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Other desirable tests, for more complete control of operation and for additional information concerning the efficiency of treatment, include dissolved oxygen, free ammonia, nitrites, nitrates, organic nitrogen, chlorides, chlorine demand and oxygen consumed.

Special determinations are also necessary at times if industrial wastes, which are not normally present in the raw sewage, are suspected and if interference with treatment efficiencies is being experienced.

Sampling

The results of analytical determinations included in the operation report can only represent true conditions if the samples collected are representative of the sewage flow and the determinations are made in accordance with accepted standard practice.

It is best to collect individual samples at definite intervals, and to combine these individual portions into a composite sample for analysis. Daily composite samples can be made up from individual samples collected over 12- or 24-hr. periods, and weekly composite samples can be made from composite daily samples. If at all possible, the individual samples should be combined into the composite sample in volumes proportional to the volumes of flow. The analyses of composite samples will be much more representative of conditions at the plant than results obtained from mere "catch" or "grab" samples.

If personnel is not available to permit the collection and compositing of individual samples over 12- to 24-hr. periods, than a composite sample might be made covering a shorter period, provided that such period is selected to coincide with the general prevailing periods of greatest sewage load.

Care should be taken in collecting sewage samples to use wide-mouthed sampling containers. In making composite samples definite intervals for the collection of the individual portions that make up the composite sample should be established and followed. If a short period of compositing is used, individual samples should be collected at least every half-hour, and if a longer period is used, individual samples should be collected at least every hour.

The manual *Standard Methods of Water and Sewage Analysis* should be followed closely in all laboratory procedures.

Miscellaneous Records

Permanent records should also be kept of the power consumption within the plant by the taking of daily meter readings, with separate readings of power consumption for special processes.

Regular checks should be made to determine the conditions of all mechanical and electrical equipment in the plant, and notations made in the daily log of any replacements or repairs made to such equipment, and of all maintenance done in connection therewith.

Where records are made of such things as air temperature, rainfall, time of emptying and filling tanks and other related matters, they should be made at a stated time each day.

No plant records are complete without a detailed record of the costs of operation. In addition to the usual fixed charges, the plant operator should maintain a complete record of the costs of materials and chemicals used for maintenance and operation of the plant, cost of power purchased, cost of equipment replaced and cost of additional labor employed.

If adequate and satisfactory weekly or monthly records are maintained, then annual operation and cost reports can be readily made up in a convenient manner.

Use of Operation Reports

Records maintained just for the sake of having them are of little value to the plant operator or to the officials responsible for the supervision of the treatment works. They should be referred to frequently by the plant operator and should be used as yard-sticks for measuring the efficiency of the plant, for indicating changes in operation and treatment methods to secure better plant performance, and to show the need for additions or enlargements to the plant, or the need for additional treatment.

THE EFFECT OF INDUSTRIAL WASTES ON SEWAGE TREATMENT *

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This paper is intended primarily as an aid to sewage works operators and interested municipal authorities in their establishment of policies and regulations concerning the discharge of industrial wastes to the public sewer system. In approaching this subject, it appears desirable to classify industrial waste problems into three groups, according to the general method of handling: (1) the discharge of untreated wastes directly to the public sewers, (2) the discharge of partially treated wastes, after preliminary treatment by the industry, to the public sewers for final treatment and disposal and (3) complete treatment and disposal by the industry in its own facilities and with no discharge to the public sewers. This paper deals only with problems of the first two classes.

In most of our older and larger cities, and also in many smaller communities, the discharge of untreated wastes to public sewers has become established from earlier days when the town drain, usually an open ditch, constituted the beginning of the sewer system. As sewage treatment works were added to sewer systems it became common practice to continue to accept industrial wastes for treatment with sewage. The increasing complexity and magnitude of industrial waste problems, as well as the refinement and increased sensitivity of sewage treatment processes, have brought about difficulties in the operation of sewage treatment works. The history of such difficulties confirms the importance of so regulating the discharge of industrial wastes to public sewer systems that abuse of the treatment works will not result. This is now ordinarily accomplished by private preliminary treatment of the industrial wastes or, in some instances, by the exclusion of particularly troublesome wastes from the sewers.

The acceptance of untreated industrial wastes by the public system is ordinarily most economical in over-all cost. This is particularly true in the larger communities having diversified industries of ordinary type and magnitude wherein the waste waters, of varying character and of not disproportionate volume, mix with domestic sewage so that their objectionable characteristics are largely neutralized or offset to permit unimpaired operation of sewage treatment works. Very real difficulties may result, however, in relatively small communities due to the discharge to the sewer system of incompatible waste waters from one or a few large industrial establishments.

It is obvious that, even if industrial wastes are of generally acceptable

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character, proper consideration must be given to the type of sewage treatment selected and to the capacities to be provided. Also, some industrial establishments are so located that, due to space limitations or other considerations, it is not practicable to provide private treatment worthy of the term, and municipal authorities may elect to accept the untreated waste waters into the sewer system and to design the sewage treatment works to treat the sewage and industrial wastes jointly.

Objectionable Industrial Waste Characteristics

Certain industrial wastes are of such character that they will disturb sewage treatment processes, harm structures or add unduly to the cost of operating the treatment plant. Obviously, such wastes must be excluded from the sewer system and the responsibility for disposal must be placed entirely on the industrial management.

A number of characteristics making industrial wastes objectionable or unacceptable in public sewer systems are listed and discussed:

Excessive Volume

Whether continuous or periodic, large volumes of industrial wastes would ordinarily require unreasonably large sewage treatment units and would usually justify the installation of private treatment works particularly designed for the character of the individual waste. Waste waters from some paper mills would be typical of this category.

Clean Water

There would be nothing to gain and everything to lose in adding clean or very slightly polluted waste waters to sewage, unless dilution is desired. Waste water from condensers, air conditioners and refrigerating systems should be discharged directly to streams or to storm drains and relatively clean rinse waters may sometimes be disposed of similarly. Arrangements are under way in Philadelphia for the construction of separate drains to convey to the river the tremendous volumes of slightly polluted waste waters from the barometric condensers of evaporating systems for treating the highly polluting slops from large commercial alcohol distilleries. At Paterson, New Jersey, diversion to the river of an average of 11 m.g.d. of rinse waters from textile dye houses relieved the overloaded Passaic Valley trunk sewer to save an annual expense in sewage treatment of $35,000 as well as an estimated $908,000 for construction of a relief trunk sewer.

Hot Water

Appreciable increase in the temperature of sewage stimulates septic action in sewers, releases offensive gases at manholes, accelerates deterioration of cement and bituminous joints in sewers and increases odors at sewage treatment works.

Excessive Inorganic Solids

Grit or insoluble slurries may overload grit chambers, add to sludge volumes, compact sludge to clog hoppers and pipes and, possibly, develop heavy inert accumulations difficult to remove from sludge digestion tanks. Coal ash from boiler rooms, foundry sand, surface wash, automobile laundry wastes, lime wastes from tanneries, acetylene gas generator sludge and wash water from vegetable canneries are among the waste waters containing such substances. The literature contains references to difficulties at Milwaukee attributed to wastes from stone and marble works and acetylene sludge, and to the clogging of sewers in Massachusetts by tannery lime wastes. The removal of sand and grit from Imhoff tanks has been frequently reported.

Coarse Suspended Matter

Obstruction of sewers, overloading of screens, excess scum in settling and digestion tanks, putrefaction in sewers and disturbance of digestion may be caused by coarse suspended matter such as spent grains from breweries and distilleries, fleshings from meat packing houses and tanneries, solids from vegetable canneries and yarn and fabric from textile mills. Some years ago the writer found that foul odors from sewer manholes in Erie, Pa., were caused by decomposition of stranded fleshings from a meat packing plant and the trouble was solved by installing specially locked screen plates in all floor and tank drains to prevent workmen from lifting the loose screen plates and flushing the scraps to the sewer. At a shoddy mill in Norristown, Pa., it was necessary to install mechanical fine screens to prevent clogging of municipal sewers with matted masses of yarn and fabric resulting from the shredding of woolen cloth.

Excessive Suspended Solids

Sewage treatment works are intended to remove suspended solids but an excess of such matter over the designed capacity, particularly if rapidly decomposable, often impairs plant operation by preventing effective clarification, increasing sludge volumes and causing difficulties in sludge digestion. In the small community of Jeanette, Pa., brewery wastes, including the explosively decomposable proteins of spent yeast flushed from the bottoms of ageing vats, caused such violent disturbance in the activated sludge plant that it was necessary to suspend entirely its operation until the brewery wastes were excluded. At the South plant in Lancaster, Pa., also an activated sludge plant, brewery wastes were again responsible for at least part of the disturbance in plant operation. At Akron, Ohio, rubber reclamation wastes carried more suspended solids than the sewage from the entire city. It is reported from Michigan that paper mill white water produces excessive sludge volumes, although mention is not made of particular difficulties in sludge digestion.

Dissolved or Colloidal Organic Matter

Overloading of sewage treatment works with reduced efficiency, septic disturbances and offensive odors may be caused by excessive organic matter in solution or as colloids. Milk and milk products plants produce waste waters ordinarily having a B.O.D. of about 1,000 p.p.m., or about five times that of average sewage, and heavy discharges of such wastes will affect sewage treatment processes. Many instances have been reported of foaming in Imhoff tanks due to milk wastes. The waste waters from vegetable canneries (corn 2,500 p.p.m. B.O.D., peas 1,400 p.p.m. and tomatoes 850 p.p.m), usually large in volume and seasonal in incidence, may easily disrupt plant operation. Wastes from distilleries, breweries, tanneries, rubber reclamation plants, wool scouring and textile washing may also be troublesome. Cherry and tomato cannery wastes seriously affected the sewage treatment plant at North East, Pa. Dissolved and colloidal matter in brewery wastes has contributed to operating difficulties at Jeannette, Lancaster, and Norristown, Pa. A large meat-packing plant in Allentown, Pa., quite effectively removes grease and the larger solids from its waste waters but, nevertheless, odors and other objectionable conditions result therefrom at the municipal sewage treatment plant. In Washington, D. C., yeast plant wastes, high in both sulphur and temperature, have been held responsible for disintegration of sewers. It is reported that in Gastonia, N. C., textile wastes not only colored the effluent of the sewage treatment plant but disrupted the activated sludge process.

Grease, Oil and Tar

Many sewage treatment plants have been somewhat affected by floating oil

and accumulations of grease. Grease and oil, as well as heavy tar, may become incorporated with settling solids to disturb normal sludge digestion. Furthermore oil in a treatment plant is a possible fire hazard. Automobile laundries, garages and service stations, oil refineries, machine shops, meat packing plants, hotel and institutional kitchens, wool scouring plants, and gas works are common sources of such objectionable matter. Garages and service stations, particularly, are a potential danger because of the convenience of the floor drain for disposal of oil by the careless employee, and suitable separators or traps should always be required and their frequent cleaning enforced. At Clifton Heights, Pa., the waste waters from wool scouring plants are separately collected and subjected to preliminary sedimentation and grease flotation before discharge to the public sewer.

It seems pertinent to mention the inadequacy of most grease traps installed in the drains serving large kitchens, and their almost universal neglect. It is the writer's opinion that, in most instances, the commercial grease trap as installed by the average plumber is of practically no value to anyone, except for the profit to the plumber, because it is invariably filled with grease in a very short time and, not being cleaned at proper intervals, is about as useful as is the human appendix.

Inflammable Substances

Explosions in sewers, pumping stations and sewage treatment plants caused by gasoline or other inflammable liquids have been all too frequent and have resulted in loss of life, personal injuries and great property damage. Waste waters from garages, dry cleaning plants, chemical industries and gas works are among the possible sources of such dangerous liquids. The literature records an explosion in a sewage pumping station in East Boston in 1914 which killed six persons and injured others, and also a serious explosion at Springfield, Mass., in 1934. The writer recalls viewing the damage of a sewer explosion in Pittsburgh some years ago when several blocks of a street were destroyed.

Acid Wastes

The disintegration of concrete sewers, cement joints, treatment plant structures, pumps and iron pipe may be caused by acid wastes, which sometimes may be sufficiently strong to interfere with biological sewage treatment processes. Waste waters from metal pickling, certain oil refining processes and many miscellaneous industrial processes contain acid. At Fostoria, Ohio, acid-iron wastes completely clogged a trickling filter and Cleveland also reported serious difficulties from such wastes. At West Pittsburgh, Pa., some years ago, the piping valves and concrete of the small community sewage treatment plant were so disintegrated by the spent acid pickle liquor of the town's principal industry that major reconstruction was necessary. It seems pertinent to mention here the danger of the clogging of air diffusers in activated sludge plants by acid-iron wastes discharged to sewers.

The Maryland Board of Health has established a minimum pH of 4.0 for wastes discharged to concrete sewers and some other authorities consider pH 5.5 as the acceptable minimum.

Strongly Alkaline or Caustic Wastes

Pumps and metal pipe may be attacked by strong alkaline or caustic wastes which may also affect biological treatment processes. Kier liquor from textile mills and caustic rag digester wastes from some paper mills are possible causes of such trouble. Salt from the leaching of green salted hides at Hanover, Pa., caused the destruction of a pump serving to lift the waste waters from a hide and tallow plant to

the public sewer system, and the overflow from the inoperative pumping station killed thousands of fish over a stretch of several miles in the receiving stream.

Toxic Substances

The disruption of biological processes of sewage treatment by a number of toxic wastes has become more common recently, due in no small part to the development of metal plating and to the more common application of chemical processes in many of the smaller industrial establishments. Cyanides as wasted from metal plating, although not cumulative, are toxic to biological activity when present in dilutions as low as 1 p.p.m. Copper, also common in plating wastes, is cumulative in effect and even small amounts will prevent sludge digestion. Phenols from gas works, arsenic and lead compounds are also harmful. Activated sludge plants and trickling filters are particularly susceptible to disinfectant or toxic substances.

At the Calumet plant of The Sanitary District of Chicago, wastes from the paint industry, containing copper, arsenic and lead interfered seriously with activated sludge and trickling filter units. At Muskegon Heights, Mich., copper and cyanides from metal plating practically stopped sludge digestion. At Lancaster, Pa., overflow of phenolic wastes from a gas works to the public sewers disrupted the action of an activated sludge plant.

Miscellaneous Wastes

Appearance or odor of sewage treatment plant effluent may be affected, as well as disturbance of biological treatment processes, by dye wastes, spent tanning liquor and strong wastes from meat packing, wool scouring and other industries. Faint color, of itself, need not be objectionable in a treatment plant effluent, as considered by the sanitary engineer, but most complaint from the public is based on appearance of a stream. Most of the dyes now used in the textile industry are of the "direct" type and the wasted color is largely absorbed by sewage particles or dissipated in oxidation processes. Odors in sewage treatment plant effluents are, however, sometimes quite significant and may lead to the identification of industrial wastes whose harmful effects on the sewage treatment process might not otherwise be recognized.

Although often overlooked, laundry wastes are sometimes a disturbing factor in sewage treatment plant operation, as learned by a number of operators of treatment works at military establishments. It appears logical, in general, to assume that if laundering were done entirely in homes there would be no question about the propriety of admitting the laundry water to the sewers, in spite of the heavy Monday load. Large commercial laundries, however, particularly in small communities, may discharge intermittently such large quantities of wastes, heavy with soap, that sensitive sewage treatment processes may be seriously disrupted. Institutional laundries are notorious for their effect on sewage treatment plant operation. It is well to remember that laundry wastes are considerably higher in pollutional characteristics than is the average dye house waste.

Preliminary Treatment of Industrial Wastes

In spite of the many difficulties involved in the acceptance of industrial wastes in the public sewer system the practice is, in general, the best method of handling the problem. Certain wastes having objectionable characteristics, however, must be given preliminary treatment at the source to eliminate or minimize their harmful effects. In addition, the few wastes which are incompatible and incapable of satisfactory treatment by available sewage

treatment processes must be excluded from the sewers. The usual methods applicable to the preliminary treatment and control of industrial wastes follow:

Regulated Discharge: It is obvious that if a waste normally discharged in 8 hours is uniformly distributed over 24 hours its effect should be reduced to one-third. This applies not only to volume but also to organic load and temperature. Holding tanks or basins with orifice box control of discharge are practical for this purpose and may be supplemented by aeration to prevent odors of decomposition during the storage period.

Screening: Excessive solids can be retained by passage through screens of suitable fineness. Mechanical screens of both the vibrating and rotary type are in common use and are much more satisfactory than manually cleaned screens which are too often neglected.

Plain Sedimentation: Heavy settleable solids, such as grit and other mineral matter, can be retained in grit chambers or properly designed sedimentation tanks. Similar treatment may sometimes be justifiable for removal of excessive organic solids such as from meat packing plants and vegetable canneries.

Chemical Coagulation and Sedimentation: In addition to plain sedimentation, chemical coagulation may be resorted to for removal of fine suspended solids and colloidal matter if such matter proves troublesome.

Flotation: Removal of oil and grease by flotation in units known as separators or grease traps is standard practice and the value of the reclaimed material often pays for the cost of its recovery. Application of diffused air or chlorine adds to the effectiveness of such treatment.

Acid Cracking: Grease and oils in emulsified form are not separable by plain flotation and must sometimes be subjected to acidification to break the emulsion and cause the grease or oil to float.

Neutralization: Acid wastes may be neutralized by properly controlled application of alkaline agents but it may be necessary to supplement this with sedimentation to prevent admission of resultant sludge to the sewer system.

Modification of Manufacturing Processes: It may be justifiable and even necessary in extreme cases to reduce or eliminate particularly objectionable waste water characteristics by effecting major changes in plant operations or processes. Careful studies to this end undertaken by plant managements will often reveal needless extravagance in use of water, waste of soap or chemicals and failure to recover materials which may become valuable by-products.

Heat Exchange: Reduction in temperature of waste waters may be reduced, often with substantial savings in fuel, by the installation of heat-exchange apparatus.

Chlorination: Rapidly decomposable material may be treated with chlorine before discharge to suspend decomposition and thereby control objectionable odors from sewer manholes and prevent production of destructive compounds until the waste waters become sufficiently diluted farther down in the sewer to establish a safe balance.

A few examples of typical methods of preliminary treatment follow:

1. *Abattoirs and Packing Plants:* Segregation and salvage of blood, paunch manure, etc., screening and salvage of fleshings, sedimentation of fine solids, flotation and recovery of grease (possibly with addition of chlorine or air) and carefully planned economy in use of water.
2. *Acid Pickle Liquor:* Neutralization and sedimentation.
3. *Breweries:* Screening of spent grain for use as cattle feed and, sometimes, regulated discharge of aging vat lees, bottle wash and keg wash. In large breweries conversion of vat lees to foodstuff of high vitamin and protein content might be profitable or at least justifiable if exclusion from the sewer system is necessary to prevent disturbance of sewage treatment processes.
4. *Gas Works:* Exclude entirely from sewers.
5. *Paper Mills:* Generally to be excluded from sewers but sometimes admissible if the volume is reduced to a minimum by recirculating or closed system, including an efficient "save-all" for retention of settleable or flotable solids.
6. *Vegetable Canneries:* Screening through 30- or 40-mesh wires, correction of reaction if a low pH is troublesome and possible regulated discharge. Relatively clean cooling water should be excluded from the sewers.
7. *Milk Plants:* Minimize milk losses from can washing by installation of drip savers and pre-rinse jets and prevent losses from evaporators by the installation of entrainment separators. Positively prevent the discard of skim milk to sewers. Regulated discharge is sometimes advisable because of peak high loads and aeration of waste holding tanks is desirable to prevent septic action and local nuisance.
8. *Textile Mills:* Screening and regulated discharge may suffice but chemical coagulation and sedimentation may be necessary in some cases. Regulated discharge is sometimes important to prevent bulking in activated sludge plants. Color, in itself, is ordinarily not important, particularly if the sewage treatment process includes oxidation. If sulfur dyes are present special treatment may be necessary. Wool scouring wastes usually require special treatment for removal of grease.
9. *Distilleries:* All distillery slop should be screened for recovery of spent grain, which is valuable as stock feed, and the screened slop should be completely evaporated to produce material of high vitamin and protein content for fortification of foodstuffs. Large volumes of barometric condenser water should be excluded from the sewer system.

Inspection and Control

The problem is not solved merely by the installation of properly designed works for preliminary treatment of objectionable waste waters. Routine inspection by municipal authorities and tests of efficiency of such works must be made to insure their proper operation and maintenance. Industrial managements are too likely to forget their responsibilities in matters which do not produce a profit but which, on the contrary, usually cost in proportion to their effectiveness.

An essential feature in a program for control of sewage treatment difficulties due to industrial wastes is an orderly system of recognizing trouble when it occurs, identifying its source and setting in motion the machinery for correction at the source. Following is an outline of procedure applicable to an average situation:

1. Operator observes and records difficulties—date, time of day, appearance, effect, etc.
2. Operator reports to superintendent or engineer.
3. Superintendent or engineer makes survey to identify source of harmful waste.
4. Superintendent or engineer reports conclusions to department head or council.
5. Municipal authorities negotiate with management of responsible establishment for adoption of suitable preliminary treatment or elimination of harmful discharge.
6. Careful study of plans for preliminary treatment by the engineer and approval of treatment by municipal authorities only if the proposal is fully satisfactory and then subject to suitable conditions and stipulations.

Conclusion

The operator who merely grumbles, speculates and struggles to combat the

effects of industrial wastes on his plant is likely to cultivate an unpleasant disposition while the condition steadily becomes worse. Alertness to unusual difficulties and a systematic procedure toward correction are necessary to keep plant ailments from becoming chronic.

The best efforts of a plant operator are of little avail if he is not supported by superiors who are willing to help him in his difficulties and who have proper legal control over the use of the sewerage system. Every municipality should have a comprehensive ordinance, prepared by experts, specifically regulating industrial waste discharges to the sewer system. Moreover, although this is perhaps beyond the intended scope of this paper, the writer is of the firm opinion that an equitable and rigidly administered fee or rental system for admission of industrial wastes to the public sewer system not only places the burden of expense where it belongs, but is an important element in establishing the proper responsibility to prevent abuse of sewage works.

USE OF EFFLUENT WATER IN SEWAGE TREATMENT PLANTS *

By Robert Burrell

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The proper use of water in any sewage treatment plant is an important factor in the economy of plant operation. If plant effluent water can be used as a substitute for the public water supply in operations where potable water is not absolutely essential, a yearly saving can be realized which may pay off the cost of the original investment in two or three years. At West Haven, use of the public supply has not been abandoned, but it is reserved for necessary services only. In cities or towns where the watersheds are in a constant source of danger from drought and evaporation the saving of public water by the local sewage treatment plant might well be an obligation which should not be overlooked.

An effluent water pumping system is used successfully at West Haven. The raw sewage at the plant is settled in three plain sedimentation tanks, each 100 ft. long, 12 ft. wide, and having an average water depth of 8 ft. Raw sludge is collected in hoppers at one end of the tanks. This raw sludge is filtered through two vacuum filters. Before discharge to Long Island Sound the settled sewage is disinfected with chlorine. The town population is 30,000; the sewerage system serves 25,000. The remaining 5,000 people are served by private septic tanks and cesspools.

In 1940 Mr. Robert J. Hodge, president of the American Buckle Company and a member of the local Board of Finance, criticized the yearly plant bill for public water which amounted to $1,300. He said that his company used a well-point system with pressure tank and air compressor, which supplied them with all the water required at a good saving in plant operation. He suggested that this system be investigated and, if found practical, that a similar one be installed at the sewage treatment plant.

Well-point tests made at the plant indicated a fine sand infiltration at depths down to 50 ft. This method was abandoned and studies were made by John F. Lynch, Town Engineer, to determine the use of effluent water pumped through a pressure system. It was decided that a basement storeroom 12 ft. square in the main operating building would serve as a pump room. Effluent water could be taken by gravity from the effluent channel to the pump. The difference in elevation allowed a minimum 6-ft. head of water above the center line of the pump inlet.

The project, as installed, will be discussed in this paper under the following five divisions: (1) construction, (2) maintenance, (3) uses and advantages, (4) disadvantages and (5) cost and savings.

Construction

A pump, motor, pressure tank, Nu-Matic tank and pressure regulator were brought from the Fairbanks-Morse Co. These items comprise the pumping system and are described in detail as follows:

One 1½-in. centrifugal pump. Figure Number 5870 NE, with a speed of 3,450 r.p.m. This pump is capable of discharging 100 g.p.m. at 60 p.s.i.

One 7.5-h.p. Type QS Fairbanks-Morse ball bearing motor, 3,600 r.p.m., 3 phase, 60 cycles, 220 volts.

One 525-gal. capacity black iron pneumatic pressure tank, 10 ft. long and 3 ft. in diameter. The working pressure is 75 p.s.i. This tank is equipped with a manhole and cover on one end and with water gauge glass, valve and drain cock fittings.

One Cutler-Hammer diaphragm pressure regulator, set to operate between 50 and 70 p.s.i.

One Nu-Matic water and air control tank manufactured by the Clayton Manufacturing Company of Alhambra, California.

The price of all the above equipment was $415 with freight allowed to West Haven, Conn. These prices were at pre-war levels. The equipment was installed with plant labor and engineering but electrical and plumbing work was done by contract.

It was suggested that a small air compressor be installed as a standby unit in case of an emergency breakdown, which unit would have cost $100. This was not purchased but a broken connection was installed in order to use the public water service if required. This has been a safety factor and it has been necessary to use it several times in five years. Each time the effluent water system was restored to service as soon as possible.

During construction work the pump house was by-passed and the flow of water diverted from the effluent channel to Oldfield Creek, which flows to New Haven harbor.

About 80 ft. of 4-in. feeder pipe was installed from the effluent channel to the pump inlet in the pump room. This run of pipe required holes to be broken in three concrete walls and the last 2 ft. of excavation was in mud. A sump pit dug lower than the trench floor helped the pumping operations considerably. All piping laid in trenches was supported with 12 in. of stone ballast, which covered the floor of the trench. All piping of 2-in. or over was lined inside with bitumastic and the outside was covered with bitumastic and wrapped in felt.

It is necessary to strain the effluent water before it enters the pumping system (Figure 1). A standard piece of 4-in. pipe, 4 ft. long, was drilled with 6 rows of ½-in. diameter holes spaced 4 in. on centers. This strainer is capped at one end and the other end is connected to a 4-in. gate valve.

Another strainer made of fine wire mesh was built to enclose the perforated pipe. The protection of both strainers allows nothing but the finest silt or grease to flow through to the pumping system. There are occasions, however, when tomato seeds pass through the strainers. This strainer system is located in the effluent channel of the settling tanks and a 6-in. baffle was built ahead of the strainer

* Presented at the 16th Annual Meeting of the New England Sewage Works Association held at Springfield, Mass., on September 12, 1945.