Water Pollution Control — A Need of the Day

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Introduction

Twentyfive hundred years ago father of Greek philosophy, Thales of Miletus, founded his school of thought on the basic premise : "All things are water". Nothing that the technical advances of the intervening centuries have revealed, nothing that the development of the electron microscope or atomic energy or satellite travel has disclosed, has diminished the place and importance of water. In the sap of plants, the bloodstreams of animals, in rainfall on the surface of the land, in rivers flowing to the sea, water represents the great circulation system of our planet. It has covered the earth with evolving life and its presence, so far as science can determine, makes earth unique among the planets.

Of all natural substances on earth water is perhaps the most unique. It is present in total quantity in a fixed amount which circulates from the land to the oceans to the atmosphere and back again. Its quality is influenced by nature as well as by man. The properties of water—with two in particular, surface tension and solvent action—combine to create continuing conditions of change in its quality. The cohesive and adhesive force of water establish the mode of movement through soil. Its great solvent action dissolves various salts and minerals found in the soil. In rain, it carries dust and gaseous chemicals to earth.

Evolution of water pollution

A currently acceptable and rational definition of water pollution is "the presence of substances in water in such quantities and of such quality that the water's value to other users is unreasonably impaired". A distinction should

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be made between pollution and contamination, the first of which causes economic inconvenience or hardships, aesthetic distress and reduced water availability, and the second of which is the addition of substances that endanger human life or that of desirable acquatic species.

Any substance, natural or man-made, in ground or surface water can be a potential pollutant; some in sufficient concentration can represent contamination. Yet no substance, if diluted sufficiently, wlll be pollutant. Natural 'pure' water is unavailable on the earth. Man has produced essentially pure water for certain uses. For most needs, however, ultra-pure water is unnecessary and in some cases even undesirable.

Through the ages, man has learnt how to live with nature's pollution. As one obvious example, the oceans are presently unavailable for many uses due to their high salt content. For many centuries man-made pollution and contamination, superimposed on nature's pollution, was tolerated, partly out of ignorance and partly because the supply of water of reasonable quality far exceeded the demand.

Science has taught man how to control contamination. As a result the incidence of death due to water borne diseases has decreased significantly. The demand of water of "reasonable quality" has continued to increase with population growth and industrialisation. This growth has increased man-made pollution proportionately.

The quality and quantity of water available for use on earth remains essentially constant, yet pollution which degrades available water quality increases along with the need. This situation presents an urgent problem and if left unsolved can do irreparable damage in the future. Even if there were no population explosion man's use of water would increase as the standard of living of the country increases.

It is anticipated that the demand for fresh water will exceed the available supply on a once-use basis throughout the country after the turn of the century. Today, water supply is a regional problem. Some areas have abundant, high quality reserves, while other areas have recurring water shortage of increasing frequency and magnitude. Use and demand already exceed supply in many localities.

The act

The most comprehensive legislation ever enacted to clean up the nation's waters became law on 23rd March 1974. Known as the Water (Prevention and Control of Pollution) Act, 1974, the new Act mandates a

Centre-State campaign to prevent, control and eliminate water pollution. The Act has been adopted by the States of Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Punjab, Rajasthan, Tripura, Uttar Pradesh and West Bengal. The Act is applicable to all Union Territories. However, State of Maharashtra had encted its own Water Pollution and Prevention Act before the enactment of Water (Prevention and Control of Pollution) Act, 1974 realising its importance and urgency.

Central and state boards

The Act envisages setting up of a Central Board and State Boards for prevention and control of water pollution. The Central Board will co-ordinate the activities of the State Boards and will plan and execute a nationwide programme for the prevention, control and abatement of water pollution. The different State Boards will plan a comprehensive programme for the prevention and control of water pollution in the respective States. The Central Board will act as a State Board as far as Union Territories are concered. There is also provision in the Act for the constitution of Joint Boards in pursuance of an agreement that may be entered into by two or more Governments of contiguous States or by the Central Government (in respect of one or more Union Territories) and one or more Governments of States contiguous to such Union Territory or Union Territories.

Enforcement

The law envisages stringent enforcement machinery with heavy penalties for non-compliance of the Act. Polluters must keep proper records, install and use monitoring equipment and sample their discharges. The Boards have powers to take for the purpose of analysis samples of water from any stream or well or samples of any sewage or trade affluent from any premises. The Boards have powers to enter and inspect any polluting factory, to check its records and treatment units and to sample its discharges.

Penalties for violating the law includes imprisonment for a term which may extend to three months or with fine which may extend to five thousand rupees or with both. For continued violations of the Act, a penalty of one thousand rupees for every day during which such failure continues has been prescribed in the Act.

To assist in enforcement as well as to measure the effectiveness of the water pollution control programme, it is being contemplated to establish a national surveillance system to monitor water quality by the Central Board in co-operation with the different State Boards. TheState Boards that have been constituted in the various States are to be provided with sufficient funds to undertake this activity.

Key lies in reuse

Water resources problem associated with concurrent population explosion, urbanisation and industrialisation are becoming increasingly a matter of international concern. Engineers and others charged with the responsibility for water resource planning and development are faced with the difficult task of responding to constantly increasing demands for more and better quality water. This task in made more formidable by the fact that the total resources and natural fresh water within land boundaries of any country, although subject to some redistribution, remains essentially constant.

The increased water requirements and intensified pollution have already severely taxed the water resources of the country. It is apparent that future demands for water must be either by seeking previously untapped natural fresh water or by making more efficient use of existing supplies.

Excluding the arid regions, most water problems involve water quality and availability. This latter factor is important. Excess water during certain times of the year, if unused and permitted to discharge to the ocean, is of little value. A notable exception might be controlled discharge of wastes during periods of high flow. The exception may be based on the principle that depletion of dissolved oxygen in a stream is conditional upon the load of oxygen-demanding wastes added to a stream and the amount of stream flow available to waste assimiliation. But overall, there does not appear to be serious shortage of fresh water nor it is expected to be in the next decade or so. The problem is one of ensuring a constant yield of high quality fresh water in all localities to meet demands. Storage, low flow augmentation, ground water recharging and other techniques can be used to improve availability.

Desalination of sea and brackish water may be a practical solution in some coastal areas in arid regions. At this time, however, converting ocean water to fresh water does not appear to be an attractive universal answer to the water supply problem. Not only are conversion costs high, but they do not include the cost of transporation and distribution which will be higher than normal. The water is produced at sea level and will have to be moved to points of use, many of which will be on substantially higher elevation.

Neither mass transportation of water over long distances, from areas of abundance to areas of chronic deficiency, nor establishing inter-water shed grids offers an immediate solution to the water problem. The engineeing, economic, political and inter-Governmental considerations are enormous. Certainly no region of surplus will look with favour upon another region of apparent deficiency to use their water before taking maximum use of the water at hand.

Re-use of fresh water offers the greatest immediate hope for ensuring adequate supplies to meet all foreseeable needs The same water must be used many times before it is allowed to pass to the ocean. Because each use of water causes some degradation of quality (pollution), each user must assume responsibility of minimising water intake and upgrading the used water to a quality approaching its "as received" condition before passing it on to the next user. While long range water planning is necessary now, it is important that each watershed puts its house in order first before considering inter-regional water transport or desalting on a massive scale. In view of the importance to comprehensive river basin planning at this time, it is important that adequate research on watersheds be directed towards gaining new technology and better information for determination of optimal combination of land treatment and structural measures on upstream water sheds to minimize the adverse effects of low flows of stream which some time fall to one-fifth or even one-tenth the average annual.

Present water reclamation technology and economics permit extensive reuse of water for industrial, agricultural and even recreational purposes. Water can be re-employed in uses that we require for poor characteristics. This happens when the domestic sewage. more or less treated, is employed for agriculture irrigation or when cooling water is reused for other cycles of the same plan and for the same purpose for which it was previously utilized.

Water circuit—closing of

Recycling and reuse of water can be practised to degrees of varying dimensions. Essentially complete closure by a single user or within a single facility, which could include even a whole municipality, is one possibility. Recycling at a single facility may involve one large water circuit or several smaller circuits operating about specific process operations. This approach has manifold advantages. It is generally easier to treat waste water at its source before it is mixed with other polluted waters. If a water circuit is closed completely, an industry can maintain complete control over its own water problem without interference and control by Government. If waste water discharge is minimised through maximum reuse, the cost of terminal treatment and/or sewer charges will be less.

Semi-closed water circuits can involve several users or many within a watershed. Authors suggest that one way to solve the pollution problem in the country could be to force users to discharge waste waters upstream from their fresh water intake. In this way the user has to live with his own pollution problem and not pass it on to down-stream users, which is common practice today. In a sense this is a semi-closed circuit with the user benefiting from any dilution available in the water course between the points of discharge and intake.

Many industries in the world over use sewage treatment plant effluent or raw sewage as their sole source of processed water or supplemental supply. Some municipalities reuse water by creating recreational lakes with treated sewage affluent in arid regions, or renovate water for recharge to underground aquifers to augment the supply or prevent salt water intrusion. In a sense these are all examples of semi-closed water circuits within the water sheds.

Water reuse or recycle is stressed because the authors feel that it is the only means to solve the two-fold problem of environmental improvement and future water shortage. For industry, decreased water intake by water reuse offers the maximum immediate oppotunities for achieving significant savings in a relatively short time without requiring more substantial process modification which in turn would require considerable research and greater risk.

Despite the many examples that are seen, some may have doubts that water reuse can truely be achieved to a high degree. In certain instances these doubts may be true. But, overall, the outlook is bright. Statistics on industrial water use generated by the U.S. Bureau of the Census are extremely encouraging and indicate that water reuse or reduced water intake has enormous possibilities.

Water reuse statistics

Water reuse statistics for our country is not available though it is recycled to some extent. Figures of developed countries like U.S.A. throw encouraging light on the issue. The 1966 report of the Bureau of the Census on industry water use in 1964 indicated a total United States industry water intake of 14,055 billion gallons of fresh water and 2,837 billion gallons of brackish water. However, the gross water used (this includes recirculation reuse) was 30,645 billion gallons. The reuse factor was 120 per cent. A reuse factor of 100 per cent indicates that a gallon of water intake is used twice prior to discharge.

Based on the above statistics, an obvious conclusion is that when the need exists industry finds a way to reduce fresh water intake. In regions where water has always been in short supply, its value as a raw material and a resource is appreciated. Fresh water intake can be reduced by substituting brackish or sea water for certain process operations in many instances. Just as important, however, has been the recirculation and reuse of fresh water. The reuse factor dramatically demonstrate what can be done to attain improved water management and largely through present-day technology is now being accomplished.

Technological deficiencies

What are some of the technical deficiencies existing now that hamper progress in water pollution control ? Most of the problems do not involve basic approaches but rather their application, modernisation, optimisation and operation. It is well-known that the pace of technological development in the sanitary engineering field is slow. Many technologists from other scientific areas might view application of our existing processes as almost primitive by their standards. The sanitary engineering profession, consisting largely of sanitary civil engineers, is too technologically inbred mainly due to limitations in the present set up, but the talents and capabilities of other scientific discipline must be utilized to a much greater extent. If water pollution control programmes, promoted by the Union Government, emphasizing research and more industrial participation are taken up it should solve this problem reasonably.