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President 74th Session

EDITORIAL

Energy Consumption and Production Trends

Fellow Engineers

اَلسَّلَامُ عَلَيْكُمْ وَ رَحْمَةُ اللّٰهِ وَبَرَكَاتُهٗ

Present World Population as on April 2017 is 7.5 Billion and is visualized to be 8.5 Billion by 2030 and 11.2 Billion by 2100, a demographic cataclysm of unimaginable magnitude: The Pakistan Scenario is no different and the population as on January 2017 is 194.9 million projected to be 245 million by 2030 i.e. an additional 50 million souls the Country would have to increase its food and fibre production by at least 50%--not an easy task. Pakistan is the 6th most populated country in the world. In addition its urban population is approximately 70 million (36% of 195 million) and urbanization is proceeding fast

The above scenario is mindboggling and in addition to myriad problems would certainly require Energy generation in staggering proportions. The World wide trends of Energy Consumption and energy production as quoted by the "Economist" are;

		Percentage of Energy Consumption (%)	
1.	**Renewables**		
	- Wind/Solar	1.6	
	- Hydro-Power	3.6	
	- Geo/Thermal/Solar Heat	4.2	
	- Traditional/Bio-Mass	9.1	
	- Bio Fuels	0.8	19.3
2.	**Non-Renewables-Bio-Fuels**		
	- Nuclear Power	2.3	
	- Fossil Fuels	78.4	80.7
			100%

Similarly, the global Electricity Production as per 2016 figures is

		Electricity Production (%)	
1.	**Renewables**		
	- Hydro Power	16.6	24.5
	- Others	7.9	
2.	**Non-Renewables**		
	Fossils Fuels/Nuclear		75.5
			100%

Energy Experts are of the firm opinion that the use of Fossil Fuels will continue to dominate the energy scenario for decades to come. This trend has been forecasted inspite of following;

- Use of Fossil Fuels is highly detrimental as the planet Earth is on the path of 3.6 degree Fahrenheit (2-degree Celsius) increase in global temperature
- Production of "tight" or shale oil in North America and its discovery in other countries including Pakistan
- Increasing investment the world over in wind/solar energy--a renewable source
- Introduction of Electric Cars which has touched 2-Million mark is no doubt an appreciable step towards clean energy but is still a far cry as there are more than 40-million vehicles and the number goes on increasing.

Fossil Fuels domination in energy generation was not the destiny of Pakistan. Nature has endowed it with 60000 MW Hydel Potential. The Hydel Generation is presently a dismal 7000 MW. However, now actions for Construction of 4320 MW Dasu Dam have started. Moreover the construction of 4500 MW Diamer Basha Dam has been brought under the ambit of CPEC and it's a good omen.

Engr. Ch. Foad Hussain
Chief Editor

INTRODUCTORY REMARKS

By

ENGR. CH. GHULAM HUSSAIN

PRESIDENT

PAKISTAN ENGINEERING CONGRESS

At

COMMEMORATION OF WORLD WATER DAY – 25th MARCH 2017

ON THE THEME OF 'WASTE WATER'

Distinguished Guests,

Members of Pakistan Engineering Congress,

Fellow Engineers, Ladies and Gentlemen!

Assalam-o-Alaikum

It gives me immense pleasure to inform that Pakistan Engineering Congress has a unique distinction of commemorating World Water Day since 2005 based on universal themes. Not only this, but the papers presented / discussed and recommendations resulting from these events have been published and disseminated complimentarily by the Congress to all concerned, particularly Federal / Provincial Government Agencies.

Ladies and Gentlemen!

As you aware, the theme of this event is 'Waste Water'. This seems to be a very relevant topic for Pakistan, where per capita water availability is approaching the stage of "acute water stress".

Waste water is the one that has been adversely affected in quality by human influence. It can originate from a combination of domestic, industrial, commercial or agricultural activities, surface runoff or storm water and from sewerage effluents.

Since all natural waterways contain bacteria and nutrients, almost any waste compounds introduced in such bodies will initiate bio-chemical reactions. These bio-chemical reactions create what is measured in the laboratory as biochemical oxygen demand (BOD). Laboratory test procedures for determining BOD are detailed in many standards. American version includes "Standard Methods for Examination of Water and Waste Water".

World Health Organization (WHO) has also prescribed various parameters for determining quality of waste water. This, in turn, helps in adopting appropriate waste water treatment and management measures to enable its beneficial reuse or recycling.

For a holistic appreciation of waste water issue, it is important to gauge its harmful impacts, which are:

i. Water pollution: Freshwater bodies and marine waters receiving waste water may get polluted and rendered unsafe for human use.

ii. Water security: This is becoming a crucial issue particularly for water scarce countries like Pakistan. Waste water discharged on lands can seep into groundwater and contaminate, particularly fresh aquifers.

iii. Ecosystem services: All ecosystems are connected and ultimately depend on water. Similarly, surface and groundwater are connected. Therefore, careless waste water discharge can have serious ripple effects. If one part of an ecosystem chain is destroyed, it can upset its entire food chain.

iv. Agriculture / fisheries / tourism: Waste water for irrigation may contain unsuitable chemicals and result in delayed crop maturity and under yielding. Untreated waste water discharged into fresh water bodies or sea may contain pathogens and harmful dissolved chemicals, which can affect fishing in that area. Similarly, smell in those areas may discourage tourism.

v. Health of urban and rural populations: Wastewater is a big health issue as it carries and transports a myriad of diseases and illnesses. According to WHO, about 3 million people die annually due to diarrhoeal disease. At least another 2 million children under 5 years die every year due to water related diseases or one every 20 seconds.

Wastewater treatment for its beneficial reuse is a dire need of Pakistan with particular focus on municipal sewerage and industrial effluent. Waste water treatment methodologies can be broadly grouped as: -

i. Disposal or reuse

ii. Processes used

iii. Treatment plants

Since disposal or reuse are basic objectives of waste water treatment, these options provide basis for treatment decisions. Water bodies, entirely within national jurisdiction, should be subject to multiple regulations of local governments. Disposal into rivers crossing international boundaries or sea may be subject to bilateral or multilateral treaties. The options available in this case are evaporation ponds, infiltration basins or injection wells.

Basic processes used for waste water treatment are: sedimentation; filtration; and oxidation. Sedimentation process is generally used for gravity separation of solids. For sewerage treatment, primary settling tanks are used. This process is also widely used for treatment of other waste waters. Solids that are heavier that water will accumulate at the bottom of quiescent settling basins. Colloidal suspensions of fine solids are removed by filtration through fine physical barriers distinguished from coarser screens or sieves to particles smaller than openings through which the water passes. Oxidation reduces BOD of wastewater as well as toxicity of some impurities. Secondary treatment by biochemical oxidation of dissolved and colloidal organic compounds is widely used in sewerage treatment and is also applicable to some agricultural or industrial waste waters.

Ladies & Gentleman!

You will notice from the Programme that 14 technical papers are being presented through inaugural and two technical sessions. These, by and large, cover various facets of waste water issues highlighted by me. I am sure that these high quality presentations will: enhance our knowledge about waste water; create awareness about the issue among engineering fraternity; and generate useful discussions through active involvement of participants. This will enable us to formulate appropriate recommendations for dissemination among all concerned quarters for consideration, particularly by the policy decision makers and public sector entities.

I don’t want to stand any longer between you and paper presenters and request the Stage Secretary for starting the technical proceedings. I also wish all present here to enjoy this day well spent in pursuit of enriching our professional knowledge.

Thank you for patient hearing of my introductory remarks.

PAKISTAN PAINDABAD

KEY RECOMMENDATIONS

By

PAKISTAN ENGINEERING CONGRESS

On

WORLD WATER DAY 2017 Held on 25th March, 2017

Pakistan Engineering Congress celebrated World Water Day on the theme of **"Wastewater"** on 25th March, 2017. Welcome Address was presented by Engr. Ch. Ghulam Hussain, President Pakistan Engineering Congress. Fourteen (14) papers were presented by Water and Irrigation specialists. It was a very well attended event and was widely covered by News & Electronic Media. The Papers are being printed in a book form and will be distributed free of cost.

Given below are the recommendations made by the Speakers:-

Paper: ***Water Availability in Pakistan and Wastewater***

Author: Dr. Izhar-ul-Haq, Mr. A. Dastgir

Recommendations:

- Increase national level awareness and commitments to solve badly neglected water pollution by increasing waste water treatment, restoring polluted water bodies and address pollution prevention at its source in all forms.
- Treatment of waste water would improve environment and health of the people.
- Once treated adequately, used water needs to be recognized as a valuable source.
- Encourage the use of treated water especially where it can mitigate the water scarcity.
- Increase support for water and sanitation investments, particularly the mobilization of local capital.
- The recovery and reuse of materials removed from used water (such as energy and nutrients) should be encouraged alongwith appropriate legislation adopted to encourage this form of circular economy.

Paper: ***Water Resources Development and Management in Pothohar***

Author: Dr. Muhammad Nawaz Bhutta, Dr. Saleem Sarwar

Recommendations:

General: Pothohar region presents a good potential for construction of rainwater harvesting structures for storing runoff water and bringing barren lands under cultivation.

Criteria: Following criteria was adopted for analysis:

a) Mark the potential RHS sites utilizing imagery and general land use map of the Pothohar area.

b) Determine height and storage capacity of the reservoir on the basis of topographical survey.

c) Identify command area in the vicinity of the rainwater harvesting structure.

d) Recheck design of the structure on the basis of general geology of the area assuming that rock will be available approximately at 10 ft depth from the surface. Moreover, availability of impervious material within 3 miles haulage distance shall be assumed.

e) Design of spillway will be assessed on the basis of 25 year return period inflow whereas highest flood level (HFL) of the RHS will be determined on return period.

f) Prepare BOQ and calculate base cost of the RHS and add 5% for physical contingencies.

g) Considering water and land resources as constraining factors, 25% of command area is proposed to be served with high efficiency irrigation system (HEIS) and Drip Irrigation is the option. The rest area will receive surface / flood irrigation and bed and furrow irrigation. The crop production is envisaged to be achieved through bringing barren land under cultivation and practicing of cropping pattern and intensity of 140% with high return crops including orchards and high value crops on 25% of the command area proposed to be served with HEIS and traditional crops on 75% of area proposed to be served with conventional irrigation and bed furrow method of irrigation.

h) Calculate agriculture benefits per acre of command area.

i) Perform economic analysis of the RHS.

j) Structures having storage capacity less than 10 AF and above 100 AF will not be considered is recommended.

k) Solar system shall be installed for such RHSs with pumps ranging from 2Hp to 5Hp depending upon availability of command area and willingness of farmers to adopt HEIS as more than 90% RHSs would require lifting of water instead of gravitational flow.

Geological Studies: Mostly shale and clays predominate at the abutments while hard strata of sand stone is encountered in the nullah beds at shallow depths at most of the sites. Required construction material in adequate quantities and of suitable quality for the construction of these sites is available.

Hydrological Studies: The catchment area for these sites will vary from 0.25 to 3 mile^2 and average annual yield for 1 mile^2 is about 161 acre feet. The annual sediment yield is 2 AF/mile^2. The spillway will be designed to pass 100 year return period.

Sediment Control and other Benefits: With the construction of these RHSs, flows will be conserved for regulated flows for sustained irrigation in the Pothohar region. Moreover, these RHSs will be helpful in checking sediment in already constructed small dams in the Pothohar region.

Agricultural Studies: Command area is available in the vicinity of these sites. The present agriculture in the command area is meager and below subsistence level mainly due to slopping land and non-availability of regular supply of irrigation water. Because of assured irrigation supplies after the construction of these RHSs, annual cropping intensity of 140% will be achieved within a period of 4 years after project commencement.

Project Cost & Economic Analysis: The basic cost of 40 sites including RHS and Spillway comes to about Rs. 181.511 million. The average per acre of CCA cost is about Rs. 182,606. The overall project cost also includes HEIS, social and environmental management. Agriculture marketing support and project management cost etc. and it comes to about Rs. 279 million with average cost per acre of CCA as Rs. 280,824. A threshold limit of RHS cost in terms of its being economically feasible is about Rs. 375,000 per acre of CCA.

Paper: ***Seasonal Variations in the Efficiency of Oxidation and Stabilization Ponds for the treatment of Sewage in Faisalabad City***

Author: Dr. Engr. Abdullah Yasar, Dr. A.B Tabinda, Noreen Ashraf, M. Naveed Anwar, Mujtaba Baqir, Ahmad Iqbal, Anam Waheed

Recommendations:

The study concluded that the concentration of pollutant parameters in sewage waste water is higher than permissible limits of NEQS in influent and reduced in effluent, but in some cases i.e. COD, BOD, TSS and FC the concentration of pollutant is also higher than NEQS.

WSP removal efficiency in summer is higher than the cold winter. The removal efficiency of COD, BOD, TSS, TN, EC, FC in summer are 66.1 %, 72 %, 63 %, 58 %, 85 % and 82 % respectively, while in winter are 59 %, 61 %, 43 %, 54 %, 40 % and 78 % respectively. Temperature and pH showed negative sign that mean these parameters increased after the treatment. This treatment plant is not as better for treatment as stabilization ponds should be.

This treated water is again dumped into the drain rather utilization in the crops, because farmers resist the salinity of water after treatment and they use the untreated water for crops cultivation, this highly polluted sewage water can give more nutrient to the crops but it is highly unhygienic for human consumption.

At present in Pakistan approximately all installed wastewater treatment systems are not working appropriately due to operation and maintenance troubles associated with these systems. Consequently there is dire need to look for an alternative wastewater treatment system, like macrophyte waste stabilization pond system utilization the local macrophyte species for wastewater treatment.

The treatment should first be done in the drains through cost effective technologies

- ✓ Aquatic weeds will also help to increase the performance of ponds by holding them in the ponds. Aquatic weeds will in the improvement of removal efficiency of different matters that pollutes the water and will help in the reduction of BOD, will decrease the phosphate and metal in the ponds and by the removal of suspended solids. And will also enhance the efficiency of pond by providing them natural ingredients.
- ✓ In developing countries like Pakistan where salinity is already a problem so before using the wastewater it should meet the national standards to avoid further loss of land. Also the major factors that increase the degree of salinity are climate conditions and this aspect needs to be taken into account.
- ✓ WASA should go for low cost treatment technologies like lagoons, and stabilization ponds rather than to the other treatment plants.

- ✓ The solid waste system is checked and needs to be improved so that they may not mix into the water

Sewage system should be improved, as sewage is lying open on the roads and open places that affect the esthetic beauty as well as open to serious health problems.

Paper: ***Reuse of Wastewater in Agriculture recovered from Constructed Wetlands***

Authors: Ms. Khushbakht Andleeb, Dr. Imran Hashmi, Hamza Farooq Gabriel, Tariq Mehmood

Recommendations:

Constructed wetlands are less costly and efficient wastewater treatment technique. Agricultural production can be greatly improved in the arid regions by implementing such techniques and will substantially increase the water use efficiency across all the sectors of the society. Fertilizer production from sludge of the sedimentation pond can reduce the use of costly harmful synthetic fertilizers. There is dire need of implementing such techniques in the arid region by improving policies, financial management and institutional dialogues, which would ultimately improve the agricultural production and can, boost up the economy of the Country.

This research will be helpful to create awareness among the masses in the form of research papers, newspaper clippings, seminars, and short training programs, poster presentations at local and international levels. This technique if implemented will reduce water borne diseases as mixing of wastewater with the drinking water supplies will be considerably reduced which is the major aspect highlighted in Sustainable development goals.

Paper: ***Indus Drainage – Issues and Opportunities***

Author: Engr. Usman-e-Ghani

Recommendations:

We conclude by saying that though the irrigated agriculture has established its indispensability to the development of many countries in the arid and semi-arid regions and to the food security throughout the world, it has also brought the associated consequences of waterlogging and salinity due to defective conveyance and inefficient irrigation methods. Drainage provision to the irrigated lands helps in mitigating the adversities of these two serious problems. However, disposal of drainage effluent itself has become a major issue, which is a peril for long-term productivity of irrigated agriculture/lands. However, along with the issue, there is an opportunity side as well.

For Pakistan the agricultural sector is the lynchpin of the country's economy. Since independence, it continues to be the single largest sector and a dominant driving force for the growth and the development of the national economy. Hence, there is a dire need that this sector should be given not only the best protection but also the best of all opportunities. Beside the various forms of development projects, for example, the construction of storage reservoirs, the remodelling of existing water courses, etc. The menace of drainage is equally important to be addressed. Measures for reduction in drainable surplus would be important not only for sustainability of agricultural but also

for environmental, climatic, social and several other facets of national growth.

We know well that at present the surface water supplies in the country are insufficient to meet the crop water requirements. Hence, side by side, the safe and sustainable reuse of the drainage effluent for agriculture is an imbibed opportunity which needs to be considered and adopted. Reasonable crop production is possible even with saline irrigation water with, without or after some treatment. Saline groundwater could also be used to meet the crop water requirements but this water has different types of salts which ultimately affect the chemical composition of the soil. The exact extent of harmfulness of this phenomenon, along with the various other options, which have been discussed, and the precise solution for the farming community of the country, needs to be further investigated so as to assess the long-term effects of drainage water on soil characteristics and to evaluate sustainable use of drainage water for growing of salt-tolerant crops and tree species, as well as to explore more of the possibilities for the reclamation of salt affected lands and the overall socio-economic uplift of the farmers community, which indeed is the main contributor to our national wealth.

Paper: ***Designing and Developing Wetland Technology to Treat Wastewater for Irrigation***

Authors: Syed Hamid Hussain Shah, Dr. Allah Bakhsh, Muhammad Adnan Shahid, Saeed-ur-Rehman & Junaid Nawaz Chaudhry

Recommendations:

This study was designed to develop the prototype of wetland to investigate optimum Hydraulic Retention Time (HRT) for wastewater treatments. The statistical analysis was also performed on observed values to check the significance of results. The scheme of study was based on Randomized Complete Block Design (RCBD) having three treatments with different HRT and three replications in one treatment. Inflow of wastewater was constant for all treatments. *Water Lettuce* and *Pennywort* were the plants selected for treatment of water. The statistical analysis showed that treatment effects on all parameters except pH were highly significant but non-significant for blocks/ replications. Treatment with 7 days HRT showed better results in comparison to those with 3 and 5 days HRT. Following specific conclusions were derived based on this study:

- **i.** Direct use of waste water for irrigation is not recommended because it has large values of each parameter as compared with those under FAO standards of water for irrigation (FAO, 1976).
- **ii.** Wastewater contained heavy metals concentration posing a direct threat to soil and groundwater and human health.
- **iii.** Wetland is the technology by which we can treat wastewater with the help of plants with some proper management.
- **iv.** Wetland treatment with 7 days Hydraulic Retention Time (HRT) showed best results to treat wastewater in this study.
- **v.** The levels of TH, EC, pH, DO, Ca^{++}, Mg^{++}, Fe and Cu in wastewater were not in permissible limits. But when this water was passed through the wetland, these levels moved towards the standards and made this water fit for irrigation.

vi. Wastewater sites can be developed into visiting places or gardens and treated water can be used for irrigation.

Paper: ***Groundwater Pollution with Wastewater: Generated by Industries and Mega Cities of the Country***

Authors: Engr. Dr. Muhammad Saeed, Engr. Ijaz Javed, Engr. Hafiz-ur-Rehman & Dilbar Hassan

Recommendations:

In the best public interest, high concentration of heavy metals and other hazardous substances in the groundwater quality in the country in general and big cities like Faisalabad, Gujranwala, Sialkot and Multan in particular are being evaluated. Through this, a better balance should be achieved by minimizing the seepage of concentrations and anthropogenic contaminants into the groundwater and open water body areas.

There should be rigorous check on industrial water pollution by implementing strictly the pollution control laws. The government should move forward to ensure control on the disposal of untreated effluents around the industries.

- Groundwater is being contaminated by irrigating the crops with (sewage +industrial) waste water surrounding the cities. It could be avoided with treatment of the effluent.
- The contamination in groundwater may also be due to cracks in the lined sewerage system and through seepage, it is mixing in groundwater, so the sewerage system should be rehabilitated.
- In the big cities, the industry is main source of groundwater contamination, so further studies should be taken to evaluate the role of industry in contaminating the groundwater.
- Water treatment plants should be constructed before throwing (sewage + industrial waste water) in the fresh water bodies.
- As Arsenic value is 200% more in Faisalabad city than the permissible limit. It is very alarming situation so the Government of Pakistan may formulate “Monitoring Committee” to look into the matter in detail.
- Cost effective methodology should be adopted for monitoring and surveillance of all critical parameters of surface and groundwater.
- Personnel responsible for monitoring the quality of water should be educated and provided in-service training on a regular basis.
- Public awareness of their responsibility towards establishment and maintenance of drinking water quality standards. In this view low cost measures to be applied at a household level (use of chlorination etc.) should be applied.
- Prime importance should be given to the issue of quality and quantity of water where water is scarce such as in Baluchistan and efforts should be made to improve the availability and accessibility of the quality water.
- In water scarce countries like Pakistan, reuse of waste water for irrigation of various crops after treatment should be very effective method to meet water and food demands.

Paper: ***Treatment of Wastewater using Solar Bioreactor***

Authors: Dr. Muhammad Anwar Baig, Saad Khan, Mehwish Haq Nawaz

Recommendations:

Bio- Solar Reactor (SBR) was designed by PAKOSWISS Technologies and tested by IESE as joint venture and is functioning perfectly. Innovative method of feeding microbes using macaroni and plastic fiber was found very effective. The algal bloom started appearing at the initial stages of test runs and finally cleared when bacterial consortium became active in the pond. The COD reduction up to 85 % was observed within 10-15 days with maximum rate after 4th day. Maximum efficiency is observed in spring phase. The system can be successfully installed at any remote pond site to treat its COD and nutrient load for further use after disinfection.

Paper: ***Improved Resource Efficiency through Increased Compliance to Environmental Standards-An Initiative towards Sustainability in the Industrial Sector of Pakistan***

Authors: Mr. Nouraiz Nazar, Zonia Awan, Sohail Ali Naqvi

Recommendations:

On the basis of above discussion, following are the key recommendations for the sustainable management of resources by SEMPs for reducing the wastewater in the industrial sector.

- The SEMPs will be a tool for the implementation of National environmental quality standards and translating the MEAs which will not only impact the environmental conditions of the industry but will also contribute to the improvement of economy and export of the country.
- The existing laws/standards could be dealt in a way that these could be encouraging for industries to be adopted for reducing the pollution level.
- The industries should adopt sustainable practices for resources efficiency. These practices have business case in terms of cost-benefit analysis.
- The capacity building of government implementing agencies is needed for the implementation of local standards after 18th amendment.

Paper: ***Wastewater-A Threat for Groundwater***

Authors: Mr. Ghulam Zakir Hassan Sial, Ghulam Shabir, Faiz Raza Hassan & Saleem Akhtar

Recommendations:

- Discharge and quality of urban sewage and industrial effluent should be monitored regularly and may be classified on quantitatively and qualitatively basis.
- Sewage may be properly treated according to NEQS through biological or other treatment before throwing into river.
- The industrial effluents may be properly treated according to NEQS through engineering solutions before throwing into drains or river so that treated water can be reused for agriculture, horticulture or other suitable purposes.

- Industrial units and housing societies may be directed to install in-house wastewater treatment plants to implement the 3-R principle.
- Environmental flow in the Ravi River should be maintained at least for dilution and washing off the wastewater pollution load.
- Rainwater harvesting within the city and at up stream of Ravi River may be carried out for aquifer recharge.
- Building bye-laws should be amended for rainwater harvesting mandatory, as a means of artificial recharge, in private as well as public buildings.
- Some relatively clean wastewater can be reused without treatment for meeting the agriculture requirement or simple treatment by chlorination.
- Reuse of industrial effluents imposes less pressure on groundwater pumpage.
- Quality of Surface and groundwater monitoring should be conducted on regular basis.
- To develop an integrated Water Resources Management Policy and Regulatory framework for groundwater Management.
- Awareness raising campaign regarding value of Ravi River, pollution in Ravi, and its impact on groundwater may be promoted among the stakeholders
- Training and capacity building and mutual coordination among the stakeholders in mandatory.

Paper: ***Waste Water Management at WAPDA Hydropower Projects***

Authors: Mr. Attia Dastgir, Dr. Fayyaz Ahmad, Mr. Sarfraz Naseer

Recommendations:

Water & Power Development Authority (WAPDA) is spearheading the construction of many hydropower projects. The implementation of these projects, as an aftermath changes existing ecosystems. One of the impacts is generation of huge amount of wastewater, during project implementation. WAPDA chalk out wastewater management techniques at design and feasibility levels of project. The measure to be adopted include existing baseline water quality survey, land grading to control surface runoff and soil erosion during and after construction, preservation of natural vegetation to the extent possible, taking care of batching plant wastewater with pollutants including cement, sand aggregates and having high pH, dissolved solids, oil and grease and other chemicals. After sludge removal through sedimentation process, the wastewater is sometimes used for mixing concrete with a tolerance of upto 50,000 PPM of total solids (Portland Cement Association). Handling of domestic wastewater (from labor camps, offices and residential sites) is done on site by providing septic tanks. De-siltation of wastewater in settling tanks originated from tunnels and provision of environmental flows in case of impact of water regulation in downstream reaches of river. Judicious implementation of all these measures lead to sustainable management of wastewater generated at WAPDA projects.

Glimpses of World Water Day on the Theme of "Wastewater"
Held on March 25-2017



(From Left) Engr. Ch. Ghulam Hussain, President Pakistan Engineering Congress, Engr. S.M.A Zaidi Member Executive Council, Former Secretary-PEC



Engr. Ch. Ghulam Hussain, President Pakistan Engineering Congress presenting Welcome Address at the Event



Engr. Dr. Izhar Ul Haq, Vice President Pakistan Engineering Congress presenting his Paper on the Topic of ***Water Availability in Pakistan and Wastewater***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Engr. Dr. Izhar Ul Haq, Vice President-PEC for presenting Paper on the topic of "***Water Availability in Pakistan and Wastewater"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Mr. Abdul Qadeer Khan, for presenting Paper on the topic of "***Treatment of Waste Water being generated in Lahore"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Dr. Saleem Sarwar, for presenting Paper on the topic of "***Water Resources Development and Management in Pothohar"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Mr. Mujtaba Baqir for presenting Paper on the topic of "***Seasonal Variations in the Efficiency of Oxidation and Stabilization Ponds for the treatment of Sewage in Faisalabad City"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Dr. Imran Hashmi for presenting Paper on the topic of "***Reuse of Wastewater in Agriculture recovered from Constructed Wetlands"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Engr. Usman-e-Ghani for presenting Paper on the topic of "***Indus Drainage – Issues and Opportunities"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Engr. Dr. Muhammad Saeed for presenting Paper on the topic of "***Groundwater Pollution with Wastewater: Generated by Industries and Mega Cities of the Country"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Ms. Mehwish Haq Nawaz for presenting Paper on the topic of ***"Treatment of Wastewater using Solar Bioreactor"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Mr. Azhar Iqbal for presenting Paper on the topic of ***"Presence of Heavy Metals in Solid Waste Leachate and its Removal using Agricultural Waste"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Mr. Attia Dastgir for presenting Paper on the topic of ***"Waste Water Management at WAPDA Hydropower Projects"***



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Mr. Ghulam Zakir Hassan Sial for presenting Paper on the topic of ***"Wastewater-A Threat for Groundwater"***



(From left) Engr. Dr. Izhar Ul Haq, VP-PEC in interview with the Media



(From Right) Engr. Riaz Nazir Tarar, Water Resources Specialist being interviewed by the Media

Questions/Answers Session



(From Left) Engr. Mushtaq Ahmad raising questions



(From Left) Engr. Iftikhar-Ul-Haq, Member Executive Council-PEC in Questions/Answers Session

Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Press Clippings / News

CLEAN FUEL FIRM STRUGGLES DESPITE ENERGY SHORTAGES

Dawn – April 1, 2017

CHAKWAL: Hassan Raza says his clean fuel company which captures natural gas "flared" at Pakistan's oilfields and sells it to industrial customers, is struggling to expand despite energy shortages and concerns over the country's poor pollution record.

EGas Pvt. Ltd. has a number of high-profile clients, some of whom turned to the small firm during the worst shortages in 2010 and 2011, but Mr. Raza says the government should be doing more to encourage environmentally friendly technology.

"A high cost penalty on emitted carbon is the only way this type of business can grow; otherwise what incentive would companies have to stop flaring?" Mr. Raza told reuters at the EGas compression plant in Chakwal district.\"You penalize them and they will be forced to clean up their act. And that's where we come in. "A spokesman at the Pakistan Environmental Protection Agency said flaring occurred, but that measurers were being taken to control it.

"We are in touch with all stakeholders and are seeking their compliance as per international standards," he said.

Chronic power shortages severely dented Pakistan's economy earlier in the decade, and industry turned to burning wood, rubber and even used shoes to keep its furnaces, boilers and generators running.

Those pressures have eased considerably, with rising volumes of imported liquefied natural gas (LNG) and heavy investment in pipelines and port terminals. There are plans to have five LNG terminals operational by the start of 2019.

Compared to state-led investment in LNG, Mr. Raza operates at the margins but sees potential for growth in a country that generates only two-thirds of its energy needs.

Despite being around for seven years, and employing about 100 people, EGas only captures three million cubic feet per day (mmcfd) of the estimated 150 mmcfd of gas tha Pakistan flares, or burns, daily.

"I'm only utilizing a tiny portion of the gas that is being wasted around the country,: Mr. Raza said.

Expansion is not cheap. EGas started out with one truck in 2010 and now has 25, each fitted with a network of cylinders inside to store and transport highly pressurized gas. The largest of the trucks costs $1 million apiece.

The company has also had to lay down an expensive network of pipelines that take the captured gas from the oil wells to the company\s hydration and compression plants.

While Mr. Raza wants more support from Pakistan, some of his clients turned to the company because of concern about pressure from foreign regulators and businesses.

Kohinoor Textile Mills, one of Pakistan's largest exporters which sells bed linen to major foreign brands, chose EGas in 2011 partly because of its green credentials.

To keep its plants running during the height of energy shortages, it was burning huge piles of wood and coal each day.

“Foreign regulators and clients come and if you are burning away rubber and diesel and wood, it doesn’t look good to them,” said Usman Zafar, Kohinoor’s general manager for processing. “Harming the environment is almost as big a no-no now as child labour. So we had to find new ways to keep running.”

Another major client is Murree Brewery that started sourcing gas from EGas in 2015. |We wanted to find something better than furnace oil, or burning wood, something that caused less pollution,” said Mohammad Javaid, the brewery’s general manager – Reuters.

(with courtesy of Dawn)

THE ROBOT DEBATE IS OVER: JOBS ARE GONE

Dawn – April 1, 2017

By Tim Dunlop:

LONDON: In 2013, the Oxford Martin School released a report that looked at the automation of work, asserting the likelihood that robots and other technologies would replace humans. It concluded that of the 702 job categories examined, 47 percent were susceptible to automation within the next 20 years. The report completely upended our ideas about the future of work.

Now, a new report by the National Bureau of Economics Research (NBER) in the United States is set to be an even bigger wake-up call. Written by economists Daron Acemoglu (MIT) and Pascual Restrepo (Boston University), it not only adds support to the Oxford Martin conclusions, it actually suggests the jobs are already lost and unlikely to come back.

It contends that in the US between 1990 and 2007, the addition of each robot into manufacturing industries resulted in the loss, on average, of 6.2 human jobs. It also suggests automation depressed wages by between a quarter and a half of one per cent. “Using this approach,” the report says, “we estimate large and robust negative effects of robots on employment and wages across commuting tones”.

There is another important insight; these jobs losses and lower wages are likely to have a lasting and devastating effect.

Author Daron Acemoglu told the New York Times that, “even if overall employment and wages recover, there will be losers in the process, and it’s going to take a very long time for these communities to recover. The market economy is not going to create the jobs by itself for these workers who are bearing the brunt of the change”.

These are game changing findings, so let me put them into context of the overall debate. There has been a rather unproductive back-and-forth over whether or not robots are going to take our jobs. This dead end approach was something I warned about in my book Why The Future Is Workless when I wrote, “Let’s not go down the same route we have with climate change and mindlessly divide ourselves into camps of sceptics and advocates.

‘WORKLESS FUTURE’: Let’s instead bypass the ultimately futile argument about whether or not robots will take our jobs (they will) and make the imaginative leap, together, into a workless future that can liberate us all”.

Much of the argument has rested on the claim that technology ultimately creates as

many jobs as it destroys (an approach that author Calum Chace calls the (reverse Luddite fallacy").

Probably the most influential proponent of this argument is MIT economist David Autor. His important paper, Why Are There Still So Many Jobs? , although careful to allow for the fact that past behavior is not always a great indicator of future outcomes, nonetheless notes that "journalists and even expert commentators tend to overstate the extent of machine substitution for human labor and ignore the strong complementarities between automation and labor that increase productivity , raise earnings, and augment demand for labor".

As recently as last week, Australian economic commentator, Ross Gittins, ran a similar line in a strongly worded piece decrying so –called "futurologists" for scaring everyone about job losses. He wrote, "Improving the productivity of a nation's labour increases its real income. When that income is spent, jobs are created somewhere in the economy. Technological advance doesn't destroy jobs, it 'displaces' them from one part of the economy to another".

This claim, of course, was always as much a guess about the future of work as anything offered by dreaded "futurologists", but the point is, the NBER report makes it even more tenuous than it was. In fact, Acemoglu and Restrepo specifically argue there is little evidence of new jobs being created, saying the results "indicate a very limited set of offsetting employment increases in other industries and occupations.

What lends the NBER report added authority is it doesn't rely on modelling to predict what robots are likely to do to jobs in the future, but on hard data to look at what robots are already doing to jobs in the present. The results are so startling that even the authors were surprised, having previously taken a much more skeptical line.

Related: Robots will destroy our jobs – and we're not ready for it so where does this leave us? Well, we need to keep things in perspective. The future of work is a hugely complex issue, social and political as much as technological, and one new report, however important, hardly settles the matter. Nonetheless, Acemoglu and Restrepo's findings do give us a new baseline for our discussions.

In so doing, they will likely reanimate calls for a universal basic income, we are going to need new ways of distributing wealth.

The report also challenges the new-liberal tenet also unregulated markets and it can reasonably be taken to imply a large role for governments in managing the change that is coming. Additionally, it undermines the persistent claim that technology will create enough jobs in the future because this is what happened in the past.

Most importantly, the results suggest politicians and other who carelessly promise "jobs and growth" need to stop waffling and start taking seriously the fact that the future of work is going to be a very different beast to the past and present of work. We are likely to face not just different sorts of work, but far fewer jobs.

How we respond to this reality will be a huge test for our democracies, and this report is an important contribution to the ongoing debate.

Dawn-Guardian News Service.

(with courtesy of Dawn)

TRUMP' COAL POLICY WILL LIKELY DO JUST WHAT OBAMA' DID

Daily Time – April 2, 2017

President Trump's latest executive order on energy policy seeks to fulfill what he repeatedly promised during his campaign rallies: "A lot of people are going to be put back to work, a lot of coal miners are going back to work. The miners are coming back." Understandably, laid-off and underemployed miners in Appalachian hollows like to hear his message – but few of them will actually be hired. Robert Murray, chief executive of the country's largest privately held coal-mining company, put it bluntly: "He can't bring them back."

This reality has almost nothing to do with government's preferences or orders: The retreat from American coal mining was not caused by President Barack Obama's environmental regulations or by any ideological dislike of the fuel that provided the energy foundations of modern civilization. The history of energy use is a sequence of transitions to sources that are cheaper, cleaner and more flexible.

Size of the markets and technical imperatives make these transitions relatively slow, but the process is inexorable. That is why coal displaced wood and charcoal and why in turn, its former uses (rail-roads, shipping, household heating, industrial production) were displaced by fuels refined from crude oil and by natural gas.

At the beginning of the 21st century, global coal use was largely limited to two big remaining markets: generating electricity and using high quality coal to produce metallurgical coke to produce iron (which is then turned into steel). In 2000, the United States derived half of its electricity from coal – a substantial share of it produced in aging plants built during the 1952s and 1960s (the decades of rising electricity demand). At this point, natural gas generated only 16 percent of electricity, and its stagnating domestic production seemed to make future large-scale imports of natural gas inevitable. Then came the rapid advances of hydraulic fracturing (shale gas and oil), and by 2009, the United States once again become the world's largest producer of natural gas.

The economics became irresistible. Burning clean natural gas in highly efficient gas turbines (which can convert 60 percent of fuel's energy, compared with 40 percent in the best coal-fired stations) became the most obvious choice. Secondarily, falling costs of wind turbines and solar panels make these new renewables more affordable in windy and sunny locations.

The result has been dramatic: in 2016, 30 percent of U.S. electricity came from coal (a reduction of more than 40 percent in 15 years). 34 percent originated from natural gas, and more than 6 percent came from wind and solar. Coal might not have fallen so quickly had electricity demand kept growing, but since 2010, consumption has been wither flat or slightly declining. The other formerly large coal market is almost gone: More than 90 percent of China's steel production starts with iron produced in blast furnaces fueled with coke, but two- thirds of America's declining domestic steel production now comes from recycled metal melted in electric arc furnaces. As a result, coking coal's share in America's overall coal use has fallen below 3 percent.

And while the United States is still a net coal exporter, foreign sales declined by nearly 60 percent between 2014 and 2016. International coal prices have been falling as well. So where would additional coal go in a country with stagnating electricity generation that is now dominated by natural gas, with marginal need for coking coal and with plummeting exports in a softening global market?

Exceptional circumstances can accelerate the gradual process of energy transitions: France's decision to develop nuclear energy on a grand scale is perhaps the best example of how that can be done by government fiat. In contrast, America's accelerated shift from coal has been driven by an inevitable embrace of cheaper natural gas.

And this substitution has another welcome consequence: Because per unit energy natural gas combustion produces only about 45 percent of the carbon dioxide that coal does, energy related emissions of this leading greenhouse gas in the United States declined by about 15 percent since fracking took off in 2005 – at a faster rate than in Germany with its "Energiewende, a highly subsidized pursuit of accelerated shift to non-carbon energies.

This all leads to an unexpected conclusion: Actions by Trump may have as little effect on America's energy use as did those issued by the previous administration. Economic and technical imperatives – not any preconceived directives – will keep propelling the process of energy transition.

(Courtesy the Washington post)

TOLL FROM COLOMBIA MUDSLIDE SOARS TO 200

Dawn – April 3, 2017

MOCOA: Colombia on Sunday mourned the deaths of an estimated 200 people in the mudslide devastated town of Mocoa as rescuers searched from survivors in a sea of muck and debris.

A "profoundly saddened" Pope Francis weighed in with a message of grief and solidarity with the suffering people of Mocoa, a town of 40,000 in Colombia's Amazon basin.

"I pray for the victims and want to assure those who weep for the missing of my closeness to them," the pope said in a statement.

The torrent of mud, boulders and debris struck the town with little warning on Friday after days of heavy rains that caused three rivers to flood.

It swept away homes, bridges, vehicles and trees, leaving piles of wrecked timber buried in thick mud.

The Colombian Red Cross put the number confirmed deaths at 200, adding that it was unclear how many people were still missing. Earlier reports said more than 100 were unaccounted for.

At least 203 people were injured, some 300 families were affected and 25 homes destroyed, the Red Cross said.

As the rain lifted, residents picked their way through a landscape of destruction looking for loved ones or trying to salvage meager belongings.

Most of the hardest hit neighborhoods are poor and populated with people uprooted during the country's five decade long civil war.

Marta Ceballos, a 44 year old street vendor, said she lost everything to the mudslide but says she is thankful her family is alive. "Dear God, I don't want to even remember that", she said.

“To see how some people screamed and others cried, ran, tried to flee in cars, and how they were trapped in the mud. It’s all too, too difficult,” she said.

“The only things I fortunately did not lose were my husband, my daughters and my nephews,” she said.

Light rain and showers were in the forecast for Sunday but precipitation was expected to diminish Monday and Tuesday, Colombia’s national weather institute said.

President Juan Manuel Santos was scheduled to return to Mocoa, the capital of the department of Putumayo, along with cabinet ministers to supervise rescue efforts in the heavily forested region.

The president met with rescuers and survivors in Mocoa on Saturday, and declared a public health and safety emergency to speed up rescue and aid operations.

Putumayo Governor Sorrel Aroca called the event: “and unprecedented tragedy” for the area. There are “hundreds of families we have not yet found and whole neighborhoods have disappeared,” he told W Radio on Saturday.

Carlos Ivan Marquez, director of the National Disaster Risk Management Unit, said the mudslides were caused by the rise of the Mocoa River and its tributaries. Some 130 millimeters of rain fell on Friday night, Santos said.

“That means 30 percent of monthly rainfall fell in one night, which precipitated a sudden rise of several rivers,” he said. “Our prayers are with the victims and those affected,” he added.

One thousand emergency personnel, including soldiers and local police, were deployed to help the rescue effort. Mocoa was left without power running water, and there reports of people looting stores searching for bottled water.

“There are lots of people in the streets, lots of people displaced and many houses have collapsed,” retired Mocoa resident Hernando Rodriguez, 69, said by telephone – AFP.

(with courtesy of Dawn)

UPGRADED INFRASTRUCTURE TO BOOST INVESTMENT, SAYS ADB REPORT

Dawn – April 7, 2017

ISLAMABAD: The upgrade of Pakistan’s infrastructure is expected to attract direct investment from abroad, including mature industries in China which seek lower-cost locations, the Asian Development Bank says in new report.

The China-Pakistan Economic Corridor will significantly address Pakistan’s infrastructure deficit caused by annual spending on infrastructure at only 2-3 percent of GDP over the past four decades. The CPEC is planned to be completed by 2030. Higher economic growth in fiscal year 2018-19 reflects accelerated infrastructure investment through CPEC, which is steadily lifting consumer and investor confidence and, thereby, further catalyzing economic activity, the report says.

The large investment in infrastructure should boost construction and related industries, spurring job creation and growth, and in the long run, goods from China transiting from northern Pakistan to the seaport will bolster the transport sector, further stimulating

private investment and activity, the Asian Development Outlook 2017 states.

At the same time, CPEC investments are likely to require significant increases in imports of equipment and services to implement the projects. In the medium to long term, therse inflows will likely to be followed by financial outflows as loans are repaid and profits repatriated to foreign investors. Higher foreign exchange earnings and exports will be needed to avoid pressure on the external account, the report emphasizes.

To reap the potential benefits of CPEC and shift the economy of Pakistan to a higher growth trajectory, the government must continue to address key constraints on growth. Domestic security has improved significantly in recent years, but consolidating these gains will take continued efforts.

The government has indentified “early harvest” infrastructure projects that will be completed over the next few years. Of these, $21 billion will be spent on energy projects. These will be financed by foreign direct investment from China, supported by borrowing from banks there.

Independent electricity generating firms will be offered guaranteed tariff for their sales to distribution companies that will ensure at least 17 percent return on equity. About $10 billion investment in transport infrastructure will be financed by a combination of concessional and commercial loans from the Chinese government.

(with courtesy of Dawn)

LOOMING WATER CRISIS

Daily Time – April 9, 2017

For an agrarian economy like Pakistan, a water crisis of the kind we are currently facing becomes an existential question. Let us examine the nature and extent of the crisis.

Groundwater supplies are depleting at 16-55 centimeters (6-21 inches) a year, according to a study carried out by the International Waterlogging and Salinity Research Institute (IWASRI), a part of the Water and Power Development Authority (WAPDA). The study says about 145 million acre feet of water flows through Pakistan each year, but the country’s existing storage capacity is only 14 million acre feet. This means Pakistan can only store enough water to last 30 days. The international standard is 120 days.

The water shortage is forcing many farmers in Punjab and some parts of Khyber-Pakhtunkhwa to abandon cultivation due to the high fuel cost of watering their land by electric power. Consider the catastrophe we are setting ourselves up for – in a country where more than 50 percent of the population is food insecure.

According to the 1960 Indus Water Treaty, signed under the auspices of the World Bank, the Ravi, Beas and Sutlej were allocated to India. Similarly, Pakistan was assigned first right to the western rivers – Jhelum, Chenab and Indus. Due to controversies over the building of the Kalabagh Dam on the River Indus the government has turned to the construction of the Diamer-Bhasha Dam. This project, too, is not entirely free of disputes between provinces upstream and further down the river. Securing global funding – in terms of foreign aid to build such a vast project is not easy. It is made even harder by the well-known and much-publicized deleterious

effects of such projects on the riverine environment. The looming water crisis is also impacted by the disastrous effects of climate change on the Himalayan galciers – nature's own fresh water storage system. Traditional irrigation methods used by our farmers add to water woes. Instead of using water according to the seasonal crop demand, farmers are in the habit of inundating fields – a most wasteful approach. This means our cultivators are urgently in need of awareness regarding water usage.

The most effective and state-of-the-art drip sprinkler irrigation system is not common enough in Pakistan. The government needs to build small water storage structures to replenish groundwater levels, as well as to collect rainwater.

Disaster might still possibly be averted. But that will not happen unless the government deals with our water crisis on an emergency basis. There can be no plan B if our agrarian economy is parched into collapse.

(with courtesy of Dawn)

UNTREATED INDUSTRIAL EFFLUENTS POLLUTING GROUNDWATER WARM EXPERTS

Dawn – April 21, 2017

Faisalabad: Industrial effluents are polluting groundwater reserves, causing various fatal diseases and environment pollution, while the crops and vegetables being irrigated with this water can also cause serious health hazards to consumers.

The warning came at a seminar titled "Water footprint of cotton value chain" arranged by the University of Agriculture Faisalabad (UAF) on Thursday.

Addressing the seminar, UAF Vice Chancellor Dr. Iqrar Ahmad said the industry was polluting groundwater which was harmful for both agricultural and domestic use.

He urged the experts, scientist and policy makers to play their role to cope with the challenge of pollution.

"We are not treating industrial waste that is deteriorating the situation," he said, adding that water being pumped out through tube-wells was lowering down groundwater level, besides affecting the water quality.

Stressing the need for promoting awareness about judicious use of water, he said one of the major socioeconomic challenges was mismanagement of water resources. He said water was key natural resource for irrigation, food security, economic growth, energy production and human health.

He also urged those concerned to step up efforts to control effects of waste water released by the industry.

"We need to promote less water intensive crops in view of water shortage in the country. Water reserves had already shrunk from 5,000 cusec meter to 850 cusec meter, he warned.

Dr. Frank Andreas Weber from Aachen University, Germany, said Nitrate pollution of the groundwater was the biggest challenge in Germany.

He said strenuous efforts were needed to address the issue of the increasing pollution, hoping that strengthened Pakistan-Germany ties in academic and research fields would help address the issue.

He said water shortage was being witnessed all over the world and it could pose a threat to food security.

Dr Bernhard Tischbein from Bonn University, Germany, said rivers were also being polluted due to industrial effluents. He said collaborated efforts and interdisciplinary approaches were vital to fighting pollution and providing a healthy environment to the people.

UAF Faculty of Agri Engineering Dean Dr. Allah Bukhsh said industrial effluents treatment was essential for a healthy environment.

He said climate change was posing a serious threat and Pakistan was one of the most affected countries of the phenomenon.

(with courtesy of Dawn)

THE LOW COST OF ENDING POVERTY
Daily Time – April 23, 2017

Poverty is humanity's cruelest affliction. If you are extremely poor, you cannot afford to avoid even the easily curable disease that cause every sixth human death. Your lungs are likely to be filled with indoor air pollution, because, like 207 billion others, you cook and keep warm with fuels like dung and wood – with the same effect as smoking two packs of cigarettes every day. An inadequate diet makes your children grow up physically stunted and impairs their cognitive development, costing 4-8 IQ points on average. Such deprivation leads to profound stress and despair, making it difficult to act in ways that improve your life.

Of course, the world has made great progress in the fight against poverty. In 1820, nine out of 10 people lived in extreme poverty. The World Bank estimates that for the first time in human history, the global poverty rate dropped to single digits in 2015. Today 9.1 percent of the world's population, or almost 700 million people, live on less than $1.90 per day (or what used to be one dollar in 1985).

The $1.90 threshold for extreme poverty is a really tight limit: It is not what a wealthy tourist could buy in a low-cost, developing country. It is what an American could buy in the US for $1.90. The level is adjusted to the equivalent purchasing power in the local currency.

The late economist Anthony Clunies Ross made an initial attempt to calculate the cost of solving the poverty problems forever, by estimating how much money would be needed for cash transfers to lift every single person on the planet out of poverty.

Let us update his approach (an exercise also carried out recently by the Brookings Institution). We can start by looking, for example, at Indonesia – with some 257 million people, the world's fourth most populous country. Just 20 years ago, about half of Indonesians were poor, whereas in 2014 (the most recent estimate) shows just over 8 percent or 21 million people, below the $1.90/day threshold. On average, these Indonesians are 29 cents short of $1.90; so 21 million people need 29 cents more every day – or about $6 million in total – to get out of extreme poverty. Over a year, that adds up to $2.2 billion.

Since this is based on what Americans could buy for $2.2 billion in the US, the actual cost in Indonesian rupiah would be much lower. The exchange rate cost would be about $700 million in actual dollars.

With an estimated 268 million people in extreme poverty in the latest survey from 2011, India is home to the largest absolute number of poor people on the planet. Each is on average 38 cents an day below the extreme poverty line. For India, the cost adds up to almost $11 billion exchange rate dollars.

The most expensive countries in which to end poverty would be the Democratic Republic of Congo and Nigeria. In the DRC, 77 percent of the population is extremely poor and falls a dollar short of the poverty line, on average. Combined with a weak exchange rate, the cost for the DRC runs to more than $12 billion actual dollars.

Adjusting for the lack of data from states like North Korea, Yemen and Zimbabwe, the total cost of eradicating poverty based on the latest available data appears to be somewhat less than $100 billion actual dollars. Brookings has extrapolated previous trends and data from other countries within regions, and finds that the cost in 2015 could well be as low as $75 billion annually. To put this figure in context, the world spends $140 billion on development aid each year.

Of course, this is a thought exercise with limits. In the real world, it would not be possible to identify all of the world's needy poor and distribute exactly 29 cents or 38 cents without incurring much higher costs. But it does let us identify the scale of the world's biggest problem.

It is expected that there will be slightly fewer than 400 million poor in 2030, and income growth should almost completely eradicate poverty by 2060. Based on this information, we can estimate the aggregated future cost of eradicating poverty at about $1.5 trillion. If we set aside the money now in a fund (which would accrue interest over the next 45 years), we would need a litter less than $1 trillion to eradicate human poverty forever.

A trillion dollars sounds like a huge deal. In fact, it is equivalent to roughly 1 percent of annual global GDP, 18 months of US military spending, or one-twentieth of US national debt. It is also equivalent to the cost implied by just one year of the Paris climate agreement, which promises – if we keep paying a trillion every year – to rein in temperature rises by 0.17^{o} C in 2100.

The real tragedy is that the best solution to poverty would not cost a thing. Broad-based economic growth has always been the most effective pathway to reducing deprivation; Over 30 years, China's economic growth spurt lifted an unprecedented 680 million people above the poverty line. A global free-trade agreement – such as a successful conclusion to the stalled Doha Development Round would likely lift another 160 million people out of poverty.

Global skepticism about free trade on the part of US President Donald Trump and others means that we are missing out on an incredibly important opportunity. In the meantime, we should champion the most powerful development investments: Spending on child nutrition, immunization, early childhood education and scholarships for girls can lead to meaningful, lifelong improvements in health and income levels.

But we should also realize that, for the first time ever, an end to poverty is actually within humanity's financial reach. And we should challenge our political leaders to account for expensive policies that achieve much less.

(with courtesy of Daily Times)

WORLD BANK, AMUNDI LAUNCH $2 BILLION GREEN BOND FUND

Express Tribune – April 23, 2017

WASHINGTON: The World Bank's private financing arm on Friday launched a joint venture with Europe's largest asset manager, Amundi, to create a $2-billion green bond fund to unlock financing for environmental projects in developing countries.

According to Amundi's Deputy Head of Institutional Clients Frederic Samama, in the wake of the Paris climate deal there is greater interest in finding new ways to direct financing towards environmental projects, such as renewable energy.

"People have realized we will only tackle climate change if we are able to mobilize the civil society as well. It's no longer just in the hands of policymakers," he told AFP, adding that the goal of the fund is to mobilize financial markets.

He said Amundi already has tested the waters with large institutional investors, including pension funds in Sweden, France and Germany, and a sovereign wealth fund in New Zealand, and "received very good feedback".

The World Bank's International Finance Corporation (IFC) will invest up to $325 million in the new Green Cornerstone Bond Fund, which will buy green bonds issued by banks in Africa, Asia, the Middle East, Latin America, Eastern Europe and Central Asia.

Amundi will raise the rest of the $2 billion from institutional investors worldwide and will provide its services in managing emerging market debt. The fund will gradually shift investments to green bonds, and aims to be fully invested in green bonds within seven years.

IFC CEO Philippe Le Houerou said the fund will "lower the risk for the private sector and attract new investors – essentially creating a market where there was none".

"We've already identified dozens of banks in many developing countries around the world that could be interested in this fund. It's a win-win, supporting the green economy and deepening access to international markets for emerging market issuers," he said.

Meanwhile, Samama said that while there was a limited pool of green bonds at the moment, the size and protection offered by the new joint venture will attract investors and in turn encourage banks in developing countries to issue these vehicles to finance green projects.

"We hope demand from investors will accelerate the issuance of green bonds." **AFP.**

(with courtesy of Express Tribune)

EXPERTS CALL FOR EDUCATING PEOPLE ON ENVIRONMENT, CLIMATE

Express Tribune – April 23, 2017

MARIAM SHAFQAT LAHORE: Education can play a pivotal role in addressing environmental problems, which are increasing day by day, said WWF-Pakistan Director General Hammad Naqi Khan on Saturday.

Earth Day 2017 was marked in Lahore on Saturday themed around environmental and climate literacy, highlighting the vital role of education in providing solutions to challenges confronting the planet.

WWF-Pakistan in collaboration with agility organized an Earth Day event at Ali Institute

of Education (AIE) in Lahore. Around 70 employees of both organizations planted trees within the premises.

“With quality education, we can inspire action towards environmental protection and sensitize people to adapt green technologies,” he said in a statement issued for the day.

Hammad was of the view that people should switch to alternative energy, discontinue use of plastic bags, conserve freshwater bodies and make effective and wise use of natural resources. “In the past couple of years, humans have been breaking the wrong kind of record.”

Each passing year has been declared the hottest year compared to the previous one. “It is time to take environmental and climate issues seriously and mobilize people to develop public momentum to mitigate greenhouse emissions, increase tree cover, reduce pollution and protect endangered species.” He stressed.

Another event, in partnership with Teradata, was organized at the Changa Manga forest.

The participants planted saplings and showed commitment to protect the earth through increasing tree cover in Lahore. They pledged to plant more trees at their homes and neighborhoods, encourage a paperless environment, use energy efficient appliances and adapt recycling for sustainable use of resources.

The Access to Climate Justice Committee (ACJC) also celebrated Earth Day at the Lahore High Court auditorium.

ACJC Chairperson Asif Ali Sayal Said the government remained politically negligent on tackling climate change. “Even though a climate change law has been passed, it was done without taking environmental experts on board,” he lamented.

“Environmental protection should not be taken as an action but as an attitude since there is a need to involve communities through government institutions at all levels,” Asif said. “We should formulate a law, which requires every person to participate in or contribute towards environmental friendly activities.”

(with courtesy of Express Tribune)

ANTARCTICA WAS ONCE COVERED BY LUSH SUBTROPICAL FORESTS

Daily Time – April 23, 2017

According to scientists, nearly 300 million years ago, the frozen, inhospitable Antarctica was once covered by lush subtropical forests. Scientists have found that Antarctica, the frozen and inhospitable for nearly 300 million years ago was once covered by lush subtropical forests.

Marcelo Leppe, a paleontologist who works with the Chilean Antarctic National Institute, told Efe news on Friday, “That Antarctica was once green is a matter of consensus among scientists, but still unknown to many people.”

Leppe, Chile’s representative to the international Scientific Committee on Antarctic Research, has spent his professional life searching for fossils that offer clues to the origins of the flora and fauna of the White Continent.

Leppe said that forests began to appear in Antarctica some 298 million years ago

during the Permian geologic period, as glaciers retreated and the global climate entered a warming phase.

Fossils from the subsequent Jurassic period reveal the existence of fern and conifer forests where the Cryolophoasaurus species of dinosaur thrived. But the golden age of vegetation in Antarctica was the Cretaceous period, which began 145 million years ago and lasted until around 66 million years ago.

Leppe said, “Roughly 89 million years ago, walking in Antarctica was like walking today in a tropical of subtropical forest, something like what we could encounter in south-central Chile or in New Zealand.”

One thing that still puzzles scientists is how the forests survived the six-month-long Antactic night.

The paleontologist said, “We know that some dinosaurs migrated before the arrival winter, but in the case of plants, the matter continues to be an enigma.”

While the plants would have received as much as 22 hours of light per day during the Antarctic summer, “that doesn’t necessarily imply that they had the capacity to carry out photosynthesis for longer hours than now,” he said. The tundra that was the last vestige of the forests disappeared 15 million years ago, leaving Antarctica a frozen desert.

Now, however, scientists see grass and wild oats growing the areas of Antarctica where the ice has retreated due to global warming, Leppe said. Climate change, the introduction of invasive plants, and the retreat of the glaciers are creating the conditions for the White Continent to turn green again.

(with courtesy of Daily Times))

3,000 MANGROVE SAPLINGS PLANTED ON EARTH DAY

Daily Time – April 23, 2017

Karachi: Around 3,000 mangrove saplings were planted at Khipranwala Island off the Karachi coast on Saturday to mark the importance of the Earth Day.

The event was organized at by Mera Karachi a volunteer based platform with more than 56,000 members in Pakistan, Caritas Pakistan, Sindh Forest Department, LSO FARD Rehri, Ecolife organization, IUCN Commission on Ecosystem Management and Mangrove for Future Pakistan.

More, than 80 Experts, local community representatives, senior government officials of Sindh Forest, members, stakeholders, professionals and students participated in this event and planted 3,000 mangrove saplings at the Island.

Mera Karachi Group Founder, Imran Ahmed while speaking to media and participants said; in metropolis city like Karachi mangroves play a vital role by providing oxygen and defense from coastal hazards to the city. Furthermore, he added healthy mangroves and healthy mudflats along Karachi coast, Thatta and Baluchistan can ensure protect business, healthy harbors and coastal cities. He emphasized on protection and up scaling of mangrove work and demanded from the responsible authorities full protection of natural resources in coastal areas. He admired the Forest Department’s efforts for increasing mangrove cover on Karachi coast and asked other stakeholders for their contribution and support in this mission to make coast green for

the future of our coastal cities, their environments and businesses to cope with climate change.

While speaking to the media and stakeholders Conservator coastal Forests Agha Tahir Hussain described the activity very helping to the Mangrove Mission they are working on since long on Singh Coast. He told media that till now 64,000 ha of mangroves have been planted under two ongoing Sea Intrusion Projects funded by Government of Singh. Furthermore, he added that Sindh Forest Department had completed earlier 11,000 ha plantation under Sindh Coastal Community Project and overall mangrove resource developed is about 180,000 to 200,000 in Indus Delta. He added that community based mechanism for protection of theses planted areas have been established and community is equally getting benefits under ongoing projects. He said mangroves not only cover the coast of Singh besides these are providing enormous environmental, economic and ecological benefits to the people, province and country.

He welcomed the stakeholders, communities and organization concern and support on mangroves on World Earth Day. He assured his support and cooperation in future as well. Mr. Azizullah Rajpar, Range Forest Officer briefed participants and media that every year Coastal forest Division raises about 30,000 ha on Sindh Coastal including Karachi.

Speaking to Media and participants Expert IUCN Commission and Founder of Ecolife organization Nadeem Mirbahar said that mangroves not only are lungs that provide oxygen to citizens of Karachi but these serve more than this these are good soil binders, treat to some extent polluted water, provide habitats to fin fish, crabs shrimps and to many marines birds, cetaceans and shell life. They play vital role for mangrove dependent fishermen communities; protect harbors, coastal installations and city from cyclones and sea intrusion and erosion impacts.

Globally, Earth Day 2017's Campaign was launched with a slogan "Environmental & Climate Literacy" which further emphasizes to build a global citizenry fluent in the concepts of climate change and aware of its unprecedented threat to our planet. It endorses need to empower everyone with the knowledge to inspire action in defense of environmental protection to accelerate and support green technologies and jobs.

Mangroves for the Future (MFF) partner-led initiative to promote investment in coastal ecosystems also provided assistance in organization of the event at Khiparnwala.

(with courtesy of Express Tribune)

GOVT. STAYS SILENT AS TIDES SWALLOW UP PARTS OF COASTAL VILLAGE

The Nation – April 26, 2017

KARACHI: Threatened by a sea that is fast devouring their land, the residents of Damb, a small seaside village in Sonmiani, Balochistan's Lasbela district, have urged the government to take immediate measures for securing the coast. They also demanded compensation payment to all those affected by disaster that struck the village.

On the morning of April 16, 2016, intense wave action swallowed over 43,000 square feet of land (around two acres) in various points of the village.

“The erosion spell started in the morning large pieces of land falling apart in the northern-western side of Damb that exists in the Miani Hor Lagoon,” Master Abdul Rasheed of the Sonmiani Development Organization said, adding that more than 200 structures, including houses and shops had been lost in the disaster.

“People here are still recovering from the April 16 devastation; they saw their houses, shops and fishing vessels being drowned in the sea in a matter of few hours. What is more ironic, perhaps, is the muted response from the government,” said Muhammad Anwar, a village representative heading the community based Coastal Association for Research and Development, a non-governmental organization.

He explained that the perils of coastal erosion have been a part of the villagers’ life, but there has been an increase of its intensity in recent years. “We have never seen such an intense wave action before. We believed that the area’s vulnerability to coaster erosion has increased manifold due to a faulty jetty constructed here over a decade ago,” he said.

Master Rasheed added that the continued sea erosion had resulted in a loss of a major portion of the coastal market, besides affecting the Pakistan Coast Guards’ office and a seafood processing plant. As a result of the tragedy, fishermen now face difficulty in docking their vessels.

“Contacts with government officials, including the Provincial Disaster Management Authority (PDMA) the deputy commissioner and the coastal development authority haven’t materialized into any action. In fact, the PDMA told us that sea erosion did come with their purview,” said Mr. Anwar.

A team of the National Institute of Oceanography (NIO) experts from Karachi, however, visited the area and collected information and data about the erosion. “An area of over 43,000 square feet has been lost in the recent disaster. The fact that Damb is located in a lagoon makes it more vulnerable to sea erosion. Unfortunately, the construction of a faulty jetty over a decade ago and a breakwater has increased this vulnerability multiple times,” said Naimatullah Sohoo, a senior coastal engineer with NIO.

He explained that another factor which had contributed to sea erosion was a narrowing of the lagoon’s mouth. “Its size has decreased from 2km to 1km due to sedimentation, further intensifying wave action. Besides seafloor is composed of loose sand, not solid material.”

He said a PC-1, which addressed the issues of sea intrusion and land subsidence in Sindh and sea erosion in Balochistan had been submitted to the government and its approval would help improve the situation.

(with courtesy of Nation)

WATER SCARCITY HIGHLIGHTED

The Nation – March 27, 2017

Per capita water availability in Pakistan is approaching the stage of acute water stress due to combination of domestic, industrial, commercial and agricultural activities.

This was stated by the speakers at a seminar organized by Pakistan Engineering Congress to mark the World Water Day. The seminar on theme of “Waster Water” was addressed by Pakistan Engineering Congress president Engr. Ch. Ghulam Hussain,

Dr. Izharul Haq, Dr. Nawaz Bhutta and Dr. Saleem Sarwar. Engr. Hussain in his lecture on “Waster Water” SAID THAT wastewater for irrigation may contain unsuitable chemicals and result in delayed crop maturity and under yielding. Untreated wastewater discharged into fresh water bodies or sea may contain pathogens and harmful dissolved chemicals, which can affect fishing in that area. Similarly, smell in those may discourage tourism, he added.

He said wastewater is a big health issue as it carries and transports a myriad of diseases and illnesses. “According to WHO, about 3 million people die annually due to diarrhoeal disease. At least another 2 million children under 5 years die every year due to water related diseases or one every 20 seconds,” he added.

He said that wastewater treatment for its beneficial reuse is a dire need of Pakistan with particular focus on municipal sewerage and industrial effluent. He suggested that water bodies, entirely within national jurisdiction, should be subject to multiple regulations of local governments. Disposal into rivers crossing international boundaries or sea may be subject to bilateral or multilateral treaties. The options available in this case are evaporation ponds, infiltration basins or injection wells, he added.

Dr. Izhar in his lecture of “Water availability in Pakistan and Wastewater” observed that increasing demand of water for agricultural, domestic, industrial and municipal purposes has rendered it imperative to take stock of water availability in Pakistan and present scenario of wastewater generation and its ultimate environment friendly recycling for use. The economy of Pakistan to a large extent depends upon the Indus River system inflows. Pakistan can be classified as one of the arid countries on globe with average rainfall of 240mm a year.

He said that agriculture sector uses lion’s share of available water. Much of the available surface and groundwater, approximately 200 MAF, on the average, is predominantly used for agriculture, which contributes about 25 percent of GDP of Pakistan, and about 60 percent of export earnings. The other utilizations are domestic water supply and sanitation and industrial sectors. There are scores and factors that appear to threaten the present precarious availability of fresh water. The major driving forces that threaten future sustainable water availability in Pakistan include; droughts, climate change, low water use efficiency and untreated disposal of wastewater. “To cope with this situation, we need water storage/water retention facilities on war footing”, he said. Other sustainable water management measures include; water conservation, efficient use of water, rainwater harvesting and grey water treatment.

The quantity of wastewater produced in Pakistan is 962,335 million gallons, including 674,009 million gallons from municipal and 2,88,326 million gallons from industrial use, he added. The total wastewater discharged to the rivers is 392,511 million gallons, which includes 316,740 million gallons of municipal and 75,771 million gallons of industrial effluents. “If we look at percentage composition of various contributing sectors; then 73 percent wastewater is of residential origin, 16 percent is contributed by agriculture sector, while 6 percent and 5 percent is respectively shared by the industrial and commercial sectors.”

Dr. Izhar said there is no national policy on sustainable use of wastewater in Pakistan. A negligible portion i.e. 8 percent of wastewater is treated through sedimentation ponds to a primary level only but most of the treatment plants are not functional, therefore, the figure can be estimated around 1 percent. There is no existing concept

of treatment at secondary and tertiary level. The problem of industrial water pollution has remained uncontrolled because there have been little or no incentives for industry to treat their effluents. In villages the wastewater is disposed of by drains to open ponds or soakage pits resulting in unhygienic conditions. “We need to inculcate awareness and commitments to reduce the lavish use of water and its pollution, treat wastewater and reuse,” he suggested.

(with courtesy of Express Nation)

WELCOME TO NEW MEMBERS

The Executive Council of the Pakistan Engineering Congress 74th Session approved Membership of the following new members into the Congress fold. The Engineering News congratulates all of them and welcomes them to Pakistan Engineering Congress.

Members admitted on 74th/4th meeting of Executive Council held on 22-04-2017.

Sr.#	Name	Sr.#	Name
1	Engr. Mudassar Iqbal	26	Engr. Hafsa Riaz
2	Engr. Muhammad Ammar	27	Engr. Muhammad Afzal
3	Engr. Usman Javed	28	Engr. Sohail Maqsood
4	Engr. Bushra Saeed	29	Engr. Abdur Rehman
5	Engr. Syed Muhammad Munawar Hussain	30	Engr. Atiq ur Rahman
6	Engr. Shujaat Ali	31	Engr. Adnan Wajid
7	Engr. Muhammad Ijaz Rabbani	32	Engr. Muhammad Farrukh Zeeshan Baloch
8	Engr. Muhammad Badar	33	Engr. Muhammad Hamza Ali Khan
9	Engr. Muhammad Rizwan	34	Engr. Muhammad Ahsan Mansoor
10	Engr. Syed Muhammad Umer	35	Engr. Zulfiqar Ali
11	Engr. Mehtab Ejaz Qureshi	36	Engr. Maria Kanwal
12	Engr. Ahmad Hussain	37	Engr. Ather Iftikhar
13	Engr. Qaisar Mehmood	38	Engr. Fozia Qureshi
14	Engr. Muhammad Bilal Sharif	39	Engr. Naima Iram
15	Engr. Muhammad Salman	40	Engr. Muhammad Waseem Afzal
16	Engr. Khawaja Muhammad Awais Omer	41	Engr. Tanveer Ahmed
17	Engr. Shamsullah Shah	42	Engr. Muhammad Umair Anwer
18	Engr. Hamad Ali	43	Engr. Muhammad Farooq Azam
19	Engr. Ahmad Jawad	44	Engr. Tauqeer Iqbal
20	Engr. Nusrat Ali	45	Engr. Muhammad Imran Baig
21	Engr. Asad Hussain	46	Engr. Shafiq ur Rehman Massan
22	Engr. Ishtiaq Ahmad	47	Engr. Muhammad Zeeshan Akhtar
23	Engr. Muhammad Moayed Ali	48	Engr. Mehran Khurshid
24	Engr. Sajjad Safdar	49	Engr. Mubasher Bajwa
25	Engr. Malik Muhammad Abdullah Hassan	50	Engr. Hafiz Muhammad Aamer Zaman

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TECHNICAL VISIT TO REHABILITATION AND UPGRADING OF TRIMMU BARRAGE

On April 18, 2017

A 10-Member delegation of Pakistan Engineering Congress paid a Technical Visit to the Trimmu Barrage on March 18, 2017. The delegation was led by Engr. Dr. Muhammad Saeed, Member Executive Council/Additional Chief Engineer IWASRI (WAPDA). After the briefing session and visit to the work site the delegation returned to Lahore in the evening.

TRIMMU AND PANJNAD BARRAGES IMPROVEMENT PROJECT (TPBIP)



06-Apr-17	Project Brief
	TPBIP aims to rehabilitate and upgrade the 77 years old Trimmu barrage and 87 years old Panjnad barrage on river Chenab in Pakistan. The proposed rehabilitation and upgrading of these barrages will improve their hydraulic performance and reduce their risk of failure.

General

Water is a critical resource for sustainable economic development of Pakistan and in this perspective irrigated agriculture is of great importance in the socio-economic life of the country. It provides linkages and ripple effects though which growth in other sectors is stimulated. Pakistan's agriculture primarily depends upon irrigation and irrigated lands supply more than 90% of the total agricultural production, account for about 25% of GDP, and employ around 43% of the labour force. They supply most of the country's needed food-grain and also are the source of raw materials for major domestic industries and exports. Timely availability of water greatly influences crop production and yields. In order to meet the agricultural needs therefore adequate and timely availability of water is an essential pre-requisite.

Irrigated agriculture in Punjab province contributes 28% of Punjab's gross domestic

product (GDP), employs almost 54% percent of the labour force and uses more than 95% of the water resources. Punjab's agriculture is 66% of the national agricultural GDP. Irrigated agriculture is important for generating higher income and attaining Punjab's targeted growth rate.

The irrigation water is delivered to the field through a network of barrages, main canals, branch canals, distributaries, minors, sub minors and outlets. The irrigation system of Punjab (Fig-1) consists of about 23,184 mile length of canals, which command Culturable Commanded Area (CCA) of about 8.5 million ha (21 million acres). The 24 canal systems, which have a total capacity of 1.10 lac cusecs, draw their allocated discharges from 14 barrages of the Punjab.

Irrigated agriculture of Punjab contributes 21% to gross domestic product (GDP); Employs 50% of the labor force; and uses more than 90% of the water resources.

The barrages also control diversion of supplies to the inter-river link canals which transfer the water of the western rivers to the eastern rivers to cater for irrigation systems off taking from these rivers. The water from the rivers is diverted to Main Canals / Link Canals from Barrages and head Regulators and distributed to the farmer's fields through 58,000 outlets after flowing through the lengthy irrigation net-work.

The infrastructure has seriously deteriorated due to old aging (almost 100 years old), weak asset management planning and ineffective implementation of O&M. Deteriorated infrastructure causes unreliable irrigation services and high risks of its failure. Farmers adapted groundwater pumping for irrigation, which is also causing saline-water intrusion and land degradation. The Government of Pakistan identified the improvement of irrigation infrastructure among the priority areas. ADB evaluated the water resources and irrigation rehabilitation as core part for lending and emphasizes that both physical and nonphysical improvement are keys to sustained irrigated agriculture and reduction of rural poverty in Punjab.

Project Description

River Chenab drains 114,125 km2 at upstream of Trimmu Barrage. It has river Jhelum as main right tributary and Ravi and Sutlej rivers as left tributaries. Most of the upper catchment areas of river Chenab and its tributaries are located in India. On river Chenab, Marala barrage is the first hydraulic structure in Pakistan followed by Khanki, Qadirabad, Trimmu and Panjnad barrages. Trimmu Barrage is located downstream of confluence of Jhelum and Chenab rivers. Panjnad Barrage is located at downstream of Trimmu barrage at tail end of Chenab river.

Trimmu Barrage Trimmu Barrage formally known as Emerson Barrage was built on river Chenab, Punjab, Pakistan and was commissioned on 2nd April, 1939. The barrage has command area in semi-arid zone and irrigates a CCA of 2.68 million acres (13.19% of Punjab's total CCA) through three canals that are Haveli canal (5,170 cusec), Trimmu Sidhnai Link canal (12,500 cusec) and Rangpur canal (2,710 cusec). The present safe capacity of the barrage is 645,000 cusecs.

Panjnad Barrage Panjnad Barrage was constructed on River Chenab during the period 1925-1929 with a safe discharge capacity of 450,000 cusecs. In September 1929, a flood of 550,000 cusecs was received at the barrage site and the Islam enquiry

committee recommended raising its design discharge capacity to 700,000 cusecs. To implement the recommendations of Islam Enquiry Committee, the already constructed right guide bank was dismantled and an annexe weir comprising 14 bays (bays No. 34 to 47) was constructed, raising its capacity to 700,000 cusecs with the same HFL, crest RL and pond level. The barrage was re-commissioned in the year 1932. Currently, the barrage feeds a CCA of 1.83 million acres through three canals that are Panjnad canal (10,484 cusec), Abbasia canal (1,394 cusec) and Abbasia Link canal (5,600 cusec).

Project Components

Scope of work to be executed for Trimmu Barrage

- Enhancing the existing flood discharge capacity of Trimmu Barrage to 875,000 cusecs for passing 100-year return period flood discharge determined through hydrological analysis requiring.
- Rehabilitation and upgrading of existing Barrage and its ancillary works, enabling them to perform their designed functions and to ensure improved and reliable irrigation supplies.
- Partial removal of shoal (Bela)

Scope of work to be executed for Panjnad Barrage

- Enhancing the existing flood discharge capacity of Panjnad Barrage to 865,000 cusecs for passing 100-year return period flood discharge determined through hydrological analysis.
- Rehabilitation and upgrading of existing Barrage and its ancillary works, enabling them to perform their designed functions and to ensure improved and reliable irrigation supplies.

Contract No.	***TPBIP/ICB-01***	***TPBIP/ICB-02***
Contract Name	Rehabilitation & Upgrading of Trimmu Barrage	Rehabilitation & Upgrading of Panjnad Barrage
The Contractor	M/s Sinohydro Co. Ltd	Contract yet to be awarded
Total Cost	PKR 9,360,100,000	-
Time for Completion		
Preparatory Works	270 days	270 days
Civil, Electrical & Mechanical Works	1095 days	912 days
Letter of Acceptance	Nov 30, 2015	Not Notified
Notice to Commence	May 31, 2016	Not Served

Technical Visit to Rehabilitation & Upgrading of Trimmu Barrage



Glimpses of the Briefing Session

1. Mr. Ghulam Raza Khan, Chief Resident Engineer Trimmu Barrage, Trimmu Panjnad Barrages Consultants
2. Mr. Dai Kei, Mechanical Design Engineer, Sinohydro Corporation)



Group Photo of the Delegation

1. Mr. Ajmal, SDO Trimmu Barrage, Irrigation Department, Govt. of Punjab
2. Mr. Ghulam Raza Khan, Chief Resident Engineer Trimmu Barrage, Trimmu Panjnad Barrages Consultants



Glimpses of the Briefing Session



Group Photo of the Delegation with the Personnel of the Project



(From Left) Engr. Dr. Muhammad Saeed, Member Executive Council (PEC)/Leader of the Delegation presenting Shield of the Congress to Major (R) Ghulam Raza Khan, Chief Resident Engineer, TPB Consultants, Trimmu Barrage Jhang (on right).



(From Left) Engr. Dr. Muhammad Saeed, Member Executive Council (PEC)/Leader of the Delegation presenting Publications of the Congress to Major (R) Ghulam Raza Khan, Chief Resident Engineer, TPB Consultants, Trimmu Barrage Jhang (on right)

WELCOME ADDRESS

BY

ENGR. CH. GHULAM HUSSAIN[1],

PRESIDENT, PAKISTAN ENGINEERING CONGRESS

ON

BOOK LAUNCHING CEREMONY

ON THE TOPIC OF

"KALABAGH DAM – A GOLD MINE FOR PAKISTAN"

BY

ENGR. BARKAT ALI LUNA, CHAIRMAN,

NATIONAL DEVELOPMENT CONSULTANTS (PVT) LIMITED

ON MONDAY 15TH MAY, 2017

Honourable Chief Guest Engr. Asif H. Kazi, former Member (Water), WAPDA and Chairman Federal Flood Commission, distinguished delegates, Members Pakistan Engineering Congress. Ladies and Gentlemen:

اَلسَّلَامُ عَلَيْكُمْ وَرَحْمَةُ اللهِ وَبَرَكَاتُهُ

I feel extremely delighted to welcome you all to Book Launching Ceremony of ***"Kalabagh Dam- A Gold Mine for Pakistan".*** The author of this book Engr. Barkat Ali Luna, Chairman, National Development Consultants (Pvt) Ltd (NDC) is renowned Engineer of Water Sector. He started his career as a Class-I Engineer, which at that time was a very privileged position and rose to the position of Superintending Engineer in about 10 years. He worked as a Consultant to the World Bank. He took retirement of government service and started his career in private sector as Chairman, National Development Consultants (NDC) writing this book at his age of about 90 years well substantiate his patriotic and sincere commitment to the national interests.

This Book clarifies the doubts and misconception created about this Project by the opponents of Kala- Bagh Dam.

Ladies & Gentlemen, had Kala Bagh Dam been constructed as planned by WAPDA by early 2000, there would have been no energy crisis in the country and considerable industrial and agricultural development would have been achieved due to cheaper energy.

Ladies & Gentlemen:

HYDROELECTRIC power is the cheapest and cleanest form of energy. It is the most commonly used resource for generating renewable energy worldwide. However, Pakistan has miserably failed to harness this energy resource.

Federal Minister of Water and Power recently informed the National Assembly that the Appolo Solar Development limited, Best Green Energy Pak. Ltd, Crest Energy Pak.

[1] President, Pakistan Engineering Congress & Chief Executive, National Development Consultants (Pvt) Ltd

Ltd were generating electricity at the cost of Rs. 18.04 per kilowatt hour.

He further said the Quaid-e-Azam Solar Park has been granted tariff of Rs. 19.52 for every kwh while wind power projects Younas Energy and Tapal were charging Rs. 18.42 and Rs.18.44 for every unit of electricity.

Whereas, the cost of producing electricity from hydel was Rs. 1.88 during 2015-16 when some of the above power plants were granted a generous tariff by the National Electricity Power Regulator Authority.

Pakistan has potential of about 60,000 MW of hydropower generation. But WAPDA has been able to add only 7,116 MW of hydropower, to the national grid which is hardly 33 percent of the country's total generation capacity.

Several factors – inter-provincial discord on mega water storage projects, corruption, lack of funding for hydropower projects etc. – have contributed to slow progress on hydropower generation. Moreover, the policymakers' obsession with Kalabagh Dam also blocked hydropower development.

Almost all planned hydropower projects were put on the back burner after shift of focus of the decision makers in early 1990s, to thermal power generation based on imported oil, as a quick fix for electricity shortages, etc.

Nonetheless, the rising prices of thermal electricity appears to have re-focused policymakers on harnessing the country's hitherto neglected hydropower potential and increasing its share in energy mix to keep down the average cost of power generation.

It is learnt that government has planned to add over 16,000 MW of hydropower 10,997 MW in public sector and 5,347 MW in private sector to the system by 2024. At present only 214 MW, 3 percent of hydropower generation, is owned by the private sector.

Today's Pakistan faces twin problems of water and electricity scarcity. In case of electricity, we need more generation at affordable rates. Part of the solution for these issues lies in immediate development of new water storages and hydropower generation in the country.

Same is the case of water storage. Out of 142 MAF water (available under Indus Basin Treaty). Pakistan has a capacity to store only 15 MAF. Whereas 30 MAF or 20pc, worth $15bn. is allowed to flow directly into the sea. As a consequence, Pakistan has become a water stressed country. This situation warrants immediate action for starting the construction of Kalabagh Dam, Basha Dam and other mega dam projects, whose planning and designs have already been prepared by WAPDA.

Thank you again for your participation and patient hearing.

PAKISTAN PAINDABAD

Monday, May 15, 2017, Launching Ceremony of the Book "*Kalabagh Dam – A Gold Mine for Pakistan*"

At the time of the construction of Mangla/Tarbela Dam the World Bank advised that Pakistan should construct one Dam after every 10-Year to cope with its water and energy requirements. In line with this advice as per WAPDA's plan Kalabagh Dam should have been constructed by early 2000. Not only the Dam was not constructed on the plea of absence of National Consensus but no other Dam was also put in place. The result was that as against Hydel Power Potential of 60,000 MW. The Hydro Power being generated is only 7116 MW resulting in the present 3000 to 4000 MW Energy Deficit and the per capita availability of water sliding from 5000 cubic meters per capita in 1950 to 1000 cubic meters per capita in 2016.

In the launching of the above cited book authored by Engr. Barkat Ali Luna the speaker apprised the audience comprising of very Senior Engineers/ Young professionals academia about the benefits that would have flowed if the Dam was constructed as scheduled and the benefits that will ensue if it is constructed now as well as the Socio-economic implications of its Continued non-construction.

The event was well attended and broadly covered by the Media.

1. THE BEGINNING OF KALABAGH DAM

Impressed upon the World Bank (WB) the need for a Development Plan beyond Tarbela Dam. WB set-up 'Indus Special Study' under international experts of repute. After three years they produced a report titled 'Development of Water and Power Resources of West Pakistan – A Sectoral Analysis'. This report made the following recommendations.

i. If Pakistan wants to maintain its pace of progress then it must have a third large dam by 1992. And the preliminary engineering work on the dam must begin in 1977.

ii. This large dam should be Kalabagh dam followed by Basha dam.

WAPDA started investigations in 1977 and feasibility reports on Kalabagh dam were prepared twice. Work was completed in 1988.

Pakistan has got the largest irrigation network in the World for which the present use of water is as below:

Present Position of Water Use

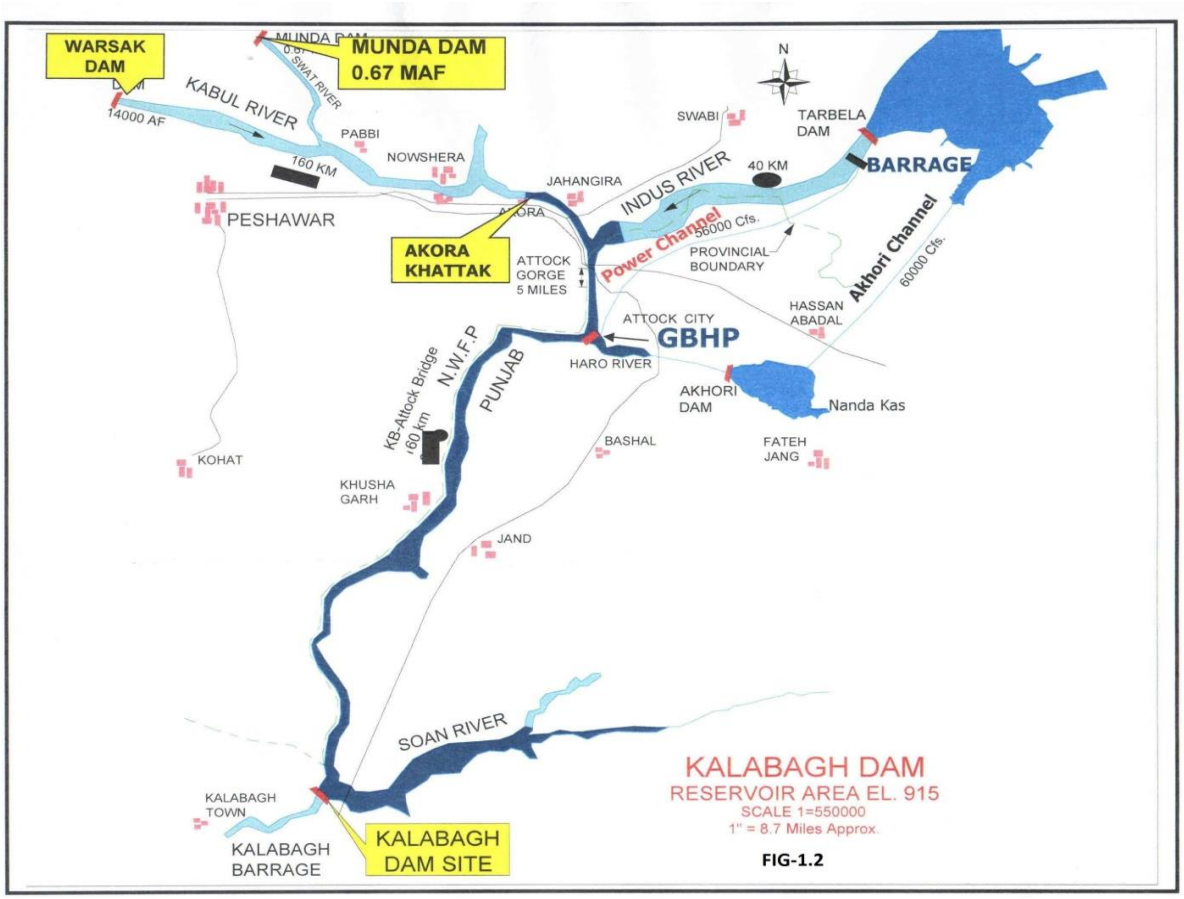
Season	Total Available (MAF)	Need in the Season (MAF)	Surplus (+), Shortage (-) (MAF)
Summer	114.7 (83%)	79.1 (69%)	(+) 35.6 (31%)
Winter	23.1 (17%)	38.2 (28%)	(-) 15.1 (11%)

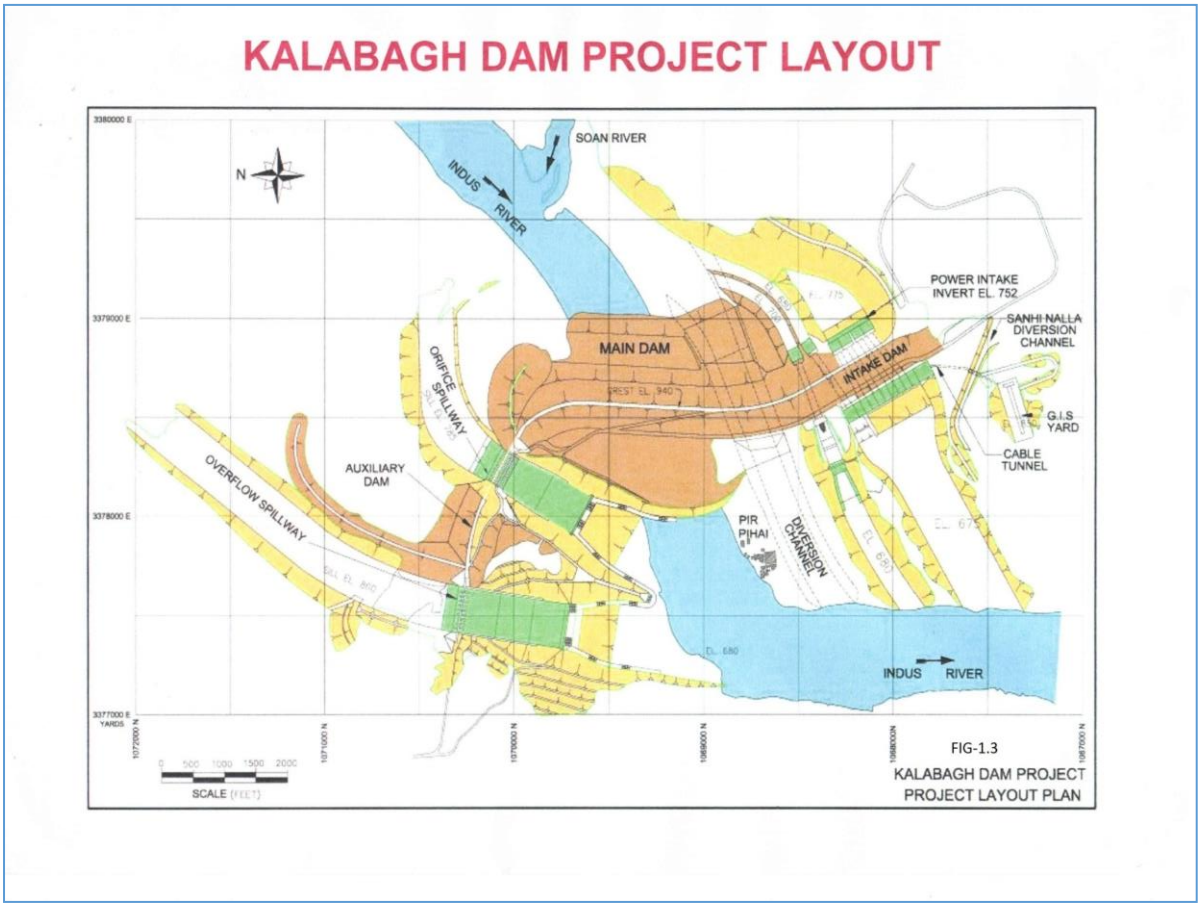
It is obvious that a big reservoir which is the most feasible in all respects is through Kalabagh Dam, whose construction should be started immediately.

The Project is located near Kalabagh Town. Its location & layout are shown in Figs-1 & 2.

The Salient Features of the Project are listed below:-

- **INDUS RIVER AT SITE**
  - Maximum Observed Flood — 1,200,000 cfs
- **RESERVOIR**
  - Gross Storage — 7.9 MAF
  - Live Storage — 6.1 MAF
  - Dead Storage — 1.8 MAF
- **MAIN DAM**
  - Crest Elevation — 940 ft. SPD
  - Max. Height (above river bed) — 260 ft.
- **OVERFLOW SPILLWAY**
  - Sill level — 860 ft. SPD
  - PMF Discharge — 1,040,000 cfs.
- **ORIFICE SPILLWAY**
  - Sill level — 785 ft. SPD
  - PMF Discharge — 950,000 cfs
- **INSTALLED CAPACITY** — 3600 MW





2. KALABAGH DAM FUNCTIONS AND BENEFITS

World Bank has indicated the important functions of Kalabagh Dam Project as follows:-

- **i.** To generate a large amount of low cost hydro-electric power close to major load centres.
- **ii.** To complement the reduction in the storage capacities of Mangla and Tarbela reservoirs.
- **iii.** Supplying adequate and timely water for agricultural, industrial and domestic uses.
- **iv.** To control the extreme flood peaks of the Indus, the Kabul and the Swan rivers.
- **v.** To provide irrigation facilities to new areas and improve supply to non-perennial and perennial areas.
- **vi.** Reducing dependence on imported fuels and substantially reducing average power generation costs.

3. IF KALA BAGH DAM IS NOT BUILT – CONSEQUENCES

- **i.** Population explosion will subject the economy to additional burden of numerous impacts.
- **ii.** By the year 2020 loss of storage capacity of on-line reservoirs (Mangla excluded) due to sedimentation (=5.69 MAF) would result in increasing shortage of committed irrigation.

iii. New storages are essential. In its absence it would give rise to bitter interprovincial disputes.

iv. The annual energy generated at Kalabagh would be equivalent to 20 million barrels of oil to produce thermal power.

v. Thermal generation would further upset the thermal-hydel mix in the system causing prohibitive rise in the power tariff.

vi. Had the country built Kalabagh dam by this time, with a very low rate of Rs. 1.5 per unit, the country could thus have an additional Rs. 220 billion from this source per annum.

vii. Growth of domestic industrial and agricultural sectors would be impeded due to high power cost.

viii. Due to non-availability of enough fresh water, secondary salinisation of lands will become difficult to control.

ix. There is a fertile virgin tract of land about 850,000 acres in Bannu & Dera Ismail Khan districts. The province of Khyber Pakhtunkhwa will lose a major development opportunity of agriculture in this area.

x. Sindh will be the maximum beneficiary from the Kalabagh Dam. It would get additional supplies of 2.257 MAF from the stored supplies.

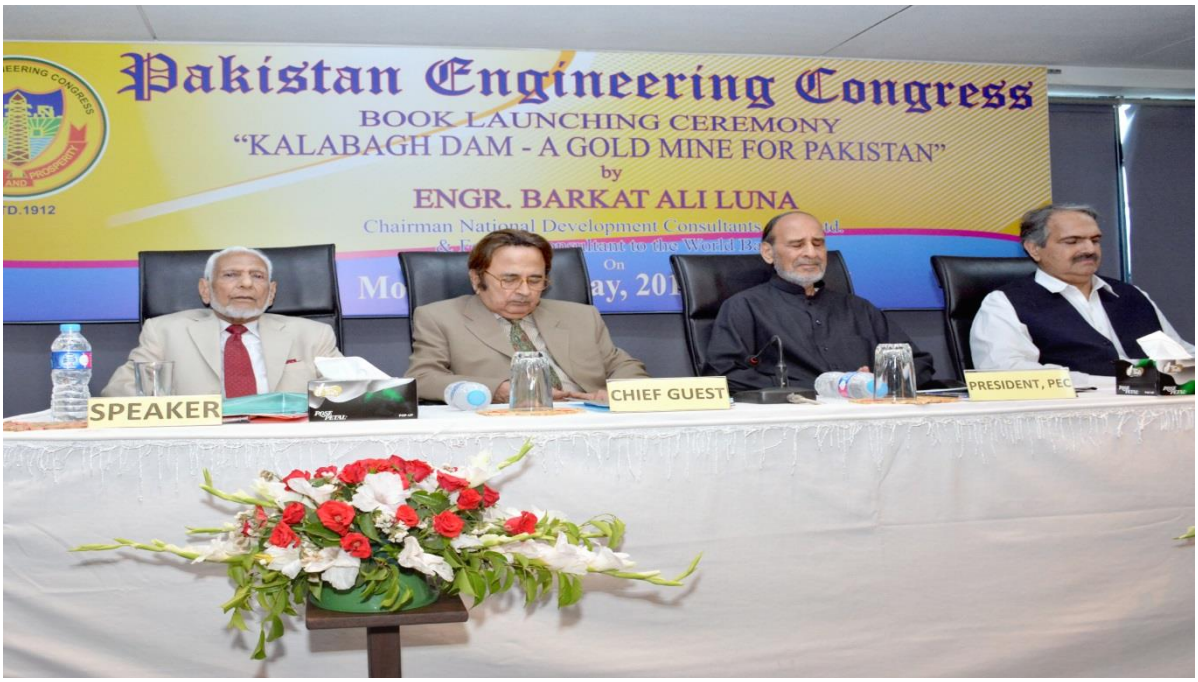
xi. The province of Balochistan can use additional supplies equal to 0.732 MAF in Kachhi Canal and Patfeeder Extension which are presently being built.

xii. Punjab has its share equal to Sindh i.e 2.257 MAF. This will recoup the supplies to the Sutlej Valley Canals.

xiii. If we calculate the cost of failing to build the dam for the last 15 years the total cost of failure works out to a horrendous amount of $40 billion.

Book Launching Ceremony
On the topic of

"Kalabagh Dam – A Gold Mine for Pakistan"
Monday, May 15th, 2017



(From Left) Engr. Barkat Ali Luna (Speaker) Author of the Book, Engr. Asif H. Qazi (Chief Guest), Engr. Ch. Ghulam Hussain (President-PEC), Engr. Nayyar Saeed (Secretary-PEC)



Engr. Nayyar Saeed, Secretary-PEC speaking on the Program of the Event



Engr. Ch. Ghulam Hussain, President-PEC presenting the Welcome Address at the Event



Engr. Barkat Ali Luna, Chairman National Development Consultants (Pvt) Ltd presenting his Book Titled ***"Kalabagh Dam – A Gold Mine for Pakistan"*** / Speaking on the various aspects of Kalabagh Dam in Context of its Non-Construction



(From Right) Engr. Ch. Ghulam Hussain, President-PEC and Chief Guest Engr. Asif H. Qazi Chief Advisor, M/s. Associated Consulting Engineers (Pvt.) Ltd awarding Shield to the Author of the Book, Engr. Barkat Ali Luna, Chairman National Development Consultants (Pvt.) Ltd.



(From Right) Engr. Ch. Ghulam Hussain, President-PEC awarding Shield to Chief Guest Engr. Asif H. Qazi Chief Advisor, M/s. Associated Consulting Engineers (Pvt.) Ltd.



Group Photo of the Eminent Engineers at the Event

Questions/Answers Session



Questions/Answers Session



(From Right) Engr. Ch. Ghulam Hussain, President-PEC expressing his views on the issues discussed in Questions/Answers Session



Engr. Asif H. Qazi expressing his views on the issues expressed in the Book on Kalabagh Dam and those expressed by the veteran Engineers Present at the event

Questions/Answers Session





Questions/Answers Session



Engr. Barkat Ali Luna, Author of the Book speaking with the Media



Engr. Ch. Ghulam Hussain, President-PEC being interviewed by the Electronic Media

Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





College Add

Address of Welcome
By
Engr. Ch. Ghulam Hussain
President Pakistan Engineering Congress
At the
Technical Lecture
on the Topic of
"Essential Hydro Engineering"
On

May 23, 2017

BY

MR. JOHN H. GUMMER ON THE TOPIC OF "ESSENTIAL HYDRO ENGINEERING"



Chief Guest Engineer Ahmad Khan Bhatti, learned Speaker Mr. John Gummer, fellow engineers, ladies and gentlemen.

اَلسَّلَامُ عَلَيْكُمْ وَ رَحْمَةُ اللّٰهِ وَبَرَكَاتُهٗ

It is my privilege to welcome you all on this occasion where a world renowned expert Mr. Gummer will deliver lecture on the topic of "Essential Hydro Engineering". This particular topic is of particular interest to us as lot of related engineering activities are already in hand and going to pick up further due to inclusion of Indus cascade hydropower projects in CPEC. We are thankful that despite his heavy preoccupation he has found time for the lecture. In this respect good offices of Dr. Izhar-ul-Haq are appreciated who is Vice President, Pakistan Engineering Congress and President, Institution of Engineer, Pakistan.

Before start of the lecture, it seems necessary to introduce the learned speaker, Mr. Gummer. He completed his basic technical education in 1960 at Bristol College of Advanced Science and Technology, UK through a 'Diploma in Mechanical and Aeronautical Engineering' followed by completion of DIC Applied Mechanics at Imperial College, London University, UK in 1961. Later on, during his actual professional career he attained the distinction of becoming Fellow Institution of Mechanical Engineers UK. Currently he is Registered European Engineer, as well as Chartered Engineer UK. Through his professional experience over the last half century or so he has acquired an expertise in the disciplines of hydro mechanics and hydropower.

Mr. Gummer is on the Editorial Board of the International Journal on Hydropower and Dams. In pursuit of professional expertise he has also published 55 technical papers mostly relating to the topic of his today's lecture.

Some of you may be also aware that currently, he is serving as a member of WADA's Panels of Experts to advise on electrical / mechanical design aspects relating to: Tarbela Powerhouse 4th Extension; Neelum-Jhelum Hydropower Project; and Dasu Hydropower Project. I am sure that through this lecture, he will enlighten us not only about hydro engineering but innovative mechanical / electrical aspects being

incorporated in the designs of these projects.

We are all aware that Indus River and its tributaries bring in large concentrations of coarser sediments, particularly during high flow season. This sediment, if not properly managed, causes a lot of abrasion on the runners of hydraulic turbines. A case in point is Warsak Dam Project, where due to heavy reservoir sedimentation, turbine runners are undergoing a perpetual process of repair, refurbishing or even replacement. Consequently, the whole M&E plant of Warsak Powerhouse is now being replaced.

It is gathered that through improved metallurgy, better corrosion resisting materials are now available for manufacture of turbine runners. Notwithstanding this, for long term durability of this equipment, sediment management through sluicing upstream trapping or at site is necessary.

Under implementation Phase I of Dasu Hydropower Project has a limited re-regulating storage capacity of about 0.7 MAF. This is likely to be depleted within a short period of 10-15 years in the absence of sediment trapping behind the proposed upstream Diamer Basha Dam. I will request Mr. Gummer to throw light on this particular design aspect of Dasu Hydropower Project. In his opinion, without upstream or at site sediment management, will the turbine runners at Dasu be able to give satisfactory service for their designed life?

I no longer want to stand between Mr. Gummer and the audience and request him to start the lecture.

Thanking you.

-.-.-.-.-.-.-

Technical Lecture
on the Topic of
"Essential Hydro Engineering"
By: Mr. John Herbert Gummer
an International Electro Mechanic Hydro Power Expert

Introduction:

Mr. John Herbert Gummer is serving as a member of WAPDA's Panels of Experts to advise on electrical / mechanical design aspects relating to: Tarbela Powerhouse 4th Extension; Neelum-Jhelum Hydropower Project; and Dasu Hydropower Project.

In this connection an introduction of Mr. John Herbert Gummer is given below;

r. Gummer has completed his basic technical education in 1960 at Bristol College of Advanced Science and Technology, UK through a 'Diploma in Mechanical and Aeronautical Engineering' followed by completion of DIC Applied Mechanics at Imperial College, London University, UK in 1961. Later on, during his actual professional career he attained the distinction of becoming Fellow Institution of Mechanical Engineers UK. Currently he is Registered European Engineer, as well as Chartered Engineer UK. Through his professional experience over the last half century or so he has acquired an expertise in the disciplines of hydro mechanics and hydropower.

Mr. Gummer is on the Editorial Board of the International Journal on Hydropower and Dams. In pursuit of his professional expertise he has also published 55 technical papers mostly relating to the topic of his today's lecture.

The President-PEC, Engr. Ch. Ghulam Hussain presented the welcome Address. As the topic of the Lecture was of high significance, Water Sector Engineers of WAPDA, Punjab Irrigation Department, Consultants, Educationist etc. were present in large numbers.

The Learned speaker spoke for almost 2-hrs followed by lively Question/Answers session. At the end President-PEC, Engr. Ch. Ghulam Hussain thanked Mr. John Herbert Gummer for his excellent discourse and presented shield and Certificate. Refreshments followed.

Technical Lecture:

Technical Lecture by Mr. John Herbert Gummer was held on 23rd May, 2017 by Pakistan Engineering Congress at Mashhadi Hall, (4th Floor), PEC Building, 97-A/D-1, Liberty Market, Gulberg III Lahore. Mr. John Herbert Gummer is an International Electro Mechanic Hydro Power Expert. He attained the distinction of becoming Fellow Institution of Mechanical Engineers UK. Currently he is Registered European Engineer, as well as Chartered Engineer UK. Through his professional experience over the last half century or so he has acquired an expertise in the disciplines of hydro mechanics and hydropower.

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The Lecture was attended by a galaxy of very senior Engineers/Young Professionals of WAPDA Consultants, Organizations. In view of the high importance of the Lecture the presentation made by the author is attached.

Lecture on the Topic of
"Essential Hydro Engineering"
By Engr. John Herbert Gummer
May 23, 2017



(From Right) Engr. Ch. Ghulam Hussain, President-PEC, Engr. Ahmad Khan Bhatti, Chief Executive Barqaab Consulting Services (Pvt.) Ltd., (the Chief Guest) & Mr. John Herbert Gummer, the Learned speaker on the topic of "Essential Hydro-Engineering"



Engr. Nayyar Saeed, Secretary-PEC presenting the Program of the event



Engr. Ch. Ghulam Hussain, President-PEC presenting the Welcome Address



Mr. John Herbert Gummer presenting his paper on the topic of “Essential Hydro-Engineering”



(From Right) Engr. Ch. Ghulam Hussain, President-PEC & the Chief Guest Engr. Ahmad Khan Bhatti (on Left) presenting Congress Shield to the speaker Mr. John Herbert Gummer



(From Left) Engr. Ahmad Khan Bhatti, the Chief Guest in a jovial mood with the speaker Mr. John Herbert Gummer



(From Right) Engr. Ch. Ghulam Hussain, President-PEC & the speaker Mr. John Herbert Gummer presenting Shield to the Chief Guest Engr. Ahmad Khan Bhatti



Group photo of Eminent Engineers with the Speaker, Mr. John Herbert Gummer and Engr. Ch. Ghulam Hussain, President-PEC (3rd from Right) and Dr. Izhar ul Haq



Group Photo of Participants of the Lecture on the Topic of "Essential Hydro-Engineering" By Mr. John Herbert Gummer with Engr. Nayyar Saeed, Secretary-PEC (6th from left)

Glimpses of the Audiences



Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





WORLD ENVIRONMENT DAY-2017

Pakistan Engineering Congress Commemorated World Environment Day-2017 on the theme of ***"CONNECTING PEOPLE TO NATURE; IN THE CITIES, ON THE LAND; FROM THE POLES, TO THE EQUATOR"*** on 5th June-2017 at 3.00 P.M. Engineer Ch. Ghulam Hussain, President –PEC presented the introductory remarks.
11-technical papers were presented on the above cited theme on the following topics;

1 **Greening the Landscape in Pakistan**
Dr. Abdul Aleem Chaudhry

2 **Environmental Impact of Manchar Lake on Indus River**
Engr. Zamir Ahmed Soomro

3 **Stakeholders' Involvement in Natural Sustainability of WAPDA Projects – A Strategy Paying Dividends**
Mr. Attia Dastgir, Dr. Fayyaz Ahmad and Mr. Sarfraz Naseer

4 **A Brief on Forestry Resources of Cholistan Desert and a Future Potential Opportunity**
Ms. Fatima Tanveer and Ms. Tayyaba Seemab

5 **Challenges for Environmental Sustainability and Food Security in Pakistan**
Dr. Azeem Khalid

6 **Urban Heat Island in Changing Climate (A case study of Karachi Heat wave, 2015)**
Ms. Zeenat Yasmeen, Dr. Muhammad Afzaal, M. Akram Anjum, Burhan A. Khan

7 **Environmental Concerns for Sustainable Use of Groundwater for Food Security in Punjab**
Mr. Ghulam Zakir Hassan Sial and Mr. Faiz Raza Hassan

8 **Global Warming, Climate Change (Causes, Impacts, Mitigation, Adaptation) and Carbon-Di-Oxide Measurement; A Review**
Aqsa Fayyaz, M. Naveed Anwar, Engr. Dr. Abdullah Yasir, Anita Kanwal, Farwah Hassan, Mujtaba Baqir, Dr. Waqas U Din Khan

9 **De-colorization of Ultra Black DR (Synozol) Dye by combined Fenton-Like/UV Process using Rice Husk Ash Based Catalyst**
Malik Muhammad Arslan Aslam

10 **Global Warming, Climate Change, Carbon Capturing, and Storage – A Review**
Nabia Farrukh, M. Naveed Anwar, Engr. Dr. Abdullah Yasir ,Amna Aman, Mahnoor Abid, Dr. Waqas U Din Khan, Mujtaba Baqir

11 **Environmental Risks related to Shale Gas Advancement and their Mitigation**
Mr. Bilal Naveed, Talha Ayub, Muhammad Wajahat, Muhammad Junaid and Faizan Ahmed

After the Lecture a lively Questions/Answers discussion ensued. It was a highly attended event comprising Members of the Congress and delegates from various institutions. At the end President-PEC presented Shield/Certificates to the learned speakers followed by refreshment.

INTRODUCTORY REMARKS
By
Engr. Ch. Ghulam Hussain
President
PAKISTAN ENGINEERING CONGRESS
ON
WORLD ENVIRONMENT DAY
(Monday 05th June 2017)

Fellow Engineers, Members of Pakistan Engineering Congress, Participants, Ladies and Gentlemen!

اَلسَّلَامُ عَلَيْكُمْ وَ رَحْمَةُ اللّٰهِ وَبَرَكَاتُهٗ

I take this opportunity on behalf of Pakistan Engineering Congress in general and on my own in particular to welcome you all to this gathering for observing World Environment Day 2017. Significance of marking this day is directly linked with the vital importance of environment in the life of the peoples and the nations. Consequently, United Nations Conference on Environment Development in 1992 declared 5th June as "World Environment Day"

Regarding usage of resources, both natural and financial, there are injunctions in the Holy Quran, for guidance of the humanity and I quote: *"Eat and drink, but do not waste; indeed He does not like the wasteful".*

Every year, the theme is of World Environment Day is carefully selected to cover various aspects: relating to Environmental issues facing the humanity; affecting the lives of the people: and the surroundings of their habitats. UN suggested theme for this year is:

"Connecting People to Nature: in the Cities; on the Land; from the Poles to the Equator"

This theme invites you to think about how we are part of nature and how intimately we depend on it? It challenges us to find fun and exciting ways to experience and cherish this vital relationship.

In recent decades scientific advances as well as growing environmental problems such as global warming, are helping us to understand the countless ways in which natural systems support our own prosperity and well-being. For example, world's oceans, forests and soils act as vast stores for greenhouse gases such as carbon dioxide and methane; farmers and fisher folk harness nature on land and under water to provide us with food; scientists develop medicines using genetic material drawn from the millions of species that make up Earth's astounding biological diversity.

Billions of rural people around the world spend every working day 'connected to nature' and appreciate full well their dependence on natural water supplies and how nature provides their livelihoods in the form of fertile soil? They are among the first to suffer when ecosystems are threatened, whether by pollution, climate change or over-exploitation.

Nature's gifts are often hard to value in monetary terms. Like clean air, they are often taken for granted, at least until they become scarce. However, economists are developing ways to measure the multi-trillion-dollar worth of many so-called ecosystem services from insects pollinating fruit trees in the orchards of California to the leisure health and spiritual benefits of hike up into a Himalayan / Karakoram valley.

In the present age of asphalt and smart phones and among the distractions of modern life, connections with nature can be fleeting. This commemoration of World Environment Day 2017 can make clearer than ever that we need harmony between humanity and nature so that both are able to thrive.

World Environment Day is a day for everyone, everywhere, since it began in 1992, global citizens have organized many thousands of events, from neighborhood clean-ups to action against wildlife crime to replanting forests.

Connecting People to Nature, the theme for World Environment Day 2017 implores to get outdoors and into nature to appreciate its beauty and its importance.

بقول شاعر مشرق

فطرت کے مقاصد کی کرتا ہے نگہبانی
یا بندۂ صحرائی یا مردِ کہستانی

Ladies & Gentlemen!

This year's World Environment Day is an ideal occasion to go out and enjoy your country's national parks and other wilderness areas. Park authorities in some countries may follow Canada's example and waive or reduce park entry fees on June 5 or for a longer period. We request Government to allow free entry to all citizens to the national parks of Pakistan.

With this prologue, I conclude my introductory remarks and once again thank you all for participating in this event.

Pakistan Paindabad

GLIMPSES OF "WORLD ENVIRONMENT DAY – 2017"
On the topic of
"CONNECTING PEOPLE TO NATURE; IN THE CITIES, ON THE LAND; FROM THE POLES, TO THE EQUATOR"



(From Left) Engr. Ch. Ghulam Hussain, President Pakistan Engineering Congress, Engr. Dr. Izhar Ul Haq, vice President PEC and Engr. Nayyar Saeed, Secretary PEC



Engr. Nayyar Saeed, Secretary-PEC presenting the Program of the event



Engr. Ch. Ghulam Hussain, President-PEC presenting the Welcome Address



Dr. Abdul Aleem Chaudhry presenting his paper on the topic of **"Greening the Landscape in Pakistan"**



Engr. Zamir Ahmed Soomro presenting his paper on the topic of **"Environmental Impact of Manchar Lake on Indus River"**



Mr. Attia Dastgir presenting his paper on the topic of **"Stakeholders' Involvement in Natural Sustainability of WAPDA Projects – A Strategy Paying Dividends"**



(From Right) Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq Vice President PEC presenting Shield to Engr. Zamir Ahmad Soomro for presenting his paper on the topic of "**Environmental Impact of Manchar Lake on Indus River"**



(From Left) Engr. Dr. Izhar Ul Haq Vice President- PEC Engr. Ch. Ghulam Hussain, President-PEC presenting Shield to Ms. Fatima Tanveer and Ms. Tayyaba Seemab for presenting the paper on the topic of "**A Brief on Forestry Resources of Cholistan Desert and a Future Potential Opportunity"**



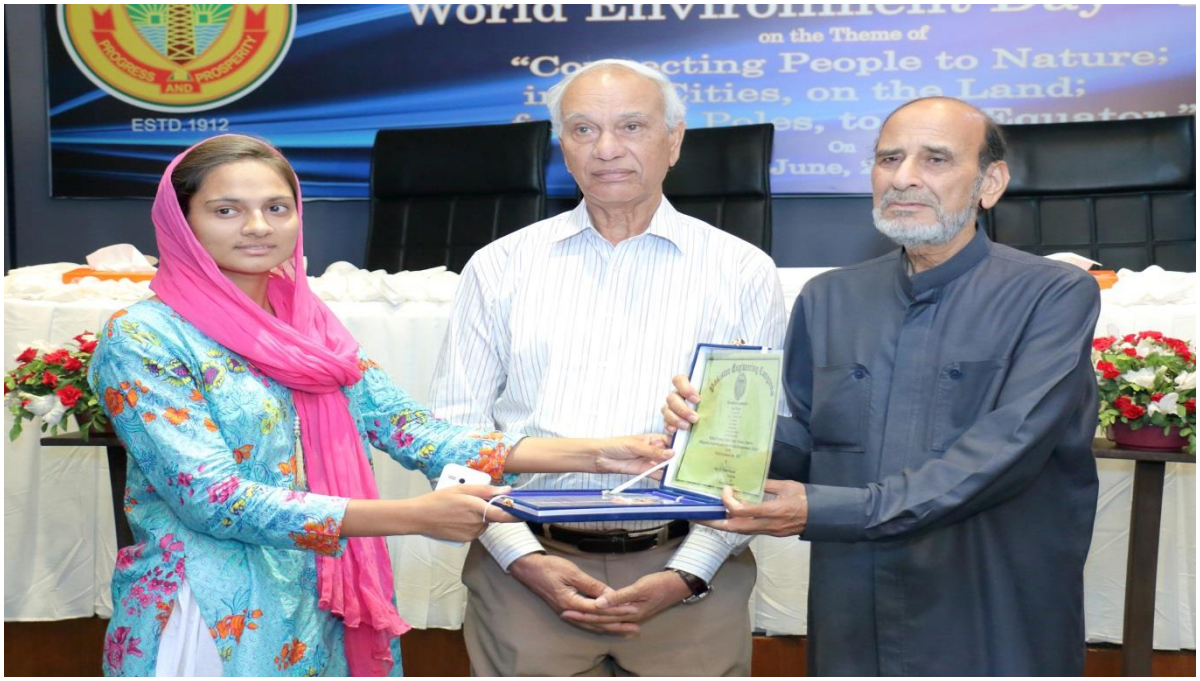
(From Right) Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq, Vice President PEC presenting Shield to Dr. Muhammad Shahid for presenting paper on the topic of "**Challenges for Environmental Sustainability and Food Security in Pakistan"**



(From Right) Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq, Vice President PEC presenting Shield to M. Akram Anjum for presenting his paper on the topic of "Urban Heat Island in Changing Climate (A case study of Karachi Heat wave, 2015)"



Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq Vice President PEC presenting Shield to Mr. Ghulam Zakir Hassan Sial for presenting his paper on the topic of "**Environmental Concerns for Sustainable Use of Groundwater for Food Security in Punjab"**



(From Right) Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq, Vice President PEC presenting Shield to Ms. Aqsa Fayyaz for presenting paper on the topic of "**Global Warming, Climate Change (Causes, Impacts, Mitigation, Adaptation) and Carbon-Di-Oxide Measurement; A Review"**



(From Right) Engr. Ch. Ghulam Hussain, President-PEC Engr. Dr. Izhar Ul Haq Vice President PEC presenting Shield to Ms. Nabia Farrukh and Ms. Mahnoor Abid for presenting paper on the topic of "**Global Warming, Climate Change, Carbon Capturing, and Storage – A Review"**

Glimpses of the Audiences

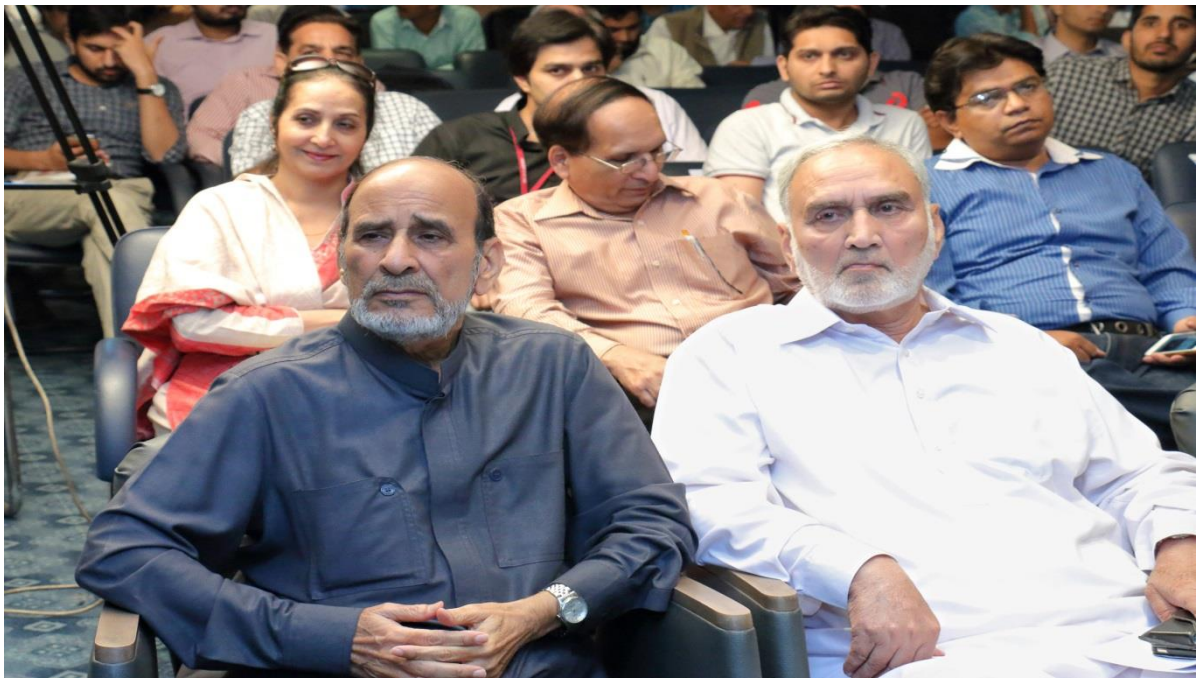


Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Glimpses of the Audiences





Technical Lecture
On the topic of

"ESSENTIAL HYDRO ENGINEERING"

By: Mr. John Herbert Gummer

(Tuesday, May 23rd, 2017)

Mr. John Herbert Gummer is an International Electro-Mechanical Hydro Power Expert. He was on a visit to Pakistan on a Govt. assignment and very kindly agreed to speak on the topic of "Essential Hydro Engineering". The Presentation made by the learned author has been reproduced for the benefit of the Engineering Fraternity.

Subjects:

- Compiling E and M Specifications
- Quality Assurance
- Contracting out Rehabilitation
- Some pointers for those of you in hydro
  - Resonance due to dynamic hydro forces
  - Floating generator rotors
  - Turbine model testing and air admission
  - Dealing with silt erosion
  - Pipework
  - Generator CO_2 fire fighting
  - New developments
- Questions

1. Compiling E and M Specifications:

Why specify?

- Level playing field for competitive bidding
- Define the scope of work even if no competitive bidding
- Obtain funding and approval of relevant authorities
- Budget and cash flow
- Ensure quality
- Guarantee that environmental and safety requirements are met
- Interface between all interested parties
- Define limits of supply
- Stipulate close off point

Origin and precedence

- Feasibility and/or inception study is source of all specifications
- All major decisions will be taken at inception study phase
- End objective is to generate power and control water – not to minimize civil costs
- Consider future application and operation
- Get opinions from all sources
- Contractual arrangements
- Number of separate contracts
- General conditions of contract
- Pre and post qualifications
- Liquidated damages and loading for bid analysis
- Optional contractual items

- Unusual requirements
- Enforcement

Tendering information

General approach

- Separation of tendering requirements and specification
- Technical information required with the tender
- Sub contracts
- Tender price split up

Technical Details

- Specification drawings
- International standards
- National standards
- Rehabilitation versus green fields
- Proprietary equipment
- Standard technical clauses
- Contractual interfaces

Policing

- Design approval
- Approval of sub-contracts
- Quality control of manufacturing and erection
- Provision for future Operation and Maintenance
- Finishing the paperwork

2. <u>Quality Assurance:</u>

Scope of quality control

- Quality control commences at feasibility stage, follows through specification to manufacturing, erection and operation and maintenance
- No matter how good the manufacturing quality it cannot compensate for an incorrect conceptual layout, a poor specification, an inadequate design or poor operation and maintenance
- Many early incorrect decisions are extremely difficult to rectify at a later stage

Manufacturing and erection quality control

- ISO 9001-2000
- Quality Audit sometimes necessary
- Involvement of the PMU in approval of design and inspection of manufacturing
- Plan of inspection and test for both manufacture and erection
- In progress inspection and monitoring by PMU
- Hold points kept to a minimum

Minor items are also important

- Even the smallest item of equipment can put the station in jeopardy
- Auxiliary equipment is usually the first to fail
- Availability of spare parts
- Difficult to specify the required quality (approved equal)

3. Contracting out Rehabilitation:

Hydro's longevity and the need for rehabilitation and possible upgrading

- Hydro is long lasting. Civil works more so than E & M equipment but even E & M equipment can go on for 30 years without a major make-over
- The time for rehabilitation can vary from early, in the case of inadequate or troublesome equipment, to many years for well-designed equipment which has led a tranquil life
- Once the decision to rehabilitate and possibly upgrade is taken then the next decision is who is going to determine the extent and scope of the work and how will work be handled

Requirements for investigation, specification and administration of the rehabilitation work

- The initial investigation and specification of the work must encompass the following factors
- Updated hydrology; especially in respect of spillway capacity
- Current role of the hydro facility in the overall integrated electrical system
- Environment; especially in respect of discharge of pollutants
- State and safety of the civil works
- State of the E & M works and operation and maintenance procedures

Investigation, specification and administration by an equipment manufacturer

- Manufacturers tend to concentrate on their own field to the exclusion of other considerations such as the civil works, hydrology and the changing demands of the electrical system
- Manufacturers tend to put emphasis on equipment replacement rather than repair.
- A more general approach is better with "water to wire" companies however these are sometimes less universal than their publicity would imply
- Opinions to various manufacturers should be sought which would be difficult for one manufacturer to obtain
- Evaluation by a manufacturer would not be looked on favourably by a funding agency

Investigation, specification and administration by the owner

- If the rehabilitation is to owner financed then investigation, specification and administration by the owner is viable assuming that he has the capacity
- This should not be done part time. A dedicated department should be established comprising members with all the necessary skills
- Should be open to new ideas and concepts
- The opinion of operating and maintenance staff should be solicited but should be filtered to eliminate wish lists
- Staff opinions may be prejudice if redundancies are being considered as a result of the rehabilitation
- Owner evaluation would probably not be acceptable to a financing agency

Investigation, specification and administration by an outside consultant body

- Best solution which circumvents problems associated with manufacturer or owner led evaluation

- Essential that body sets up a dedicated team encompassing experts in all necessary disciplines
- Feasibility and inception reports should be presented to owner and financing bodies
- Extent of work may be limited by available funds
- All operating and maintenance staff should be informed of the study and measures taken to ensure complete co-operation (fear of redundancy)
- All operating records should be made available to the consultant's team
- Team should watch out for wish lists
- Owner and possibly funding agency should help with political aspects

Risk

- Rehabilitation carries more risk for both contractor and owner than green fields
- Manufacturer is taking on "old iron" and the owner is looking at a blank cheque
- Best to split the work into "Known known", "Known unknown" and "Unknown unknown" factors.
- "Known known" from O & M records, system demand and historical hydrology etc.
- "Known unknowns" from experience
- "Unknown unknowns" covered by generous contingency allowances
- "Known unknowns" can be priced as options which, if included in any lump sum price will assist in the contingency allowance (both financial and material)
- Bidders should have reasonable access to the plant
- Contractors should produce independent evaluation reports at the start of the contract and dismantling reports to limit surprises

Contract

- Complete specification with competitive bidding
- Some benefit in using the original manufacturer but not sufficient to outweigh the potential benefits of competitive bidding
- In the light of the "Known unknowns" and "Unknowns unknowns" possibly "cost plus" would be preferable but is frowned upon by funding agencies
- As few contracts as possible
- Pre-qualification and post-qualification
- Commercial clauses – FIDIC
- Involvement of funding agencies

Contract administration

- Project management – PMU
- Quality assurance and inspection – ISO 9001 but cannot be left only to the contractor the owner must be involved
- External inspection – instant decisions
- Everybody is concerned about quality but are so reluctant to spend money to assure it
- Site representation – instant decisions
- Must be a combined effort between Owner, Consultant and Contractor

Follow-up

- Training – tours for management, on the job training both at site and in the Contractor's factories

- Setting up good maintenance practices inclusive of computerised record keeping
- Trending and predictive maintenance
- Spare parts and funding for them

4. <u>Some pointers for those of you in Hydro:</u>

Resonance due to dynamic forces

- Typically major E&M components such as runners, stay vanes, rotors and stators do not fail because of static forces; they fail because of dynamic forces
- These result in dynamic stresses which give rise to fatigue failure
- If the forces are strong enough then fatigue can result “off resonance” (forced vibration).
- However typically failure occurs when the frequency of a relatively small force is coincident with the natural frequency of a component and resonance occurs
- Dynamic forces whether hydraulic or electrical must be identified. Their frequencies must be established and all components inclusive of penstocks must be checked for resonant conditions

Floating generator rotors

- Floating rims became popular for or large hydro generators in the 1970’s, especially in the U.S.A.
- The principal behind them was that on increasing speed the rim would float outward under centrifugal forces and return to roundness at zero speed
- This would circumvent the need for shrining the rim on to the rotor arms and lead to a much cheaper rotor structure
- Unfortunately practice never followed theory and several major accidents occurred which resulted in the rotor contacting the stator
- In spite of instances of their poor performance floating rim generators are still pursued by manufacturers and care should be taken to specify against them by ensuring that the rim remains attached to the arms up to a certain speed (not less than 60% rotational speed)

Evan so air gap monitoring is also necessary

- Turbine model testing and air admission
- Although much can be gleaned from a turbine model test its limitations must be understood
- It should reflect turbine efficiency via the majoration formula provided that the prototype is made precisely to the model. However it is worth checking the prototype curve with the Winter Kennedy taps
- Servomotor and guide vane forces (including misaligned ones) should be representative
- Cavitation tests both via efficiency drop-off and observation should give a good indication of prototype performance
- Pressure pulsation tests and guide bearing dynamic tests give but a rough reflection of prototype as model dynamics often cloud the issue.
- Air admission tests are pretty useless
- As a general principal provide facilities for air admission (embedded piping etc.) even though the manufacturer says that you will not need it

Dealing with silt erosion

- If there is any doubt you must do a detailed analysis for silt, not only now but for 50 years hence
- If silt is proven to be a problem now or in the future then a closed loop cooling water system is imperative. This will avoid clogging in bearing coolers and erosion of pipes
- If possible arrange for bottom dismantling of the runner, bottom ring and guide vanes. Largest unit to date has 4.5m diameter runner
- Runner should be designed for silt with a sacrifice of efficiency. Do not have runners with alternating short blades if the runner is coated
- Wearing rings will be a necessity
- Order spare runners, wearing rings and guide vanes
- Arrange for coated runners, wearing rings and bottom rings and top covers (in the vicinity of the guide vanes). HVOF metallic ceramics appears to be the most suitable coating for these components
- Coating will lower efficiency and will also need to be repaired. Have to decide whether to send back to factory or buy equipment to do the repair at site
- Stay rings may be coated with soft polyurethane, it will help

Pipework

- Pipework is the bane of most hydro power plants
- Even if you have neutral PH benign water, rust is still a problem due to galvanic action (stray electrical currents)
- Also bacteria, mussels and other organisms can attack pipework
- After say 20 years replacement may be necessary in which case what do you do with embedded pipes?
- Best to avoid embedded pipes. Provide pipe runs, and pipe chimneys such that the pipework can always be replaced. Where you have to traverse walls provide block-outs filled with mastic
- Use stainless steel pipes. Not that more expensive and will last far longer
- Again closed loop cooling water systems should be considered

Generator CO2 firefighting

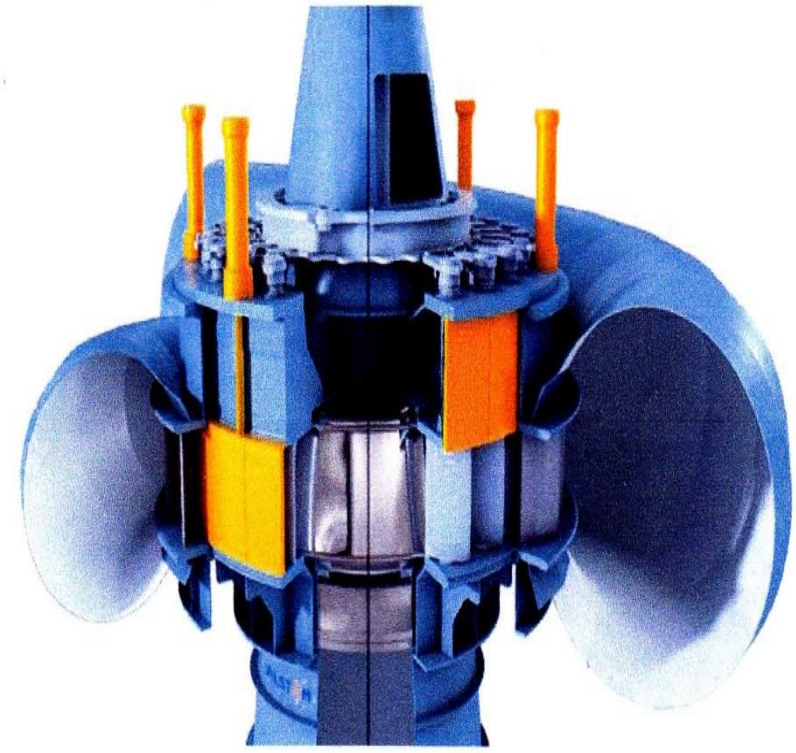
- CO_2 is very dangerous in a hydro powerhouse
- If there is any leak then being heavier than air is will collect at the lowest points and can and has caused asphyxiation
- This is particularly so in underground powerhouses where CO_2 should never be used.
- Class F insulation does not burn and fire protection is only necessary to guard against an oil fire for which CO_2 is ineffective
- Utilities are removing their old CO_2 systems and doing without any fire protection or installing water mist systems
- A half-way house is to replace the CO_2 with an inert gas such as Inergen which is not as dangerous as CO_2

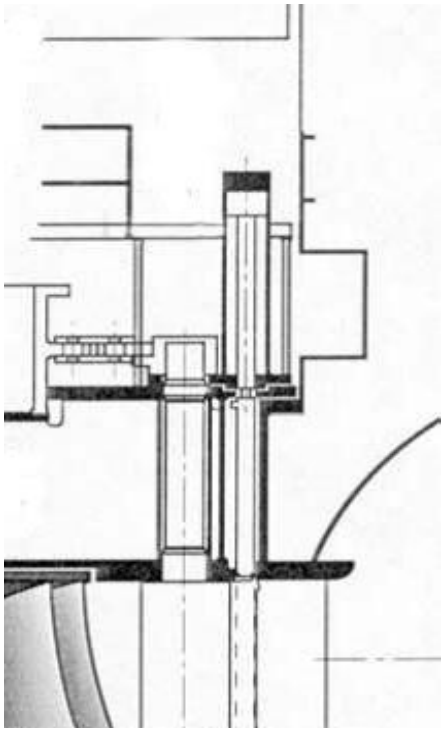
New developments

- Some of the so called “new developments” are not that new and have been around in various forms for many years. Each one should be examined on its merits for a green fields project

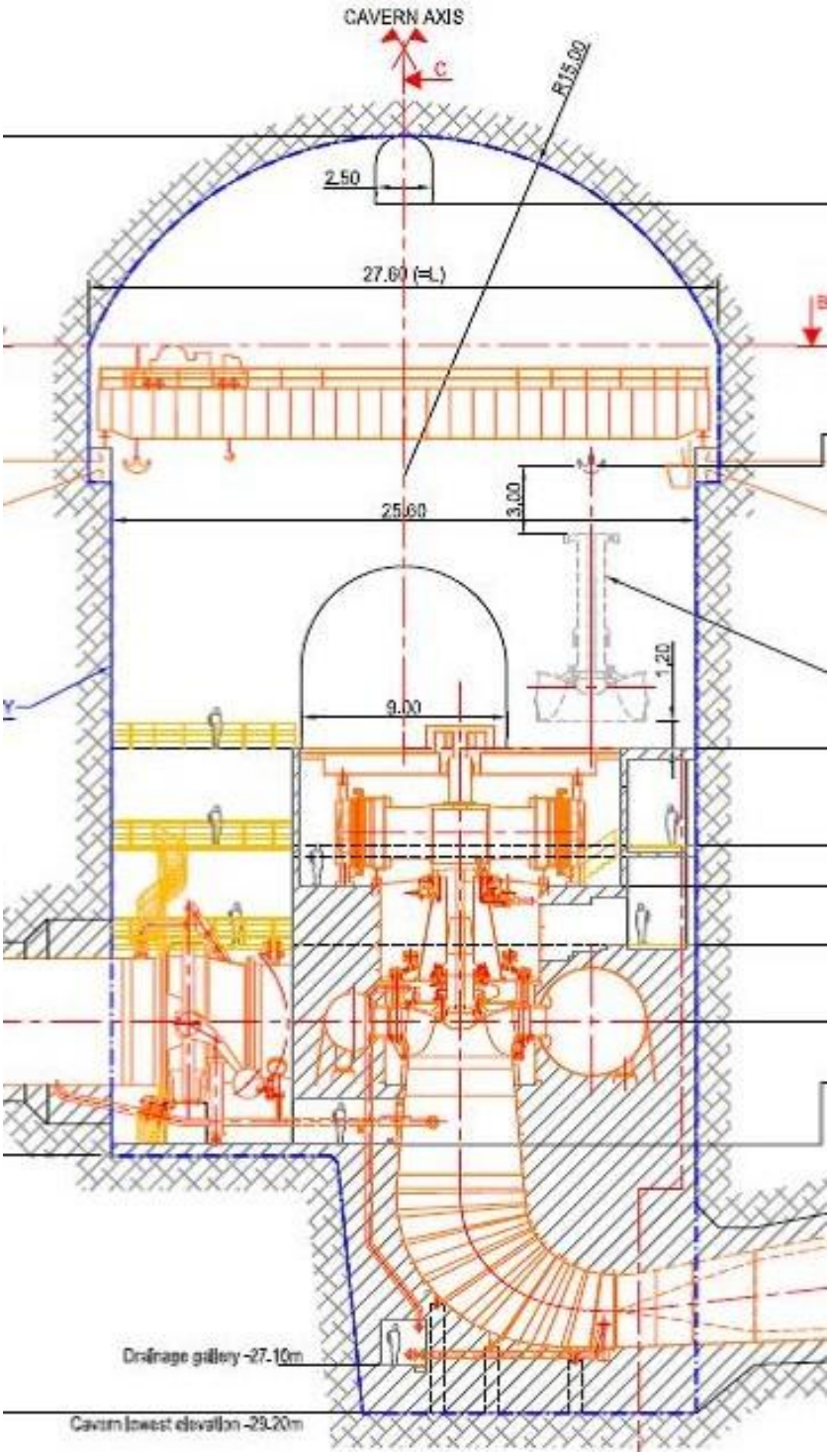
- Ring gates have a long pedigree and although they do have their disadvantages they can save a lot of money in the case of underground powerhouses where the alternative would be a turbine main inlet valve
- They can also save water waste and give additional security for units on dedicated penstocks which typically do not have turbine inlet valves

Ring Gate alternative to an inlet valve



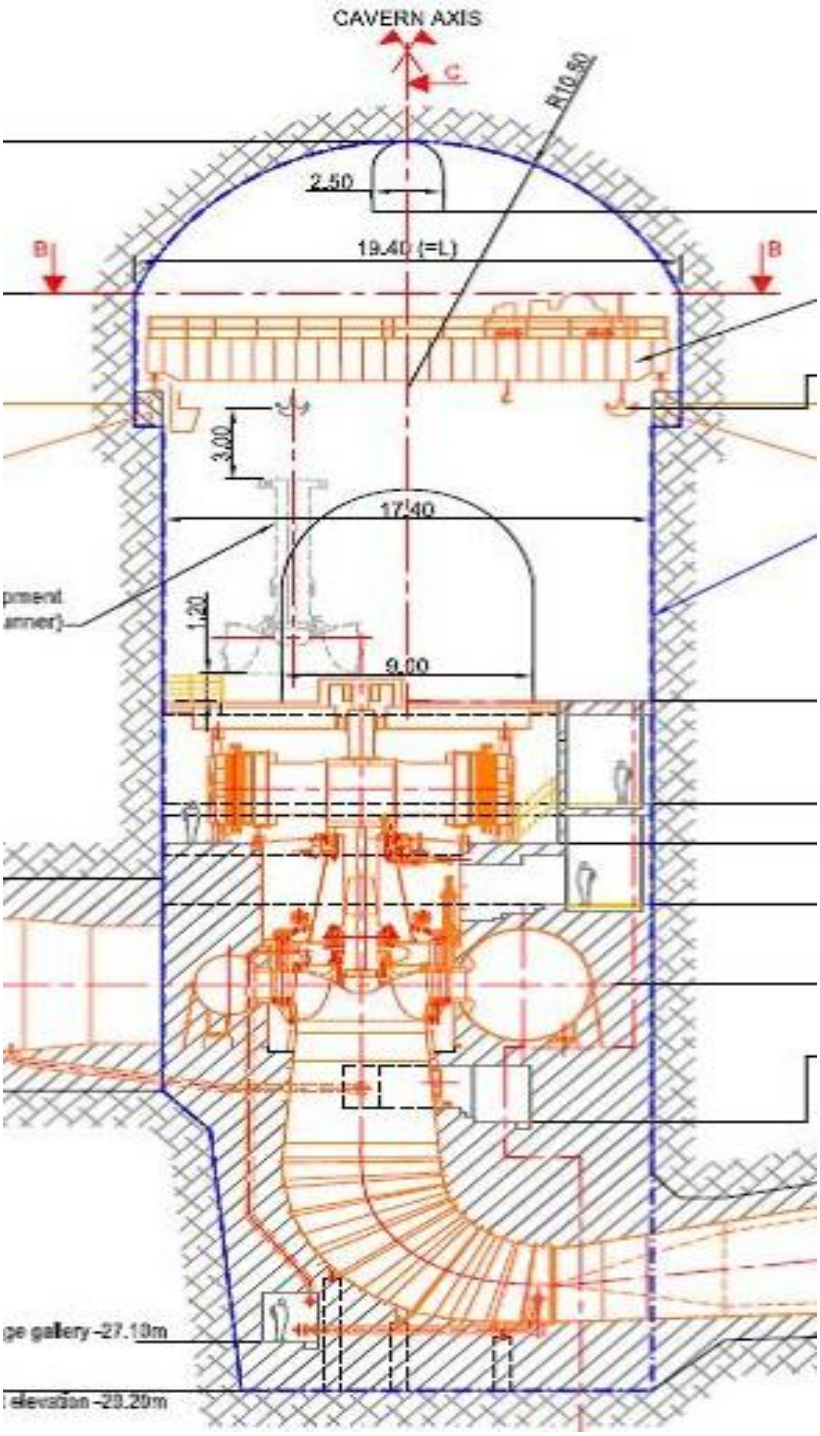


Ring gate



With inlet valve

Ring gate



With Ring Gate - Considerable advantages for an underground powerhouse

New developments

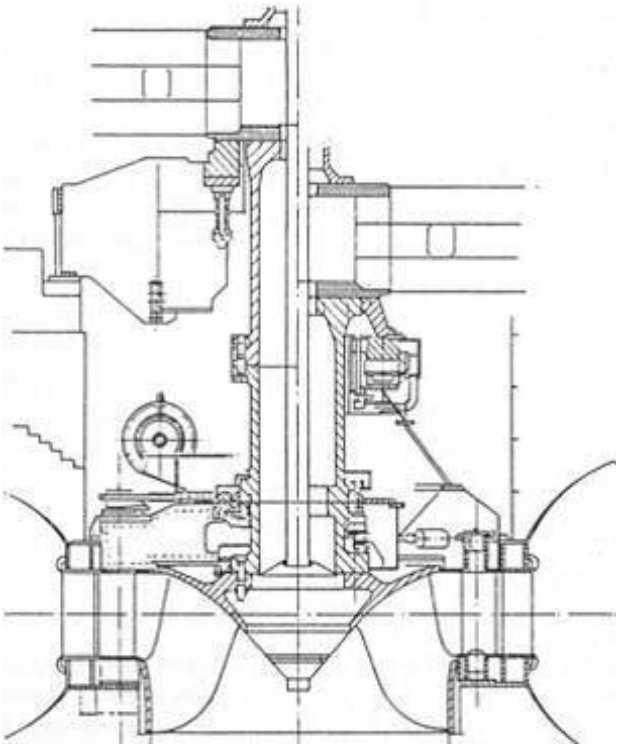
- Individual servomotors on very large machines can have maintenance and handling advantages as well as saving money by using proprietary hydraulic components.

Individual servomotors



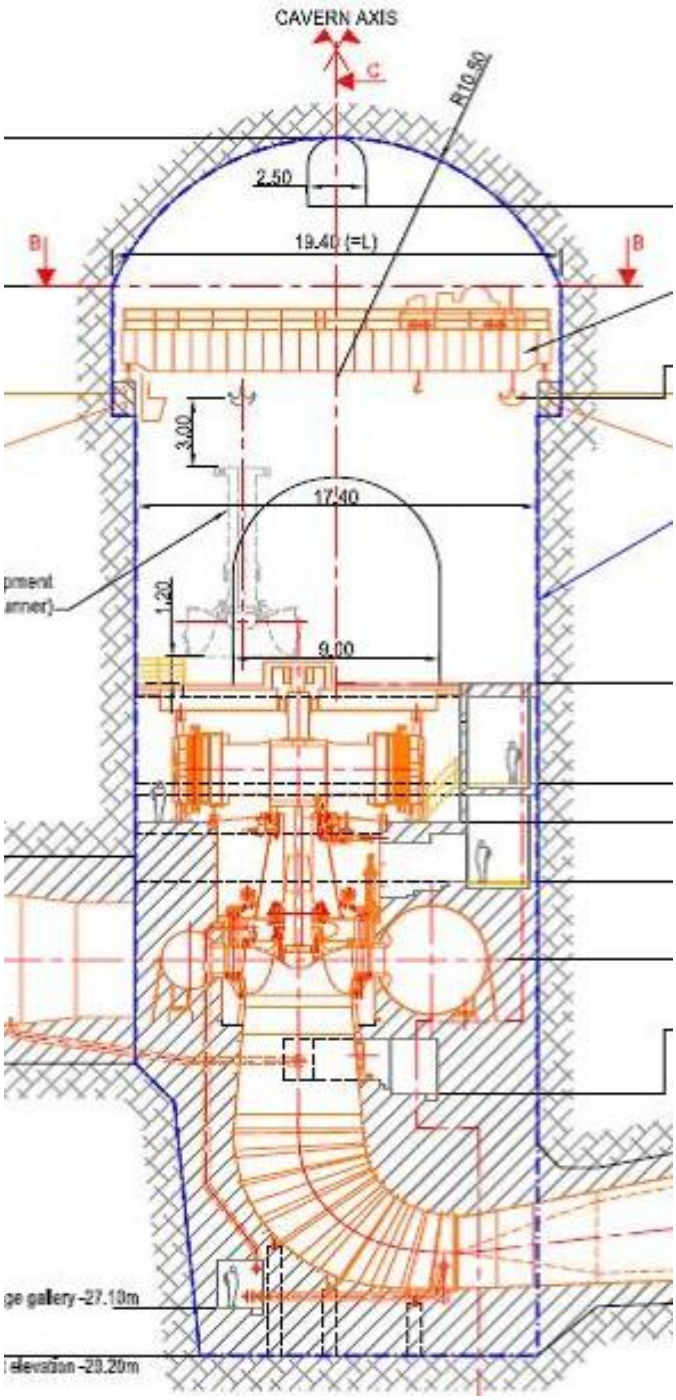
But only for really large units – this one is too small

- Head cover mounted thrust bearings for large machines save considerable vertical space in a powerhouse and can offer great cost savings for underground powerhouses
- Although there are savings in equipment cost for surface powerhouse these are often rejected in favour of the maintenance advantages of the traditional solution of the thrust bearing mounted on the bottom bracket



Bearing configurations

Top cover mounted thrust bearing



With top cover mounted thrust bearing – there are some advantages for an underground powerhouse

Not so many for an above ground powerhouse

New developments

- Variable speed units especially for pump turbines give higher efficiency and greater flexibility in operation
- Take advantage of new monitoring and control systems they can give more precise control over operation and lower maintenance costs

EFFECT OF ACCIDENTAL MATERIALS ON THE PROPERTIES OF CONCRETE.

Muhammad Afzal[1], Moazzam Nawaz[2],
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1. GENERAL:-

1.1. Preface:-The main object of this report is to see the effect of various substance on concrete. One of the most important requirements of concrete is that it should be durable under certain conditions of exposure. In this thesis the nature and consequences of the interaction of various substance are:-

Acids, Sulphates, Chlorides, Carbonates, Salts and alkalis, Sulpher and Phosphates, Petroleum oils, Vegetable oils, miscelleous substances i.e Juices, Sugar solution, Sewage,Pepsietc.

2. INTRODUCTION:-

2.1. Chemical effect on concrete:- Dry concrete is generally immune to attack by dry chemicals. Higher is the temperature, higher is the rate of attack and similar behavior for pressure. Concrete in soil carrying waters containing aggressive chemicals is usually not attacked as rapidly as concrete of same quality exposed to moving surface waters of same chemicals composition because soil reduce the rate of renewal of these chemicals at the concrete surface. In practice several degradation mechanisms can act simultaneously with possible synergistic effects.

2.2. The constituent materials are cement (OPC), fine aggregate (dry lawrencepur sand), coarse aggregate (saturated margala crush) retained on #3(3/8'') B.S.S and passing #6 (3/4") B.S.S ,retained, (3/16") B.S.S & passing #3 (3/8") B.S.S. Tap ordinary water collected from water supply (underground water) at room temperature shall be used.

2.3. Properties of constituent

2.3.1. Specific Gravity:- S_G

Cement:	3.14
Lawrencepur Sand:	2.70
Margala Crush:	2.69

2.3.2. Bulk density:

Cement:	Nil
Lawrencepur Sand:	96.48PCF
Margala Crush:	93.13 PCF

2.3.3. 1:2:4 by weight mix proportion of concrete mix

2.3.4. W/C = 0.55

Casting Procedure adopted:- Liquid solution were taken by weight of cement but water required for w/cis 0.55 was sum of liquid and water , but in case of solid

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substance required amount of water according to w/c ratio was used .Curing were done by immersion in water for 14/15 days.28 days fc'(concrete crushing compressive strength) of plain concrete cube 4" x 4" x 4" is 40.22 MPa or 5750 PSI (avg. of 2 cubes strength). However 7,14, 2months, 3months and 4months age compressive strength is also determined in lab on 300 ton testing machine & steel models of 4" x 4" x 4".

3. EFFECT OF ACIDS ON THE PROPERTIES OF CONCRETE:-

3.1. General:- Concrete is chemically basic, having a pH of 13. An acidity represented by a PH 5.5 – 6 may be considered the practical limit of tolerance of high quality concrete. It should be remembered that no OPC is acid resistant. In practice attack occurs at value of pH below than 6.5. Concrete is also attacked by water containing freeCO_2.Flowing pure water also dissolves Ca $(OH)_2$ thus causing surface erosion. Water with $CO_2$is aggressive with pH as 4.4 .This type of attack may be important in conduits in mountains region, for durability and thus increase the roughness of pipe. The behavior of concrete exposed to acidic soil, water has been reviewed by Ellington German classification is given in table below as:-

Degree of aggressiveness	Aggressive Action by		
	Water		Soil
	pH	Aggressive CO_2 (ppm)	Exchangeable acids (0.1 N) ml/ 100 g of soils
Slight	6.5 – 5.5	15 – 30	20
Severe	5.5 – 4.5	30 – 60	-
Very Severe	< 4.5	>60	-

H2S gaH_2S gas dissolved in water form a weak acid with mild corrosive action on concrete. Principally, in sewers carrying organic wastes, H_2S can be oxidized by bacterial action to H_2SO_4 which can attack concrete. The attack occurs above the level of flow of sewage. The cement is gradually dissolved & progressive deterioration of concrete takes place. Portland blast furnace cement and plasticizers i.e. pozzolaneous with Portland cement are used in acidic solutions. Good protection of the concrete from acid attack is obtained by subjecting the concrete in a vacuum to the action of silicon tetra fluoride gas. The treatment applied to precast concrete known as ocrat – concrete.

3.2. SULFURIC ACID H_2SO_4:-

3.2.1. When mixed in concrete:-Sulfuric acid is available in liquid form, having odors & bad smell as well as very dangerous to the skin, if applied.

pH	Solution of H_2SO_4 depth of deterioration of concrete cm, for theoretical life of structure, Yrs		
	25	50	100
2	5.4	7.6	10.8
3	1.7	2.4	3.4
4	0.5	0.7	1.1
4.5	0.3	0.4	0.6
5	0.2	0.3	0.4

Ref: Durability of reinforced concrete in aggressive media by S.N Alekseen of OPC at w/c = 0.6

10% of H_2SO_4 acid was tried by weight of cement but mix appeared like a dried material and destroys the cement binding power. Afterword 5% of H_2SO_4 acid by weight of cement was used. The increased strength is much lower than the corresponding PCC cube strength. Highly disappearance was observed at the surface. The compressive strength at 28 days fc' is 5.497 MPa or 785.30 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	3.43	3.43	3.43
30	4.91	6.87	5.89
60	4.91	7.36	6.14
90	16.19	15.70	15.95
120	16.68	15.70	16.19

3.2.2. <u>On Concrete Surface</u>:-Generally there are certain chemical factories in which sulfuric acid is used. When this H_2SO_4 is leaked through the vessels, in which it was stored and spread over the concrete surface and thereby damages the structure.5% solution of H_2SO_4 was prepared and a pH of 4.0 is observed. Sulfuric acid attack the cement and not with the aggregate so reaction is with cement not with the aggregate. The compressive strength fc' at 28 days is 32.35 MPa or 4622 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	32.37	30.41	31.39
42	38.01	38.26	38.14
70	32.37	33.45	32.86
90	36.30	38.26	37.28
120	39.24	44.15	41.70

3.3. <u>NITRIC ACID:-</u>

3.3.1. <u>When mixed in Concrete</u>:-Nitric acid is available in liquid form, having odor & bad smell as well as very dangerous to the skin if applied. 2 cubes each for 7,30,60,90,120 days were tested by using 5%of HNO_3 by weight of cement. At 28 days fc' (concrete crushing compressive strength in MPa) is 16.04 MPa or 2292 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	14.72	14.22	14.47
30	15.70	16.68	16.19
60	31.39	32.86	32.13
90	37.28	37.77	37.53
120	38.26	37.28	37.77

3.3.2. <u>On concrete surface</u>:-Generally there are certain chemical factories in which nitric acid is used. When this nitric acid is leaked through the vessel, in which it was stored & spread over the crack surface and thereby damages the structure. The chemical lining is done on and surrounding the surface where these chemicals are to be stored. When concrete specimen is immersed in nitric acid solution of 5% by weight of cement and pH value of 3 is observed with colored pH paper which shows highly acidic solution. The concrete compressive strength is 36.713 MPa or 5245 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.81	36.30	36.06
42	37.77	38.26	38.02
70	40.22	40.22	40.22
90	40.22	40.22	40.22
120	41.20	42.18	41.69

pH	Solution of HNO_3		
	Dept of water deterioration of concrete, cm, for theoretical service life of structures, years.		
	25	50	100
2	2.8	8.2	11.6
3	1.8	2.5	3.7
4	0.6	0.8	1.2
4.5	0.3	0.4	0.6
5	0.2	0.3	0.4

Ref: Durability of Reinforced concrete in Aggressive media by S.N. Alek seen of OPC at w/c = 0.6

3.4. HYDROCHLORIC ACID:

3.4.1. When mixed in Concrete:-HCl is available in liquid form cubes were prepared using 5% of HCl by weight of cement. Slightly lesser workability of concrete was observed. Little effect is seen on the surface by usual appearance. The compressive strength at 28 days fc' is 23.36 MPa or 3337 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	16.68	15.70	16.19
30	28.45	19.62	24.04
60	32.37	32.86	32.62
90	35.32	34.34	34.83
120	36.30	35.06	36.06

3.4.2. Effect Of HClacid on Concrete Surface:- Generally there are certain chemical factories in which HCl is used when this HCl is leaked through vessels, in which it was stored and spread over the concrete surface and thereby damages the structure. Chemical lining to this surface surrounding it is applied on the concrete surface where these chemicals is to be stored. However, the purpose is to see the effects of HCl on the strength of concrete when concrete specimen is immersed in acidic solution. 5% HCl was prepared and immersed in water for 14 days curing. ApHof 4, highly acidic solution was obtained. The compressive strength at 28 days, fc' of 33.193 MPa or 4742PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	29.43	31.88	30.66
42	37.28	39.24	38.26
70	39.73	40.22	39.98
90	40.22	39.24	39.73
120	41.20	41.20	41.20

pH	Solution of HCl		
	Depth of deterioration of concrete, cm, for theoretical service of structure, Years.		
	25	50	100
2	2.8	8.2	11.6
3	1.8	2.5	3.7
4	0.6	0.8	1.2
4.5	0.3	0.4	0.6
5	0.2	0.3	0.4

Durability of Reinforced concrete in Aggressive media by S.N Alekseen of OPC at w/c = 0.60

4. EFFECT OF SULPHATES ON THE PROPERTIES OF CONCRETE:-

4.1. Solid salts do not attack concrete, but when present in solution they can react with hardened cement paste. Some clay contain for instance alkali, magnesium, $CaSO_4$and ground water .Gypsum and Calcium sulpho-aluminate have reaction with sulphates leads to expansion and disruption of concrete. Attack of $MgSO_4$ is more severe than by other sulphates. Concrete attacked by sulphates have a whitish appearance. Sulphate resisting cement is suggested for sulphate attack. The use of pozzalanas instead of cement resists sulphate attack.

4.2. Sea water contains sulphates, concrete b/w tide marks subjected to drying and wetting is severely attacked, while immersed in water is least attacked. In RCC the concrete cover is 2 to 3 in. A w/c ratio of not more than 0.40 is recommended.

4.3. **Classification of sulphate attack vide ACI 318** :-When sulphate contents are 0.1 % in soil or under 150 ppm (mg/litre) in water, any cement type and w/c ratio may be used. This is negligible attack. When 0.1 %-0.2% sulphate content or 150-1500 ppm in water, ASTM type-II Portland cement or Portland pozzolanic or Portland slag cement with less than as 0.5 w/c, for normal weight concrete shall be used. This is moderate attack. When the sulphate contents are 0.2%-2% in soil, or 1500-10000 ppm in water, ASTM type V port land cement with less than or equal to 0.45 w/c, shall be used. This is severe attack. When the sulphate contents is greater than 2% in soil or over 10,000 ppm in water ASTM type V cement plus a Pozzolanic admixtures with less than 0.45 % shall be used.

Concentration of asphalt expressed as SO3				Type of cement	Min cement contact in kg/m3 for nominal max size of aggregates			Max free w/c ratio
In soil								
Class	Total SO3 present	SO3 in 2:1 (water:Soil) extract) gm/ltr	In ground water (ppm)		40 mm	20mm	10 mm	
1	< 0.2	0	< 300	OPC or blast furnace cement	240	280	330	
2	0.2-0.5	0	300-1200	OPC or blast furnace cement	290	330	380	0.55

				Sulphate resisting Portland	240	280	330	0.55
				Super sulphated	270	310	360	0.5
3	0.5-1.0	1.9-3.1	1200-2500	Sulphate resisting Portland or super sulphated	290	330	380	0.5
4	1.0-2.0	3.1-5.6	2500-5000	Sulphate resisting Portland or super sulphated	330	370	420	0.45
5	Over 2	Over 5.6	Over 5000	As for class 4, but an addition of adequate protective coatings of inert material such as asphalt or bituminous emulsions reinforced with fiber glass membranes.				

4.4. EFFECT OF $MgSO_4$ (MAGNESIUM SULPHATE):

It is also used in tanning, but beyond a concentration of about 0.5% about of Mg SO_4 or 1% of Na_2SO_4 the rate of increase in the intensity of the attack becomes smaller. A saturated solution of $MgSO_4$ leads to serious deterioration of concrete. The concentration of sulphates as a number of parts by weight of SO_3 /million PPM is 1000 ppm is considered moderately severe and 2000 ppm are very severe. In order to estimate the danger of the sulphate attack the movement of ground water has to be known. Sulphate bearing water rate of attack is highest. Likewise alternate saturation and drying lead to rapid deterioration. When concrete attacked by sulphate at edges & corners and progressive cracking to friable or even soft state. In practice sulphate resisting cement C_3A and pozzolaneous is better to use where sulphate attack is suspected .However, British code of practice CP 110:1972 and BS 5328:1976 allows not to use fly ash with sulphate resisting cement. The resistance of concrete to sulphate attack depends also on its impermeability.

4.4.1. When mixed in concrete:-Hydrated magnesium sulphate ($MgSO_4.7H_2O$) is also called 'Epsom salt' .It is colorless crystalline solid. It is soluble in the water and get moisture in open atmosphere.5% $MgSO_4$ was used in the concrete mix. Concrete became very dry and less workable when it was mixed in the concrete. The compressive strength at 28 days fc' was 25.39 MPa or 3627 PSI (avg. of two cubes).

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	26.98	26.49	26.74
30	26.49	24.03	25.26
60	27.96	28.45	28.21
90	29.43	30.41	29.92
120	31.39	31.39	31.39

4.4.2. <u>On the surface of concrete</u>:-$MgSO_4$ is largely used in ceramics, cement, soap and paper industry. Plain concrete cubes were immersed in solution of 5% Mg SO_4, pH value of 9, alkaline. The compressive strength at 28 days fc' is 35.07 MPa or 5010 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	33.45	32.86	33.11
42	38.75	39.24	39.00
70	41.20	41.20	41.20
90	39.24	40.22	39.73
120	38.26	41.20	39.73

4.5. <u>SODIUM SULPHATE</u>:-

4.5.1. <u>Effect of Na_2SO_4 when mixed in concrete</u>:-5% sodium sulphate was used in the concrete mix. Workability of the concrete mix was increased. The compressive strength at 28 days fc' is 24.22 MPa or 3460 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	19.87	22.07	20.97
30	23.54	25.51	24.53
60	33.35	34.34	33.85
90	36.30	36.54	36.42
120	38.75	39.24	39.00

4.5.2. <u>Effect of Na_2SO_4 when applied on concrete surface</u>:-5% Na_2SO_4 shows pH value of 11, alkaline in nature .The compressive strength at 28 days fc' is 35.48 MPa or 5069 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	31.88	34.34	33.11
42	37.28	43.16	40.22
70	27.47	28.45	27.96
90	29.43	31.39	30.41
120	31.39	35.32	33.36

4.6. <u>CALCIUM SULPHATE</u>:-

4.6.1. <u>Effect of $CaSO_4$ on the properties of concrete when mixed in concrete</u> :-
Calcium sulphate is available in anhydrous as well as in hydrous form. Dehydrated form is called Gypsum. It is sparingly soluble in water. It was used in solid form while preparing the concrete mix.5% by weight of cement of calcium sulphate on 7,30,60,90 and 120 days on avg of 2 cubes(British standard specification).The compressive strength at 28 days fc' is 28.91 MPa or 4130 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	20.60	21.09	20.85
30	29.43	29.92	29.68
60	41.20	43.16	42.18
90	44.15	44.65	44.40
120	45.13	45.13	45.13

4.6.2. <u>On surface of concrete</u>:-$CaSO_4$ is used in making plaster of Paris, wall-board, fertilizers and glazing papers. Concrete structures in these industries are effected by $CaSO_4$.10 numbers cubes of concrete are immersed for 15 days in solution of 5% $CaSO_4$.The compressive strength of 28 days , fc' is 34.50MPa or 4929 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	32.37	33.35	32.86
42	37.28	38.26	37.77
70	39.24	40.22	39.73
90	39.24	38.26	38.75
120	41.20	40.22	40.71

4.7. <u>COPPER SULPHATE</u>:-

4.7.1. <u>Effect of $CuSO_4$ when mixed in concrete</u>:-Copper sulphate ($CuSO_4.5H_2O$) is also called Nila thotha. It is a blue crystalline efflorescence solid. It is highly soluble in the water. It was used in solution form in the concrete while mixing. The compressive strength of avg of 2 numbers cubes tested in compressive testing machine shows at 28 days, fc' is 27.107 MPa or 3873 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	17.66	18.64	18.15
30	27.47	28.45	27.96
60	37.28	37.77	37.53
90	39.24	41.20	40.22
120	42.18	40.71	41.45

4.7.2. <u>Effect of $CuSO_4$ when applied on concrete surface</u>:-$CuSO_4$ is used in copper refining ,electroplating, Calcio dying and printing industries.10 numbers cubes prepared by 21,42,70,90,120 days after 14/15 days curing in 5% solution of water and avg of 2 nos. cubes compressive strength, fc' at 28 days is 35.07 MPa or 5010 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	31.88	34.34	33.11
42	38.75	39.24	39.00
70	40.71	41.20	40.96
90	39.24	38.26	38.75
120	37.28	36.30	36.79

5. <u>EFFECT OF ALKALIES</u>:

5.1. <u>General</u> : Alkalies may be defined as a chemical compound which yield hydroxyl OH^{-1} ions in water solution .They have pH value more than 7.Common examples are sodium hydroxide, Calcium hydroxide and ammonium hydroxide .Concrete is unaffected by continuous exposure to 10 % solution of sodium or potassium hydroxides. Calcium, ammonium, barium and strontium hydroxides are harmless to concrete. <u>Concentrated basic solution (having above 20%) corrosion may occur to concrete</u>. Pozzolanic cements should not be used for concrete subjected to strong basic solutions. Alkali aggregate reaction is b/w certain highly silicious constituents of aggregates and <u>cement having high alkali contents results in strength</u>

loss, excessive expansion, cracking and distintegration. The expansion may close the expansion joints dislocate structural members, cause machinery to be disclosed.

5.2. The alkali silica reaction (ASR) occurs in a concrete pavement and hence cracking in within 5-10 years. We are investigating several geochemical and mineralogical issues related to ASR.ASR is often detected using a geochemical labeling techniques. AAR (Alkali Aggregate reaction) in which sodium and potassium ions in solution react with certain types of aggregates in concrete .The reaction forms a hydroscopic alkali-silica gel which enable water and swell. The swelling forces generated may be sufficient to disrupt aggregate and the surrounding concrete, causing expansion, cracking, and associated deterioration.

5.3. Enrichment concentration and recycling of alkalies in concrete:-It has been suggested that moisture mobility through concrete can cause alkali metal salts to migrate and create temporary or permanent concentrations of these salts in some regions of the concrete.

5.4. SODIUM HYDROXIDE:-

5.4.1. Effect of NaOH when mixed in concrete:-NaOH is available in white solid form, it is extremely strong base (alkali) and it tends to dissolve the skin, if applied. Its common name is caustic soda and chemical formula is NaOH.

$Na_2CO_3 + Ca(OH)_2$ ---------- 2 NaOH + $CaCO_3$

$NaOH + H_2O$ ----------$Na^+_{(aq)} + OH^-_{(aq)}$ - 10,000 Calories

10 cubes were casted after mixing 10 % of NaOH by weight of cement. The compressive strength, fc' at 28 days is 14.76 MPa or 2109 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	9.81	10.30	10.06
30	14.72	15.70	15.21
60	18.64	18.15	18.40
90	21.58	23.54	22.56
120	23.54	24.03	23.79

5.4.2. On the surface of concrete:-It is widely used in the manufacturing of soap, silk finish of mercerized cotton, rubber reclaiming, paper making, rayon textile production. It is immersed in NaOH solution the concrete cubes.10% of NaOH shows pH is 14, highly basic solution. In addition to decrease in strength, high surface efflurorescence was also observed. The compressive strength at 28 days on avg. of two cubes tested was 37.93 MPa or 5419 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	36.30	38.26	37.28
42	39.24	39.24	39.24
70	42.18	41.20	41.69
90	37.77	36.30	37.04
120	37.28	38.26	37.77

5.5. CALCIUM HYDROXIDE: The strongly alkaline nature of $Ca(OH)_2$with pH of 13 prevents the corrosion of the steel reinforcement by the formation of a thin protective film of iron oxide on the metal surface known as ' passivity'. If concrete is permeable

then carbonation reaction reaches the concrete with steel or soluble chlorides can penetrate upto reinforcement, and water and oxygen are present, then corrosion of reinforcement will take place. The passive iron oxide layer is destroyed when pH falls below 11 and carbonation lowers to 9pH.The formation of rust results in an increase in volume with original steel so swelling pressure will cause cracking and spalling of the concrete. It has been suggested that the optimum relative humidity for corrosion is 70%-80%.Corrosion of steel occurs because of electrochemical action which is met when two different metals are in electrical contact in the presence of moisture and oxygen.

5.5.1. <u>When mixed with in concrete</u>:- $Ca(OH)_2$ is available in liquid form and is a base known as lime water. We casted 10 cubes after mixing 10 % of $Ca(OH)_2$ by weight of cement. The deterioration effect was observed when mixed with/in concrete. The compressive strength fc' at 28 days is 23.90 MPa or 3415 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	16.68	12.75	14.72
30	24.53	25.02	24.78
60	26.00	25.51	25.76
90	27.47	28.45	27.96
120	30.41	29.43	29.92

5.5.2. <u>On surface of concrete</u>:-Chemical lining is carried out where it is generally in contact with concrete. However, the purpose is to see the effect of $Ca(OH)_2$ on the strength of concrete when concrete specimen is immersed in its solution. Solution of 10% $Ca(OH)_2$ shows a pH of 10 ,basic. It was observed that specimen immersed in $Ca(OH)_2$ have very small change in strength .Hence it has less effect as compared to NaOH and NH_4OH.In addition to decrease in strength high surface efflorescence was also observed. The crushing compressive strength fc' at 28 days is 37.94 Mpa or 5420 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.32	33.35	34.34
42	45.13	45.13	45.13
70	44.15	44.64	44.40
90	45.13	44.15	44.64
120	46.11	45.13	45.62

5.6. <u>AMMONIUM HYDROXIDE /AMMONIA SOLN</u>:-

5.6.1. <u>When mixed in concrete</u> :-NH_4OH is available in liquid form basically it is a solution of ammonia ,it is strong base and it has very pungent smell.10 cubes were casted after mixing 10 % NH_4OH by weight of cement.NH_4OH results shows has disintegrative effect when mixed in concrete. The compressive strength is 28.59 MPa or 4085 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	16.19	18.15	17.72
30	28.45	30.90	29.68
60	35.32	32.37	33.85

90	39.24	40.22	39.73
120	40.22	40.22	40.22

5.6.2. <u>On surface of concrete</u>:- It is widely used in the manufacturing of nitric acid, rayon textile production and manufacturing of fertilizers .10% of NH_4OH was prepared, pHof 14 ,basic solution. There is decrease in strength, high surface efflorescence was also observed. The fc' is 35.15 MPa or 5022 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.07	33.35	34.21
42	36.79	37.28	37.04
70	40.71	41.20	40.96
90	41.20	39.24	40.22
120	42.18	42.18	42.18

6. <u>EFFECT OF CARBONATES</u>:-

6.1. <u>General</u>: Sodium carbonate solution have little or no chemical action on dense matured OPC. Ammonium bicarbonates solution seems to have some actions on concrete. Carbonate aggregates used in concrete are generally provide a strong bond with the cement paste. Certain type of carbonate rocks used as aggregate produce expansion in concrete in the form of pattern or map cracking. Carbonation results in a soft dusty surface to normal concrete .Carbonation is defined as the chemical combining of CO2 with the hydration products of OPC. Carbonation can affects concrete to various degrees from a light dust on the surface to a deep of ¼'' or more.

6.2. <u>SODIUM CARBONATE</u>:-

6.2.1. <u>When mixed with concrete</u>:-Sodium carbonate is a transparent, crystalline solid. It is also called washing soda. Anhydrous sodium carbonate is called soda ash. It is highly soluble in water and its solubility is 21.4 gram at 25 ^{0}C.Therefore it was used in soln form while preparing the concrete mix.5% by weight of cement was used. On testing after 7,30,60,90 and 120 days the compressive strength was reduced by 21%,46%,45%,45% and 44% respectively as compared with OPC. The fc' is 21.49 MPa or 3071 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	21.58	19.62	20.60
30	22.56	20.60	21.58
60	21.83	22.56	22.20
90	25.75	26.98	26.37
120	27.47	27.47	27.47

6.2.2. <u>When applied on the concrete surface</u>:-Na_2CO_3 is largely used in manufacturing of glass, enamels, soap, paper and for water softening .10 cubes were Na_2CO_3 having pH value 11.On testing at 42 days strength increased by 23% and after 70, 90,120 days the strength was reduced to 7%,19%,16% w.r.t plain cubes. The fc' is 36.22 MPa or 5174 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	31.39	32.37	31.88
42	44.64	45.13	44.89
70	38.26	37.28	37.77
90	39.24	39.73	39.49
120	41.69	40.22	40.96

6.3. CALCIUM CARBONATE:

6.3.1. When mixed in concrete:-$CaCO_3$ is a white crystalline solid. It is slightly soluble in water. It was used in solid form while preparing the concrete mix as it is soluble in water.5% by weight of cement was used.10 nos. of cubes were casted and tested. The test results showed that the compressive strength is much less than plain cube strength. The fc' is 21.78 MPa or 3112 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	20.00	19.00	19.50
30	23.00	21.00	22.00
60	22.00	23.00	22.50
90	26.00	27.00	26.50
120	28.00	28.00	28.00

6.3.2. On concrete surface:- $CaCO_3$ is widely used in medicine.10 cubes were prepared and tested after 14 days curing when immersed in 5% solution of $CaCO_3$.The pH of 8, slightly alkaline solution .The fc' is 32.67 MPa or 4667 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	28.00	29.00	28.50
42	38.00	44.00	41.00
70	39.00	37.00	38.00
90	40.00	39.73	39.87
120	42.00	40.22	41.11

6.4. Magnesium Carbonate:-

6.4.1. When mixed in concrete: It is white crystalline solid. It is slightly soluble in water. Since it is soluble in water, therefore it was used in solidform.5% by weight of cement was used. The fc' is 20.83 Mpa or 2975 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	18.00	20.00	19.00
30	22.00	20.00	21.00
60	22.00	23.00	22.50
90	26.00	27.00	26.50
120	28.00	28.00	28.00

6.4.2. On surface of concrete:-$MgSO_4$ is widely used in medicines.10 cubes were prepared and immersed for 14 days curing in 5% Mg_2CO_3 solution of concrete cubes. The pH value obtained was 8-alkaline solution. The fc' is 32.33 N/mm^2 or 4619 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	27.00	30.00	28.50
42	37.00	43.00	40.00
70	39.00	37.00	38.00
90	39.00	39.73	39.37
120	42.00	41.00	41.50

6.5. Sodium Bicarbonate $NaHCO_3$:-

6.5.1. When mixed in concrete: It is white crystalline solid. It is slightly soluble in water and its solubility is 8.2 g. Solution of NaHCO3 is alkaline and hydrolyzes in water. Since it is soluble in water, therefore, it was used in solidform.5% by weight of cement was used. The fc' is 23.95 Mpa or 3422 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	18.15	17.66	17.91
30	24.53	24.53	24.53
60	32.86	33.35	33.11
90	32.37	31.64	32.01
120	35.32	31.88	33.60

6.5.2. On surface of concrete:- $NaHCO_3$ is widely used in medicines.10 cubes were prepared and immersed for 14 days curing in 5% Mg_2CO_3 solution of concrete cubes. The pH value obtained was 8 alkaline solution. The fc' is 32.33 N/mm^2 or 4619 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	36.30	37.28	36.79
42	40.22	40.22	40.22
70	39.24	40.22	39.73
90	35.32	33.35	34.34
120	31.39	29.43	30.41

7. EFFECT OF CHLORIDES:-

7.1. General: The addition of calcium chlorides reduces initial and final setting time and reduces the curing period and early hardening of concrete. Increase early strength early hardening of concrete. Increase early strength during cold weather and affords resistance to damage by frost action or freezing temperature at early age. An admixture of it reduces the resistance of concrete to sulphate. They chemically increases the expansion caused by AAR and should be avoided with special cement. This increase shrinkage 10%-70% has gradual disintegrating of concrete.

Fe^{+2} ---------- 2Cl- ---------- $FeCl_2$
$FeCl_2 + 2H_2O$ ----------$Fe(OH)_2 + 2HCl$.

Chloride ions present in the cement paste surrounding the reinforcement react with anodic sites to HCl which destroys the passive protective film on the steel. The surface of the steel then becomes activated locally to form the anode, with the passive surface of the cathode, and then ensuring corrosion is the form of localized pitting.

BS 8110: Part 1: 1985 limit of chlorides contents by concrete

Type	**Max chlorides contents exposed as %age of chlorides ions in mass of cement**
Pre-stressed concrete heat cured containing embedded metal concrete made with sulphate resisting Portland type V cement or sulphated cement	0.1
Concrete containing embedded steel and cement following types used as OPC (type-I)	0.2
Rapid hardening cement (type III) Portland blast furnace (type II) Low heat Portland cement (Type IV) Low heat port land cement (type I,IP) Low heat Portland slag (PFA)	0.4

7.1.1. ACI 318-83 limit of chlorides contents of concrete

Types	**Max chloride contents expressed as %age of chlorides ions in mass of cement**
Pre-stressed concrete	0.06
reinforced concrete exposed chloride in service	0.15
reinforced concrete which will be dry	0.30
other reinforced concrete construction	0.30

7.1.2. $CaCl_2$ in concrete by V.S Ramchadran:-The romans used blood, pigs fat and milk as additions to Pozzolanic cements to improve the workability and durability. Admixtures are added to water, aggregate and hydraulic cement in before or during mixing. Typical examples water reducers, retarders, water reducing accelerating agents, accelerators and water proofers. An accelerator, in chemical sense accelerate rate of reaction, physical sense increase in the rate of setting, in mechanical sense increase in the rate of setting, in mechanical sense increase in the rate of development of strength. Practical point of view reduced the curing period and reduction in the time during which concrete must be protected in cold weather several chemicals like Calcium formate, $CaCl_2$ is most commonly used are accelerators.

7.1.2.1. Methods of adding $CaCl_2$:-It is recommended that dosage should not exceed 2% by weight of cement. Max 2% flake $CaCl_2$ or 1.5% anhydrous $CaCl_2$. $CaCl_2$ is available as pellets or flakes or in solution form. $CaCl_2$ is soluble in cold or hot water. Add salt to the water. It is (with 77% min $CaCl_2$) or 3.25 pounds of pellet or concentrated flake or other granular form (with 94% min $CaCl_2$) in each gallon of soln.

Then add 1 quart of solution/sack of cement when 1% $CaCl_2$ is specified or 2% quarts /sack for 2% $CaCl_2$. Then no water shall be mixed for concrete.

7.1.2.2. **Effect on physical properties of concrete**:- Calcium chloride significantly reduces both initial and final setting time of concrete. Very excessive amount and even small amount should be avoided. As its rapid set placing and finish may become difficult. CSA A266.2-1973 &ASTMC 494-1971 standards initial setting time of 1 hr earlier but not more than 3 hrs for CSA and 3 ½ hrs to ASTM. ASTM says it should be 1 hr earlier than without $CaCl_2$. As it is an accelerator, it may tend to induce early stiffening thus reduce bleeding. In many instances a whitish deposit on cured concrete is attributed to the presence of $CaCl_2$. When efflorescence does occur it can be removed with dilute HCl, followed by rinsing with water.

7.1.2.3. **Effect of $CaCl_2$ on mechanical behaviour of concrete**:-Addition of $CaCl_2$ results in accelerated hardening of concrete containing any type of Portland cement amount of $CaCl_2$ in excess of accepted standards cause lowering of strength. Flexural strength does not increase so much as compressive strength with addition of $CaCl_2$. ASTM C-494 show flexural strength at 3 days is 110% but at 3 days compressive strength is 125%.

7.1.2.4. **Chemical effects on concrete**:- When concrete is exposed to solutions of sulphates react with calcium and aluminum ions in the cement paste to form calcium sulphate and calcium sulpho-aluminate hydrates, due to $CaCl_2$ the sulphate attack is reduced. Experiments have shown that $CaCl_2$ in concrete aggravates the alkali-aggregates reaction. If $CaCl_2$ has to be used, the use of low alkali cement, pozzolaneous or a non-reactive aggregate. Some countries do not recommend the use of $CaCl_2$ in reinforced concrete. $CaCl_2$ is prohibited for pre-stressed concrete. In post-tensioned concrete (wires are encasted in tubes), it should be used in grout of $CaCl_2$, for steam cured concreting $CaCl_2$ is not recommended for use.

7.1.2.5. **Concluding remarks**:- There are misconception to the use of $CaCl_2$ as an antifreeze. It is no substitute for good design or poor workmanship or quality material. However, that calcium chloride is still the most practical accelerator for concrete.

7.2. AMMONIUM CHLORIDE

7.2.1. **When mixed in water to form concrete**:- NH_4Cl is available in white solid form. It gives smell.10 cubes were casted after mixing 10% of NH_4Cl by weight of cement. The result shows it has a disintegrative effect when mixed in concrete and this effect depends upon the amount of NH_4Cl used. The deterioration effect of NH_4Cl is more as compared to KCl and $CaCl_2$ and less than that of NaCl .The crushing compressive strength fc' at 28 days used in design is 19.44 MPa or 2778 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	15.21	14.72	14.97
30	19.62	20.11	19.87
60	23.54	24.53	24.04
90	27.96	28.94	28.45
120	33.35	31.88	32.62

7.2.2. <u>When applied on concrete surface</u>:-10 cubes were casted after 15 days curing in a solution of NH_4Cl mixed in water and cubes immersed in mixed solution. A pH is 9, slightly basic solution. The fc' is 37.69 MPa or 5384 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	38.26	34.34	36.30
42	39.73	41.20	40.47
70	37.28	37.28	37.28
90	39.24	37.28	38.26
120	44.64	41.20	42.92

7.3. <u>POTASIUM CHLORIDE</u>:-Potassium chloride, KCl, does not chemically attack concrete. It can cause damage in winter from freeze-induced expansion pressure by increasing number of freeze/thaw cycles.

7.3.1. <u>When mixed in water of concrete</u>: It is available in white solid form. Its common name is black salt and chemical formula is KCl. We casted 10 cubes after mixing 10 % of KCl by weight of cement. The results show that it has a very less disintegrating effect when mixed in water of concrete used and this effect depends upon the KCl used. The fc' is 36.06 MPa or 5151 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	30.41	31.39	30.90
30	36.79	36.30	36.55
60	39.24	39.24	39.24
90	41.20	41.45	41.33
120	45.13	46.11	45.62

7.3.2. <u>When applied on concrete surface</u>:-Concrete cube specimen immersed in 10% KCl solution immersed for 15 day curing ,shows pH value 9,slightly basic solution. The crushing compressive strength fc' at 28 days is 39.32 MPa or 5618 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	41.20	38.26	39.73
42	37.77	39.24	38.51
70	40.22	40.22	40.22
90	38.26	37.28	37.77
120	36.79	37.28	37.04

7.4. <u>SODIUM CHLORIDE</u>:-

7.4.1. <u>Effect of NaCl when mixed in water (concrete)</u>:- It is available in white solid form. Its common name is table salt and chemical formula is NaCl. When 10 cubes casted after mixing 10 % of NaCl by weight of cement. The result shows that with the passage of time the decrease in strength due to the mix of NaCl is significant. Most authorities agrees that NaCl and $CaCl_2$ can cause deterioration to concrete. If good concrete practice are followed, damage can be kept to a minimum. These include using good air-entrained concrete and sealing all cracks. Good surface drainage should be provided and now debris cleaned from gutters during winter. The fc' is 27.921 MPa or 3989 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	25.51	26.98	26.25
30	27.47	28.69	28.08
60	33.35	34.34	33.85
90	29.43	28.45	28.94
120	26.00	26.49	26.25

7.4.2. When applied on concrete surface :-10 % NaCl solution was immersed in water and cubes casted without NaCl were placed in NaCl included water for 15 days curing shows a pH of 7 ,neutral .The fc' is 35.48 MPa or 5069 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	34.34	34.58	34.46
42	36.79	38.26	37.53
70	41.20	39.24	40.22
90	36.30	34.34	35.32
120	33.35	36.30	34.83

7.5. CALCIUM CHLORIDE:-$CaCl_2$ accelerates the hydration of cement, which reduces initial setting time i.e 45 min, final setting time i.e 10 hrs and shrinkage, while increasing early strength, surface wear, cold weather protection and workability. It is used in the manufacturing of ready-mix concrete, concrete block, pipe, precast products. It is also used by paving contractors, engg. Firms, const companies.

When $CaCl_2$ is added to OPC at normal temp of 25 C, it lower's initial setting time from 3 hr to 1 hr and final setting time from 6 hr to 2 hr.
It compressive strength at 1 day is more than 50% at 26^0C, 3 days compressive strength is 51% higher and at 7days is 32% higher. It also can improve ultimate strength. The Portland cement association found $CaCl_2$ have ultimate strength improvement of 9% in 3 years and California department of public works strength improves by 10 % in 5 yrs. $CaCl_2$ is often added when temperature falls below 19C in the 24 hrs after concrete placement. Its curing lowers evaporation accelerates hydration, which reduces curing.$CaCl_2$ increase concrete flow and workability with same water cement ratio for OPC. It allows greater density by reducing water content upto 0.5 gallon/bag of cement.

7.5.1. When mixed in concrete:- It is pungent smell and white solid form, chemical formula is $CaCl_2$.10 cubes after mixing 10 % of $CaCl_2$ by weight of cement. The results show that $CaCl_2$ has no disintegrative effect when mixed in concrete and this effect depends upon the amount of $CaCl_2$ used .It should confirm to requirement ASTM D98 and should be sampled /tested in accordance with ASTM D345.The fc' is 32.562 MPa or 4652 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	29.43	29.43	29.43
30	33.35	32.37	32.86
60	45.13	45.62	45.38
90	46.11	45.13	45.62
120	47.09	48.07	47.58

7.5.2. <u>When applied on concrete surface</u> :-15 days curing done by adding 10% $CaCl_2$ in water used for curing and 10 cubes casted were immersed in this water ,pH value of 8,slightly basic. It was observed a decrease /same/minor compressive

Strength observed, but at 90,120 days high surface efflorescence was also observed .The fc' is 34.913 MPa or 4988 PSI .

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.32	32.37	33.85
42	37.28	36.79	37.04
70	40.22	40.47	40.47
90	39.24	40.22	39.73
120	38.26	37.28	37.77

8. <u>EFFECT OF SULPHER & PHOSPHOROUS</u>:-

8.1. <u>Effect of SULPHER when mixed with/in concrete</u>:-It is yellow colored powder material which is insoluble in the water. Therefore it was used in the solid form while preparing the concrete mix. Percentage of Sulpher used was 5% by the weight of cement. The fc' is 21.486 MPa or 3069 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	19.62	18.64	19.13
30	22.81	20.60	21.71
60	23.79	24.53	24.16
90	25.02	23.79	24.41
120	26.49	24.03	25.26

8.2. <u>When applied on surface of concrete</u>:- Sulpher is mostly used in the preparing of sulphuric acid. Sulpher is used in paper, rubber, fertilizers, explosives and matches industries.10 cubes of plain concrete cubes were immersed in the solution of 5% Sulpher, pH value tested is 7, neutral obtained. The fc' is 35.48 MPa or 5069 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	34.34	30.41	32.38
42	42.18	41.20	41.69
70	41.20	40.22	40.71
90	42.18	40.22	41.20
120	42.18	45.13	43.66

8.3. <u>TRI SODIUM PHOSPHATE</u> :-

8.3.1. <u>When mixed in concrete</u>:-Cubes were prepared by using 5% of tri sodium phosphate by weight of cement. The fc' is 18.02 MPa or 2574 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	13.73	14.22	13.98
30	17.66	19.13	18.40
60	22.56	21.58	22.07
90	25.51	26.00	25.76
120	26.49	25.51	26.00

8.3.2. When immersed in surface of concrete:- After 15 days curing in 5% solution of tri sodium phosphate .10 cubes were casted and immersed in water /tri sodium phosphate for 14 days and tested. The fc' is 33.6 MPa or 4800 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	29.43	31.39	30.41
42	40.22	39.73	39.98
70	42.18	40.22	41.20
90	41.20	38.26	39.73
120	39.24	40.22	39.73

9. EFFECT OF VEGETABLE & MINERAL OIL:-

9.1. General:-Many vegetable oils contain free fatty acids cause deterioration of concrete surface. Free animal oils contain acids and cause corrosion. Fish oils are more corrosive than other animal oils. Glycerin attacks concrete. Petroleum oils are harmless to concrete. Common non-mineral oils are cotton seed oils, palm oils, rape seed, olive, linseed, tang, lard and fish oils. It is assumed that all such oils are dangerous to OPC. For soap and oil seed industry OPC is not recommended for floors. To resist oil attack German recommend use of blast furnace cement or pozzalana, but not immunity to attack. Concrete tanks are used for storage of many oils and suffer attack. A surface coating of sodium silicate and magnesium silico-fluoride are used but in severe condition resin –base coating found satisfactory.

9.2. MUSTARD OIL:-

9.2.1. Effect of mustard oil when mixed in concrete:-Cubes were casted using 7.5% of mustard oil by weight of cement .It was observed that the oil increases the workability. Heavy white crystals were formed on the surface of cubes. Mustard oil reduces the strength of the cubes because oil envelopes the particles of cement and aggregates and as a result binding b/w the particles were not proper resultantly decreases the compressive strength of concrete cubes .The crushing compressive strength fc' is 27.11 MPa or 3873 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	17.66	18.64	18.15
30	27.47	28.45	27.96
60	37.28	37.77	37.53
90	39.24	41.20	40.22
120	42.18	40.71	41.45

9.2.2. When applied on concrete surface:-14 days curing simple cubes were immersed in oil. Pure oil was used for observing the effect on surface. There is not much change in compressive strength of cubes. The fc' is 34.50 MPa or 4929 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	29.43	34.34	31.89
42	39.24	40.22	39.73
70	38.26	41.20	39.73
90	37.28	36.30	36.79
120	39.24	40.22	39.73

9.3. COCONUT OIL:-

9.3.1. When mixed in concrete :-Cubes were casted using 7.5% of coconut oil by weight of cement .Coconut oil increases the workability but it reduces the strength of cubes. The fc' is 27.11 MPa or 3873 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	17.66	18.64	18.15
30	27.47	28.45	27.96
60	37.28	37.77	37.53
90	39.24	41.20	40.22
120	42.18	40.71	41.45

9.3.2. When applied on surface of concrete:- Pure coconut oil was used. Same compressive strength achieved as ordinary cubes because the oil are good curing medium. The fc' is 34.50 MPaor 4929 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	29.43	34.34	31.89
42	39.24	40.22	39.73
70	38.26	41.20	39.73
90	37.28	36.30	36.79
120	39.24	40.22	39.73

9.4. TURPENTINE:-Turpentine has little effect on concrete but considerable penetration occurs. Such oils when continuously split on concrete floors, often cause gradual deterioration as well as penetration deeply into or even through the concrete. High alumina cement is more resistant.

9.4.1. When mixed in concrete:-7.5 % turpentine mixed in water to be used for concrete preparation by weight of cement. The fc' is 30.00 MPa or 4287 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	25.51	26.00	25.76
30	32.37	28.45	30.41
60	30.41	28.45	29.43
90	33.35	29.43	31.39
120	30.41	32.37	31.39

9.4.2. On the concrete surface:- Pure turpentine oil was used for observing the effect on concrete .There is increase in strength and penetrate more than other oils as viscosity is low. The fc' is 36.10 MPa or 5158 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	31.88	35.32	33.60
42	42.00	40.22	41.11
70	42.18	37.28	39.73
90	48.00	47.00	47.50
120	49.00	50.00	49.50

9.5. SOYABEAN OIL:-

9.5.1. When mixed in concrete:-Cubes were casted using 7.5% soybeans oil by weight of cement. Workability was reduced. The fc' is 15.76 Mpa or 2252 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	10.79	11.77	11.28
30	14.72	17.66	16.19
60	18.64	15.70	17.17
90	17.17	17.66	17.42
120	16.68	17.66	17.17

9.5.2. When applied on concrete surface:-Pure soybean (vegetable /cooking oil) is applied on cubes of concrete and immersed in water for14 days. It is indicated that soybean has acted as curing medium. The fc' is 36.22 MPa or 5175 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.32	34.34	34.83
42	38.75	39.24	39.00
70	40.71	42.18	41.45
90	39.24	40.22	39.73
120	39.73	41.20	40.47

9.6. MINERAL OIL:- Mineral oil such as petrol, fuel oils, petroleum do not attack matured concrete. Lubricating oils do not attack concrete .Concrete floors or mortars joints in brick and tile floors may also be permeable to lighter oil surface treatment with sodium silicate is recommended. In case of petrol, various plastic thin sheet lining are used. The kerosene oil 10% by weight of cement if used will retard against alkalis. Concrete covers to 50-100 mm is recommended for foundation and footing over reinforcement .Construction joint should also be reduced to minimum. Add protection by the use of chemical resistant stone facing or a layer of plaster of Paris with jute or tar. Petrol oil has no effect on concrete.

9.7. KEROSEAN OIL:-

9.7.1. When mixed in/with concrete:-Cubes casted 10 nos. after 10% kerosene oil by weight of cement. At testing the compressive strength is considerably reduced as compared with plain cube of same age. The fc' is 23.36 MPa or 3337 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	15.70	16.68	16.19
30	23.54	24.53	24.04
60	29.43	26.49	27.96
90	27.47	29.92	28.70
120	29.43	30.41	29.92

9.7.2. When applied on concrete surface only:-The pure Kerosene oil applied on concrete cubes for 14 days .It was concluded that kerosene oil have lesser effect on surface. The crushing compressive strength at 28 days is fc' is 32.133 MPa or 4591 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	31.88	27.47	29.68
42	38.75	35.32	37.04
70	38.26	39.73	39.00
90	37.28	38.26	37.77
120	39.24	36.30	37.77

10. EFFECT OF MISCELLENEOUS SUBSTANCES:-

10.1. Organic acids:-The organic acids are lactic acid, butyric acid, milk, butter, and acetic acid/vinegar. The 2nd group has as constituents of various oils and fats.

10.1.1. Lactic acid:- Acetic acid has most destructive action on set cement. Concrete floor like in diaries, cheese factories also have adverse effect on it. Effluent from dairies contain lactic acid, in treatment plant high alumina cement is used instead of OPC. Acid resisting cements for tile floors in milk processing and bottling rooms are used. Effluent from daries contain lactic in treatment plants high alumina cement used instead of OPC.

10.1.2. Butric acid:- Seems to have similar actions to lactic acid.

10.1.3. Acetic acid:- Attacks set cement and concretes. Pozzalanic and blast furnace slag cements are more resistant than OPC. For weak solution of acetic acid, acid resistant paints and for strong solution lining are needed.

10.1.4. Tartaric acid:- Tartic acid have similar in action like lactic and acetic acid. This is present in fruit juices which required some surface treatment.

10.1.5. Malic acid:- Apple juice in which malic acid occurs serious deterioration to OPC and high alumina cement.1% solution can cause serious attack to OPC.

10.2. PEPSI:-

10.2.1. When mixed in concrete:-10 numbers cubes were casted using 20% by weight of cement. The result shows that app 100% decreased in strength versus duration is due to improper bonding due to adding pepsi. The fc' is 1.46 Mpa or 209 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	1.47	1.23	1.35
30	1.47	1.47	1.47
60	2.45	2.21	2.33
90	2.94	3.19	3.07
120	3.43	3.43	3.43

10.2.2. When applied on concrete surface: Pepsi solution cubes were immersed and cured for 14/15 days in water solution. The fc' is 35.32 Mpa or 5045 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	34.83	31.39	33.11
42	39.24	40.22	39.73
70	37.28	41.20	39.24

90	44.15	43.16	43.66
120	47.09	46.11	46.60

10.3. MANGO JUICE:-

10.3.1. When mixed in concrete:- Cubes were casted using 10 % apple juice by weight of cement .Workability was increased and when immersed in water for curing small bubbles were present on surface, shows air-entraining effect. Surface cracks were also produced in the cubes also bonding was not perfect .There is considerable reduction in strength as compared to plain concrete. The fc' is 9.42 Mpa or 1346 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	6.50	5.50	6.00
30	10.50	9.00	9.75
60	12.20	10.00	11.10
90	13.00	13.80	13.40
120	13.50	14.50	14.00

10.3.2. When applied on concrete surface:- Mango juices solution with 15 days curing were immersed in it. Juice penetrated into concrete which was observed after breaking of cubes. The attack is due to malic acid produced by mango juice. The fc' is 35.64 MPa or 5092 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	35.81	33.35	34.58
42	37.28	38.26	37.77
70	39.24	39.73	39.49
90	37.28	40.22	38.75
120	38.26	29.43	33.85

11. MILK :-

11.1. When mixed in concrete:- 10 numbers cubes were casted after adding 15% by weight of cement. There was 100 % decrease in strength w.r.t plain cubes due to improper bonding due to adding of milk. The fc' was 1.07 MPa or 153 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	0.50	0.98	0.74
30	0.98	1.23	1.10
60	2.45	2.45	2.45
90	2.45	2.94	2.70
120	2.94	3.19	3.07

11.2. When applied on concrete surface:- Cubes were immersed in milk to see the effect of milk on the surface with 14 days curing. The fc' is 35.32 Mpa or 5046 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	34.34	32.37	33.36
42	38.26	40.22	39.24

70	37.28	37.77	37.53
90	36.30	34.34	35.32
120	37.28	35.32	36.30

11.3. SUGAR SOLUTION:- The effects of sugar depends greatly on the quality used. A small quantity of sugar will act as an acceptable retardar. The delay in setting of concrete is app 4 hrs. It can be used as an admixture.

11.3.1. When mixed in concrete:- Cubes were casted using 2.5% of sugar by weight of cement which increases workability. Initial setting time was also increased to 48 hrs. High concentration of sugar can cause drastic decrease in strength. After 30 days cracks were observed. The crushing compressive strength fc' at 28 days was 28.95 MPa or 4136 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	20.00	18.00	19.00
30	30.80	29.00	29.90
60	32.80	31.00	31.90
90	45.00	42.00	43.50
120	46.00	44.00	45.00

11.3.2. When immersed in sugar soln of concrete cubes:- 10% solution of sugar was mixed by weight of cement,15 days curing shows pH value is 8 ,shows slightly alkaline. The crushing compressive strength fc' at 28 days was 37.33MPa or 5334 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	37.00	36.00	36.50
42	40.00	38.00	39.00
70	41.00	38.50	39.50
90	40.00	42.00	41.00
120	42.00	40.50	41.25

11.4. GLYCERIN:- It is produced in soap manufacturing through free glycerin is not constituent of hard soaps it is usually present in soft soaps .Stronger solution i.e 10% and more have a very destructive effect on concrete .Concentrated glycerin with few %age of water is less destructive.

11.4.1. When mixed in concrete:- Cubes were casted by using 10% of glycerin by weight of cement mixed within the concrete .The strength at 7 day were slightly lower and 60,120 days remains almost same. The fc' is 31.81 MPa or 4544PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	17.66	18.64	18.15
30	32.86	33.35	33.11
60	37.28	38.26	37.77
90	35.32	38.26	36.79
120	39.24	37.28	38.26

11.4.2. When applied on concrete surface:- 15 days ordinary cured cubes immersed in liquid having 10 % soln of glycerin with water. 10 cubes were casted. The strength almost remain the same. The fc' is 36.5 MPa or 5215 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	37.00	35.00	36.00
42	39.00	36.00	37.50
70	38.00	40.00	39.00
90	40.00	42.00	41.00
120	41.00	40.00	40.50

11.5. SPIRIT:-

11.5.1. When mixed in concrete:- Cubes were casted by using 10% spirit by weight of cement mixed within of cement.10 numbers cubes were casted. The strength obtained at 7,30,60,90 and 120 days were sufficiently lower than the plain concrete strength. The fc' is 23.98 MPa or 3425 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	14.72	21.58	18.15
30	25.51	23.54	24.53
60	27.47	31.39	29.43
90	28.45	32.37	30.41
120	30.41	29.92	30.17

11.5.2. When applied on concrete surface:- 14 days curing concrete cubes were applied 5% solution of spirit with water which gives pH value of 8.0 shows slightly alkaline. The strength at 21, 42 days remain same but at 70, 90, 120 days slightly increase was observed. The fc' is 36.167 MPa or 5167 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	36.00	37.00	36.50
42	35.00	36.00	35.50
70	39.00	39.00	39.00
90	40.00	38.00	39.00
120	41.00	42.00	41.50

11.6. BLEACHING SOLUTION:-

11.6.1. When mixed in concrete:-10 numbers cubes casted using 10% by weight of cement. The strength is not much different as compared to plain cement cubes. The fc' is 34.27 Mpa or 4896 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	25.00	23.00	24.00
30	36.00	34.50	35.25
60	40.00	42.00	41.00
90	43.00	45.00	44.00
120	46.50	48.50	47.50

11.6.2. When applied on concrete surface:- 10 numbers cubes using 3% bleaching solution with water immersed in 14 days of curing concrete cubes having

pH is 7.0 , neutral solution. There is not much change in compressive strength .The fc' is 37.92 MPa or 5417 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	38.00	36.00	37.00
42	40.00	39.50	39.75
70	39.00	36.50	37.75
90	42.00	41.00	41.50
120	39.24	38.25	38.75

11.7. SEWAGE:- Domestic sewage is alkaline in nature. When high concentration of sewage used H_2S gas evolved which converts to H_2SO_4 (by oxidation action) by condensation, gradually dissolved and progressive deterioration of concrete take place. Sewage with 150 PPM of SO_4 sulphate salts attack may occur like industrial effluent so cement not more than 8% C_3A content is recommended for use. To retard rate of attack of acid in concrete pipes we may use calcareous aggregate (like stone or dolomite).

11.7.1. When mixed in concrete:-Cubes were casted using 10% waste water solution by weight of cement. The strength is much lower w.r.t plain cubes. In this context case should be taken in those areas where there is shortage of water and people tends to use polluted water for constructed purpose. The fc' is 29.24 MPa or 4177 psi.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
7	22.56	21.58	22.07
30	29.43	30.41	29.92
60	26.00	28.94	27.47
90	36.79	38.26	37.53
120	37.28	38.26	37.77

11.7.2. When applied on concrete surface:- 10 cubes cured cubes immersed in domestic sewage/waste water. There is not much variation of strength as compared with plain cube. The fc' is 35.56 MPa or 5081 PSI.

Age	Compressive Strength (MPa)		
	Cube 1	Cube 2	Average
21	34.56	36.00	35.28
42	38.26	34.00	36.13
70	37.00	39.00	38.00
90	40.00	41.50	40.75
120	41.00	42.00	41.50

12. VARIOUS PROTECTIVE COATINGS SURFACE TREATMENT:-

12.1. Magnesium flousilicate or Zinc Flousilicate:- The treatment consists of two or more applications. First a solution of about 1 lb of the flousilicate crystals per gal of water is used. For subsequent applications about 2 lb of crystals per gal of water is used. Large brushes are convenient for applying on vertical surfaces and mops on horizontal areas. Each application should be allowed to dry after the last one dried, the surface should be brushed and washed with water to remove crystals which have

formed. The treatment hardens the surface by chemical action and makes it more impervious. Flousilicate are available from chemical dealers.

12.2. **Sodium silicate/water glass**:- This is quite viscous and must be diluted with water to secure water penetration, the amount of dilution depends on the quality of the silicate and permeability of the concrete. Silicate of about 45.4^0 baumi gravity diluted in proportions of 1 gal with 4 gal of water makes each coat to dry thoroughly. On horizontal surfaces it may be poured on and then spread evenly with brooms or brushes. Scrubbing each coat with water after it has been hardened provides a better condition for application of succeeding coats. For tanks and similar structures, progressively stronger solutions are often used for succeeding coats.

12.3. **Drying oils**:- Boiled or raw linseed oil may be used but the boiled oil dies more rapidly. China wood oil or tung oil and soybean oil are also effective. Applied hot better penetration is secured. The oil should be applied immediately after heating, however, as it will become more viscous if allowed to stand. Two or three coats may be applied, allowing each to dry thoroughly before the next applications. Diluting oil with turpentine, up to a mixture of equal parts, gives better penetration for first coat. The concrete should be well cured and seasoned before the first application. The oil is sometimes applied after magnesium flousilicate treatment, providing a good coating over a hardened surface.

12.4. **Cumar**:- Cumar is a synthetic resin soluble in xylol and similar hydrocarbon solvents. A solution consists of about 6 lbs of cumar gal of xylol with ½ pt boiled linseed oil makes a good coating. Two or more coats should be applied. Concrete should be fairly dry. The cumar should be powered to aid dissolving. It is available in grades from dark brown to colorless, and sold through paint and varnish trades.

12.5. **Varnishes & paints**:- Any varnish can be applied to the dry concrete. High grade varnishes of the spar, china wood oil, or Bakelite types and synthetic resin paints and coatings, or paints consisting largely of chlorinated rubber or synthetic rubber give good protection against many substances. Two or more coats should be applied. Some manufacturing can supply specially compounded coatings for certain conditions.

12.6. **Bituminous or Coal tar paints, tar and pitches**:-These are usually applied in two coats, a thin priming coat to ensure bond and a thicker finish coat. Finish coat must be carefully applied to secure continuity and pinholes. Surface should be touched up when necessary.

12.7. **Bituminous enamel**:-This is suitable protection against acids. It does not resist abrasion at high temperatures. Two materials are used, a priming solution and the enamel proper. The priming solution is of thin brushing consistency and should be applied so as to completely cover, touching up any un-coated spots before applying the enamel. When the primer has dried to a tacky state, it is ready for the enamel. The enamel usually consists of bitumen with finely powered siliceous mineral filler. The enamel should be melted and carefully heated until it is fluid enough to brush .The temperature should not exceed 375^0F/141 ^{0}C. When fluid it should be mopped on quickly, as it sets and hardens rapidly.

12.8. **Bituminous Mastic**:- This is used chiefly for floors on account of the thickness of the layer which must be applied, but some mastic can be toweled on the vertical surfaces. Some mastics are applied cold. Others must be heated until fluid. The cold mastic consists of two compositions the priming solution and the body coat or mastic

.The primer is first brushed on. When the primer has dried to a tacky state, a thin layer about 1/32 in of the mastic is toweled on. When this has dried –successive 1/32 in coat of the mastic are applied until they required thickness has been built up. The mastic is similar to the primer but is ground with sufficient asbestos and finely powered siliceous material fillers to make a thick pasty fibrous mass. The hot mastics are somewhat similar to the mixtures used in sheet asphalt pavements, but contain more asphaltic binder so that when heated to fluid conditions they can be poured and toweled into place. They are satisfactory only when supplied in layers 1 inch or more in thickness .When ready to lay, the mixture usually consists of about 15% asphaltic binder,20% finely powered siliceous mineral filler, and the remainder is sand graded up to ¼ in maximum size.

12.9. Vitrified brick or tile:- These are special burnt clay products which possess high resistance to attack by acids or alkalis. They must, of course, be laid in mortar which is also resistant against the substance to which they are to be exposed. A water proof membrane and a bed of mortar are usually placed between the brick or tile and concrete. Some of the acid resist cements are melted and poured in the joints. Only materials suitable for the conditions should be used and the manufacturer's directions for installion must be followed. Silica brick and cement are not resistant to the hydrofluoric acid and the hydroxides, but special brick and cement for these substances are available.

12.10. Glass:-may be cemented to concrete.

12.11. Lead:-may be cemented to the concrete with an asphalt paint.

12.12. Sheets of synthetic resin, rubber resistant to many acids, alkalies and other substances are available. These are cemented to concrete with special adhesives.

Effect due to various materials and proposed surface treatment (Table)

Material	**Effect on Concrete**	**Surface Treatment**
Acids		
Acetic	Disintegrates slowly	12.5,12.6,12.7
Acid waters	Natural acid waters may enode surface mortar,but usually action then stopes	12.1,12.2,12.3
Carbolic	Disintegrates slowly	12.1,12.2,12.3,12.5
Carbonic	Disintegrates slowly	12.2,12.3,12.4
Humic	Depends on humus material,but may cause slow disintegrates	12.1,12.2,12.3
Hydrochloric	Disintegrates	12.8,12.9,12.10,12.11, 12.12
Hydrofluoric	Disintegrates	12.8,12.9,12.11,12.12
Lactie	Disintegrates slowly	12.3,12.4,12.5
Muriatic	Disintegrates	12.8,12.9,12.10,12.11, 12.12
Nitrie	Disintegrates	12.8,12.9,12.10,12.11, 12.12

Material	Effect on Concrete	Surface Treatment
Oxalic	None	None
Phosphoric	Attacks surface slowly	12.1,12.2,12.3
Sulfuric	Disintegrates	12.8,12.9,12.10,12.11, 12.12
Sulfurous	Disintegrates	12.8,12.9,12.10,12.11, 12.12
Tannie	Disintegrates slowly	12.1,12.2,12.3
Salts and Alkalies (solutions)		
Carbonates of ammonia ,potassium ,sodium	None	None
Chlorides of calcium,potassium, sodium, stronium	None unless concrete is alternately wet and dry with the soln ,when it is advisable to treat with	12.1,12.2,12.3
Chlorides of ammonia ,copper,iron, magnesium,mercury,sinc	Disintegrates slowly	12.1,12.3,12.4
Fluorides	None except amonium fluoride	12.3,12.4,12.5
Hydroxides of ammonia,calcium, potasium, sodium	None	None
Potassium permanganate	None	None
Silicates	None	None
Sulfates of ammonia	Disintegrates	12.6,12.7,12.8,12.9
Aluminum,calcium, cabalt,copper,iron, manganese,nickel, potassium,sodium, zinc	Disintegrates; however ,concrete products cured in high pressure steam are highly resistant to sulfates	12.1,12.3,12.4

Material	Effect on Concrete	Surface Treatment
Petroleum oils		
Heavy oils below 35 baume	None	None
Light oils above 35 degree bauma	None require impervious concrete to prevent loss from pentration ,surface treatment are generally used	12.1,12.2,12.3,12.5,12.9
Benzine,gasoline,kerosene,naphta	None require impervious concrete to prevent loss from penetration ,surface treatment are generally used	12.1,12.2,12.3,12.5,12.9
Nigh-octane gasoline		12.12
Coal –tar distillates		
Aizarin,anthracene, benzol,cumol, paraffin,pitch,tolrol, xylol	None	None
Creosote,cresol, phenol	Disintegrate slowly	12.1,12.2,12.5,12.9
Vegetable oils		
Cottonseed	No action if air is excluded Slight disintegrating if exposed to air	None 12.1,12.2,12.5,12.9
Rosin	None	None
Almond,castor, Chinawood,coconut,linseed,oilive, peanut,poppy seed,rapeseed soyabean,tung, walnut	Disintegrates surfaces slowly	12.1,12.2,12.5,12.9
Turpentine	None-considerable penetration	12.1,12.2,12.5,12.9
Fats and fatty acids(animals)		
Fish oil	Most fish oils attack concrete slightly	12.1,12.2,12.3,12.5,12.9
Foot oil,lard and lard oil,tallow and tallow oil.	Disintegrates surface slowly	12.1,12.2,12.3,12.5,12.9
Miscellaneous		
Alcohol	None	None

Material	Effect on Concrete	Surface Treatment
Ammonia water(ammonium hydroxide)	None	None
Baking soda	None	None
Beer	Beer will cause no progressive disintegration of concrete,but in beer storage and fermenting tanks a special coating is used to guard against contaminationof beer.	Coatings made and applied by turner rostock Co. 420 lexington Ave,New york and borsari tank corp of Amercia,60 E 42d St New Yark
Bleaching solution	Usually no effect.Where subject to frequent wetting and drying with soln. containing calcium chloride provide	12.1,12.3,12.4
Borax,boracic acid,boric acid	No effect	None
Brine(salt)	Usually no effect on impervious concrete.Where subject to frequent wetting and drying of brine provide	12.1,12.2,12.3
Buttermilk	Same as milk	12.3,12.4,12.5
Charged water	Same as carbonic acid-slow attack	12.1,12.2,12.3
Caustic soda	None	None
Cider	Disintegrates(see acetic acid)	12.5,12.6,12.7
Cinders	May cause some disintegrating	12.1,12.2,12.3
Coal tar distillates	Great majority of structures show no deterioration.Exceptional cases have been coal high in pyrites(sulfide of iron) and moisture showing some action but the rate is greatly retarded by deposit of an insoluble film.Action may be stopped by surface treatments	
Corn syrup	Disintegrates slowly	12.1,12.2,12.3
Cyanide solutions	Disintegrates slowly	12.7,12.8,12.9,12.10,12.12

Material	Effect on Concrete	Surface Treatment
Electrolyte	Depends on liquid.For lead and zinc refining and chrome plating use nickel and copper plating	12.7,12.8,12.9,12.10,12.11
Formalin	Aqueous soln. of formaldehyde disintegrates concrete	12.5,12.9,12.10,12.11, 12.12
Fruit juices	Most fruit juices have little if any effect as tartaric acid and citric acid acid do not appreciably affect concrete .Floors under raisin seeding machines have shown some effect,probably due to poor concrete	12.1,12.2,12.3
Glucose	Disintegrates slowly	
Clycerin	Disintegrates slowly	12.1,12.2,12.3,12.4, 12.5,12.9
Honey	None	None
Lye	None	None
Milk	Sweet milk should have no effect,butif allowed to sour te lactic acid will attack	12.3,12.4,12.5
Molasses	Does not affect impervious,thoroughly cured concrete ,Dark,partly refined molasses may attack concrete that is not thoroughly cured.Such concrete may be protected with	12.2,12.5,12.9
Niter	None	None
Sal ammoniac	Same as ammonium chloride-causes slow disintegration	12.1,12.2,12.3
Sal soda	None	12.1,12.2,12.3
Saltpeter	None	None
Sauerkraut	Little,if any,effect.Protect taste with	12.1,12.2
Silage	Attacks concrete slowly	12.3,12.4,12.5
Sugar	Dry sugar has no effect on concrete that is thoroughly cored	None
Sulfide liquor	Attacks concrete slowly	12.1,12.2,12.3
Tanning liquor	Depends on liquid .Most of them have no effect .Tanneries using chromium report no effects.of liquid is acid,protect with	
Trisodium phosphate	None	None

Material	Effect on Concrete	Surface Treatment
Vinegar	Disintegrates	12.5,12.6,12.7
Washing soda	None	None
Whey	The lactic acid will attack concrete	12.3,12.4,12.5
Wine	Many wine tanks with no surface coatings have given good results but taste of first batch may be affected unless concrete has been given tartic acid treatment	For fine wines the concrete has been treated with 2 or 3 applications of tartic acid soln (1 lb tartic acid soln 3 lb water)sodium silicate is also effective in a few cases tanks havebeenlined with been lined with glass tile.
Wood pulp	None	None

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"PRESENCE OF HEAVY METALS IN SOLID WASTE LEACHATE AND ITS REMOVAL USING AGRICULTURAL WASTE"

Nadeem Hussain[1], Muhammad Anwar Baig[2], Azhar Iqbal[3], Shahid Rehman[4]

Abstract—Municipal solid waste leachate contains many contaminations like organic pollutants and toxic metals which cause serious effect on human health and environment. In this study, removal efficiency of toxic metals including Pb, Cr, Cu and Co by using agriculture waste adsorbents i.e. rice husk and corn cub was observed. Under Batch sorption experiment the parameters including contact time, dosage of adsorbents and pH were studied. Concentration of metals was determined by using atomic adsorption spectroscopy and it was observed that various adsorbents exhibited differently at various pH levels, the adsorption efficiency is directly proportional to contact time and metals ion concentration is inversely proportional to the amount of adsorbents. Rice husk showed better adsorption (90 to 95 %) at pH range (2-5) and corn cub performed relatively better (90%) at neutral pH 7. It was found that Removal of heavy metals using locally available agriculture waste is cheaper and environmental friendly.

Key words:

Municipal solid waste leachate, Heavy Metals, Adsorption efficiency

I. INTRODUCTION

Landfill leachate is a complex wastewater generated when the moisture content of a landfilled solid waste is higher than its field capacity [1]. The organic carbon compounds (e.g. BOD, COD), nitrogenous compounds, and metal ions are generally main pollutants in landfill leachate [2, 3]. The quality and quantity of leachate varies from landfill to landfill, and over times, as a particular landfill ages, that is why the selection and design of leachate treatment system are not so simple.

Landfill leachate often contain various toxic metals such as Barium, Copper, Nickel, Calcium, Cadmium, Chromium, Mercury, Zinc and Cobalt [3]. Varieties of industrial activities become cause of these heavy metals origination and waste sources and some are well known toxic and carcinogenic. The environment is threated by residual metals on the one hand and on the other hand theses metals cause serious detrimental effects on aquatic ecosystems [4]. Sometimes landfill leachate permeates through landfill liners and becomes cause of contamination of the ground water. So we can say that the removal of heavy metals from landfill leachate is important matter that requires proper consideration.

Traditionally, conventional landfill leachate treatment processes have been similar to those that have been used for regular wastewater. The main approaches include: biological, physical and chemical treatment processes. Biological treatment processes primarily remove high concentrations of organic compounds. However, to date, there is no evidence indicating that biological leachate treatment processes can provide the

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adequate microbial transformations of heavy metals through the selection of suitable microorganism [5, 6]. Besides most chemical and physical treatment processes prove costly when removal of heavy metals considered [7,8]. It has been identified by several researchers that adsorption is the most appropriate process for heavy metals removal [9,10].

Activated carbon is used as the main adsorption medium in traditional adsorption processes, but it is not so cheap and particularly effective for heavy metals. Many investigations have shown that natural low cost materials as adsorbents for heavy metals removal from aqueous solution and waste water, are alternative to activated carbon. These include: chitin and chitosan [11], macroalgae [12], etc. In this study rice husk and corn cob were tested as potential natural adsorbents for the removal of heavy metals from leachate. In Pakistan, there are extensive unexplored agriculture wastes, which are following the hierarchy of waste management strategies. There wastes possess high efficiency of adsorption and can be utilized for the treatment of waste water.

II. MATERIALS AND METHODS

Material collection

The municipal solid waste leachate and low cast agricultural adsorbents were collected from different places. Leachate was collected from Losar Dumpsite (an official dumpsite of Rawalpindi city), Pakistan. Per day municipal solid waste is dumped in Losar is about 1,200 metric tons. Most of the waste which is dumped is organic. Low cost agricultural adsorbents includes Rice Husk and Corn Cob were collected from local market where these are readily available.

Leachate and Adsorbents Preparation

Leachate was filtered using filter paper of 0.1µ to remove suspensions for further experiment. The adsorbents were also washed in plastic tubs to clean them from dust using distilled water. Adsorbents were then oven dried at 105ºC for 24 hours [13]. Adsorbents were ground to make in powder form using laboratory mill, then sieved to 0.2mm. The material is quite ready for experimental analysis.

Experimental Setup

The batch experiment was used for adsorbent analysis. In batch experiment 50ml leachate sample with different dosage 1, 2, 3, and 4g of adsorbent add in 250ml flask and flask was kept on shaking using Shaker (Thermolyne Sybron, Big Bill SE Rotator/Shaker) at 150 round per minute in different 1, 2, 3, and 4hrs time intervals at constant temperature 18º C ± 2. The pH of leachate was changed by using 0.1M H_2SO_4 and 0.1N NaOH solutions. After shaking at different time intervals sample was then filtered using filter paper of 0.1µ and prepared for metals analysis using Atomic Absorption Spectroscopy (AAS).

Leachate analysis

The basic parameters of leachate, pH and Electrical Conductivity were analyzed using pH meter (WTW pH 526) and EC meter (inoLab pH/Cond 720). The analysis of chemical oxygen demand was conducted in PTFE vial which were heated in COD reactor (HACH) at 120oC for 2 hrs. X-Ray Fluorescence (XRF) Elemental Analyser JEOL JSX 3202 M Elemental Analysis (Na-U) was used to analyse metals present in leachate. The Atomic Absorption Spectroscopy (AAS) (AAnalyst 800) was used for quantitative analysis of metals present in leachate.

The amount of metal ion adsorbed was calculated by using equation 1;

$$\% \text{ adsorption} = (Co - Ce)/Ce \times 100 \quad (1)$$

Where;
Co = Initial concentration of metal ions
Ce = Final concentration of metal ions

III. RESULT AND DISCUSSION

Effect of Contact time

The effect of contact time of adsorption efficiency has been showed in figure 1 for rice husk and in figure 2 for corn cob. Our results showed that the adsorption efficiency is directly proportional to contact time. The adsorption increased with increased the contact time till the equilibrium attained. This is concurrent with previous studies [14]. The percent adsorption of different metals found different the Pb (89.5%), Cr (90.1%), Cu (86.1%), Co (78.9 %) for rice husk and Pb (80 %), Cr (77.6 %), Cu (75.6 %), Co (62.5 %) for corn cob were found. Maximum adsorption obtained at 4 hours contact time. There is no significant effect on adsorption by increasing further contact time, it may be due to the saturation of active sides of adsorbent and achievement of equilibrium at 4 hours.

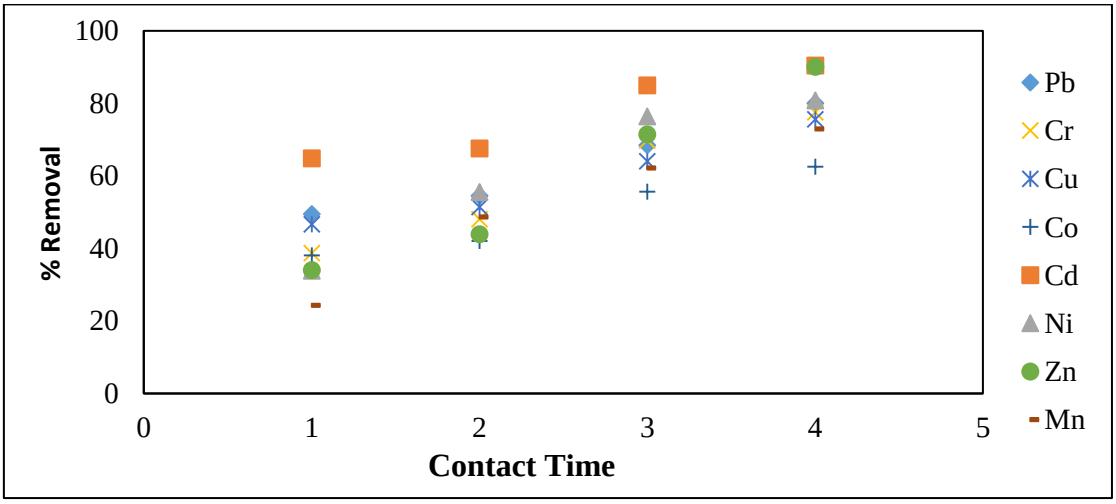


Figure 1: Effect of contact time using 4 g sorbent dose of rice husk

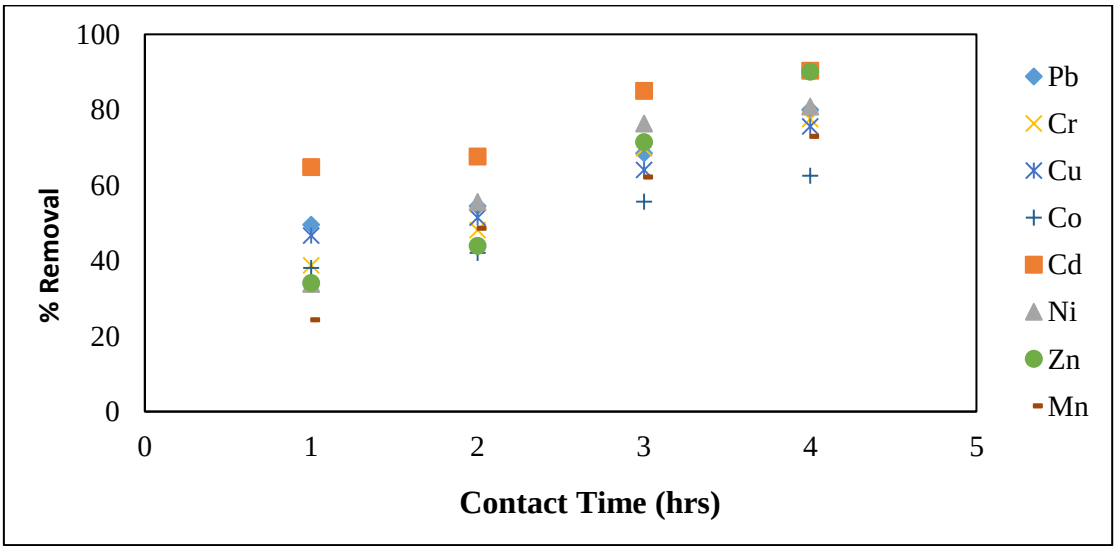


Figure 2: Effect of contact time using 4 g sorbent dose of corn cob

Effect of Dosage

The effect of dosage of adsorbents on the removal of heavy metals by rice husk is shown in figure 3 and by corn cob is shown in figure 4. The percent adsorption of different metals found different the Pb (89.5%), Cr (90.1%), Cu (86.1%), Co (78.9 %) for rice husk and Pb (80 %), Cr (77.6 %), Cu (75.6 %), Co (62.5 %) for corn cob were found. It is anticipated that metals ion concentration is inversely proportional to the amount of adsorbents, which means that heavy metals concentration in solution decreases with increasing the dose of adsorbents till the equilibrium is attained. This is concurrent of the previous studies [15].

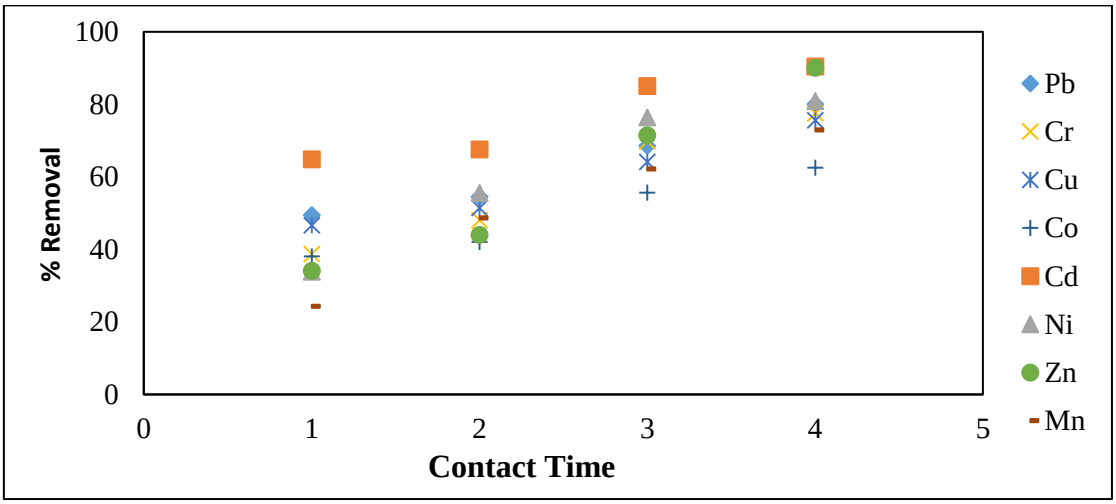


Figure 3 : Effect of sorbent dose of rice husk

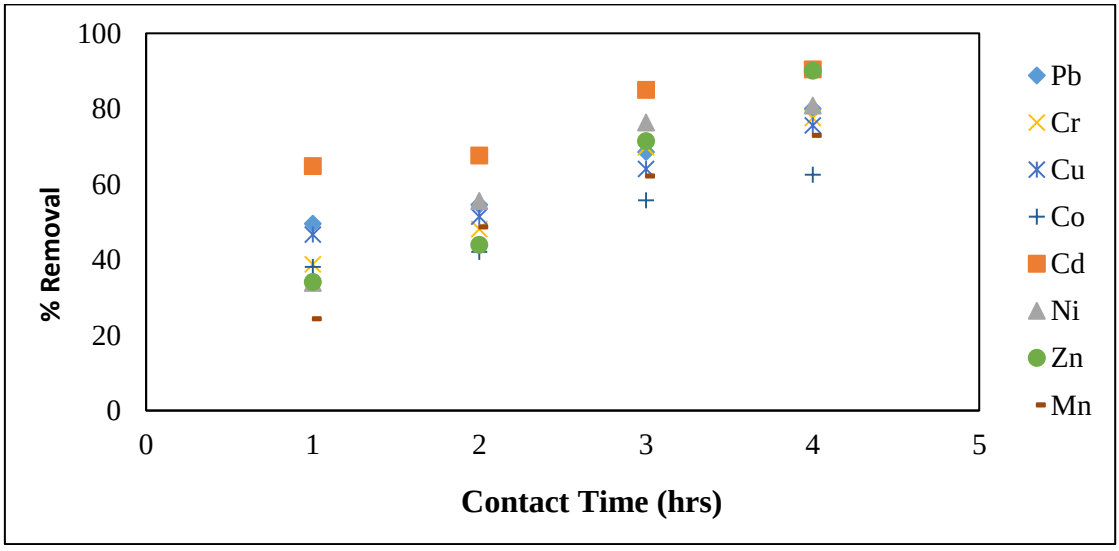


Figure 4: Effect of sorbent dose of corn cob

Effect of pH

When optimum contact time and dosage of adsorbent was identified then further to verify the pH effect as one of important factors on the heavy metals (Pb, Cd, Cr, and Co) removal using rice husk and corn cob, different experiments were performed by changing pH of leachate i.e. 2, 5, 9 and 11. It is also reported by several scientists that adsorption is pH dependent [16, 17]. Our results showed in figure 5 and figure 6, the maximum adsorption efficiency of rice husk obtained at pH 2 for Pb (95 %), Cr (93.7 %), Cu (93.3 %), Co (90.4 %) and for corn cob Pb (80 %), Cr (77.5 %), Cu (75.6 %), Co (62.5 %) at pH 7.5.

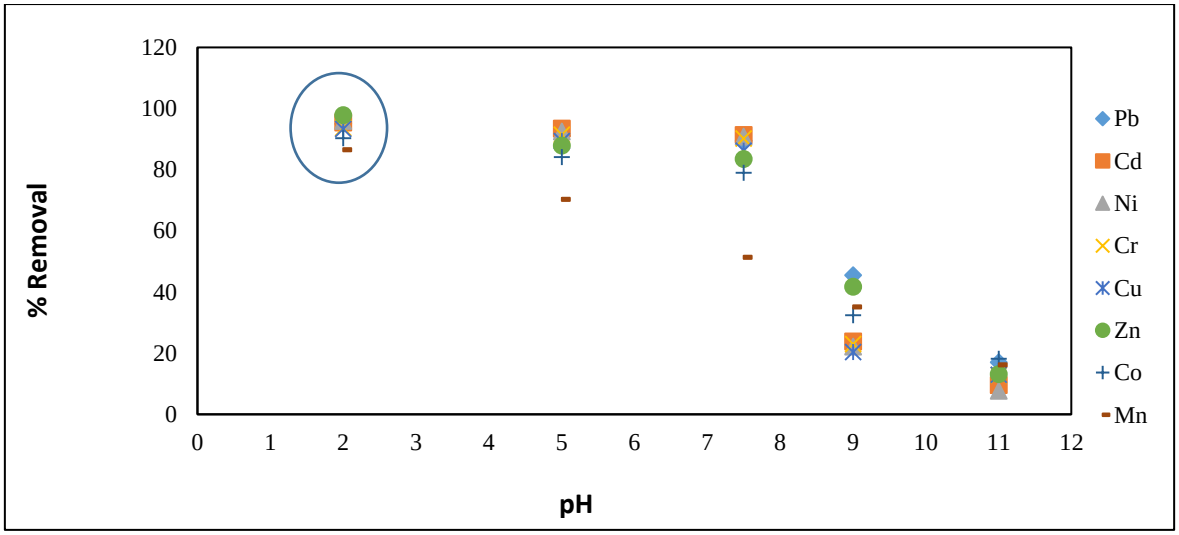


Figure 5: The removal of heavy metals in % studied at various pH using rice husk

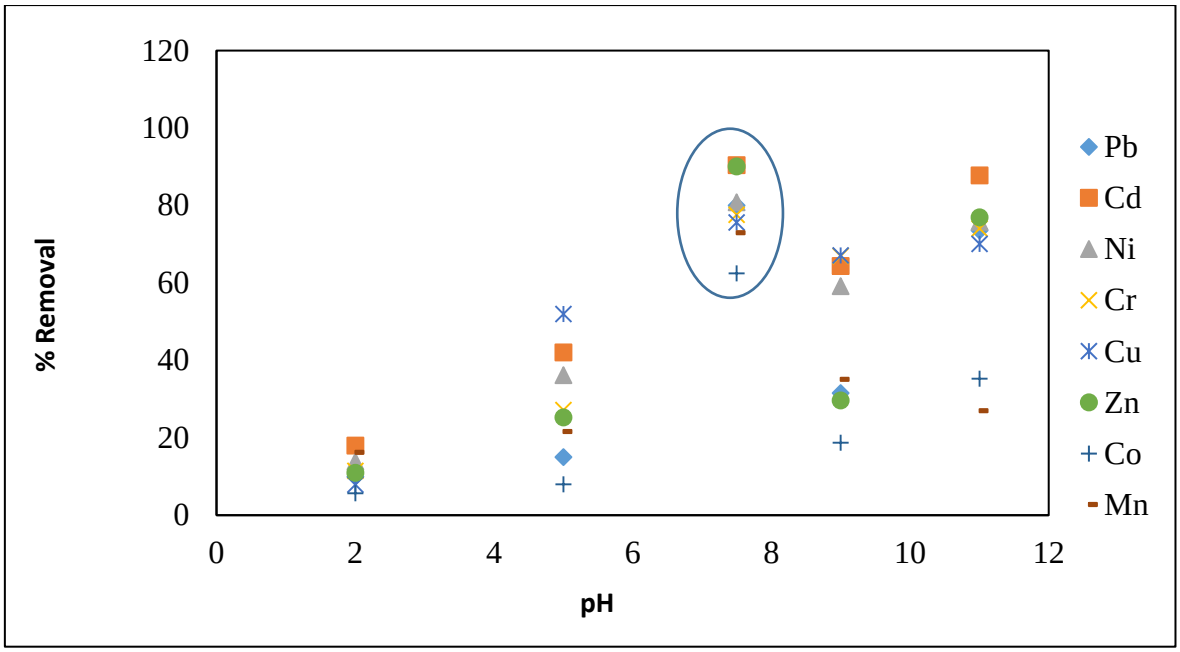


FIGURE 6: THE REMOVAL OF HEAVY METALS IN % STUDIED AT VARIOUS PH USING CORN COB

IV. CONCLUSION

The rice husk and corn cob are low cost easily available agricultural waste substances and are very effective adsorbents for heavy metals removal in leachates solution. The removal efficiency of rice husk (95 %) is significantly better at pH 2 as compare to the removal efficiency of corn cob (90%) which showed better efficiency at neutral pH. The rice husk and corn cob are very useful adsorbents for the removal of heavy metals in municipal solid waste leachate.

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Environmental Risks related to Shale Gas Advancement and their Mitigations

Bilal Naveed[1], Talha Ayub[1], Muhammad Wajahat[1], Muhammad Junaid[1], Faizan Ahmed[1]

Abstract:

As the world is running out of Conventional resources of Oil and Gas, the biggest Unconventional resource (Shale) play an imperative role to meet the country's demand of energy consumption. It has raised the estimate of reserves abruptly of the countries which was once considered as impractical. Today USA is by far the dominant producer of tight gas and oil with 13.5 Tcf gas production in 2015. USA has sparked the world towards the Shale gas production.

This paper will review the major environmental risks affiliate with the Shale gas development and the strategies relevant to the minimization of issues. Environmental risks that will analyze in this paper associated with the Shale gas Production are:

1. Water Availability
2. Flow back Management.
3. Ground water Contamination.
4. Air quality Contamination.
5. Noise Pollution.
6. Moderate Earthquakes.

Further this paper will present strategies and solutions to overcome the concerned risks associated with Shale gas development.

Introduction:

Some years ago, oil and gas exploration companies scrutinized the natural gas resources in low permeable, tight shale as inappropriate and uneconomical to produce. But during the past years Shale gas development and enhancement has increased the reserves of countries to a very high number. According to the USEIA, United State has highest proven reserves of Shale gas 175,601 Bcf (2015). As the conventional resources of Pakistan is at its depletion phase, there is need to exploit the unconventional resources such as shale gas and coal bed methane. Total reserves of gas that can be produced technically are 15Tcf (EIA). Reservoirs with a permeability than of less the 0.1md are considered Tight Reservoir, and to make these deposits producible a well-established technique of Hydraulic Fracturing is used.

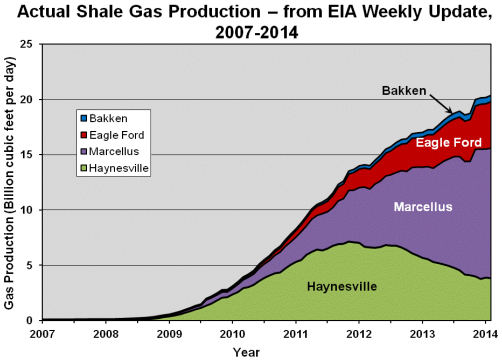


Figure 1: Actual shale gas production from four plays,USEIA[i]

Hydraulic Fracturing:

Hydraulic fracturing is a treatment of stimulation that is performed on less permeable

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reservoirs, whereby an appropriate engineered fluid is pumped into the well under high rate and pressure which causes to open the vertical fractures within the formation. Initially Hydrochloric acid is pumped into the well to wipe out the debris resulted from casing and cementing, then a pad approximately of 100,000gallons of slick water fills the wellbore and open the formation for the flow of proppants, then a mix slurry of fluid and solids are pumped into the formation to create fracture and intended to open it and, then finally an excess water is pumped into the wellbore to flush the proppant into the fractures that remained in the wellbore. Today over 1 million of reservoirs have fractured hydraulically [3]. Modern enhancements in hydraulic fracturing technique make it a very sophisticated engineering approach for the exploitation of tight resources.

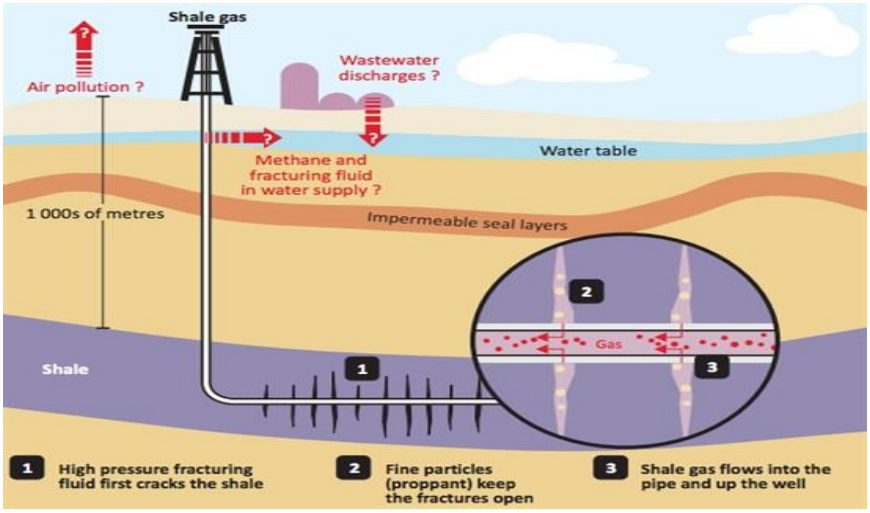


Figure 2: Overview of shale gas development (Carbon brief clear on climate)

The gap between the channels to open, the length of the fracture and extent of the pressure demand to achieve it are dictated by formation stress. The magnitude of the stress are calculated and tested by rock properties, tectonic system of that particular region, pore pressures and different tests and techniques. Fractures usually occur in a less stress region, overburden pressure of rock can also play role to make crack on rock. A fracture must have enough width & height so that fluid can transmit easily. The fracture gradient has a range from about 0.5 psi/ft. to over 1 psi/ft.

Figure 3: Evaluating claims of groundwater contamination from hydraulic fracturing – tarek Saba (ogj)

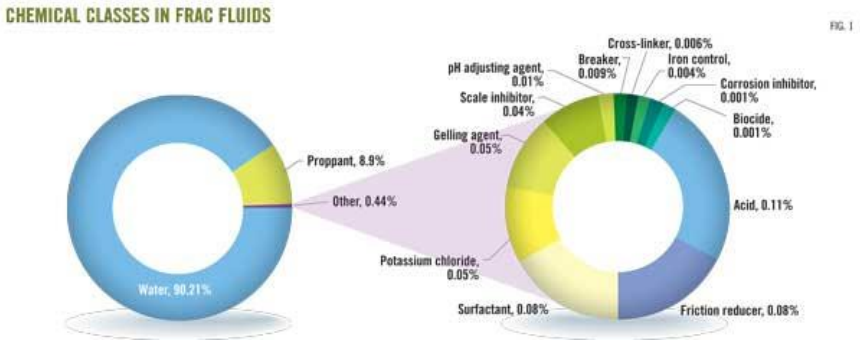


Figure 3: Composition of Hydraulic Fracturing Fluid (Adapted from OGJ Journal)

USA Shale Play:

Advanced drilling and reservoir stimulation methods have dramatically increased gas production from unconventional shales. The U.S. increased its natural gas reserves

by 6% from 1970 to 2006, producing approximately 725 Tcf of gas during that period (BP, 2008; Navigant Consulting, 2008). The biggest shale plays of USA include Permian, Barnett, eagle ford and Marcellus shale that was once considered as uneconomical to produce. Marcellus Shale of the Appalachian Basin, located within parts of eight eastern U.S. states takes up a land area of about 54,000 square miles – an area larger than the state of Florida **[9]**.

Each basin is different from the other and has a unique set of exploration criteria and operational challenges. Environmental impacts are the major consideration for the producers.EPA (Environmental Protection Agency) released new source performance standards and national emissions standards for hazardous air pollutants in the oil and natural gas sector on April 17, 2012. The standards for hydraulically fractured gas wells require reduced emission (green) completions or flaring or released natural gas for wells developed prior to January 1, 2015 and green completions only on wells developed in 2015 and thereafter. This regulation is expected to reduce VOC emissions from shale gas wells by 95%. [10]

Hydraulic Fracturing process raises significant concerns about air and groundwater pollution, which has led to a polarizing, often heated public debate that continues to this day, and will likely continue for the future. Current US federal regulation of hydraulic fracturing, and oil and gas industry extraction operations, largely consists of a little oversight. The bulk of the regulatory responsibility is given to the several states, and these regulations vary widely in their complexity and level of protection of human health and the environment. New Jersey, for example, has banned hydraulic fracking [11].

Pakistan Shale Potential:

World is gearing its resources of hydrocarbons by exploiting the unconventional shale reservoirs. Pakistan is running out of its conventional reserves, according to Minister of Petroleum Shahid Khaqan Abbasi Pakistan is facing a huge gap between demand & supply of energy. The total production of gas is 4 Bcf/d against the consumption of 8 BCF/d. To improve the situation Mr. Abbasi said that OGDCL & PPL have given a task to drill pilot projects of shale gas and oil wells along with the help of international operators.

In the first assessment, USAID estimates showed that Pakistan had massive deposits of 10,159 trillion cubic feet of shale gas and 2.3 trillion barrels of shale oil. ARI estimates a total of 1,170 Tcf of risked shale gas in-place for India/Pakistan, 584 Tcf in India and 586 Tcf in Pakistan. The risked, technically recoverable shale gas resource is estimated at 201 Tcf, with 96 Tcf in India and 105 Tcf in Pakistan. In addition, we estimate risked shale oil in-place for India/Pakistan of 314 billion barrels, with 87 billion barrels in India and 227 billion barrels in Pakistan. The risked, technically recoverable shale oil resource is estimated at 12.9 billion barrels for the two countries, with 3.8 billion barrels for India and 9.1 billion barrels for Pakistan. The major deposits of shale gas are pressurized in Sembar, Kirthar, Ranikot, Chichali and Rakhshani formations [12].

Environmental Risks associated with Shale Gas Advancement:

Oil and Gas industry is bearing an exacting and tightening rules and regulations concerning the environmental issues. This trend is set and continuously growing with time. Advancement of Shale gas development yield the impacts on environment and it is crucial to discern the environmental considerations link with the drilling, completion

and production of Shale gas. New challenges have been faced as the development of shale gas advances into high populated areas, new strategies and technologies are implementing and the expanding rules and strict regulations of environmental and governing agencies.

This paper will discuss the potential risks on environments that have been identified in Shale gas development. Following are the issues caused by Shale gas advancement:

1. Water Availability
2. Flow back Management.
3. Ground water Contamination.
4. Air quality Contamination.
5. Noise Pollution.
6. Moderate Earthquakes.

1. Water Availability:

Large quantities of water are required for drilling and completion of a well. Drilling of a vertical and horizontal well may require 400-4000 m^3 of water for many purposes. Then 7000-18000 m3 of water are needed for hydraulic fracturing of each well [1]. The common sources of water are groundwater, municipal supply, nearby surface water and produced water from wells for exploitation of shale gas. Municipal water supply will not be enough for the job because of shortage and limitations. Water from surface and ground may create a future problems for nearby population, over production of groundwater may alter the water tables.

2. Flow Back Management:

After the job of hydraulic fracturing , fracture pressure is released from the surface pumps that causes to a fluid to reverse back to the surface which is referred to as “flow back “.This fluid is a combined mixture of the pumped and the natural formation fluid which contains dissolved or undissolved minerals and organic constituents. The flow back can occur for days to weeks, the highest rate of fluid appears on the first day. The typical initial rate may be as high as 1000 m^3 (GWPC). The existence of radioactive element i.e. uranium, radium, radon and thorium is dependent on the geology of formation [4].

3. Ground Water Contamination:

Successful hydraulic fracturing requires mixture water, chemicals, proppants and thickening material pumped into a desired low permeable formation with a controlled and monitored manner above formation fracture pressure. Different type of acids, inhibitors and antibacterial compounds are also used in this operation to prevent formation damage, corrosion and blockage. These chemicals are the extreme threat for ground water contamination. Texas reported at most ~100 cases of confirmed contamination of groundwater from oilfield injection wells, saltwater pits and abandoned wells, even though at that time the state hosted more than 50,000 injection wells associated with oil and gas [5]. Methane migration has also a severe impact on ground water contamination.

4. Air Quality Contamination :

Volatile organic compounds have hazardous impact on air pollution when released during hydraulic fracturing operation. These compounds may be present in the flowback, produced hydrocarbons and as a recipe of an injected fluid. By products of combustion also discharge into environment which consist of diesel flaming emitted by the machinery use in tight gas drilling, completion and production. Other emission may result from produced natural gas flaming. These polluted gases causes a number of diseases to a nearby populated areas and create an impact on air quality.

5. Noise Pollution :

A bulk area is needed to prepare well site in which heavy machinery is run to drill the wells, a noise created from those machineries, heavy duty transportations, blasts from the failure of pumps or equipments can be very challenging for the Shale gas developers in areas nearby urban areas.

6. Moderate Earthquakes :

A number of moderate earthquakes under a magnitude of 3 have resulted to the injection of waste water by fracturing pressure [3]. These earthquakes are generated by the seismicity of disposal of millions of gallons of flow back, rather than hydraulic fracturing process. There is another possible cause of earthquake that's the injection of waste water and salt water into the sub surface cause the earthquake.

Practical Approach to Handle Environmental Impacts:

Production of oil and gas from unconventional reservoirs has become necessary due to the depletion of conventional reserves, but it should be balanced by minimizing the effects of environmental risks related to shale gas development. These risks can be mitigated by using proper rules and regulations, advance technologies and high performance planning & strategies.

Following are the practices that can help to mitigate the environmental impacts of hydraulic fracturing:

a) Private and government holding environmental agencies should focus and monitoring the exact composition of hydraulic fracturing fluid used in a particular well.
b) Use of fresh water should be limited by recycling and reuse of flowback , as the cost of disposing it can also be saved.
c) Flowback with high concentration of TDS can be treated and reused to the other simulation job.
d) Disposal wells should be drilled very far from fresh drinking water sources.
e) Companies should find alternative sources of fresh water such as high saline water, marginal ground water and impounded storm water that is unable to drink.
f) High performance technologies and strategies should be applied in drilling, completion & production of shale gas reservoirs.
g) 24 hours automated gas chromatograph should be installed near wellsite locations to investigate volatile organic compounds (VOC) emission.
h) Reduction of methane migration can be accessed by implementing Green completion.
i) Horizontal wells can be drilled and stimulated into the sections, instead of multiple vertical wells with multiple fracturing jobs. This can also help in reducing surface

disturbances: few well pads, reduced traffic & fewer surface facilities.

j) Sound barriers can be used to reduce the impact of noise pollution.
k) Rapid fluid flow back after treatment and reduction of fluid volume can also minimize the cause of earthquake.
l) The advancement in technologies and increased experience will lead to a successful development of shale gas and reduce the environmental footprints.

Conclusion:

Compliance of environmental rules and regulations is must for all companies. Reinforcement and advancement of technology can play a vital role in shale gas development considering environmental risks. Shale gas development is new opportunity for Pakistan oil and gas sector, much can be gained from the considerations of environment and the strategies applied to mitigate them. Otherwise, it will be very difficult to explore unconventional resources in future.

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