Industry's Concern in Pollution Abatement And Water Conservation Measures

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POLICY DETERMINATIONS and actions of State and Federal legislative bodies reflect basic problems arising in various areas of the country. These problems in turn reflect fundamental developments in our American society. To give this overall view of the industrial water supply problem, a brief summary of current legislation and investigations in the field is presented as introduction to a discussion of limited areas concerned with pollution's effects on industrial water use and water conservation measures which industry may apply in order to provide for balanced use of surface and underground water resources.

The problems of industrial water supply, present and future, are in large part an outgrowth of the tremendous industrial expansion that the country has experienced during the past half century and that will continue, according to present forecasts, during the years ahead. One might partially assess the growth of the problem and the outlook for the future by reviewing the Federal Reserve Board Index of Industrial Production for the years 1900–1950 and production estimates for the next 25 years. The index shows a 700-percent increase in production from 1900 to 1950. Forecasts indicate production will again double by 1975. But that does not tell the whole story regarding the problem of water demand. The total industrial production index is only one part of the picture. Proceeding one step further, we find that the industries using the greatest quantities of water—such as chemical, synthetic, and plastics—account for a major proportion of the industrial growth that is taking place.

Legislation

In an effort to meet the situation thus created, more than three-quarters of the State legislatures considered various types of water resources legislation during their 1953 sessions.

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This article is based on a paper presented by Mr. Dworsky at the Second Conservation Conference for Representatives of Business, Industry and Finance, held at Hidden Valley, Gaylord, Mich., May 19–21, 1953. Like its predecessor at Higgins Lake, Mich., in November 1952, the May conference was sponsored jointly by the University of Michigan, the Soil Conservation Society of America, the Michigan Department of Conservation, and the National Association of Manufacturers. The business, banking, and industrial representatives attending the May meeting formed a permanent organization—the Conservation Council of Business, Industry and Finance—with the objective of stimulating conservation efforts related to those particular fields of interest and providing coordination and leadership to such activities.

The fact that a significant portion of the proposed legislation related to broad aspects of the overall water problem is a clear indication that the States are increasingly aware of the importance of water in their future. In addition to authorizing investigation or action with respect to immediate and specific water problems, the proposals included recommendations having long-range significance. In Alabama, Arizona, California, Idaho, and New Mexico, for example, bills relating to the protection of ground-water supplies were proposed, probably as a result of specific conditions in those areas caused by extreme drought, salt-water intrusion, and so forth. In Arizona, California, Colorado, Pennsylvania, South Carolina, South Dakota, and Virginia, the establishment of State boards, commissions, or committees was proposed to make comprehensive studies of the State water resources.

Proposals presented in 19 States related to protection of surface waters through the abatement of pollution. Prior to the 1953 legislative sessions, 11 States had adopted new legislation or amendments to existing laws, patterned after the suggested State water pollution control act developed by the Public Health Service and endorsed by the Council of State Governments (*1*).

Further support to the growing demand for more adequate legislation regarding water resources and their use is given in the Symposium on Water Law in the South conducted by the Southeastern Regional Law Teachers' Conference in September 1952. In his preface to the special issue of the *South Carolina Law Journal* (*2*) which reproduced the symposium, the editor, Carl W. Littlejohn, Jr., stated: "The subject of water law is now being given marked consideration throughout the southeastern and southern States."

Excerpts from the remarks of the symposium's moderator, Dean Samuel Prince of the South Carolina University Law School, are presented below, in capsule form, as an excellent summary of present trends in water resource use and control.

This symposium deals primarily with law of water rights in the Southeastern area . . . water law far from uniform in America . . . two separate and distinct systems of water rights, management, and control . . . one based on riparian doctrine . . . the other on prior appropriation doctrine . . . two doctrines are inconsistent with each other and have separate origins. . . .

. . . prior appropriation system concerned with the artificial use of water by owners, whether riparian or not . . . riparian doctrine concerned with natural use of water—use, by owner of land on a stream, for domestic and household purposes . . . other uses whether by the riparian owner or by someone else, classified as artificial use. In the West adjustments have had to be made between these two systems, and in the adjustment vested rights have had to be fully protected. . . . In the Eastern States conflicts now beginning to appear between users for natural purposes and users for artificial purposes, in both fields—ground water and surface water . . . experience in the Western States in adjusting conflicting theories may aid in solving problems in the Eastern States. . . .

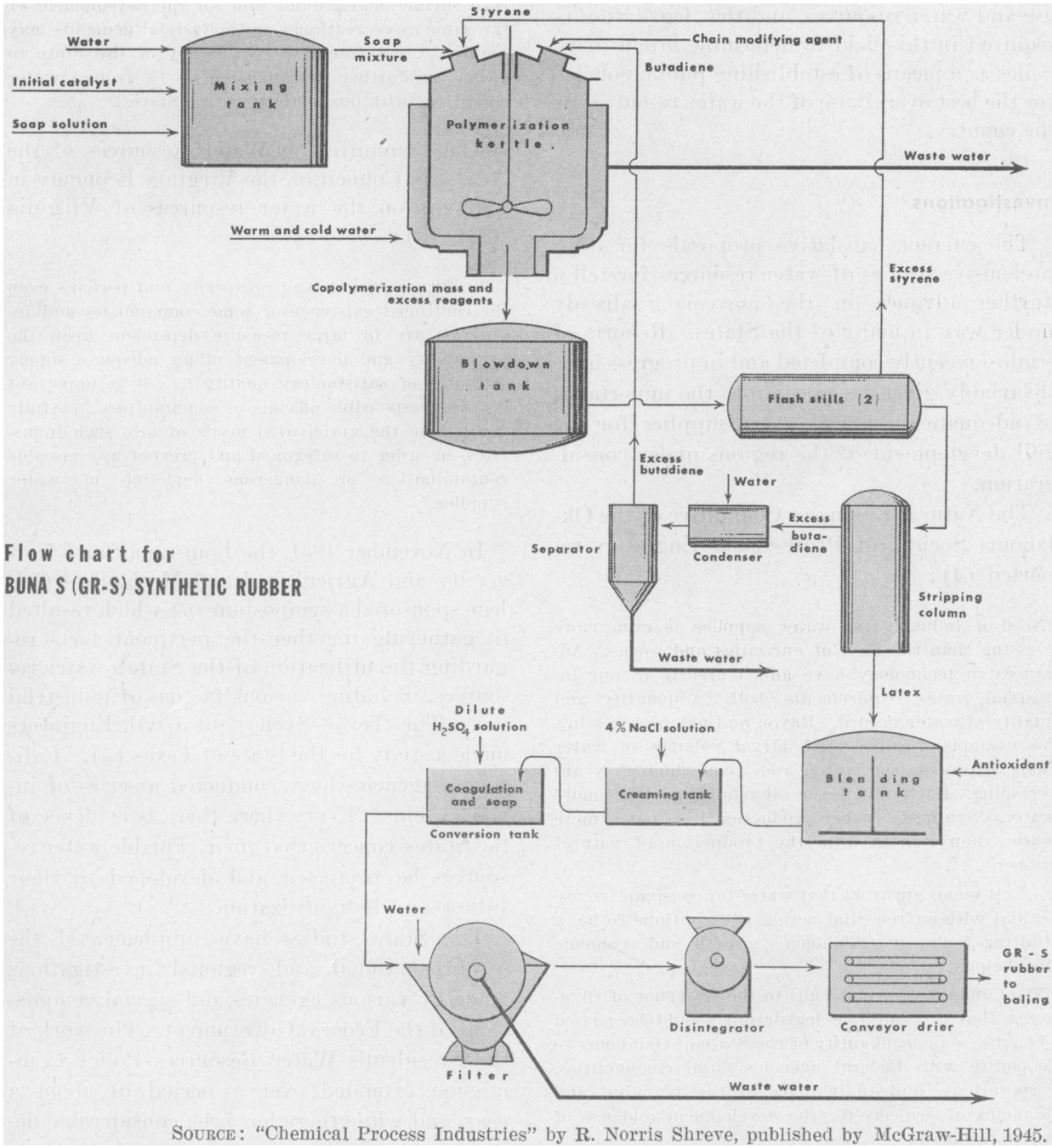
Water still plentiful in Southeastern area; but marked increase in needs for industry, agriculture, and municipalities producing conflicts . . . water supplies remaining constant while needs vastly increasing . . . section will continue to develop, and needs will be multiplied . . . the differential between supply and beneficial use needs will constantly lessen, and stresses between rights of users become greater. . . .

If present and future inhabitants are to obtain greatest beneficial use of water resources broad principles will have to be determined by legislative authority . . . there must be some administrative agency to survey and determine what resources now are, how they may be protected, and what they will be in the future . . . to determine who are riparian owners, what are their riparian rights and prescriptive rights, and to what lands these rights are appurtenant . . . to allocate water not only to riparian owners but to others, for artificial uses in agriculture and industry, for municipalities, for fishing, and even for recreation . . . to apply the "balance of convenience" doctrine . . . to modify any allocation that it may have previously made, and to regulate practices and instrumentalities in such uses . . . in making allocations there should be such a degree of permanence as to give assurance to investors that they are justified in making large outlays of money dependent upon such allocation . . . machinery should be set up with a view of preventing waste and making certain that the people obtain the greatest beneficial use from this vital resource . . . early action necessary . . . as number of vested property rights increases, flexibility of regulations for allocation and management of water decreases. . . .

There can be no question but that the State has power of regulation in these matters with due regard for the powers of the Federal Government in the field and subject to the constitutional protection of vested rights.

The conviction of the symposium's participants, in summary, appeared to be that the

The use of water in an industrial process



Flow chart for BUNA S (GR-S) SYNTHETIC RUBBER

SOURCE: "Chemical Process Industries" by R. Norris Shreve, published by McGraw-Hill, 1945.

Raw materials for manufacture of 100,000 tons per year of Buna S rubber

	Tons
Butadiene	80,000
Styrene	25,000
Soap (Sod. stearate)	4,500
Rock salt	20,000
Water	262,051,750
Coal	401,500

	Tons	
Chlorine	46	Water treatment.
Alum	345	
Soda ash	127	
Sod. metaphosphate	13	

Also unstated quantities of H_2SO_4, NaOH, initiator catalyst, chain modifier, reaction arrestor, antioxidant.

rules evolved from case or decision law are inadequate to deal with the problems of water use and water resources, and that legislation is required in this field to determine broad principles as a means of establishing public policies for the best overall use of the water resources of the country.

Investigations

The current legislative proposals for comprehensive studies of water resources foretell a further advance in the movement already under way in many of the States. Reports of studies recently completed and in progress have invariably given recognition to the importance of adequate industrial water supplies for the full development of the regions under consideration.

The Natural Resources Committee of the Oklahoma Society of Professional Engineers reported (*3*):

"Need of industry for water supplies is even more pressing than the need of our cities and towns. Advances in technology have added greatly to our industrial water requirements, both in quantity and quality of water needed. Rayon and nylon processing, for example, require much larger volumes of water than to process the cotton and wool which they are replacing. Each advance in oil refining requires more water. Synthetic rubber production uses much more water than was used in the production of natural rubber. . . .

". . . it seems apparent that water for consumptive use is, and without remedial action will continue to be, a limiting factor in Oklahoma's growth and economic well-being. . . .

"The Committee recommends to the Governor of Oklahoma that . . . suitable legislation should be passed to enable some legal entity of the State of Oklahoma to cooperate with Federal agencies, local communities, corporations, and individuals in the planning and financing of projects for the development and use of water resources. . . ."

The Rhode Island Water Resources Commission in an extensive report of a study made at the direction of the 1951 legislature, stated (*4*):

"Because of the very limited area constituting the State of Rhode Island, and the importance of maintaining the present industrial development and possible expansion of this development, the engineers feel that a policy must be adopted by the State aimed towards protection of the present water resources, both surface and ground, and for the development of the same as recreational and industrial demands may require . . . it should be the policy of the State to encourage further investigation as to ground water conditions with financial aid by the State."

The Committee on Water Resources of the Advisory Council on the Virginia Economy in a report on the water resources of Virginia states (*5*):

"The future growth and prosperity and perhaps even the continued existence of some communities and industries are in large measure dependent upon the availability and development of an adequate supply of water of satisfactory quality . . . it is important that the responsible officials of communities . . . fully investigate the anticipated needs of any such industries, in order to safeguard and prevent any possible contamination or dangerous depletion of water supplies."

In November 1951, the Louisiana State University and Agricultural and Mechanical College sponsored a symposium (*6*) which resulted in gathering together the pertinent facts regarding the utilization of the State's water resources, including various factors of industrial use. The Texas Society of Civil Engineers made a study for the State of Texas (*7*). California agencies have conducted a series of investigations. Everywhere there is evidence of the States' concern that their valuable water resources be protected and developed to their fullest and best utilization.

The State studies have supplemented the several national and regional investigations made by various agencies and special commissions of the Federal Government. The work of the President's Water Resources Policy Commission extended over a period of about a year, and while there has been considerable debate with regard to some aspects of the Commission's report (*8*), when read as a whole there is no question but that it presents an important overall view of the national water problem and its impact on our physical, social, and economic welfare.

The report of the President's Materials Policy (Paley) Commission (*9*), also based on the results of about a year's study, while accepting

several of the primary theses of the Water Resources Policy Commission, points specifically to the problem of industrial water supply. In introducing the chapter relating to that subject, the Commission stated:

"The Nation already has a serious industrial water problem and belatedly is coming to recognize it as such. During the Second World War, plans for building at least 300 industrial or military establishments had to be abandoned or modified because of inadequate water supply. Many areas of the country are feeling the pinch either because ground water reserves are being exhausted, or because surface and ground waters are polluted. There can be no question that more will feel the pinch in the next 25 years, and that it will grow sharper. By 1975, access to good water may become the most important factor in deciding where to locate industries."

Reports of the Public Lands Committee of the House of Representatives, particularly a section relating to the collection of basic data on water resources (*10*), and of the Interior and Insular Affairs Committee, particularly the volumes relating to water supply and uses and ground water problems (*11*), are indicative of the growing intensity of interest in the water problem.

Problems of both domestic and industrial water supply are being given consideration in the comprehensive water and related land use surveys directed by the Congress that are under way in the Arkansas-White-Red River Basins and the New York-New England area. These studies are being made by interagency committees composed of representatives of the Federal agencies concerned in these problems, and of the States in the areas affected. Public Health Service representatives on the interagency committees have major responsibility for the water supply and water pollution control aspects of the investigations.

In the reports on the surveys of pollution conditions in the waters of the United States, undertaken jointly by the Public Health Service and the States soon after passage of the Federal Water Pollution Control Act, there is recurring emphasis of industry's need for adequate supplies of water (*12*). The following two comments are typical:

Tennessee: "Industrial water needs in the basin exceed those for domestic purposes . . . considerable quantities are required for manufacturing processes, many of which require an extremely high water quality."

North Atlantic: "Development of the highly industrialized sections of the North Atlantic Drainage Basins has been in part due to the availability of adequate volumes of water for industrial purposes. The industrial demands on water supply have in recent years become so great that future expansion may be limited unless adequate supplies can be provided and existing supplies protected from damaging pollution."

Reports of the Department of the Interior on its study of the southwestern drought areas in 1951 (*13*) and of the Missouri River Basin Commission on its study of basin development problems, made at the direction of the President (*14*), include industrial water supply as an important factor in the economy of the regions under consideration.

The Executive Office of the President took an important action in 1952 affecting the operation of water resources development programs supported by Federal funds. Standards and procedures to be used in reviewing projects in consideration of budget requirements are set forth in Bureau of the Budget Circular A–47. Provision is made for the incorporation of water supply for domestic, municipal, or industrial purposes in Federal projects, if the total financial costs for this purpose are fully reimbursed to the Federal Government by the persons served. Provision is also made for inclusion of anticipated future requirements, if the cost of the additional facilities for such use is not more than 15 percent of the total construction costs of the project, and if local industrial or municipal users give reasonable assurance that use of the reserved water supply will begin within 10 years. All financial costs are to be paid within 50 years after date of initial use.

Water Quality

Industry's water problem is not concerned merely with adequate quantity. In many cases, quality is of equal importance. Although water quality standards are comparatively low for some industrial purposes, most uses have certain quality requirements and some are equal to or even higher than that demanded for drinking purposes.

Water used for cooling condensers must not be unduly corrosive and must not cause excessive deposition of scale. If large amounts of organic materials occur in cooling waters the efficiency of cooling is apt to be impaired, the growth of bacteria and fungus may cause unpleasant odors, and the cost of treating such water may be high. The requirements for boiler feed are more exacting. For boilers operating at low pressures water is frequently used without preliminary treatment; for higher pressures, where the composition of the water is more important, treatment such as softening, demineralization, and deaeration are often necessary.

The composition of water used for papermaking is important. For high-grade papers some of the usual quality requirements are softness, low iron and manganese content, freedom from suspended matter, low quantity of carbon dioxide, and relative freedom from organic matter and bacteria. Soft water is preferred to hard water by many industries such as soap manufacturing, wool degreasing, some types of dyeing, textile bleaching, tanning, and laundering. For a large number of industries, for example, bleaching, tanning, and dyeing, it is important that the water used should be very low in iron content (*15*).

For industries having high requirements, the widespread pollution of surface waters is daily becoming more serious. Since treatment adds to processing costs and ultimately to the price of the product, industries attempt to locate new plants where the water supply is of satisfactory quality to meet their needs with a minimum of treatment for purification. Some river valleys are now almost completely closed to further industrial growth either because present pollution makes the water supply unsatisfactory for new industries or because the pollution which new industries would create would destroy the present necessary uses of the water. This not only damages the valley itself; it is also a threat to total national production.

Pollution Damage

Data are not available to show the total effect of pollution on industrial water use. We do have some indication, however, that it is of considerable magnitude. Under the provisions of the Water Pollution Control Act, the Public Health Service and the State water pollution control agencies have made preliminary surveys to identify instances of interstate pollution; that is, cases in which pollution entering a stream in one State travels downstream and affects the health and welfare of people in an adjoining State. In about 30 percent of the 110 such cases that have been revealed by the surveys, damage to industrial water supplies is reported. Since instances of interstate pollution normally occur close to the boundary lines of States, the waters involved in these cases represent but a small proportion of the total surface waters of the United States. In the light of the fact that more than 90 percent of industry's fresh water supply is obtained from surface sources (*16*), it would appear that for the country as a whole pollution damage to industrial water uses is great.

While the information on these interstate situations indicates that pollution is causing substantial damage to industrial water supplies, it is interesting to note that the disposal of industrial water after it has been used is listed in all cases as a cause of pollution. In some instances sewage is also included as a pollutant. In the northeast, the used waters and the wastes they carry from textile and paper mills and tanneries are most frequently mentioned; in the southeast, textile and paper mills are the principal sources; in the upper midwest, paper and food processing; in the Ohio, chemical, metal finishing, steel and paper mills, and acid mine drainage; in the southwest, petroleum wastes, brine, food processing, and paper; in the Pacific northwest, paper, chemicals, and food processing.

The effects of these wastes are varied—not all of them are yet known. Paper-mill wastes, a problem in almost every area, are composed of inorganic acids, salts, and both soluble and insoluble substances, which affect biochemical oxygen demand (B. O. D.) and color. The effects of textile wastes vary according to type and process used—rayon (viscose) affects B. O. D. and pH, causes tastes and odors, and is frequently toxic; wool-scouring wastes affect B. O. D., pH, and color, contribute to taste and odor problems, and cause turbidity. Water

that has been used for cooling (steel and allied processes) raises the temperature of the stream to which it is returned, often causing difficulties. The Mahoning River in Ohio, one of the most used rivers in the country, provides an example of deleterious temperature effects. During one winter month a few years ago, the water diverted from the river, mostly for industrial cooling purposes, was 10 times the average flow of the river. Much of this water was returned after being used. The temperature of the river approached 140° F. during that month. It was so high that normal sewage-purification processes were ineffective and pollution became a serious problem (*17*).

A particularly striking example of the effect of industrial wastes on water supplies, both domestic and industrial, is related in the report of a specific study of brine contamination in the Muskingum River made by the Ohio River Valley Water Sanitation Commission in cooperation with several State, Federal and industrial agencies (*18*). The development and utilization of the vast salt deposits in Ohio resulted in large amounts of chloride wastes being discharged into the Muskingum River, with attendant effects on industrial waters taken directly from the river and on the ground waters used by industry adjacent to the river. In addition, physiological effects were felt by people in the area. This health factor is one which would certainly be taken into consideration along with the quality of industrial water supply by any industry contemplating the location of a new plant in the affected area.

Conservation Methods and Balanced Use

On the long-term average, year after year, the total amount of water is kept fairly constant, through Nature's replenishment. As the country develops, we are increasing the amount of the usable supply—that part on hand or stored either in surface reservoirs or in accessible underground aquifers—in order that there will be an adequate volume available to provide for the needs of the growing population and expanding industry. Although it is unlikely that at any time in the foreseeable future the Nation's total supply will be less than the total demand, the supply is not always available at the time and in the place that it is needed. Increased water use has already resulted in critical shortages in some areas formerly believed to have adequate resources for future development.

Among the many factors that have contributed to these unanticipated shortages are: failure to balance withdrawals from ground water sources in line with natural replenishment; failure to provide manmade structures for holding seasonal surpluses for later distribution; failure to make maximum use of supplies from surface sources because of pollution by discharge of untreated wastes; expanded requirements due to rapid growth and concentration of population and industries; increased use of air conditioning and water-using household devices; lack of adequate basic data on the availability of water resources; water wastage; failure to use available salt water, when suitable, rather than fresh water; inadequate evaluation of water supply prior to selection of plant sites; inadequate planning of water-consuming plant equipment.

Ways of combating some of these factors are already available and can be readily applied by industry in connection with its own use of water. On the matter of wastage, for example, corrective measures are usually fairly obvious. They vary with individual situations, but can be readily worked out through study of plant operations. Many industries have already achieved substantial savings through better housekeeping methods, recirculation, multiple-use, revised processes, and so on (*19–21*).

Water Pollution Control

With respect to abatement of water pollution, some progress is being made through the provision of waste-treatment facilities. During 1952, 515 communities in the United States awarded contracts for the construction of public sewage-treatment plants involving the expenditure of $137 million. Of this amount, about $78.5 million was for new plants and the remaining $58.5 million for additions, enlargements, or replacements to existing plants. This marks a step in the right direction, but the rate of construction is still far less than that required to bring under control the pollution caused by municipal wastes. It has been estimated, on the basis of a survey of sewage-treat-

ment plant needs in 1950, that the construction rate should be from $450 million to $500 million a year over a 10-year period in order to meet present needs and care for new requirements as they arise (*22*).

Similar construction data are not available to permit measurement of progress in abating pollution caused by industrial wastes. The 1950 surveys indicated that at that time about 2,800 new industrial waste-treatment plants, 100 replacements, and 600 additions or enlargements were needed, with treatment requirements of an additional 5,500 plants undetermined (*23*). The compilation of interstate situations referred to earlier and specific studies made during recent years by the New England Interstate Water Pollution Control Commission (*24*) and the Interstate Sanitation Commission (*25*) indicate the continued prevalence of industrial waste problems.

Future prospects for accelerated action appear promising, in the light of the public statements of such leaders of industry as the Dupont and Union Carbide companies to the effect that it is their policy not to permit construction of new manufacturing units until methods have been developed for properly handling the wastes of such plants (*26*). Further evidences of industry's real interest in finding solutions to industrial waste problems are apparent in the work of the National Technical Task Committee on Industrial Wastes, composed of representatives of the 36 major industrial categories. That committee is fostering the exchange of technical information on the various phases of the problem through work of task groups on specific projects and through a compilation of a punchcard inventory of present knowledge and research studies in progress. This inventory, which will consist of approximately 10,000 items, is being prepared with the assistance of committee members under the direction of the chief of the technical services branch of the Public Health Service's Division of Water Pollution Control, who acts as secretary to the National Technical Task Committee.

Basic Data Collection

In the considerable volume of recent literature on the water resources problem, there is agreement that the collection of more adequate basic data is a primary need for the operation of effective water utilization programs. Abel Wolman says ". . . the lessons to be learned are primarily those pointing to the necessity of . . . providing more flexible and prompt inventory of water resources" (*27*). A report of the House Committee on Public Lands (*28*) states:

> "A complete balance sheet should be developed and maintained that will show the total water resources, the maximum quantities of water that can be made available for all useful purposes, and the extent of the wasteful uses. The size and scope of the Federal basic-data program in water resources should be brought into harmony . . . with the magnitude and complexity of the resource itself and should provide an adequate and dependable basic-data foundation for projects to develop the maximum uses of water."

Harold E. Thomas, in the report of his studies made for the Conservation Foundation (*17*), stated:

> "Utilization of ground-water reservoirs for the greatest benefit of civilization is dependent first on adequate hydrologic data, from which the full potential of development is determined. . . We do not know enough about most ground-water reservoirs to give a quantitative answer as to their potentialities or limitations for development."

Similar acknowledgment of the basic need of increasing fundamental knowledge concerning water resources to permit their maximum utilization is made by the President's Water Resources Policy Commission (*8*), the President's Materials Policy Commission (*9*), and the Engineers Joint Council (*29*).

Data of importance to health agencies, in order that they may be prepared to participate in water resources planning activities, include information on the adequacy of domestic and municipal water supply facilities and on water needs for future population growth. It is essential, too, that health agencies interest themselves in industrial needs. Estimates indicate that from 25 to 50 percent of municipal water supplies are sold for industrial purposes. Thus in important respects the problems of providing adequate and safe public drinking water supplies are closely intertwined with those of providing a significant share of industry's water requirements.

Ground Water Replenishment

As surface water pollution has become more widespread, industries and municipalities have turned to ground-water sources of supply. In some areas the amounts withdrawn have exceeded the natural recharge, with a resultant lowering of the ground-water table. For some ground-water reservoirs, it is possible to reduce the difference between withdrawals and natural replenishment by artificial recharge. Surplus stream water may in some cases be diverted into the ground-water reservoir through construction of storage dams and percolating works. This method has been followed in several California areas.

The reclamation of water from sewage and industrial wastes and its utilization to recharge underground supplies, as well as for other more direct purposes, have been the subject of intensive investigation in California and elsewhere. A M Rawn, chief engineer and general manager of the Los Angeles County Sanitation District, reports (*30*):

"The scientific and engineering principles necessary to reclaim from sewage a water suitable for any useful purposes are already well founded."

He points out that there are significant differences between the processes of sewage disposal and water reclamation and contends that treatment of the two functions as completely separate operations would remove many of the objections now advanced, from health and esthetic standpoints, to the use of reclaimed water.

Studies made by the University of California (*31*, *32*) have indicated that through processes similar to those used for sewage disposal and water purification, it is possible to reclaim from sewage and industrial wastes water that is satisfactory for domestic, industrial, agricultural, and other purposes. The studies have demonstrated that at present the cost of reclamation is generally less than that of providing supplemental water by such means as transportation through aqueducts from watersheds having surplus supplies, sea water conversion, or controlled rainmaking. As a matter of interest in this connection, it might be noted that there has recently been considerable activity and significant progress in research relating to both weather modification and sea water conversion. Under Federal legislation enacted during the past two sessions of the Congress (*33*, *34*), the scientific advances in these fields are being evaluated and impetus is being given to further research designed to provide methods for practical application.

While there are a number of instances of industrial re-use of waste waters, according to Wolman this practice is not nearly so widespread as it might be (*27*). The two outstanding examples he cites are the Bethlehem Steel Company plant at Sparrows Point (near Baltimore) and the Fontana (California) plant of the Kaiser Steel Corporation.

The Bethlehem plant uses 40 million gallons per day of Baltimore City sewage effluent. Without it, the company would be unable to carry on its expanded operations at that location, as the water supplies of the area would be unequal to this additional drain (*35*). At Fontana, approximately 50,000 gallons of water are recirculated for every ton of steel shipped out. This recirculation requires approximately 2.5-percent makeup, or 1,400 gallons of actual consumption per ton of steel produced, in contrast to the national average of 65,000 gallons per ton of steel produced in other mills (*36*).

Conclusion

From the foregoing review of the Nation's water problem as it affects industry, several factors stand out as most important:

1. From the investigations of legislative bodies, and as a result of authorizations and recognition of the problem in law, it is apparent that considerable planning, research, and data collection are being undertaken with respect to the matter of water resources and their effect on industrial development.

2. It is evident that under many State laws, especially those of more recent origin which provide protection for all water uses, and also in the Federal legislation on the subject, damage to industrial water supplies provides an adequate basis for legal action to remedy the cause of the damage. For instances of specific

damage to a particular plant, industry of course has had remedies in law under the riparian rights or reasonable use or prior appropriation doctrines. However, under the broadened approach reflected in State legislation today, official agencies can now utilize damages to industrial water supplies, fish and wildlife, recreation, and agriculture, as well as to public health, as a basis for initiating action against polluters, whether municipal, industrial, or others.

3. Industry plays a dual role in this situation. While, on the one hand, industry represents an important economic area that is being damaged by water pollution, on the other hand, it shares with municipalities the role of a major originator of pollution. The forward-looking approach adopted by some of the Nation's leading industries, and the progress being achieved between government (Federal, State, or interstate) and industry through committees such as the National Technical Task Committee on Industrial Wastes, are indications of what can be accomplished. But there is still a great deal of work ahead before all the problems incident to the disposal of industrial waste waters are satisfactorily solved.

4. The increasingly frequent occurrences of water shortage due to ground-water depletion point to the necessity for more extensive use of surface waters as replacements for, or in conjunction with, underground supply. Because of the polluted condition of many of the surface sources, the tendency in recent years has been to avoid their use in favor of the better quality ground water. The country can no longer afford that luxury, but must make maximum use of all its resources. As water requirements increase in volume, use of the conservation practices that are available—reclamation, recirculation, pollution abatement—must be expanded.

The Engineers Joint Council, in the corrective program suggested in its "Principles of a Sound National Water Policy" (*29*), aptly summarized the goal toward which we are all working, and the manner in which it may best be achieved:

"The water demanded for our expanding industries can and must be provided. The solution of the problem, involving as it does complex economic aspects, may only be found by an enlightened viewpoint reflected by industrial management and equitable, reasonable regulations. Such regulations must be imposed by mutual agreement and cooperative effort among those affected and by constructive long-term planning by municipal and State regulations."

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