

Combined Power Stations.

The two leading public service products are light and water. Both of these are essential. Both of them are supplied from central stations. The night consumption of water is materially less than the day consumption. The total light output is in the night. These facts afford the means for the combination of central stations by utilization of a common boiler plant for the operation of pumping machinery and lighting apparatus. It will be readily seen that local conditions and the size of the town will limit the extent of such combinations, but with the development of large units, both in electrical apparatus and pumping machinery, and in high voltage transmission, it is probable that combined central stations will eventually replace the numerous smaller stations in larger cities with economical result. However, as all the larger cities have already their established municipal waterworks system, the present field for combined plants is limited to smaller municipalities.

The principal advantage of a combined station is the reduction of cost of the public service to the taxpayer, brought about by,

1. A reduction in the first cost of the building and the steam plant.
2. Utilization of the surplus boiler capacity and surplus time of employees during the minimum water pumpage, for the light output.
3. The existence of but one management, which can better utilize the employees to an advantage at all times.

Taking up the first of these, it is evident that it is an item of considerable importance. One of the essentials of a steam plant is the duplication of the boilers to facilitate cleaning and repairing. Hence, where the construction in a single plant is twice the actual needed capacity, in the existence of separate central stations for these two public service institutions, the first cost would be practically four times the cost of the actually needed boiler plant. Furthermore, a building for a municipal central station should be substantial, hence expensive, thus another saving where one will answer for two.

In the second item the utilizing of the surplus time of the employees is of considerable import. The attendants of pumping machinery and electrical apparatus, owing to the development of self-oiling journals and automatic regulators, have nothing much to do but watch the wheels turn and see that the oil-ways are clear. Yet they are essentially and must be men of intelligence, hence, demand considerable compensation. In a combined central station one force of men can practically accomplish the same results that two similar forces can in separate plants. This is not so true in the boiler-room, for with the additional coal consumption additional stokers are required.

The greatest saving, however, can be effected in the third instance. Having a man of ability at the head of a department is essential to its success. Such a man demands a salary that forms a considerable portion of cost of maintenance of a public service institution in a smaller city, likewise so with his assistants. Therefore a reduction in the number of heads, by the combination of departments, will reduce the cost. The principal objection to the small municipal industrial plant is the fact that the volume of business does not permit the paying of sufficient salaries to engage the services of competent superintendent and engineers.

Embankments and Cuttings.

The protection of the sides of cuttings and embankments should be skilfully attended to. It is very common to see these washed away in places after heavy rain or after the spring thaw; the side of the cuttings settle into and fill the open drains, and the water is forced into the road; the sides of embankments wash away leaving dangerous holes in the road. The tendency is to make cuttings and embankments too steep, with a desire to do the least possible amount of work.

The stability of earth slopes is endangered by the action of air and moisture, especially by alternate frost and thaw, and depends on the ease with which water is drained away. A certain amount of moisture increases the strength of the slopes, but too much acts like a lubricant, and reduces the earth to a semi-fluid condition. Clay retains water and becomes pasty. Sand, if in a basin of water-holding earth, becomes a quicksand and is completely unstable. A mixture of sand and clay, the former favoring the access of water, and the latter preventing its escape, is one of the most difficult cases to deal with. There is a certain "angle of repose" at which the tendency of earth to slip is overcome. This angle varies with different kinds of earth, under various conditions of moisture. Wet clay is troublesome, and an angle of about sixteen degrees is sometimes needed to secure it. Well drained clay, however, will rest at an angle of forty-five degrees, or a slope of one to one. With average gravel and compact earth, a slope of one to one is a safe angle, although first-class gravel will retain an almost vertical face for a considerable time. Sand varies greatly, "water sand" being no better than wet clay. Dry sand usually needs a slope of one and one-half to one. Vegetable earth also is apt to be unstable and needs a slope of one and one half to one. Rules of this description cannot be laid down with sufficient accuracy to be of use, except as they serve to indicate what is to be expected with different soils. The qualities of soils are so variable that it is necessary to learn by observation what slope is needed for a particular piece of earthwork.

The natural form of an earth slope when in permanent repose is a concave curve, with the flattest portion near the bottom. There is a careless tendency to leave the slope rather in the opposite form with an outward curve. Convex or straight slopes will invariably slip until the natural form is obtained, and in cuttings or embankments approaching ten feet in height, care given to a proper construction in this regard is always profitable.

A dry stone wall at the foot of an embankment or cutting will protect the drain from slipping earth. A coating of sod is one of the best protectors of the slope; and a few inches of vegetable mould over the surface with a liberal sowing of grass seed is a measure sometimes adopted.

The Purification of Sewage.

The Connecticut sewerage commissioners in their second annual report, recently issued, condemn "chemical precipitation" as unsatisfactory, and comment favorably on bacterial treatment by means of sand filters and bacterial beds, combined with the septic tanks to remove the solids. The following recommendations are made to the Governor of the State:

"First.—The disposal of sewage without nuisance is a duty which each community owes to the public. It is a problem to be settled by each community for itself, with such state supervision and control as is necessary in the public interest.

"Second.—No city, borough or town which has not now a sewerage system should be allowed hereafter to build one which will discharge sewage or polluted water into any stream, whether such stream at the time is used by others for sewage disposal or not; nor should private corporations or individuals be allowed to discharge house sewage or excreta into streams or rivers.

"Third.—To insure sewerage construction and methods of sewage disposal which will be permanently satisfactory, the general assembly should not grant to any corporation, not now operating a municipal sewerage system, authority to issue bonds for building, or to condemn land for building, or to build any sewers or system of sewers, until an accurate topographical survey of the region to be sewered has been made, and, together with plans for effective sewage purification before discharging the effluent into any stream, has been submitted to and approved by some competent State authority.

"Fourth.—Provision should also be made by which cities and boroughs now having sewage disposal works, or which may hereafter build them, may be compelled by the State to so manage them that the sewage shall at all times be effectively purified, so as not to create a nuisance by its discharge into rivers."