation Of Air Pollution At Qartaba Chowk.



Similarly, Yateem Khana Chowk, which is one of the busiest crossings, was monitored many times from September 1999 to March 2002. The concentration of particulates ranged from 509 ug/m3 to 1123ug/m3 during the study period. The minimum concentration of dust was measured on 03-02-2001 while maximum concentration was experienced on 05-04-2000. The average works out to be 713 ug/m3 for the study period. PM 10 concentration was found much higher than the USEPA standards for Ambient Air Quality. The traffic density varied from 40~50

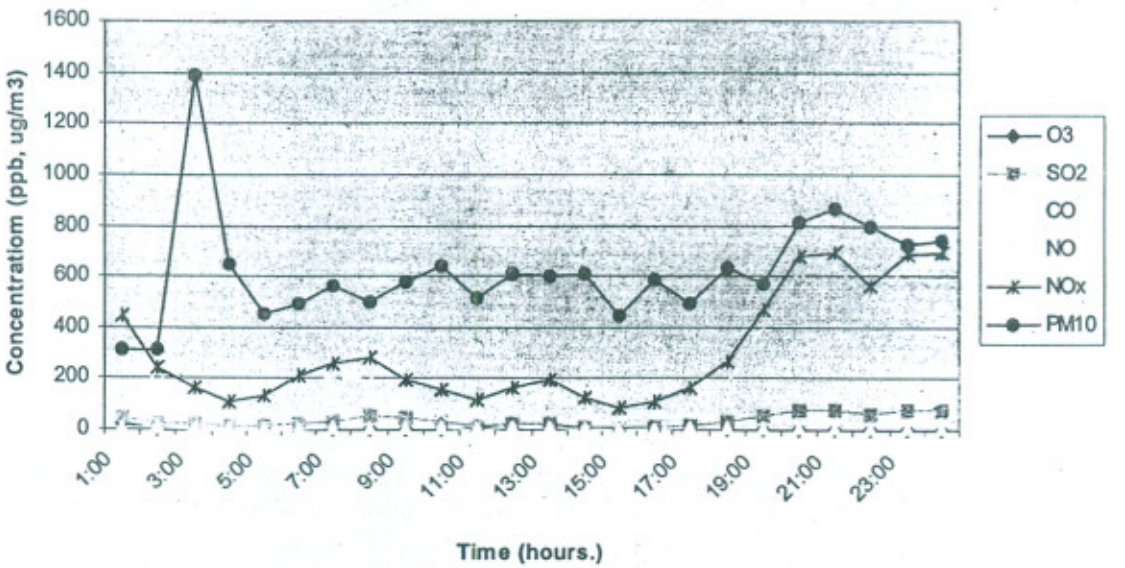
vehicles per min. The daily trend of PM10 distributions is almost same as that of Qartaba Chowk. The graphical display of the data reveals rise of PM 10 from 5.00 PM to 10 PM. After that, traffic density reduces which curbs the PM 10 level in the Square.

Air Pollutin At Yateem Khana Chowk on 05-04-00.

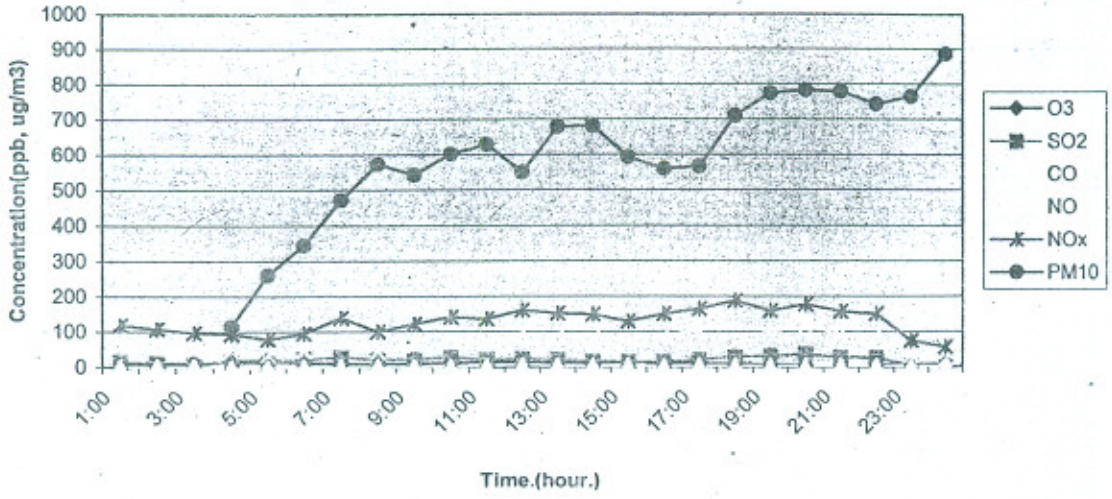


Almost same daily pattern of PM 10 distribution was observed at other busy chowks. The trend can be seen in the morning graph.

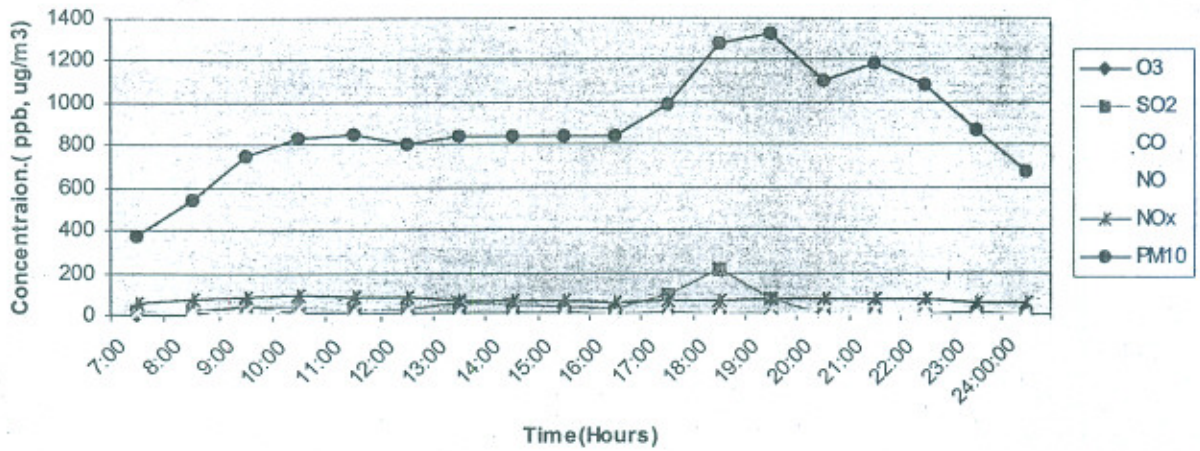
State of air Pollution at Canal crossing, Mall Road , Lahore.



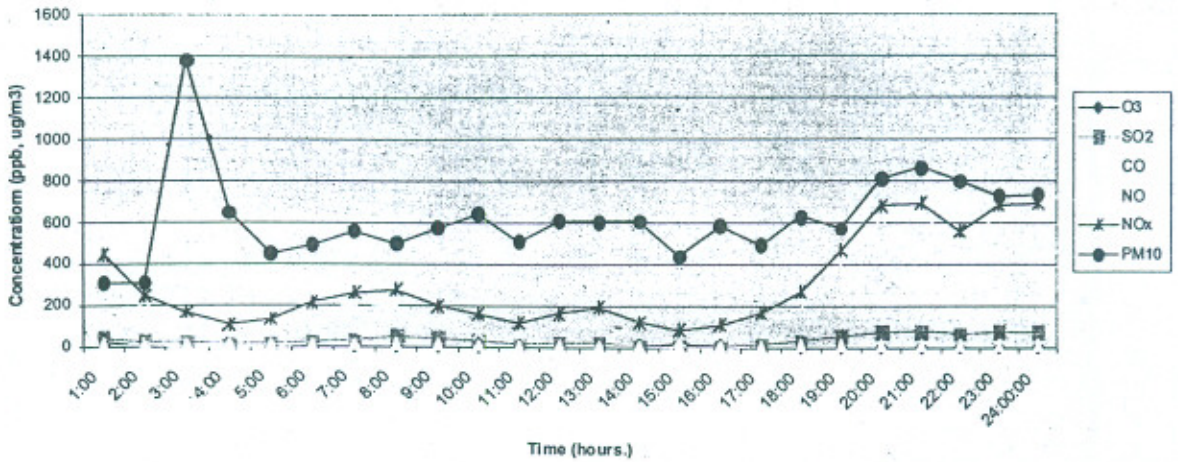
Trend of Air Pollution at Regal Chowk , Mall Road on 06-05-99.

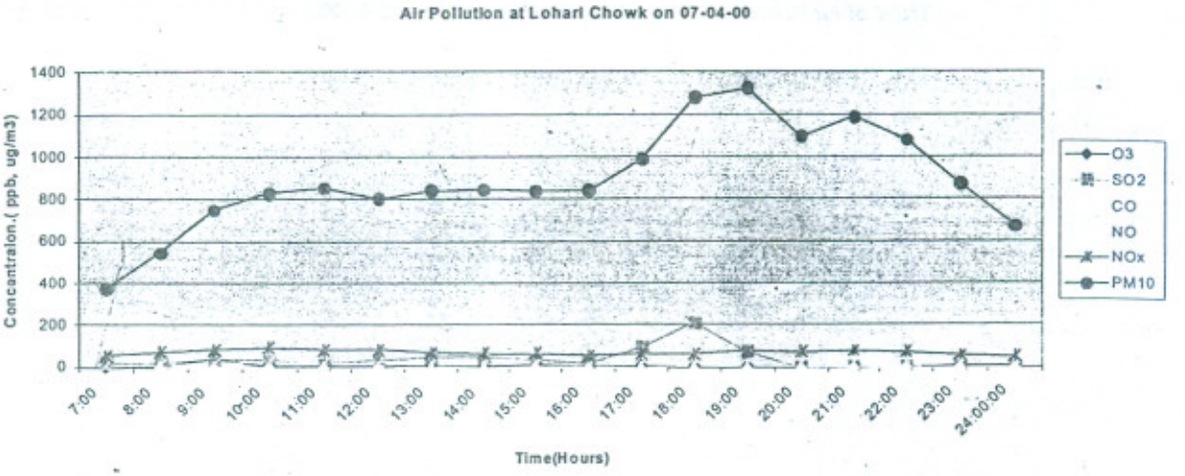


Air Pollution at Lohari Chowk on 07-04-00



State of air Pollution at Canal crossing, Mall Road , Lahore.

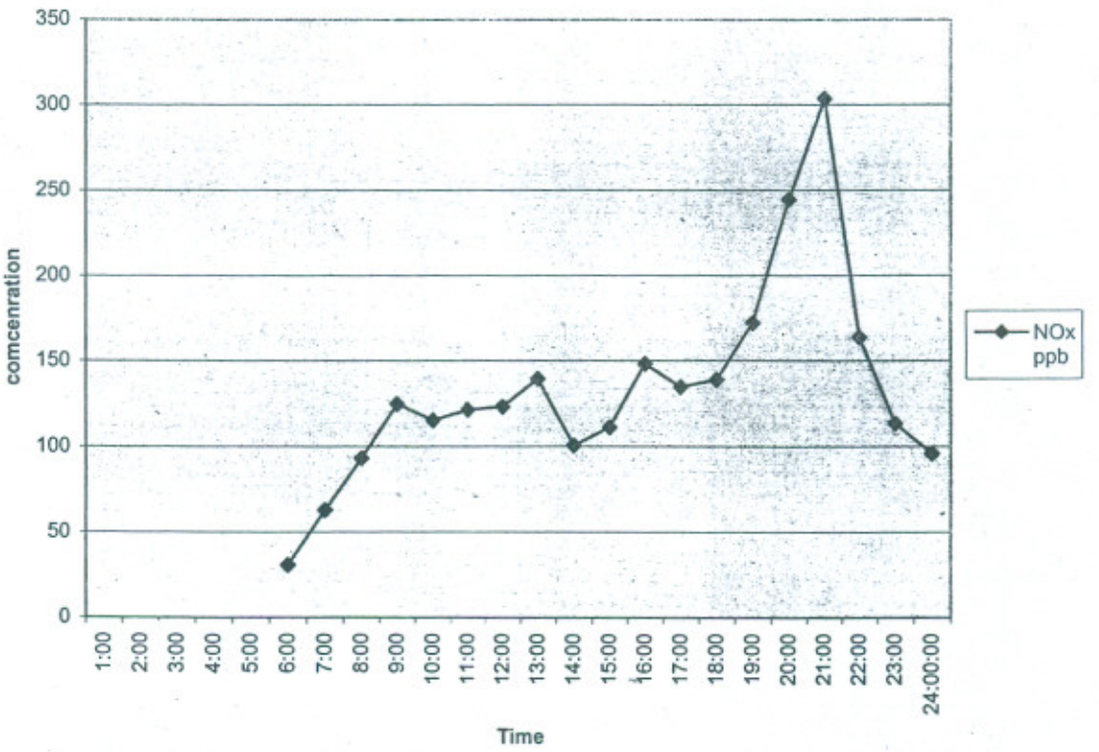




POLLUTION OF NITROGEN OXIDES (NO_x)

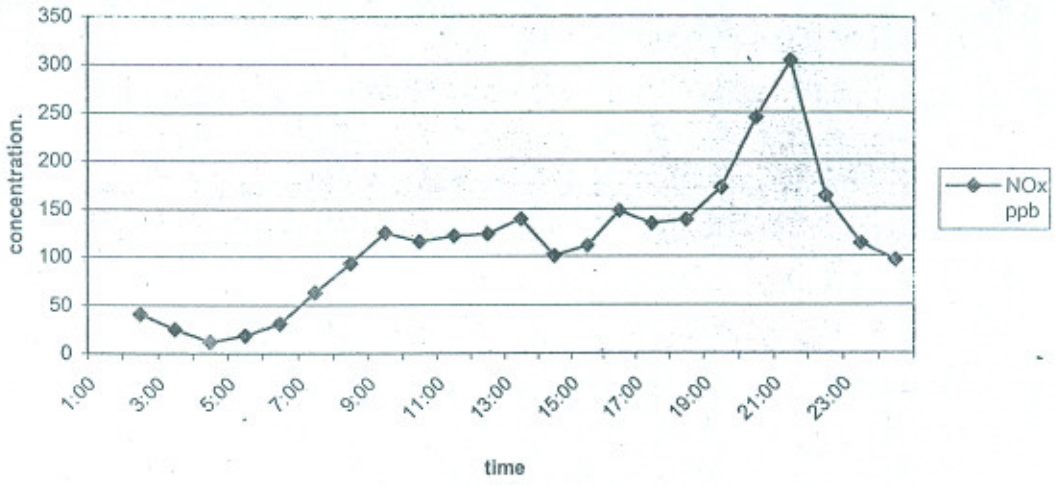
Oxides of nitrogen are generally emitted through exhausts of mobile and stationary sources which burn the fuel at high temperature. In this study the NO_2 exceeded the limit 107 ppb at Yateem Khana Chowk on 05.04.2000 with average value of 137 ppb, Qartaba Chowk on 16.11.2001 at concentration of 111 ppb. Again high NO_x was measured at Yateem Khana on 21..08.2001 with a value of 118 ppb. At Cheering Cross 150 ppb was measured on 18.01.2001 and 19.01.2001, while at rest of the places remained below the permissible limits of 107 ppb. However, NO_x goes up during the peak pollution hours from 5 to 10 pm. This is very injurious to health especially to pedestrians and motorcycle riders passing through busy chowks. The reason of high NO_x are vehicular exhaust in the city. It is apprehended that if NO_2 continues increasing at the observed rate standard of 107 ppb will be soon exceeded at all evenings.

Diurnal Behavior of NOx At Azady Chowk



The same trend can be seen at Faisal Chowk below :

Daily pattern of NOx At Faisal chowk, Lahore



High Noise level at busy roads

High noise was measured at busy chowks and commercial areas in Lahore. It generally remains 10-30% higher than 65 dB(A) (WHO guidelines) during the daytime.

High Hydro-Carbons

Non-Methane Hydrocarbons were found very high at most of the busy chowks / road crossings but only at peak hours which exceeded the limits of 0.24 ppm.

Air Pollution Control Strategy and Recommendations

1. Role of District Government

Cleanliness and maintenance of the Roads.

a. Cleanliness and sweeping of the roads in city be ensured.

b. The uncovered sides of the roads be paved or covered with greenery to reduce the fugitive dust.

Eggicient Solid waste management Practice

a. Effective solid waste collection, transportation and disposal system be implemented in the city.

b. The burning of solid waste, particularly polythene bags, be banned as it is a serious health hazard.

Road Engineering and Designing

To avoid the traffic jams at rush hours, improvement in road engineering is needed and traffic flow showed also be regulated must efficiently. Construction of under passes and flyovers may be encouraged, as' it will reduce the air pollution in the big cities like Lahore, Faisalabad and Gujranwala. This will help to decrease the PMIO, NO_x , HC and O_3 levels at the busy intersections avoiding slow speeds and traffic jams.

Checking The Fuel Adulteration

Adulteration in lubricating oil, diesel and gasoline has been identified as a root cause of excessive smoke and Particulate matter emission in passenger vehicles. Therefore, quality control of petroleum products should be ensured at gross root level. Quality fuel testing laboratories may be set up for this purpose.

2. Role of Environment Department

Implementation of the NEQS for vehicular emissions and noise.

The major source of PM 10 and NO_x in busy road intersections of the big cities is vehicular emission. Implementation of the NEQS' of vehicular emissions and noise at all types of vehicles will resolve the problems to great extent.

Studies by Environmental Protection Department of ambient air quality in Lahore indicates high concentrations of Hydrocarbons 'and NO_x at busy intersections during peak hours emitted by vehicles. These pollutants contribute towards formation of photochemical ozone, which has sharp deteriorating effects on materials and human health. There is a dire need to include NO_x and Hydrocarbons in National Environment Quality Standards for motor vehicle emission.

Checking the Fuel Adulteration

Fuel adulteration needs to may be checked. It will improve the emission of public transport in the city.

Establishment of Vehicle Testing Stations

Tune-up workshops equipped with emission testing instruments should be set, up in Lahore to ascertain fitness of the motor vehicle engines.

Campaign against Smoke Noise Emitting Vehicles

A persistent and result oriented campaign against smoke and noise emitting vehicles may be launched across the province.

Switching over to Compressed Natural Gas (CNG)

Vehicles both in Public and Private sectors be encouraged to switch over to CNG.

Permanent Monitoring Stations

On the basis of the study conducted by EPD, it is strongly recommended that stationary monitoring stations for PM 10, NO_x, O_3, CO and Poly Aromatic Hydrocarbons may be set-up covering important points in urban, industrial, residential and back ground areas in big cities to have clear picture of air quality.

The monitoring stations are useful tools to monitor the efficacy of implementation of the regulations, policies and programmes establish to reduce the air pollution in the city. This will provide feed back to judge the pros and cons of the regulations, also.

Industrial Pollution Control

1. The diesel generators installed in most of the industries are of not good quality. They have high NO_x and CO emissions. Hence the industrialists may be asked to install the generators having cleaner emissions.

2. Brick kilns use coal of low quality therefore they emit high SO2 and PM affecting the local environment arid ecology. There is a need to educate, monitor and take regulatory measures against brick kilns in Punjab.

3. Industrialists may be apprised of implications of WTO, rules and regulations which parallel in up him except to adopt environment friendly technologies and practices.

Rectification of Incinerators

The emission performance of the existing incinerators is not satisfactory therefore for oponents should be asked to adopt better technology for incineration.

Environmental Education

EPD also believes that legislation implementation is only possible through education cooperation and the public. Therefore, EPD has been concentrating on imparting environmental education and awareness through electronic and print media, publicity, seminars, workshops, speech contests and walks. Now this programme should be addressed to the masses on the scientific basis covering the political leadership, management of the country, industrialists and motor drivers.

Zoning

The industries may be established in industrial areas or zones developed for the purpose. Zoning policy for the country may be formulated for reducing the adverse effects of industrial pollution.

3. Role of Federal Government

Phasing Out Of Two Stroke Engines

Four stroke engines due to relatively complete combustion of fuel and non-mixing of fuel with lubricating oil are less smoke emitting than the two-stroke. Therefore, two stroke machines may be phased out with proper planning and policy. The Government may facilitate switching over to four-stroke engines.

Lead-Free Gasoline

Lead-free and low sulphur fuel will help to reduce the air pollution from mobile as well as stationary sources. Therefore, it should be encouraged through different market incentives. Federal Ministry of Petroleum may be approached for ensuring supply of lead free petrol and low sulphur content in diesel and furnace oil.

Change of Fuel

Fuel for industrial combustion may be changed from heavy fuel oil to light fuel or natural gas.

Formulation of Ambient Air Quality Standards

Ambient air quality standards may be formulated and notified. The ambient air quality is feed back of performance standards of industry and vehicles. There is close link between source standards and performance standards. Therefore, it is very crucial to have National Ambient air Quality Standards.

Formulation of Vehicular Emission Standards

The presently notified NEQS are relatively lax. Higher standards comparable to Euro-1 with progressively stringent targets need to be set.

DATA OF AMBIENT AIR QUALITY IN LAHORE. (2001-2002)

#	City	Area	Type	Date	Ozone ppb	SO_2 ppb	CO ppm	NO_2 ppb	NO_x ppb	PM10 ug/m3	Noise dB (A)	Humidity %	W. Speed m/sec	NMHC ppm
1	Lahore	Yateem Khana Chowk.	Commercial area-cum road intersection	03-02-2001	07	47	4	65	176	509	81	61	1.2	
2	Lahore	Yateem Khana Chowk.	Busy Chowk	21-08-2001	6.6	0.2	0.7	34	118	566	82	25	4.6	4.57
3	Lahore	Yateem Khana Chowk.	Road intersection cum commercial area	2-03-2001	7	47	4	64	176	509	81	39	1	
4	Lahore	Yateem Khana	-do-	21-08-01	7	14	4	111	176	509	82	57	1.1	4.5
WHO Guideline Value			Ug/3m	-	120	125		200		- -	-	-		
			Ppb	-				107		-	-	-		
			Mg/m3	-			10			-	-	-		
			Ppm	-			9			-	-	-		
			Averaging Time -	-							-	-		
Indian Ambient Air Quality Standards			Ug/m3	-	-	120-80	5-2 mg/m3		120-80	150-100	-	-		
			Averaging Time			24 hours.	8 hours.	-			-	-		

Note:

ppm	=	Parts per million	SO_2	=	Sulfur dioxide
Ug/m^3	=	Microgram	CO	=	Carbon |monoxide
dB	=	Decibel	No_2	=	Nitrogen dioxide
No_x	=	Oxide of Nitrogen	PM10	=	Particulate matter below 10 micron size.
NMHC	=	Non Methane Hydrocarbons.			

CONSERVATION OF CORAL REEF BIODIVERSITY

By

Muhammad Naeem Khan, Muhammad Yamin Janjua and Noor Khan*

Abstract :

South Asia has about 30% of the word reefs and is the centre of biodiversity for hard corals and most other animals and plants. The region is also experiencing rapid population increases and dynamic economic growth, concentrated mainly in coastal area has resulted in non-sustainable use and degradation of many coral reefs. Counting this as a demand from marine tourism for untouched reefs, which can generate long-term sustainable income if managed carefully. Increased sedimentation and population are major problems on mainland reefs. Unprecedented coral bleaching has seriously damaged almost all reefs in South Asia and in the world with losses of nearly 60-80% live coral cover. Such large scale damage, together with natural and human degradation, poses serious problems for coastal communities. There is an increase in environmental consciousness and attitudes towards its management in South Asia over the past few years.

Introduction :

Coral reefs are under water wave-resistant mounds that are virtual ecosystems all by themselves. They are made up of coral, algae, mollusks, bryozoans, brachiopods, echinoderms and sponges. Coral sands and solid limestone also play a large part in the buildup of coral reefs. Coral reefs grow upward by a rocklike accumulation of calcium containing endoskeletons of past generations of Coral animals.

In their ideal environment, Coral reefs will grow 1 to 100 cm per year. It has been found that reefs are very sensitive to changes in their environment. High rainfall and mainland runoff can kill reefs by increasing the amount of sedimentation in the water as well as decreasing the salinity of the water. Another danger to reefs is the absence of waves. In this environment, silt will accumulate and suffocate the coral. Corals reefs require shallow water, areas of strong wave action and 30-40 PPT salinity.

Tropical waters along western coasts of ocean basins (eastern coasts of continents) and around oceanic islands are the best to find coral reefs. They are usually only found within 30 degrees North or South of the equator and forming only where surface waters are never cooler than 20C (67 F).

South Asia occupies only 2.5% of the ocean surface but contains 30% of the world's coral reefs and links the Pacific and Indian oceans. The reefs stretch across longitudes 93E to 14 IN and straddle the equator from 21N to 11S. There are over 25,000 Islands, some are just like small dots. Most of South Asian coral reefs are off India, the Maldives, Sri Lanka and Chagos with very small areas with Bangladesh and Pakistan. Reefs along the rest of the coast are insisted by massive fresh water and sediment inputs from the Indus, Ganges and other rivers and by cold upwelling in the Northwest. This is also the reason why there are almost no reefs in Bangladesh and Pakistan. Sri Lanka has shallow fringing reefs and coral growth on sand stone and rocky reefs along about half of its coastline.

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Cold Water Corals.

Cold water corals lesser known than their warm-water cousins are much more widespread than previously thought but nevertheless face serious threat. Cold-water corals unlike the warm-water type in the tropics are usually found in depths between 200 to 1000 metres with between 4-13°C. Cold-water corals grow at only a tenth of the growth rate of warm water. Only six types of cold-water corals have been registered compared with more than 700 warm-water species.

IMPORTANCE.

Below the earth's surface lies an undersea treasure, a city full of fantastic shapes and structures. This colorful community is seldom seen by people because it is so hard to reach. This city in the sea is known as the coral reef. Corals makes their home in warm shallow water where sunlight can easily reach them, thus is found in tropical oceans all over the world. The largest coral reef is the Great Barrier Reef found over 1200 mile off the coast of Australia. This reef is so big that it can be seen from space.

Corals have been around for 500 million years. Growing inside the coral are tiny plants called zooxanthellae. These plants use the sunlight to make food. This food is passed on to the corals and it helps the coral to grow. Polyps live close together in colonies. They take calcium from the ocean to build a hard shell around themselves that they use for support and protection.

Humanity's ties to coral reefs extend far beyond their ecological importance. They provide support for local economies, protection to coastal communities, resources for medical cures and much more but these benefits will only persist as long as healthy coral reefs exist. Living coral reefs occupy only 0.7% of the ocean floor yet they provide homes and vital nursery grounds for 25% of all marine species on the planet.

As the largest industry in the world, tourism attracts millions of visitors, billions of dollars to local economies and sustains 10% of all jobs on earth. In 1992 tourism associated with coral reefs generated U.S. $ 1.9 Trillion, over 27 times that generated by the world's marine fisheries. Barrier coral reefs protect shorelines from erosion and destruction due to storm and wave damage, it is estimated that each square meter of reef protects U.S. $ 47,000 in property value. Without this protection entire islands and coastal communities would simply not exist. Like tropical rainforests, the diversity of coral reefs provides an incredible store house of beneficial medial, pharmaceuticals. Scientists have found an abundance of compounds to help fight leukemia, viruses, asthma, cancer and HIV.

BIODIVERSITY.

Coral reefs are ecosystems with well-defined structures that involve both photosynthetic algae and consumers. Living coral reefs occupy only 0.7% of the Ocean floor, yet, they provide home and vital nursery grounds for 25% of all marine species. The outer layer of a reef consists of living polyps of coral. The outer area behind a reef can shelter sea grass beds and mangrove forests. These mangroves serve as important nurseries for the young fish and shell fish. Within the coral animals live single-celled, round algae called zooxanthellae. Below and surrounding the polyps is a calcareous skeleton that contains filamentous green algae that make up most of the primary providers. Coral reefs are home to many of the world's most colorful fish species. Some 700 species of corals, thousands of plants and animals and thousands of tiny animals called coral polyps, responsible for building the largest biological structure on earth, the Great Barrier Reefs. Herbivorous fish, such as the colorful butterfly fish, as well as Sea Urchins, Sea cucumbers, brittle stars and numerous species of mollusks, feed on algae. Hiding in the numerous caves and crevices of a reef are predatory animals such as small crabs, wrasses,

moray and sharks. The numerous microhabitats and the productivity of the reefs support a great diversity of marine life.

STATUS OF CORAL REEFS IN PAKISTAN :

The coastal environment of Pakistan at present is not conducive to the healthy growth and formation of corals reefs (UNEP, 1986). The seabed on Makran coast with patches of corals in some areas is more suitable for coral growth than that of Sindh coast (Qureshi, 1961). Temperature, salinity, light, currents, siltation, sedimentation, earth quakes, sea level rise, hostile animals, over-growth of corals and pollution may be the effecting factors controlling the horizontal coral distribution.

Both living and fossilized corals have been discovered on Pakistan coast, living corals were seen by divers between the Cape Monze and Churna Island. The water temperature here does not drop below 20°C and water turbidity is much lower than anywhere along the Pakistan coast except in monsoons for a few weeks and is caused by the Water ingress from the Hub River. The corals are found in patch reefs on the rocky shoals of Churna waters.

There are three kinds of corals : Hump corals at 5-15 m, Leaf corals at 10-20 m and Star corals (Acropora) at 15 m. The fossilized corals of late Pleistocene are more flourishing. They are also found at the lowest terrace of Cape Monze and Churna Island. The reason for deterioration of present day corals of Churna waters may be the turbidity from floods of Hub River in monsoon. Now, after the construction of the Hub Dam it is foreseen that a reduction in the suspended sediment load will occur that will result in better growth of corals.

Living corals are reported in Sindh at the eastern part of Karachi in the Gulf of Katchch (Port Okha, Pirotan Island) by Srivastatara et al (1991). Makran as a subductive zone is of particular interest for elucidation of the means by which superficial sediments are deformed. Fossilized corals are extensively found on the Makran coast at Gwadar and Jiwani headland area of the same late Pleistocene. This distraction between Sindh and Makran coasts results from difference in natural environment that the corals in these two areas encounter. No living reefs were located in this area, however, about 100 km west of Pakistan border at Chah Bahar living reefs are described by Sheppard and Wells (1988).

THREATS TO CORAL REEFS AND ASSOCIATED ECOSYSTEMS.

Coral reefs are rapidly being destroyed worldwide. Scientists estimate that 25% of the world's coral reefs are already dead. If current trend continues we may face the loss of this precious resource entirely within the next 30-50 years. Environmental stress and humans cause the most significant problems affecting the coral reefs.

The threats to coral reefs and their associated ecosystems vary widely between countries, but fall in to the following four main groupings.

Resource Extraction Related Activities :

It includes over-exploitation of living resources, destructive exploitation of living resources, including blast fishing and coral and sand mining for construction.

Poorly Controlled Development :

Poor land use practices leading to erosion and sedimentation, dredging and filling operations and tourism-related activities.

Pollution Related Activities :

Pollution from land-based activities and from maritime transport.

Natural Disasters :

Topical storms, coral bleaching, global warming.

The cause for these problems are poverty and the lack of sustainable income-generating opportunities. Inadequate planning, lack of institutional will or capacity to implement policies and regulations and civil disturbances, which resulted in the displacement of many people to the coastal areas have aggravated the coral reef management problems. In many parts of the world the health of coral reefs have been declining over the past several decades. Pollution and destructive fishing practices damage the delicate corals. Nutrient run off from agricultural areas causes large algae blooms that smother coral. Scientists are also finding heavy damage to the coral Reefs from more than a dozen different diseases.

Coral reefs have also been affected by bleaching discoloration or loss of symbiotic zooxanthellae. The most extensive bleaching episode over documented occurred in 1998 and affected reefs in the Indian Ocean, Pacific Ocean, Red Sea, Persian Gulf and Caribbean Sea. In some areas 100 percent of the corals were bleached and more than 70 percent of the corals died. Pollution, global warming and ultraviolet radiation have been suggested as suspects cause, recent research indicates that the cause may be unusually warm waters. The optimum temperatures for coral growth is between 26°C – 27°C. Temperature above 29°C have been shown to cause stress in corals and may boost the rate of photosynthesis by the symbiotic Zooxanthellae, creating high concentration of free radical toxins in the coral tissues. These stressed coral polyps may actively expel zooxanthellae ; causing the coral to appear bleached/ Bleached corals have difficulty in recovering. A reef can take several years to recover and subsequent bleaching incidents may make it impossible. Not only corals but all that reef organisms could potentially lose their habitat because of bleaching incidents as the calcium carbonate structure of the reef erodes away.

Reefs are probably all linked closely by ocean currents that carry larval migratory species nutrients and pollutants across national and international boundaries. Destruction of the source of larvae on one reef may impoverish others down current therefore, an understanding of source link relationship is essential for long-term reef management. (Marine Protected Areas MPAs) are more likely to be located for the tourism industry than to conserve reef larval resources. Successful management also requires information on reef status, human usage and threats. Above all there is a fundamental need for community involvement in reef management and the incorporation of traditional management systems, user rights and socially acceptable alternatives to reef fisheries.

HOW TO PROTECT CORAL REEFS :

Following steps are recommended for protection and conservation of coral reefs and associated biodiversity.

Improvement in land use to reduce sedimentation.

Appropriate agricultural practices e.g. terracing, reforestation.

Reduce the discharge of polluting nitrogen and phosphorus.

Better waste water management.

Reduce solid waste and industrial pollution.

Promotion of environmental education on marine and coasted issues.

Limiting the effectiveness of fishing gear.

Protection of mangroves and coastal wetlands.

Better planning and control of coastal construction.

Dredging and land filling should be curtailed near coastal areas.

Capacity by building (professional and technical) integrated coastal management.

Involvement of all stake holders in planning and management.

Modernize and harmonize environmental legislation.

Work to reduce direct human impacts on coral reefs and.

Promoting sustaining fishing.

The more we know about coral the better we will be able to protect them for years to come.

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ARSENIC IN DRINKING WATER

By

Mian Iftikhar Ahmad*

Abstract

One of today's hottest, and often controversial, topics in worldwide water regulations is arsenic in drinking water. Arsenic is a naturally occurring chemical found in rocks, soil, water, air, plants and animals that can be released into the environment through geological events, such as volcanic activity and erosion. Some industrial processes, such as mining, smelting and the production of paints, metals, soaps, dyes, drugs, semiconductors and wood preservatives, may also release arsenic into the environment.

Arsenic can be dangerous to humans. International studies have linked long-term exposure to arsenic contamination with cardiovascular, pulmonary, immunological, neurological and endocrine effects and to cancer of the bladder, lungs, skin, kidney, nasal passage, liver and prostate, according to the WHO and USEPA.

What is Arsenic ?

Arsenic is widely distributed throughout the Earth's crust, most often as arsenic sulfide or as metal arsenates and arsenides. Arsenicals are used commercially and industrially, primarily as alloying agents in the manufacture of transistors, lasers and semiconductors.

There are two different forms of Arsenic – arsenite (arsenic III) and arsenate (arsenic V). Arsenic V is the most common form and is easier to remove from drinking water.

How does arsenic get into the water supply ?

Arsenic is introduced into drinking-water sources primarily through the dissolution from naturally occurring minerals and ores. It is widely thought that naturally occurring arsenic dissolves out of certain rock formations when ground water levels drop significantly. Surface arsenic-related pollutants enter the ground water system by gradually moving with the flow of ground water from rains, melting of snow, etc. Some industrial processes, such as mining, smelting and the production of paints, metals, soaps, dyes, drugs, semi-conductors and wood preservatives, may also release arsenic into the environment.

Where is arsenic contaminated water found?

There are a number of regions where arsenic may be present in drinking-water sources, particularly groundwater, at elevated concentrations.

In Punjab, Pakistan, high content of Arsenic (10-50 ppb) has been found in the Districts of Rahim Yar khan, Bahawalpur, Multan, Muzaffargarh, Layyah, Jhang, Sargodha, Jhelum and Gujrat (Unicef-2004). Rahim Yar khan, Bahawalpur and Multan are worst affected. Arsenic exposure contact is more than 50 ppb in some sporadic locations in Sargodha, Jhelum and Gujrat as well.

Arsenic contaminated drinking water is potentially poisoning 200 million people in India and Bangladesh, causing an international health crisis. Bangladesh alone, for example, estimates between 35 to 77 million of its 125 million citizens are at risk of drinking contaminated water. The origin of this crisis occurred in the 1970's when tube wells were installed to provide

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biologically safe groundwater as a means of preventing mortality from gastrointestinal disease caused by consuming contaminated surface water. Argentina and Japan also have high levels of arsenic in their water supplies. Concentrations are often highly dependent on the depth to which the well is sunk.

How does arsenic contaminated water affect human health ?

Inorganic arsenic is extremely toxic. Produced naturally and as a byproduct of industrial production, it can cause both acute and long-term health effects. One of the problems with arsenic exposure is that many of the symptoms may result from causes other than arsenic-so a person who has been exposed may not suspect arsenic. Acute arsenic poisoning may cause nausea, vomiting, diarrhea, loss of appetite, shaking, cough and headache. Chronic exposure may lead to a variety of symptoms including skin pigmentation, numbness, cardiovascular disease, diabetes, and vascular disease. Arsenic is also known to cause a variety of cancers including skin cancer (non-melanoma type), kidney, bladder, lungs, prostate and liver cancer.

While the effects of arsenic can be reversed at an early stage, long-term exposure can lead to death. Studies have shown that 1 in 10 people exposed to arsenic levels above 500 ppb may ultimately die from cancers caused by arsenic *(A. Smith, World Health Organization, 2000).*

Except for individuals who are occupationally exposed to arsenic, the most important route of exposure is through the oral intake of water, food and beverages.

Arsenic in the drinking-water is a significant cause of health effects in some areas, and arsenic considered to be a high-priority substance for screening in drinking-water sources.

Removal of Arsenic.

The arsenic removal system employs a simple process of ion exchange in which contaminated water flows under gravity or pressure through a fixed bed vessel containing the granular ferric oxide media. As the contaminated water passes through the media, arsenic is adsorbed and removed to a level below the drinking water standard of 10 ppb. Since the media have a high capacity for arsenic, it achieves long run times ranging from six months to two years before the media becomes exhausted. Exhausted media can be removed and sent to a non-hazardous landfill for disposal.

Usually some systems design and operation does not require cleaning, regeneration or any other complex process. Other systems may require regeneration of the media.

Features.

Removes As (III) and As (V) to < 4 ppb.
Media life is 6 months to 2 years.
Very low residual effluents : < 0.1% of water treated.
Low maintenance : no moving parts.
Small footprint.
Dry media.

Advantages.

Low capital and operating costs.
Simple process control : unattended operation.
Easy disposal of spent "fixed" media : no hazardous waste generated.
It is a simple treatment plant and can be manufactured locally.

What are the regulatory guidelines of arsenic ?

In WHO draft guidelines for drinking water quality, 3rd edition (2003), the maximum permissible limit of Arsenic is 0.01 mg liter or 10 ppb. In the United States of America, public water systems will have until 2006 to meet compliance with the standard of 10 ppb.

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TREATING SURFACE WATERS FOR COMMUNITIES IN DEVELOPING COUNTRIES

By

Prof. Abdul Jabbar Bari*

INTRODUCTION

Water treatment plant in developing countries should use simplified technologies that require little automation or mechanization to lower capital costs significantly. Operation and maintenance should also be less costly and more suitable for local labour conditions. In water treatment plant design, there must be a conscious effort to minimize equipment, to maximize the use of gravity and hydraulics in the treatment process and to make use of labour rather than equipment in the operation of the plant where possible.

It may be desirable to treat water for a number of reasons including the removal of pathogenic organisms, unpleasant tastes or odors, excessive color, turbidity, certain dissolved minerals, and a variety of unpleasant or potentially harmful chemical species. The product of water treatment. may be suitable for general domestic and industrial purposes or may be produced to higher standards, such as those required for high or intermediate pressure boilers, manufacture of food and beverages, and other specialized industrial purposes.

A number of treatment methods have been developed to produce water of the requisite quality Storage and plain sedimentation alone have occasionally been used, but would not be incorporated in modern treatment works since more rapid sedimentation as well as removal of colloidal particles is obtained with chemical coagulation followed by filtration. Aeration, chemical oxidizing agents, and adsorbents, will reduce or remove tastes and odors. Softening (the removal of divalent cations - generally calcium and magnesium), oxidation and precipitation of iron and manganese, stabilization to prevent corrosion or deposition in distribution systems, and disinfection are all common treatment methods. More sophisticated techniques such as ion exchange, reverse osmosis electrodialysis, and distillation are applied in those communities and industries in which the state of the raw water or the quality of the finished product require them.

The character and degree of treatment will depend upon the nature of the water and this depends largely upon its source. Surface water are likely to be bacteriological contaminated and more or less turbid. They will thus generally require coagulation, sedimentation, filtration, and disinfection. Groundwaters are usually clear and therefore may not require filtration if no chemical precipitates are formed by other processes. Filtration is desirable, however, following lime softening or iron and manganese removal – both of which may be necessary to produce a high quality supply from a groundwater source. Softening is also provided for many surface supplies. Taste and odor problems may occur in both surface and groundwaters, in the former as a result of organic contamination, in the later as a result of high metallic content or dissolved hydrogen sulfide.

1. Water Sources

Many types of water sources and treatment processes can be used in developing countries. Groundwater is the preferred source for community water supplies since it generally does not require treatment. When not available naturally, groundwater can be obtained by artificial recharge.

If no suitable aquifers are available, relatively clear waters from lakes or streams are the best and should be treated by slow sand filtration. If river waters are heavily silted, pretreatment

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prior to slow sand filtration may be provided, by plain sedimentation or horizontal-roughing filters. Only as a last resort should chemical coagulation and rapid filtration be adopted. Even then, only simple, practical technologies such as hydraulic rapid mixing and flocculation, horizontal-flow sedimentation, and manually operated filters should be used.

2. Design Guides for Treating Surface Waters

Practical design guides reflect the social, economic. and technical conditions prevailing in developing countries:

- Mechanical equipment should be limited as much as possible to that produced locally.
- Hydraulic devices that use gravity for mixing. flocculation, and rate control are preferred over motor-driven equipment.
- Head loss should be conserved where possible.
- Mechanization and automation are appropriate only where operations are not readily done manually or where they would greatly improve reliability.
- Indigenous materials should be used to reduce costs to bolster the local economy, and to expand industrial development.

Water Treatment Methods

Surface waters are high in turbidity less in dissolved solids and likely to be contaminated bacteriologically. They will thus generally require Aeration, Coagulation flocculation, sedimentation, filtration and disinfection. These methods are briefly described here.

3. Aeration

The primary purpose of aeration is to provide oxygen from the atmosphere for the oxidation of iron and manganese and to liberate hydrogen sulfide and carbon dioxide from water, hence it serves as one aspect of corrosion prevention. When iron and manganese are excessive in water. These are oxidized by aeration and are converted into insoluble form. The precipitate of iron and manganese is removed from water in sedimentation and filtration units.

Type of Aerators

Aeration practice has led to the development of the following types of the aerators.

i) Water fall aerators.
ii) Cascade aerators.
iii) Diffused air aerators.

4. Coagulation and Flocculation

Coagulation is the chemical technique directed towards destabilization of colloidal particles. The settling velocities of the fine and colloidal clay are so small that removal them in a settling tank is impossible under ordinary conditions without very long detention periods. So it is necessary to coagulate the very small particles into larger ones with higher settling velocities. It is done by adding certain chemicals to the water. These chemicals are known as coagulants. The most common coagulants are aluminum sulphate and ferrous sulphate, orther coagulants are Ferric chloride Ferric sulphate, sodium aluminate, synthetic organic polyelectrolytes.

Flocculation

It is a slow mixing technique which promotes the agglomeration of the destabilized particles. In flocculation tanks collisions are produced between particles. Generally these contacts occur by fluid motion. Difference in velocity occur from point to point in all flowing or stirred water. Because of these velocity gradients, particles suspended in water also have different velocities and hence come into contact. The rate of flocculation is dependent upon the number of particles present, the relative volume which they occupy, and the velocity Gradient (G) in the basin. Practical design factors include the use of detention time of 20 to 30 minutes and' value of G between 25 to 65 sec^{-1}. The most commonly used flocculation techniques are Baffled flocculation and Mechanical flocculation, shown in Fig. 2.1 and 2.2.

Process Description

A coagulation process has two separate and distinct components or steps. In the first step, the particles in the water must be treated chemically to make them sticky or unstable. This involves the addition of one or more chemicals in rapid mix tanks. When coagulants dissolves positive Aluminium or Ferric ions become available to neutralize the negative charges on the particles of turbidity. Rapid mixing occurs for short times normally 1 minute or less. Destabilization is fast and is completed after rapid mix.

In second stage, destabilized particles must be brought into contact with each orther so that agglomeration can occur. This is done by gentle mixing of the water in flocculation tanks. The gentle mixing is usually done mechanically, although hydraulic mixing is some times employed using baffled tanks. Detention time 20 to 30 minutes is typical.

The rapid mixing and flocculation tanks together bring about aggregation and comprise the coagulation process. No material is removed from water in these tanks. Solids are removed in subsequent settling and filtration facilities. If either one of these steps is not properly designed, the coagulation process will not function and agglomeration will not occur.

5. SEDIMENTATION

It is the removal of suspended solids from water by gravity. If the specific gravity of suspended particles is more than one, it will settle with a certain velocity, therefore, if water is allowed to remain in a basin for a certain time, the suspended particles will settle down. The purpose of sedimentation is to remove the settable floc, which are formed in flocculation basin and to reduce the concentration of suspended solids.

The factors that influence sedimentation are: (a) size, shape and weight of the floc; (b) viscosity and hence temperature of the water; (c) effective average period available for sedimentation; (d) effective depth of the basins; (c) their areas; (f) surface overflow rate; (g) velocity of flow; and (h) inlet and outlet design.

5.1 Sedimentation Tank Details

Sedimentation tanks may be rectangular, circular, or square. Rectangular basins employ a horizontal flow pattern with the flow along the long axis. Such a flow pattern minimizes the effect of inlet and outlet disturbance. Sludge removal equipment in such basins consists of horizontal scrapers which drag the solids to a hopper at one end from which they are removed intermittently or continuously by gravity, auguring or buckers. Typical designs are shown in Fig. 3.1.

In circular basins the flow may enter either at the periphery or at the center. Recent studies have demonstrated that the average detention time is greater in peripheral feed basins. Cleaning equipment in circular basins usually consists of scraper blades mounted on radial arms.

These windrow the sludge into a spiral which is gradually pushed to a central hopper from which it is removed by gravity as shown in Fig. 3.2.

Square basins may be used in situation in which land area is limited. The equipment installed in such basins is generally similar to that in circular designs.

Careful design of inlets and outlets is important to assure reasonable performance of sedimentation tanks. The ideal inlet reduces the entrance velocity to prevent pronounced currents toward the outlet, distributes the water as uniformly as possible across the width and depth of the tank, and mixes it with the water already in the tank to prevent density currents. Fig. 3.3 shows some of the inlets used.

Outlets frequently consist of free-falling weirs discharging into effluent launders like those of Fig. 3.4 Weir loading rates are limited to prevent high approach velocities near the outlet, Loading rates are generally specified in volume/unit length per day, which permits the

ready calculation of the total weir length required. Outlets are placed as far from the inlet as possible at the end of rectangular, at the periphery of center fed, and toward the center and along the radii of peripherally fed tanks. The weirs may cover a significant portion of area of the basin. The length calculated from the weir overflow rate is the total weir length, not the length over which flow occurs. Weirs frequently consist of V-notches approximately 50 mm (2 in.) in depth placed 300 mm (12" in.) on centers.

5.2 Design Criteria

The design criteria for sedimentation basin consists of specification of the surface overflow rate and the detention time or depth. The values used are dependent upon the type of basin used and characteristics of the liquid being treated.

Typical design values for standard basin following the coagulation and flocculation are presented below.

Detention period	:	2 – 8 hours.
Weir over flow rate	:	250 m^3/m/day
Surface Over flow Rate	:	20 – 30 m/day
Depth	:	2 – 6 m
Horizontal Velocity	:	Not greater than 0.3 m/sec.
Weir length	:	Should not be more than 20% to 30% of the basin length on each side.
Sludge storage volume	:	25% of the volume available for settling.
Width	:	Not less than L/4 and not greater than 12 m.

6. FILTRATION

Filtration is the removal of suspended particles by passing the water through some granular material. The most commonly used material is sand. At water treatment plants slow sand and rapid sand filters are used.

6.1 Slow Sand Filter

Slow sand filters are characterized by a slower rate of filtration where bacteriological action aids in improving treatment efficiency and where backwashing of the filter is not required, the sand is cleaned by scraping off the surface layer periodically. The range of filtration for slow sand filter is 0.1 – 0.2 m^3/m^2 hr.

6.1.1 Advantages

The advantages of slow sand filters may be summarized as follows:

a) There is no need for coagulation facilities.
b) Equipment is simple and need not be imported.
c) Suitable sand is readily secured.
d) Supervision is simple.
e) The effluent is less corrosive and more uniform in quality than chemically treated waters.
f) They give effective bacterial removal.

6.1.2 Disadvantages

The disadvantages as compared with rapid sand filters are as follows:

a) A large area is required, with correspondingly large structure and volume of sand and higher structural costs.
b) They have less flexibility in operation.
c) They ate not economical with raw waters having turbidities of over about 30 units for prolonged periods, unless preliminary plain sedimentation will secure such turbidities in the settled water.
d) They are less effective in removing colour.
e) They give poor results with water of high algal content, unless pretreatment is practiced.

In general, the advantages of these filters justify their use for small plants not under technical supervision, where relatively clear surface waters are to be treated.

6.2 A Simple Solution to the Problem of Clogging in a Slow Sand Filter

When the raw water contains high amounts of turbidity for long periods, pre-filters (coconut fiber, pea gravel, crushed stone) can be used to remove most of the turbidity, before the water passes through a slow sand filter for, polishing and removal of the remaining impurities. When the average turbidity of raw water exceeds 20 NTU, some form of pre-treatment is indispensable for the smooth operation of a slow sand filter.

The simplest and most appropriate pre-treatment systems are as follows:

- River bed filtration (or infiltration galleries).
- Storage in storage basins.
- Plain sedimentation.
- Rapid roughing filtration (coconut fiber filters).
- Horizontal flow coarse media filtration.

A short description of each of these methods is given below, in order to allow the designer to make a better decision in selecting the pre-treatment method. These are shown in Fig. 4.1.

Infiltration Galleries

The purification principle is based on the removal of suspended matter in a bed of granular filter material situated in the river bed. The filter bed should be built up from various layers of gravel and coarse sand. In this kind of filter, rates of up to 10 m/h may be applied. The success of this method depends entirely upon the availability of construction equipment and on the degree of clogging of the filter bed.

Storage

In addition to the removal of suspended solids and pathogens from raw waters, a storage basin may improve the reliability of the water supply during periods of drought.

A storage basin may be constructed by erecting a simple earth dam (barrage) to a height of about 6 meters. The detention time will be in the order of several weeks to a few months. Small storage reservoirs may be lined with stabilized soil, ferrocement, concrete, or masonry to decrease seepage.

Plain Sedimentation

Although the detention time is shorter (maximum 2 days), a plain sedimentation tank serves the same purpose as a storage reservoir. It reduces turbidity and removes suspended matter.

A sedimentation tank may have a batchwise or a continuous operation. The most common configuration of a continuously operated basin is a rectangular box made of concrete or masonry, or a dug basin with protected sloping walls.

Rapid Roughing Filtration

Rapid 'roughing' filtration can be carried out in a filter box, with coconut fiber functioning as the filter medium. Experiments at AIT (Asian Institute of Technology. Bangkok) show that the coconut fiber filters exhibit a considerable capacity to absorb turbidity "shock loading" and produce an effluent satisfactory for subsequent slow sand filtration.

Other filter materials, such as coarse gravel, can also be used for roughing filtration.

Horizontal Flow Coarse Media Pre-filtration

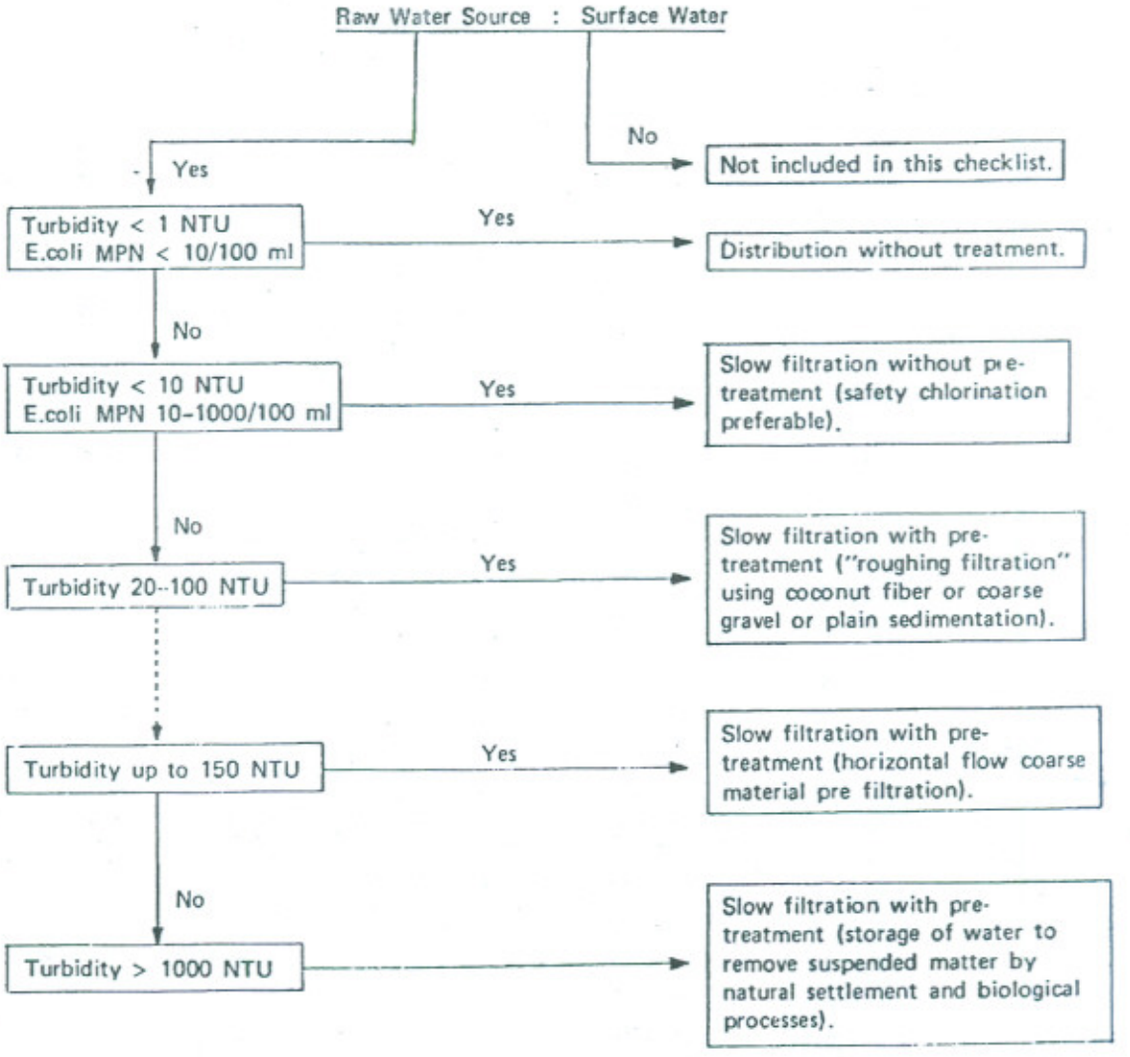
Extensive research at AIT has revealed that this system of filtration offers many advantages to rural tropical communities, as construction costs are low and maintenance is minimal, the higher tropical temperatures favor biological activity within the filter. Pilot plant studies have revealed that a properly designed pre-filtration unit is capable of removing 60 - 70% of the suspended solids and 80% of the coliform organisms in raw water.

Filtration by this method enables large quantities bf water to be filtered with only a small area of exposed water surface, thus the risk of mosquitoes breeding or snail infection is reduced to a minimum.

6.2.1 Selection of a Pre-treatment Method

On the basis of two important parameters, turbidity and E. coli content, the guide presented in Table 1 gives a procedure for the selection of a pre-treatment method to supplement the slow sand filtration process.

Table 1 A Checklist for the Selection of a Pre-Treatment Method



6.3 Design Criteria of a Slow Sand Filter

Basic design criteria of a slow sand filter concern the quantity of water to be treated, the size and number of filter units, and the various components of the filter. The size and number of the filter units are determined according to the design flow rate of the filter. The typical range for filtration rate is 0.1 – 0.2 m^2/m^2 h.

Design criteria for slow sand filtration is summarized in the following table.

Parameter	Range	Optimum Value
Filtration velocity (m/h)	0.1 – 0.2	0.1
Depth of filter bed (m)	1.0 – 1.4	1.0
Area per filter bed (m^2)	10 – 100	-
Height of supernatant water (m)	1.0 – 1.5	1.0
Depth of system of underdrains (m)	0.3 – 0.5	0.4
Specifications of filter bed	UC = 2 – 5 e=0.15 – 0.35 mm	
Number of filters	Minimum of 2	

Where; UC = Uniformity coefficient.
e = Effective size.

Parts of Slow Sand Filter

The main parts of a slow sand filter are shown in Fig. 4.2.

- Supernatant water reservoir.
- Filter bed.
- Underdrainage system.
- Filter controls.

A set of filter regulation and control devices should be available for proper Operation and Maintenance of slow sand filter Fig. 4.2.

- Valve A on the influent pipe regulates the supply of raw water into supernatant water reservoir.
- Over flow weir B is to remove surplus-water, scum and floating matters from the supernatant water.
- Valve C is to drain off the supernatant water prior to filter cleaning.
- Valve D is to drain off water to lower the water level within the bed.
- E is a calibrated flow rate measurement device to measure the effluent flow rate.
- Valve f regulates the filtration rate.
- Valve G is to back fill the filter after cleaning.
- Weir H is to ensure that negative pressure does not occur within the filter.
- Valves I and J are to convey the treated water to clear water tank or to the required area.
- Filters should be covered to minimize growth of algae.

7.0 DISINFECTION

It is the killing of disease causing microorganisms. While using the disinfectant it is important that the disinfectant be safe to handle and apply and its strength or concentration in treated waters be measurable. The following factors influence the disinfection of water.

1. The nature and number of the organisms to be destroyed.
2. The type and concentration of the disinfectant used.
3. The temperature of the water to be disinfected; the higher the temperature the more rapid is the disinfection.
4. The time of contact; the disinfection effect becomes more complete when the disinfectant remains longer in contact with the water.
5. The nature of water to be disinfected; if the water contains particulate matter, especially of a colloidal and organic nature, the disinfection process generally is hampered.
6. The pH (acidity/alkalinity) of the water.
7. Mixing; good mixing ensures proper dispersal of the disinfectant throughout the water, and so promotes the disinfection process.

Types of Disinfection

a) Chemical Disinfection

Chemical agents that can be used as disinfectant include. (I) Chlorine and its compounds (ii) Bromine (iii) Iodine (iv) Ozone (v) Ultra Violet Rays.

Bromine and Iodine occasionally are used for swimming pool. Chlorination

Water disinfection by Chlorination, first introduced in the early 20th century, was perhaps the most important technological event in the history of water treatment. The chlorination of water supplies in developing countries is extremely important. Poor sanitation resulting in the faecal pollution of water sources frequently poses the greatest threat to public health. Effective chlorination of water supplies has in many cases achieved a substantial reduction in those enteric diseases that are primarily water-related. Recent studies, still in progress, have raised the possibility that organic compounds formed ('halogenated') when chlorine is added to water, might cause certain forms of cancer in man. Due to the number of variables involved no definite evidence is available so far. On the other hand, the disinfecting properties of chlorine are well established and, to date, should outweigh the suggested possible side effects when it is used to safeguard public health.

Chlorine in its various forms has been widely used in disinfecting water supplies, because it is cheep, reliable and easy to handle. Different forms of chlorine are:

- Chlorine gas (cl_2).
- Calcium Hypochlorite $Ca(ocl)_2$ as powder. Chlorine Content is up to 70%. It does not lose the chlorine content with the passage of time.
- Sodium Hypochlorite (Na ocl) as liquid. Chlorine content is 12 to 15 percent.
- Chlorine dioxide (clo_2).

Ozonation

Ozone is a gas produced on site, as needed, by an electrical discharge in dry air. The ozone from the ozone generator is metered and diffused into the water to be disinfected. It cannot be stored for subsequent use.

Advantages

- It is generated on site; no chemical transportation requirements.
- It is a very effective disinfectant over a very wide range of operating conditions.

Disadvantages

- Ozone residual produced by excess feed does not persist, thus water quality is not protected in storage or distribution.
- The very high electrical power required to generate ozone makes it the most expensive disinfectant to use.
- The most routine maintenance requires a skilled operator.

b) Physical Agents

Physical disinfectants that can be used are heat and light. Heating water to the boiling point will destroy the major disease producing non-spore forming bacteria. Heat is commonly used in the beverage and dairy industry, but it is not a feasible means of disinfecting large quantities of water because of the high cost.

Sunlight is also a good disinfectant. In particular, ultraviolet radiation can be used. Special lamps that emit ultraviolet rays have been used successfully to disinfect small quantities of water. The efficiency of the process depends upon the penetration of the rays into water. The contact geometry between the ultraviolet light source and the water is extremely important because suspended matter, dissolved organic molecules, and water itself will absorb the radiation, in addition to the micro organisms.

Ultraviolet light is a non chemical form of disinfection. Water to be disinfected passes through a chamber where it is exposed to ultraviolet light with a given germicidal efficiency. The lamps must be kept clean so that the organisms are exposed to the full intensity of the ultraviolet light. Ultraviolet light has been proven effective for disinfecting clear water.

Advantages

- Easy to install, operate.
- The UV disinfection unit contains no moving parts. Requires minimum maintenance consisting of keeping the bulbs clean and replacing them regularly.

Disadvantages

- Leaves no residual and thus difficult to determine if disinfection has occurred.
- Requires continuous and stable power supply.
- Water must be clear so that organisms are not shielded from exposure to the ultraviolet light.

Chlorination Technology for Rural Water Supply

Groundwater obtained from shallow dug wells continues to be the major source of supply for millions of people in small communities. A number of surveys have revealed that dug wells become quite frequently contaminated. Surface water sources such as village ponds, canals and rivers are usually also polluted. While it is neither feasible for always necessary to establish complete treatment of the water from these sources, proper disinfection should at least be provided in order to protect public health.

Technically, disinfection by chlorination can give a satisfactory solution for rural and small community water supplies. Disinfection by gaseous chlorine is generally not feasible for small water supplies, due to the problems of applying small quantities of gas accurately and on a continuous basis. The choice is likely to fall on chlorine compounds.

Bleaching Power

Chlorinated lime or bleaching power is a readily available and cheep chlorine compound. This chemical is easy to transport and not dangerous to handle if it is supplied in a suitable container. It is a free flowing white or yellowish power containing about 33 to 37 percent available chlorine. It is unstable and will lose chlorine during storage. In the presence of moisture, bleaching power becomes corrosive; it is necessary to use corrosion-resistant containers made of wood, ceramic or plastics. These should be stored in a dark, cool and dry place. In order to minimize the loss of chlorine a maximum concentration of 5 percent is recommended for a bleaching power solution.

Disinfection of Open Dug Wells

As open dug wells will continue to be used in considerable numbers as sources of drinking water in rural and small communities, it is desirable to employ simple methods for disinfecting the water of these wells.

Pot Chlorination

An earthen pot of 7 to 10 liters capacity with 6 to 8 mm diameter holes at the bottom is half filled with pebbles and pea gravel of 20-40 mm size. Bleaching power and sand (in a 1 to 2 mixture) is placed on top of the pea gravel and the pot is further filled with pebbles up to the neck (Fig. 5). The pot is then lowered into the well with its mouth open. For a well from which water is taken at a rate of 1,000-1,200 litres/day, a pot containing about 1.5 kg of bleaching power should provide adequate chlorination for about one week.

Double Pot System

When a single chlorination pot is used in a small household well, it may be found to give too high a chlorine content to the water ('over-chlorination'). in such situations, a unit consisting of two cylindrical pots one inside the other has been found to work well (Fig. 6). The inner pot is tilled with a moistened mixture of 1 kg of bleaching power with 2 kg of coarse sand to a little below the level of the hole and is then placed inside the outer pot. The mouth of the outer pot is

tied with a polythene sheet and the unit lowered into the well with the help of a rope. Such a unit has been found to work effectively for 2 - 3 weeks in household wells of 4,500 litres capacity from which water is withdrawn at a rate of 400 - 450 litres/day.

In conclusion, regardless of the disinfection method or chemical selected, operating personnel should be thoroughly trained in application, use, and testing to ensure that disinfection is complete. In many areas of the world, the quality of life can be directly related to the availability of a plentiful and safe water supply.

8. WATER TREATMENT ASSESSMENTS

8.1 Laboratory Control and Records

A water treatment plant should always include a laboratory adequate in size and equipped to make bacteriological, chemical and physical tests. Daily tests should include water temperature, turbidity, alkalinity, color, hardness, residual chlorine and coliform bacteria. These tests should be made on the raw water and on partially and completely treated water in order to check the efficiency of all parts of the plant.

The daily records should show the test results, amount of water filtered, hours of operation of various filters, filters washed and amount of wash water and chemicals used in total amount in milligrams per liter. Such a record is usually kept on daily basis. Good records are of value to the operator by allowing him to increase efficiency and decrease operational costs of the water treatment plant.

8.2 Samples for reporting on operation and laboratory control of water treatment plant

1. Water Treatment Record

i)	Flow of Raw Water	Cusec	mgd
ii)	Coagulant Dose	mg/l	tbs/day
iii)	Chlorine Dose	mg/l	tbs/day
iv)	Number of filter units used		
v)	Filter run length of each unit	(hr)	
vi)	Number of filters washed		
vii)	Volume of water used in washing	(1000 gallons)	

2. Water Analysis

	Temp. °C	Turbidity NTU	Alkalinity mg/l as $CaCO_3$	Hardness mg/l	Residual Chlorine mg/l	Coliform MPN
Raw water						
Settled water						
Filtered water						

9. CONCLUSIONS

- The type and degree of treatment will depend upon the character of raw water and its extended use after treatment.
- Slow sand filters justify their use for small plants not under technical supervision where relatively clear surface water are to be treated.
- When the average turbidity of raw water exceeds 20 NTU, some form of pretreatment is indispensable for the smooth operation of slow sand filter.
- Indigenous material should be used to reduce the costs.
- An adequate contact time at least 30 minutes is given before any of the water is consumed.
- Dosage will depend upon the character of the water and may be 0.25 to 0.5 mg/l in order to obtain residual of 0.1 to 0.2 mg/l as water leaves the plant. Residual chlorine must be maintained throughout the water distribution system to avoid the contamination from cross connections.

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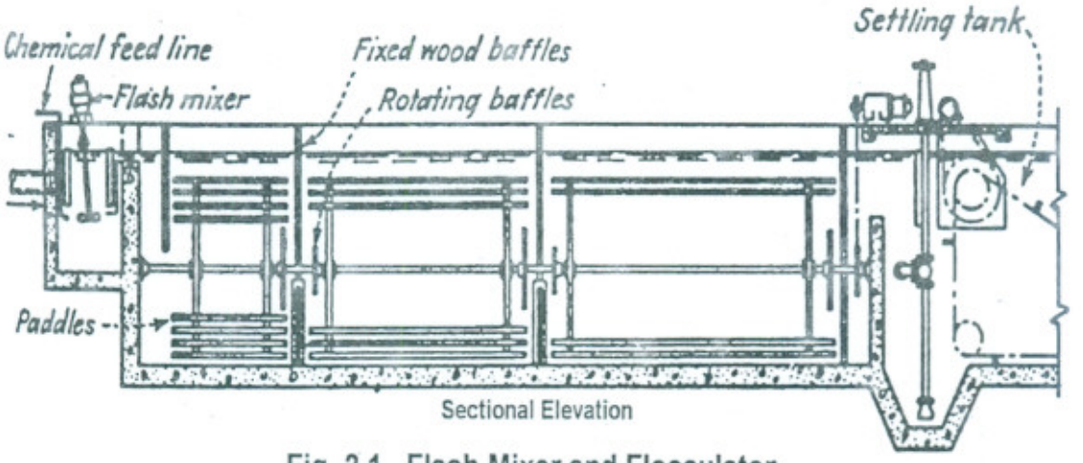


Fig. 2.1 Flash Mixer and Flocculator

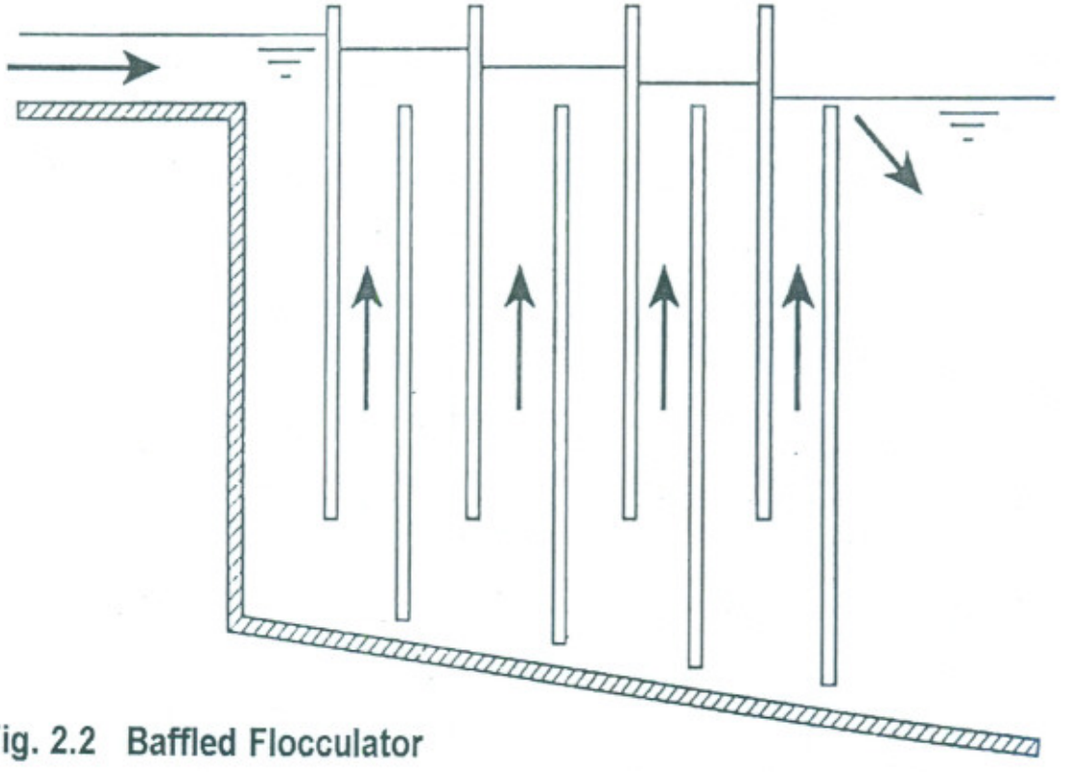


Fig. 2.2 Baffled Flocculator

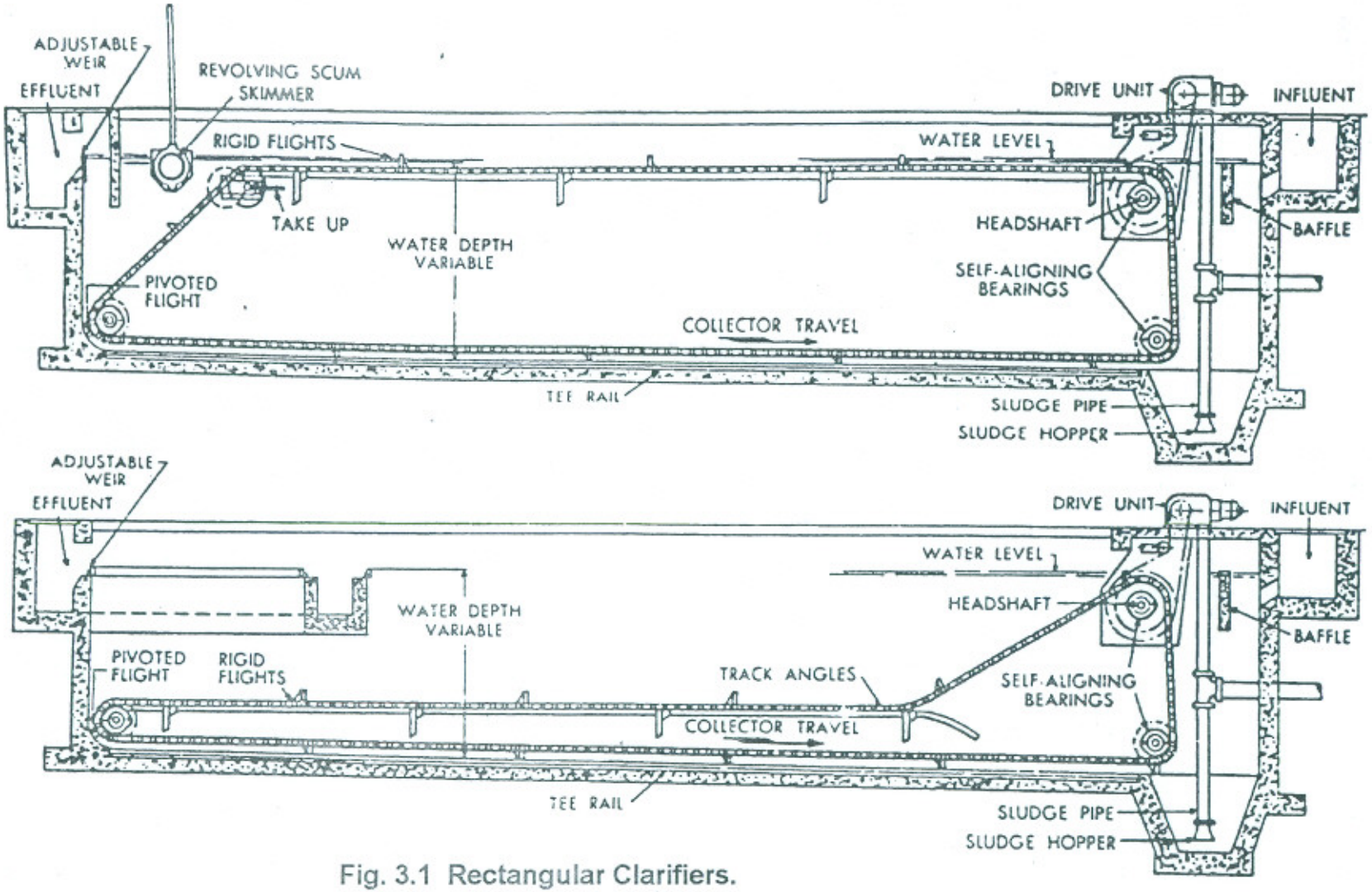


Fig. 3.1 Rectangular Clarifiers.

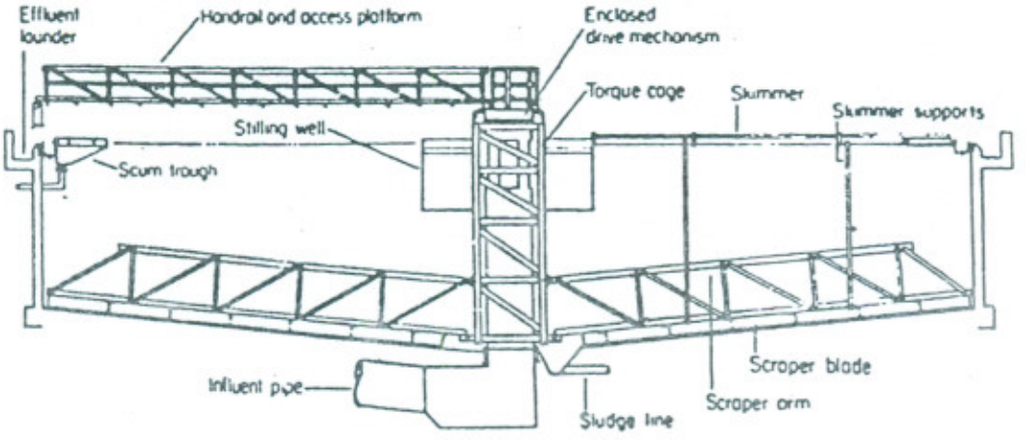


Fig. 3.2 Center Flow Clarifier

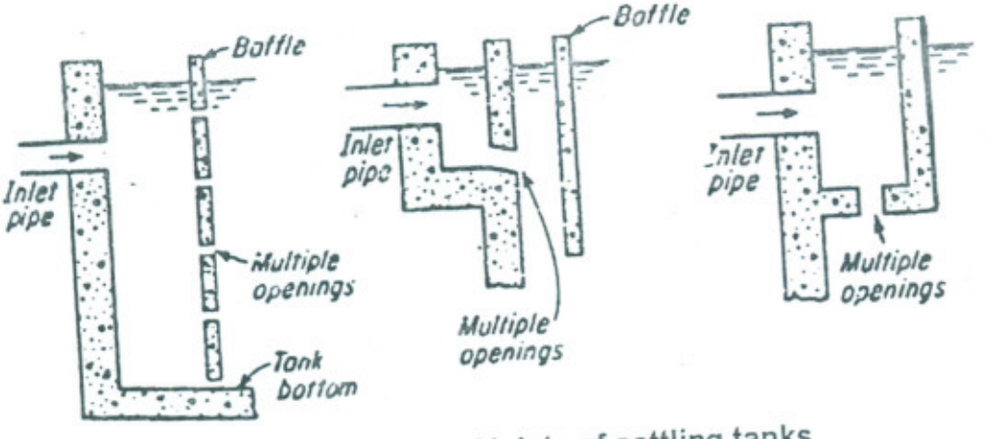


Fig. 3.3 Three types of inlets of settling tanks

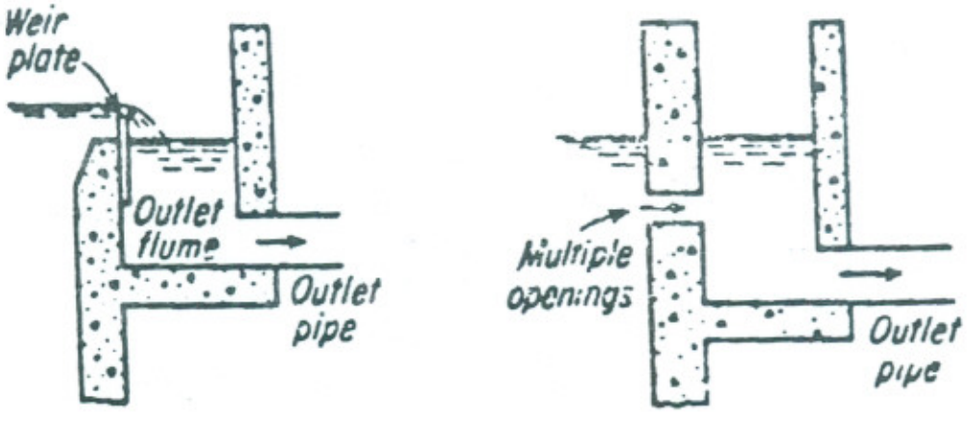
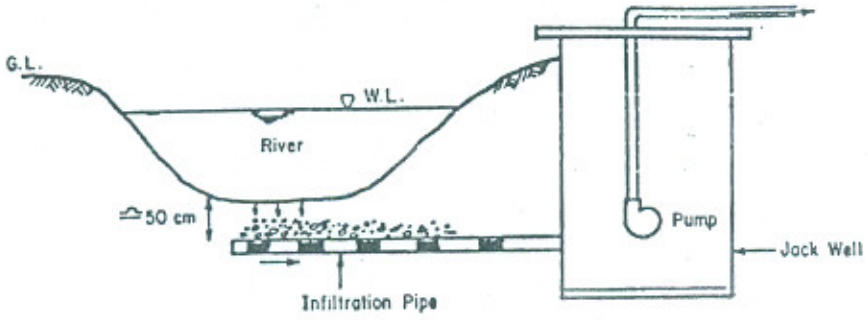
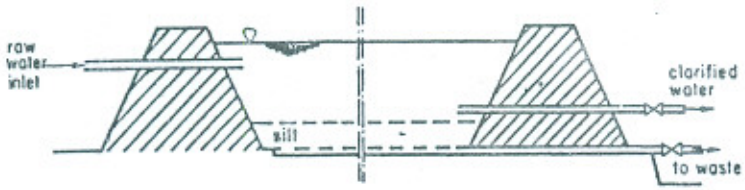


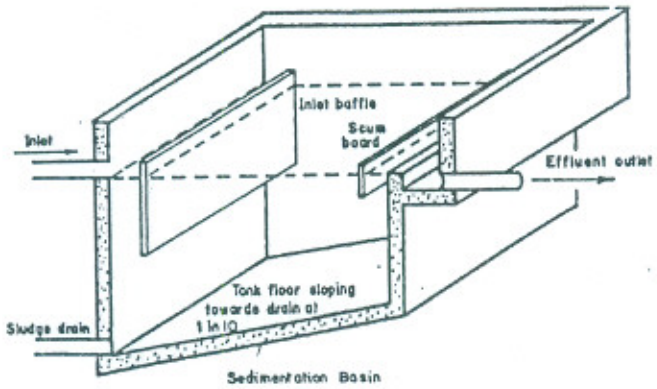
Fig. 3.4 Outlet details of settling

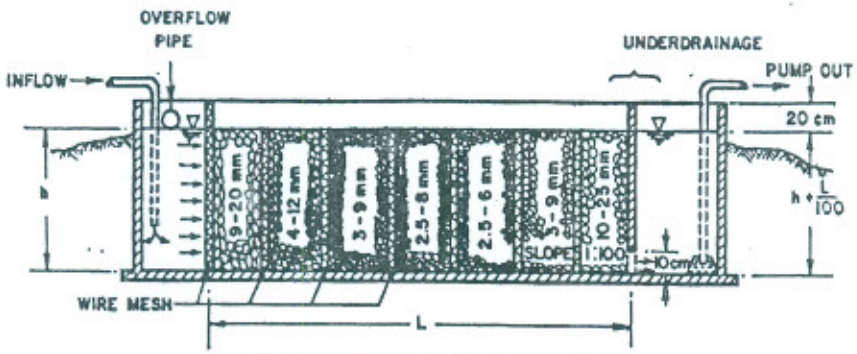


Infiltration Gallery (Pre-Treatment Method)



A Storage Basin





Horizontal Flow Coarse Media Filter

Fig. 4.1 Pre-Treatment Methods

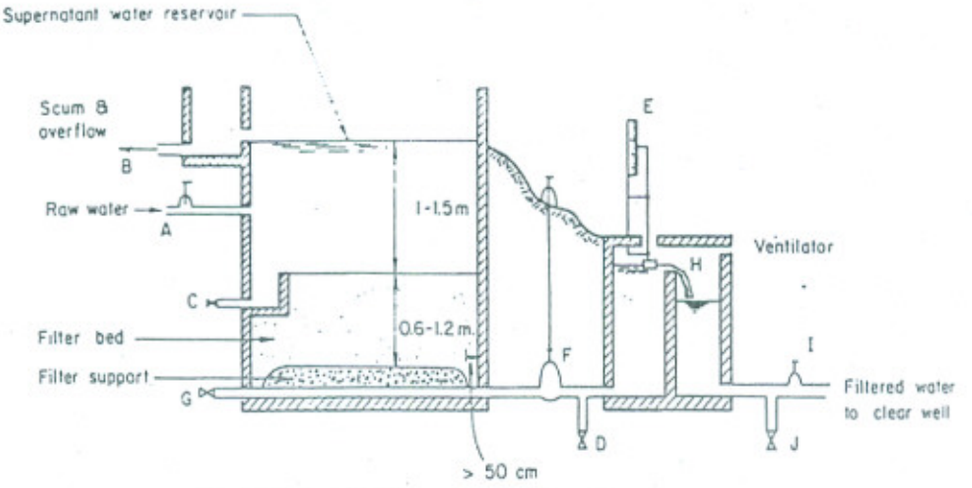


Fig. 4.2 Basic Elements of a Slow Sand Filter

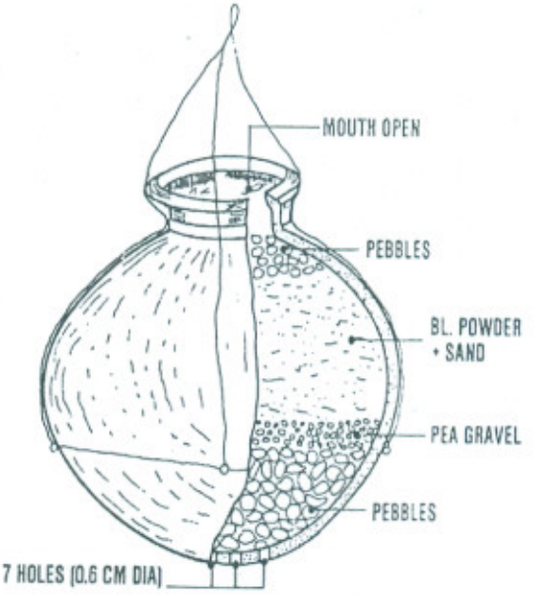


Fig. 5 Chlorination Pot with Holes at the Bottom

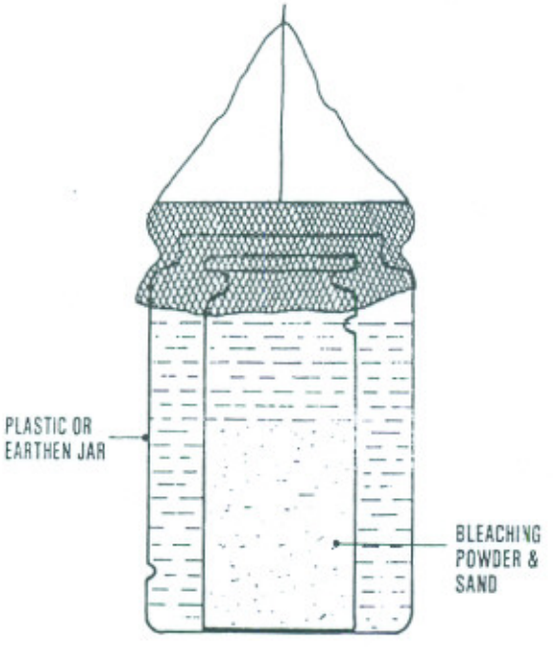


Fig. 6 Pot Chlorinator

LAHORE AND RAVI, A PARASITE-HOST PARADIGM AND THE STATE OF OUR UNDERSTANDING: A CASE STUDY.

By

Amin Ullah Khan*

Introduction

Presently blind forces of urbanization are moving along the lines of least resistance and shows no aptitude of creating an Urban-Natural pattern, that will result in a stable, self sustainable and self renewable city. In response to this onslaught and to spread a word of wisdom we have created a society of volunteers "society for the promotion of interdependence among natural and domesticated environment" (SPINDE)

The paradigm

Lahore – Ravi relationship in the past has been a mutually beneficial one, the city getting its life support goods and services from the river, which in turn benefits from their nutrients. Ravi has a vast active flood plain area bordering the main channel, beyond which it runs through some of the most fertile soils to be found any where in the world. Up till the middle of the 20th century the lahorites found the river to be a game and fish paradise, teaming with water fowl and fish. But the pressure of ill planned urbanization is such that it threatens to reduce or even completely destroy the rivers capacity as a life support system.

Just as humanity is in reality a parasite on the biosphere so it appears at the moment Lahore inhabitants are on the river Ravi. Ecological research on parasite host relationship has revealed that co-evolutionary natural selection operates to promote reciprocal adaptations so that parasite does not eliminate its host, and thereby itself. If we are to be a prudent parasite that survives, we must devote more attention to reducing our wastes, resources destruction and encroachment on our life-support rivers in order to reduce our virulence (Fig.1).

Equally important, we must invest more in reward feed back that benefit the host; otherwise the city will become a cancer that will ultimately destroy not only the river and the city itself but also many other cities downstream[1] (as the river carries the pollution load to other areas) as a result of ecological backlash. Ecological backlash are unforeseen detrimental consequences of an environmental modification, which actually creates more problems than it solves. The reason that detrimental consequences are unforeseen in this case, stems both from public misconception and from inadequate prior studies and evaluation of the impact of the city on the river and on the people whose lives are disrupted.

Almost without exception large cities throughout the world are located on large bodies of water that provide natural waste treatment facilities. Large cities had to face up to the fact that their free sewers are becoming overloaded and won't be free any more when their capacity to assimilate waste is destroyed (Fig.2). The dilemma is that efforts to enhance one part of the urbanization have degraded other equally vital natural system.

Most of the developed world realized the significance of natural environment life support system and the need to give more attention to increasing the efficiency of resource use, thereby reducing the deleterious impacts of the domesticated environments on the life-support environment. And in order to provide reward feed back they passed acts and regulations for

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*Professor and Chairman, Department of Botany at G. C. University, Lahore. Masters and Ph.D. in Ecology from Aberdeen and Imperial College of Science and Technology, London, U. K. respectively.

[1]Remedies are available in Riparian law, according to which the upstream uses of the water resources should not impair the rights of downstream property owners to use that same resource. This can be utilized to settle issues of downstream pollution.

sustainable management. Generally speaking two options were adopted. The developed world relied on costly artificial treatment, where as developing world has adopted alternative to the advanced treatment.

Restoring mutualism between the city and the river

There are two basic ways by which we can restore the mutualism:

1. Regulating land-use in the flood plains

Flood damages are the result of poor land use and environmental planning, and they can be avoided with proper floodplain management practices. Flooding is a natural event that occurs periodically when the water in a river overflows its channel banks and inundates adjacent low-lying land. This land is called the floodplain. The flood hazard area includes the active flood plains, which carries the major portion of the flood at high velocities and the flood fringes, which is covered with shallower, slowly moving water. Improper floodplain management results in economic losses, and pollution problems. It occurs mainly when the active flood plains is filled in and built upon, thus restricting the flow path. This causes an increase in the flood elevation, making the problem even more severe (Fig 3,4). The basic objective of regulating land use in the floodplain is to reduce the risk of future flood damages. In other countries of the world it is generally a responsibility of local government, subject to state guidelines. Control is also exercised by the federal government under the requirements of the national flood insurance program. Many countries have adopted regulations that restrict or prohibit certain types of construction or activities in the floodplain. Floodplain management must be preceded by a study that shows the extent of the floodplain on a suitable map. The easiest way to delineate the floodplain is to examine the area topography on available soil survey maps.

2. Wastewater management system that mimics natural processes

The functional design of the wastewater management system should be such that it mimics that of a natural riparian, stream corridor channel, which is being, used for its disposal. The effluent as it comes out of the pumping station could be directed to a large sedimentation basin along the active flood plain (Fig 5,6,7). Its purpose is to slow the surge, settle out sludge particulate material, and trash entering the basin. The basin is easily accessed for routine maintenance and the periodic removal of accumulated sludge, whereas overflows exceeding the infiltration capacity of this basin can be discharged. These chains of basins can provide the following benefits:

a) A high–quality polished effluent can be obtained by the natural processes that occur as the effluent flows over the ground surface and percolates through the soil similar to the practice of land treatment. Relatively large land areas are available along the river for this kind of treatment and soil type as well as climate is conducive to the feasibility and design of recharge basin for the effluent coming out of each pumping station.

The infiltration percolation mode of land treatment has a basic objective to recharge groundwater aquifers and to provide advanced treatment of wastewater. The filtering and adsorption action of the silty and sandy soil of active flood plains can remove most of BOD, TSS and phosphorus from the effluent.

b) Evaporation system: The large pond can also act as evaporation system. The basic objective of this type of system is to dispose of the wastewater into atmosphere and to avoid the need for discharge to either surface or groundwater (Fig 8). Factors such as average annual rainfall, wind speed, humidity, solar radiation, and temperature are all suited to the site in question. Moreover it could be effective in areas like Lahore where the evaporation rate exceeds the rate of precipitation during most part of the year.

c) Land application and marketing of biosolids: The thickened underflow of sludge, which is retained at the bottom of the basin, can be drained. The dewatered sludge can be stored temporarily into open lagoons. Although the basic objective is wastewater treatment and disposal, another goal is to obtain an economic benefit from the use of the water and nutrients to produce marketable crops. Large scale land application is an option that makes beneficial use of the nitrate and phosphate nutrients contained in the sludge. Biosolids with low levels of heavy metals or toxic compounds from municipal sewage can fertilize croplands or trees and can improve the condition of soil on large land reclamation sites. Processing, distribution, and marketing of sludge for use as fertilizer is a widely considered option for biosolids. In many communities, dried sludge is ground in hammer mills and bagged for local sale on site.

Unfortunately, planners and politicians in this country do not seem to understand city-river interdependence. It is obvious from the pace at which the active flood plains of the river are landfilled for construction of houses, factories and petrol pumps and the raw sewage is disposed directly into the river. These areas can be used to provide reward feedback to the river. That is why, careful study and planning must precede projected modification to make sure there will be a net benefit to man, not just a temporary economic benefit for a vested interest.

The time has come to view and manage entire landscape as a whole. And this is where the science of ecology can help, since it deals with the interconnectedness of humans and nature. Let us hope that our political system reach maturity before we destroy our natural resource base.

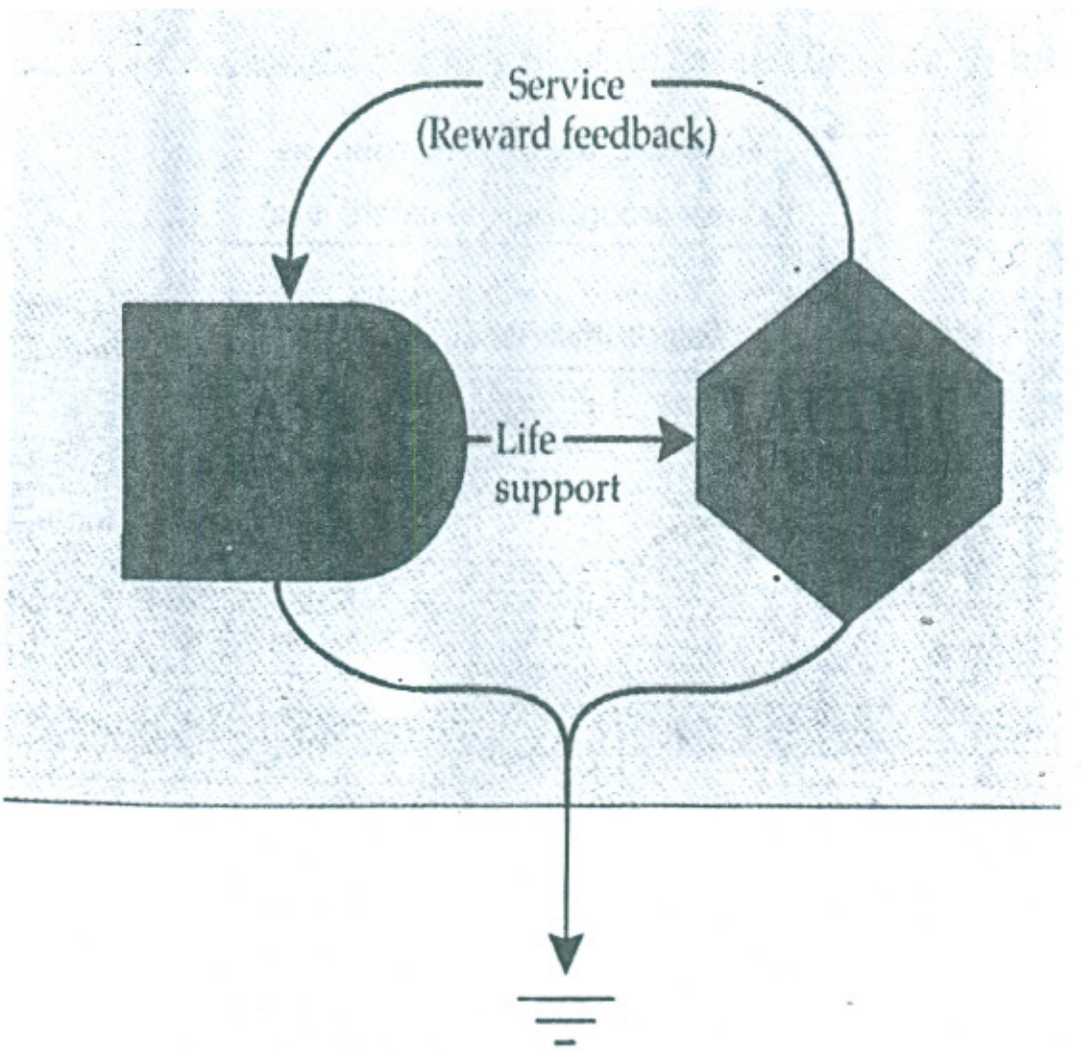


Fig 1. The paradigm

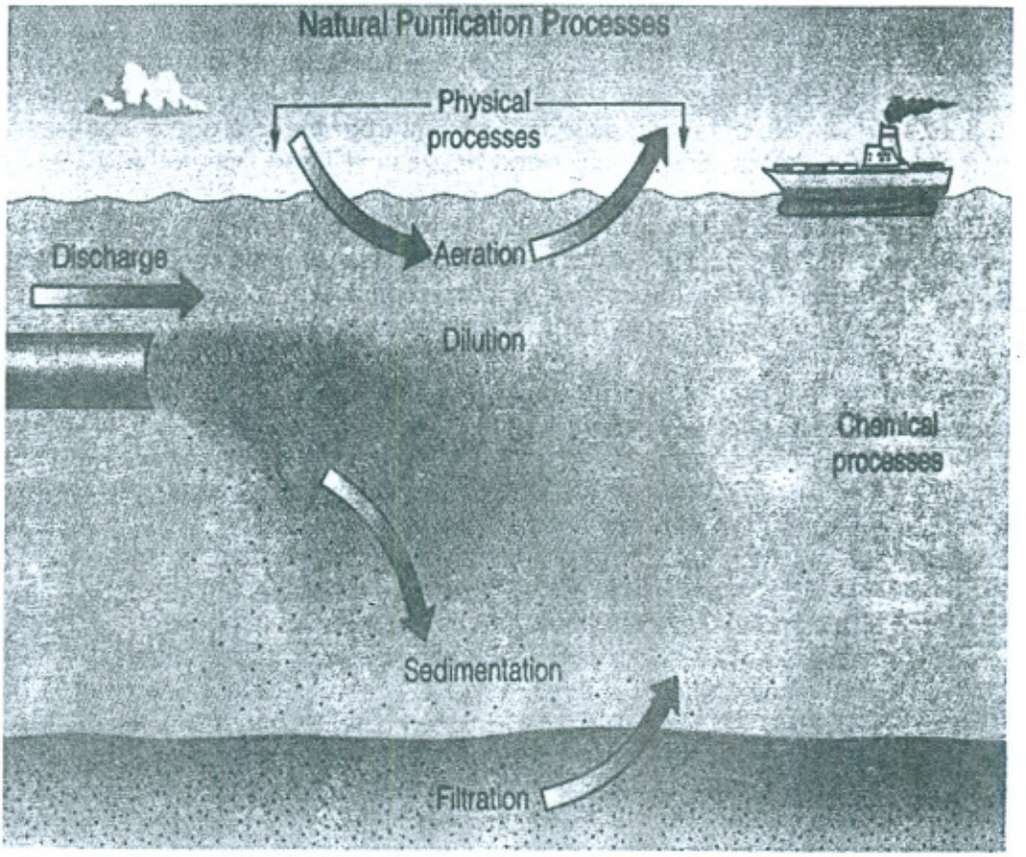


Fig 2: Natural purification process

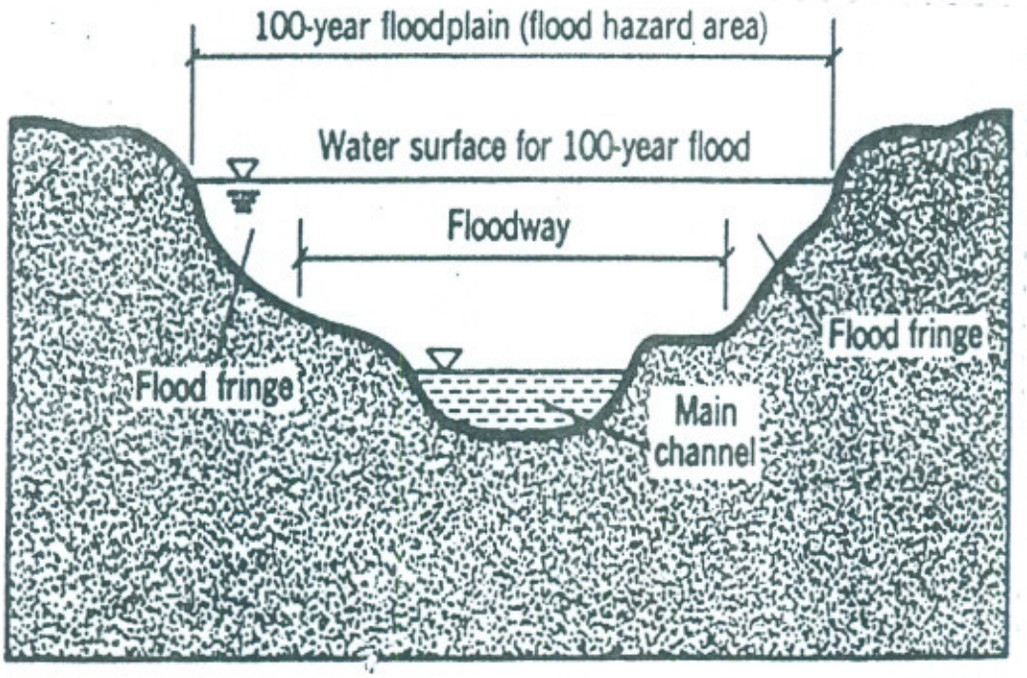


Fig.3: Active flood plains are the flood hazard areas

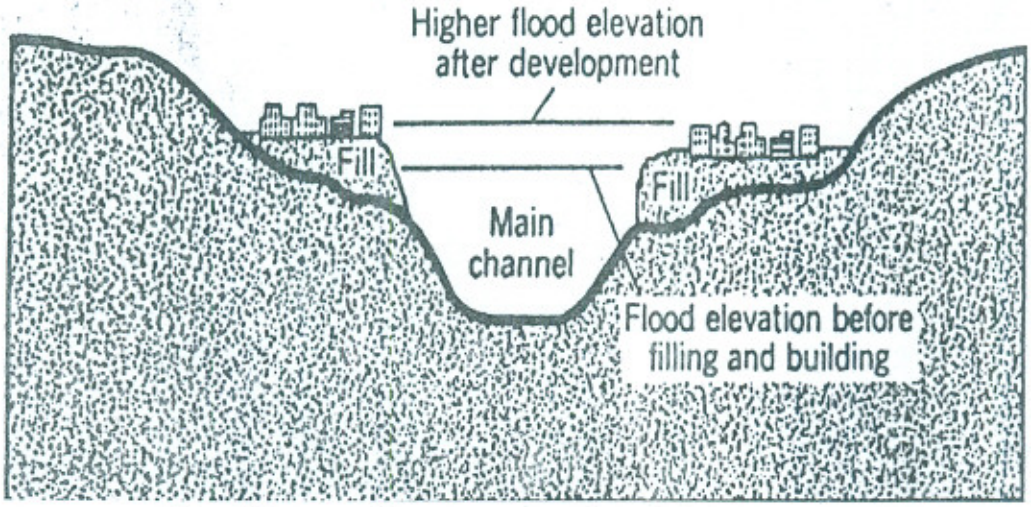


Fig.4: Encroaching on active flood plains increase flood hazard and make the river more polluted from sewage from the built up sites.

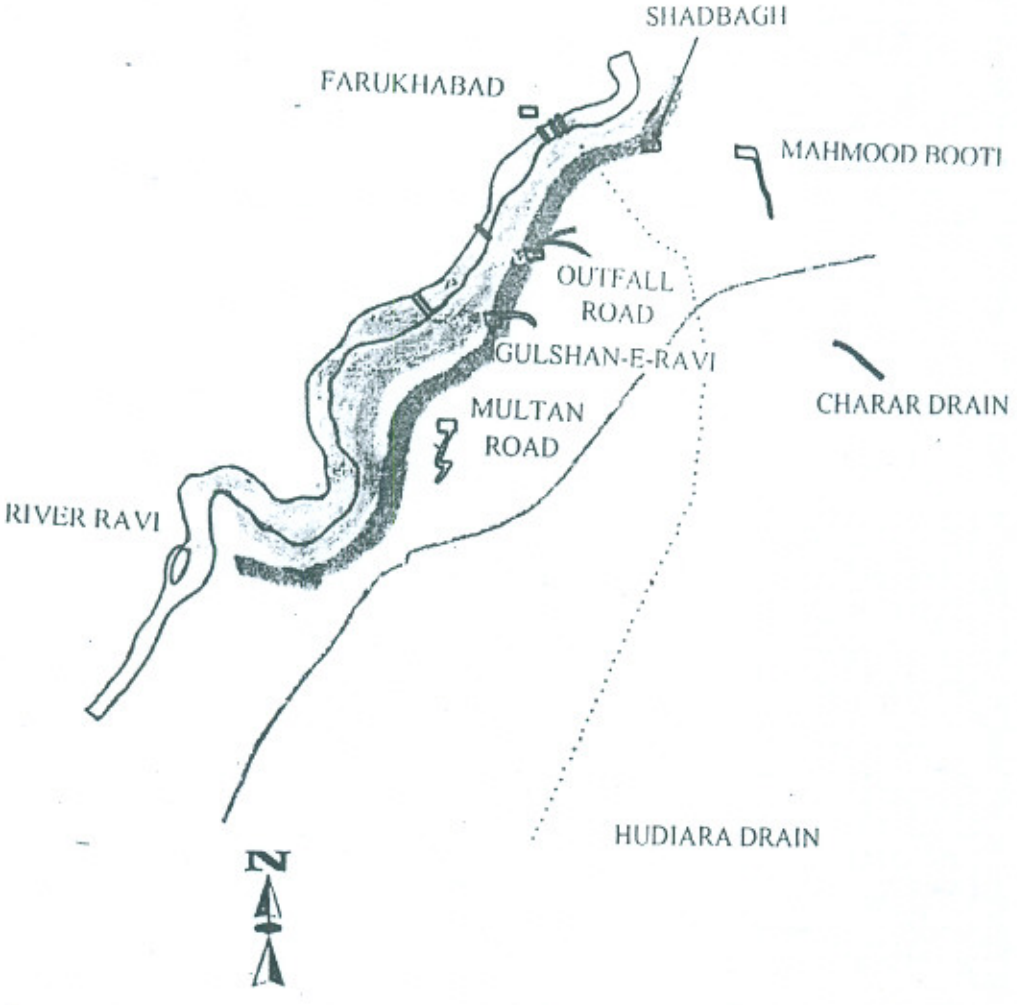


Fig. 5: River Ravi and active flood plains

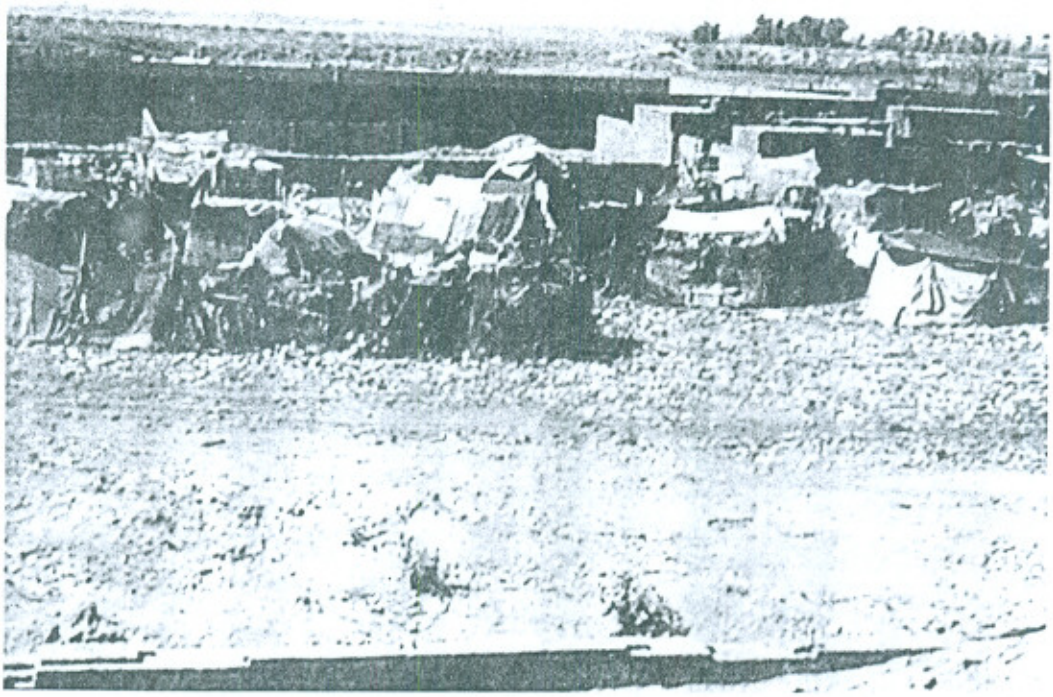


Fig 6. Land filled sites on active flood plain, which are first colonized by shanty huts to be replaced by town houses.



Fig 7. Sewage effluent channel, entering active plain to be discharged with raw sewage into the river.

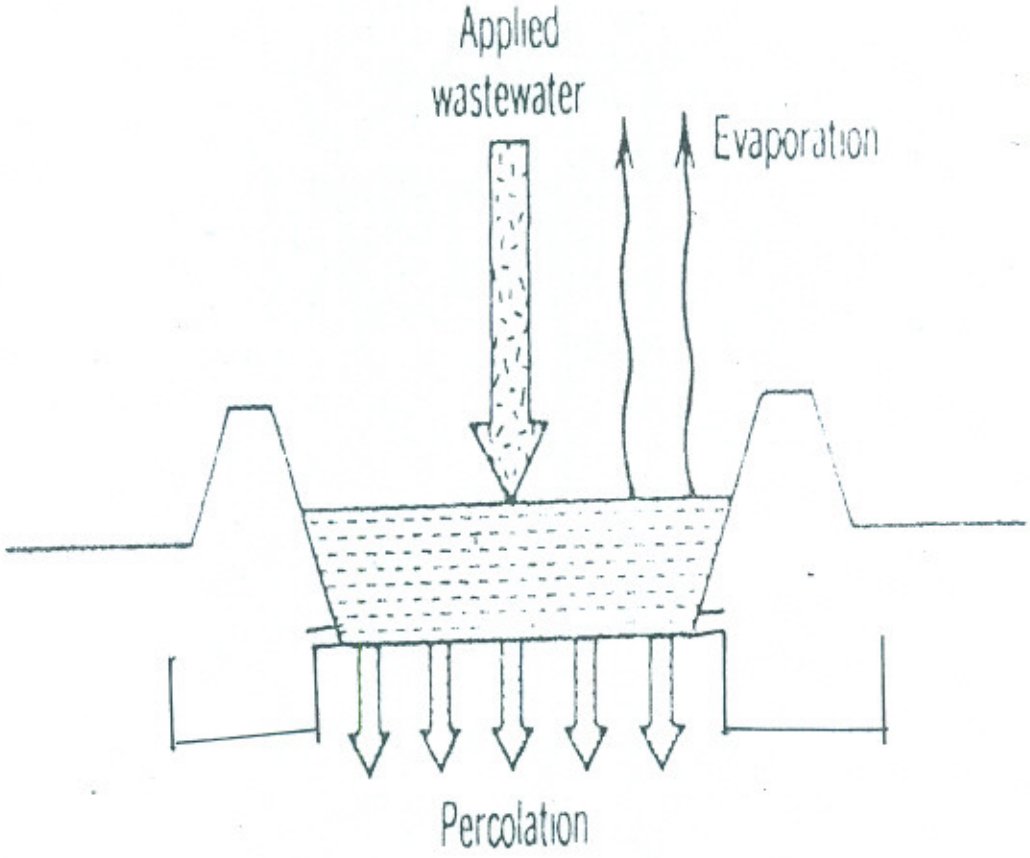


Fig.8: Large basin in the active flood plain can provide an effective alternative to the expensive and complicated advance treatment.

INVEST IN DEMAND SIDE MANAGEMENT FOR MULTIPLE BENEFITS

Saeed Akhtar Niazi*

In a discussion at a certain forum, the question of providing relief to low income consumer in slab 1 to 100 kWh by bringing them at par with lifeline slab 0 to 50 kWh, came up. Calculation showed that it would require a subsidy of RS. 4 billion to be provided either by the Wapda or the government to give the proposed relief to about 2.7 million consumer in this category. This subsidy appeared to be well nigh impossible for several valid reasons. Is there an alternate option to achieve the objective? The answer is yes. An alternative is discussed below but this requires an open mind for an approach to reach a solution.

Demand side management is a very important function of any utility operation. No utility worth the name can claim to have optimized its economic operations unless it continuously follows a well thought out load management program. In simple terms, from utility's point of view, it means that the utility manages to deliver maximum energy in a given minimum installed capacity. The daily and seasonal load curves ought to become as flat as possible with system peaks chopped off. Such a system will save the utility significantly in generation and transmission investment costs, proportionate to its efforts and input. It shall therefore, have Minimum Long Rum Marginal Costs (LRMC). Additionally, for a system like Pakistan, which has a very pronounced non-productive evening peak, there will be a significant reproduction in T & D losses. To achieve the objectives, no doubt, utility shall have to make appropriate investment. A conventional approach is to resort to Time of Day (TOD) metering. Wapda is embarking upon such an approach in industrial sector where required number of such meters is small. Any attempt to introduce TOD meters in domestic sector would be highly expensive and it would take years before it could be implemented and benefits harvested. Luckily, in Pakistan scenario, relatively small investment can bring about large dividends. For instance, if 15 million consumers in the country are persuaded or induced to use one energy saver bulb each, the system shall require 1200 MW of less generating capacity, bringing about a saving of a capital cost of almost Rs. 100 billion in system expansion. In other words, the cost of installing a power plant of size of Hubco and allied 500 kV transmission facilities would be saved. Likewise, two energy savers of 18-20/100 W for 15 million consumers shall mean reduction in generation requirement of about 2400 MW. In other words, the country shall manage to cope with the demand for a further period of two years beyond the current load projections. This suggestion apparently negates the philosophy of promoting load growth to absorb the surplus energy currently prevalent in Wapda system. But it result in far bigger advantage of deferring investment in generation bringing about economic operation of the system and reducing LRMC in the short to medium term scenario. In the immediate term, it shall open vistas of providing much needed relief to the consumers by reducing their electricity consumption and thus the bill, as spelled out in the proposed package of relief below.

Relief for the low income consumers.

The high electricity tariff is unaffordable for all categories of consumers but for low-income groups, it is indeed back breaking. There is a suggestion floating that 51 to 100 kWh bracket consumers may be brought under lifeline rate as for 1 to 50 kWh. In other words, the lowest lifeline rate should be made available to all consumers in 1 to 100 kWh bracket. It is estimated that this measure shall require a subsidy or Rs. 4 billion to be provided either by the Government or by Wapda. Such a huge subsidy by either entity is not a viable commercial proposition, particularly, when the utilities are moving towards commercialization and ultimate privatization. In order to provide the desired relief, the through that comes to mind is for the utility to take steps for the reduction of consumption rather than the rate, without jeopardizing

* Former Member Power (WAPDA).

the power usage benefits for lighting purposes that the consumer wishes to avail. It is proposed that the objective may be achieved if the consumer uses energy saver bulbs. An 18/20 W-energy saver shall provide same illumination as available from conventional 100 watt bulb. Ideally, the utility ought to take measures to improve the awareness of the consumers regarding the benefits that would accrue to him by adopting this load management measures. But a positive response from the consumers, particularly those in the lower brackets is unlikely. Firstly, because the majority of such consumers have limited educational background and secondly, the initial cost of energy saver bulbs is high. Relatively educated and affluent class of consumers in the commercial sector is already using energy savers to their advantage. However, since the number is small, the impact on the utility is hardly noticeable. The prudent approach under the circumstances therefore, would be for the utility to induce the consumers by initially providing a suitable number of energy saver bulbs free of cost. The consumers can see for themselves that such bulbs not only reduce the consumption and consequently the electricity bill but are also much longer lasting (about 6000 hours) than the conventional incandescent bulbs. Now revert to the issue of providing relief to 2.7 million consumers falling in bracket 51 to 100 kWh. Supposing the utility opts to provide a minimum of 1 to a maximum of 3 energy savers 18/100 W bulbs to this category, their consumption would automatically fall in bracket 1 to 50. Thus the desired objective of providing relief to low income group of 51 to 100 kWh into the lowest lifeline rate at an estimated cost of Rs. 4 billion per year would be accomplished just in about Rs. 0.75 billion. In fact, it would cover a period of about 2 years i.e. Rs. 0.37 billion per year if the claim of the manufacturer regarding the life of energy savers is to be believed. (See sample calculation below). This 0.75 billion is not a subsidy. Hence, there shall be no objections either from Nepra or the donors. It will be a genuine investment by the utility towards demand side management. This small investment of 0.75 billion covering a 2 years period shall bring in its wake huge dividends for the utility. Immediately, the system peak shall get chopped off by over 400 MW. Smaller cities or towns located away from the utility top brass which suffer load shedding or system breakdowns at peak load hours due to system constraints shall get a very welcome relief. The reduced current flowing through the transmission and distribution system shall also result in reduced technical losses. It will be for the utility to optimize the number of bulbs to be provided to a given bracket or a sub-bracket. In due course, it may become possible to do away with a subsidized lifeline and low – income tariff and eventually, the free supply of energy savers. The procurement and free supply of energy savers will obviously be a huge operation and may have to be spread over many months. The utility shall have to evolve a fail-proof method of bulb distribution.

Sample calculations :

Energy saver bulbs to be provided to low-income category for the purpose of relief may roughly be calculated as under :

Consumption 51 to 67 kWh – One bulb 18/20 W.

Consumption 68 to 84 kWh – Two bulbs 18/20 W.

Consumption 85 to 100 kWh – Three bulbs 18/20 W.

Average Two bulbs for 2.7 million consumers – Total 5.4 million bulbs.

Average rate per bulbs Rs. 140 – Total cost of 5.4 million bulbs = Rs. 0.75 billion.

The calculations are only indicative. The utility can optimize and refine.

Summary of benefits.

1. With an investment of Rs. 0.75 billion, the goal of the government of providing relief to the low-income consumers equivalent to those falling in lifeline category shall be accomplished. Subsidy of Rs. 4 billion shall not be a required.

2. Reduction in peak demand and optimized use of generation, transmission and distribution resources.
3. Reduction in technical losses.
4. Short/Medium Term Benefits : Saving/Postponement in generation and transmission investment cost.

KESC.

The above prescription applies to Kesc too. Advantages for Kesc, however, will be more. Its system has a big power shortage. Hub-Karachi direct link should have provided the necessary relief to both Wapda and Kesc. The former would have mitigated its huge surplus and the latter, in reducing its shortage. The completion of the link would take time. Kesc can, in the meantime, reduce its peak requirement by resorting to energy saver bulbs. Roughly, use of 1.2 million energy savers of 18/20 W displacing 100 W bulbs at a cost of approximately Rs. 170 million can reduce the system peak by 100 MW. In other words 300 MW of evening peak can be chopped off with an investment of Rs. 0.5 billion. With the precise data available to Kesc, it can optimize its benefits.

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OBITUARIES

May their souls rest in Peace

1. Renowned Engr. M. A. Akhoond, a Past President of the Pakistan Engineering Congress passed away on 12th April 2004, after protracted illness, at Karachi.

   Engr. M. A. Akhoond was one of the oldest engineers of the NDC University College Karachi, from where he graduated in 1937 securing first position in Civil Engineering. On selection by the Federal Public Service Commission, India he joined the N. W. Railways in 1938.

   He had made a mark from the very beginning of his career by proving himself to be a brilliant Civil Engineer with outstanding administrative ability. He held numerous posts in the Pakistan Railways including Chief Engineer, Vice chairman, Chairman and Ex-officio Secretary to the Government of Pakistan. In recognition of his outstanding services in Pakistan Railways during 1965 and 1970 wars with India, he was awarded the highest civil award by the President of Pakistan.

   In recognition of his services in the engineering profession, he was elected President of the Pakistan Engineering Congress in 1964-65, appointed as Chairman Pakistan Engineering Council by the Prime Minister of Pakistan, nominated as member of the Syndicate of University of Engineering and Technology Lahore and also appointed as member of the committee by the Government to consider the problems of engineers in Pakistan.

   In 1977, he was appointed as the first Vice Chancellor of NED University of Engineering and Technology, Karachi, for rendering valuable service to the cause of education and his profession.

   May God rest his soul in eternal peace.

2. Engr. Syed Suhail Jameel, Executive Engineer, Irrigation Department, Punjab, June 9, 2004.

ISO 14000 – ENVIRONMENTAL MANAGEMENT SYSTEMS IMPROVES PERFORMANCE AND PROFIT

By

Mian Iftikhar Ahmad*

Are the interests of business and the integrity of the natural environment naturally opposing forces ? In the past it often seemed so. Recent decades have seen major change as business and industry take seriously their obligations to limit exploitation of natural resources, both in their own interest and in the interest of the community at large. World Trade Organization (WTO) agreements now play an important role in setting standards for world trade. After 2005, these agreements will be implemented more strictly and Pakistan may lose export revenue if international guidelines are not followed.

It is now clearly understood that national economies worldwide depend upon the wise use of finite natural resources. The management of resources in developing countries impacts directly on the economic well being of those countries and of countries in the developed world. And not least, business realizes that it is in its best interest to resolve environmental problems before government becomes seriously involved and imposes strict regulations on industry. So for Pakistani companies, focusing now on understanding Environmental Management Systems (EMS) as part of an overall system for developing environmental policy makes good sense.

ISO 14000 (EMS) produced in 1996, is an international family of standards that includes the "Environmental Management System". This system is set up to guarantee that operation has taken the environmental impacts of its activities into consideration, has a plan for mitigating environmental harm, is keeping track of its performance and is dedicated to improving it. International Standards Organization developed the ISO 14000 as a companion to ISO 9000, a set of standards for quality management (QMS) to insure customer service. Like ISO 9000, ISO 14000 is increasingly viewed as a passport for doing business in the growing world economy where markets are demanding assurances of quality.

ISO, the International Organization for Standardization has been developing voluntary technical standards over most sectors of business, industry and technology since 1947. ISO has 110 member countries, with the United States represented by the American National Standards Institute (ANSI).

Many ISO's standards have to do with pins, rivets and screws, but consumer pressure for the development of standards for product and environmental quality encouraged ISO to develop voluntary standards relating to the quality and environmental performance of products. Countries around the world recognize the need for environmental management, and ISO has worked to create a harmonized environmental standard – ISO 14000 – that will apply to all types of production regardless of size, scope or location.

By the mid of 2004, over 365,000 business world wide had been registered to the ISO 9000 quality management system (QMS) standards. While the number of companies using QMS (ISO 9000) continues to grow, use of the ISO 14000 environmental management system (EMS) standards could have an even greater impact on businesses globally. As of June 2004, almost 44,000 organizations worldwide had already become registered to ISO 14001. The momentum building with ISO 14001 makes it clear that environmental management is becoming the new business priority.

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* Water, Sanitation and Environmental Specialist.

Benefits of ISO 14001.

Implementing an environmental management system based on ISO 14001 is important for many reasons, most of which fall into two categories : internal benefits and external benefits.

Internal benefits :

Potential reduction in process by-products and wastes, and raw materials.

Reducing costs through lower expenditure for waste treatment and disposal.

Greater employee awareness about the environment and how their jobs impact it.

Potential increased energy efficiency and energy conservation in design, production and post production processes.

Creation of systematic structure for complying with environmental regulations.

External benefits :

Customer satisfaction/requirement.

Competitive advantage in the marketplace.

Ease of trade, avoiding non-tariff trade barriers.

Potential for improved market share.

Value added for investors, supply-chain clients, and community stakeholders.

Improve image with community and environmental groups.

Further, five-phased approach helps an organization design or improve its environmental management system efficiently and effectively. Steps in the five phase include :

Phase I : Pre-assessment

Conduct a gap analysis.

Review environmental policy with top management.

Establish a project working group.

Develop an action plan.

Phase II : Planning

Flowchart environmental management system processes.

Assign process owners for each process.

Identify environmental management system documentation needs.

Identify environmental aspects and assess significance.

Develop environmental objectives and targets.

Prepare implementation plan.

Review objectives and targets, and implementation plan, with top management.

Phase III : Implementation and Training

Create or revise environmental management system procedures.

Consider process changes in light of objectives and targets and revise processes as needed.

Establish environmental management program (s)

Document additional required operating procedures.

Phase IV : Checking and Preventive Action

Implement the EMS performance monitoring procedures.

Utilize the nonconformance monitoring procedures.

Conduct internal audits.

Phase V : Management Review

Conduct management reviews to assure the management system's continued adequacy and suitability.

Identify needed changes to assure continual improvement.

Will ISO 14000 affect our industries?

How do one knows if his company needs ISO 14000 certification? One should ask himself these three questions : Does his industry export products? Does it supply goods to companies operating in other countries? Does it supply other manufactures who in turn export products? If his answer is yes to any of these questions, chances are he will be hearing a lot more about ISO 14000 in the future.

What can be done now ?

Although there seems enough time to register until next year, beginning to prepare now will give you a head start for ISO certification. The first standards to be completed will be EMS and environmental auditing. These standards are the furthest along in the process and are the least likely to change. Preparing for the EMS standard can be done without extensive effort, and may translate into immediate benefits.

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CASE FOR HYDROPOWER PROJECTS

The high level committee constituted by the President of Pakistan is seized with the issue of recommending implementation of large reservoir dams which are very vital for the economy of the country. The discussions, weighing pros and cons of various options, must presumably be in advanced stages. I hesitate to write this unsolicited note and get into a sensitive debate, which is in competent hands. Yet, the importance of the issue and my professional obligations compel me to add a straw, hopefully the last one, which the committee may like to take into account. I earnestly believe that both Kalabagh Dam and Basha Dam are good projects. Pakistan needs both of them and many more, as rightly stated by no less a person than the President of Pakistan himself in his historic address to the nation. It is only regrettable that the engineering of Basha Dam has not been done all these years. It has remained behined Kalabagh Dam by several years and now a stage has reached when further delay is simply not affordable. The suggestions for possible consideration are as follows :

1. Munda Hydroelectric and storage project. Recently, a good project named Munda has started appearing in the news. Munda storage and hydroelectric project is located on river Swat where it debauches into plains. Both as a dam and a hydroelectric station, it has many attractive features. For instance, it is located very close to the load as well as the population centers. It is capable of providing employment opportunities at people's doorstep. The project with a significant storage of 1.2 MAF can contain Probable Maximum Flood (PMF) in river Swat, correspondingly reducing the impact of a similar flood in Indus. This will go a long way in mitigating the apprehensions of those who do not favour Kalabagh for flooding reasons. Despite all this, there is a major bottleneck. According to a study carried out with Canadian assistance in 1984, Munda project was ranked very low, in fact 10th on the list. A country like Pakistan which has very limited financial resources, cannot afford the luxury of undertaking major project that are way down in the least cost sequence of candidate projects. In other words, Munda is not a stand alone project for the time being. However, there is a redeeming feature. If it is built in conjunction with a downstream hydroelectric project, say at Kalabagh, its storage can be reused to the advantage of that project, thereby improving viability of Munda. A "Munda – Kalabagh Combination project" therefore, presents a beautiful opportunity for inter-provincial cooperation and consensus.

Note:

i. According to a rough estimate : 1.2 MAF releasable surplus from Munda can produce about 204 GWh of primary energy at Kalabagh with average head of 200 ft. This benefit is rightly attributable to Munda. With prudent conjunctive operation, it may be possible to duplicate the primary energy addition during the year, by exploiting the "early riser" feature of Swat River. Total primary energy contribution of Munda at the downstream project would thus become approximately 408 GWh giving substantial boost to "Munda only" primary energy of 1507 GWh. (as per Menenco Report)

ii. Wapda would be in a better position to determine more accurate estimates of the benefits.

2. Cheap Power : So far hydel projects are treated as Wapda projects. Their benefit flow only to Wapda consumers. It may be ensured that all hydroelectric projects are treated as national projects and the benefits of cheap hydle power are made available to the people living in Karachi as well.

3. Bani Afghan Dam : Somehow, it seems that some people have become allergic to the very name of the project Kalabagh. Change in its name to " Bani Afghan" a village very close to the site might help. Naming projects to the closest villages is not uncommon. In this case, Bani Afghan is of significant size.

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