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Higher velocities are required in combined sewers in order to prevent the deposition of grit. Velocities which would be permissible in sanitary sewers would not give satisfactory results in combined sewers. Deposits would be likely to accumulate, especially if a great variation existed between the minimum rate of dry weather flow and the maximum rate of storm flow. When deposits occur in combined sewers organic matter is likely to be held back and settle out or become stranded. If putrefaction of this organic matter takes place before it is washed away malodorous conditions arise. With a long-continued very low dry weather flow deposits may cause the sewage to be ponded with the result that the sewage may become stale, or possibly septic, a condition which should by all means be avoided, independent of whether the sewage is to be treated or not.

The Disposal of the Sewage.—If the sewage is to be discharged into a body of water without any treatment whatsoever, a condition less and less likely to arise in the future, combined sewers would frequently offer the simplest and cheapest solution of the problem. If, however, the sewage is to be treated, separate sewers have certain advantages. In order to limit somewhat the scope of the paper it will be assumed that the sewage must receive some treatment before final discharge and that the treatment will be at one point. Further, that ample opportunity is afforded for the discharge of storm water without having to carry it any great distance.

Sewage treatment works cost money. It is therefore desirable to keep them as small as possible, and in order to do this the volume of liquid to be handled must be kept at a minimum. Rarely, if ever, would it be the case that all of the storm water would have to be treated; hence in this discussion the question of treating other than the first wash of the streets, in addition to the sewage, will not be considered.

With a separate system the volume to be handled at the treatment works is the total sewage flow in the sanitary sewers. The liquid is made up of house sewage, ground water leakage and trade wastes. The flow may, however, be increased in times of storm by taking in the first wash of the streets from the storm water drains, should it be found necessary or desirable to treat the first wash.

With a combined system, under dry weather conditions, the volume to be handled ordinarily is what is commonly spoken of as the dry weather flow, and is also made up of house sewage, ground water leakage and trade wastes. In times of storm, however, the flow in the combined sewers is increased by the storm water from the streets. The liquid then consists of a mixture of house sewage, ground water leakage, trade wastes and storm water.

The effect of the storm water in combined sewers is two-fold—it not only increases the volume of liquid flowing but it changes its character. The first wash from the streets is often exceedingly foul and may increase the organic content of the liquid flowing in the sewers, giving what may be called a stronger sewage. As more and more storm water enters the sewers the storm water becomes cleaner and cleaner, and with the greatly increased flow in the sewers the organic content of the liquid is decreased, resulting in what may be called a weak or dilute sewage.

The volume of liquid to be handled at the treatment works from a combined system depends on whether only the dry weather flow or the dry weather flow plus some storm water is to be intercepted. If only the dry weather flow is to be intercepted, then the volume to be handled at the treatment works would, in general, be substantially the same from the combined system as from the separate system.

One fundamental difference between the two systems, however, exists. With the separate system no raw sewage escapes to the streams or watercourses, while with the combined system raw sewage must at times be discharged into them. If it is planned to intercept only the dry weather flow, then, during storms, just as soon as the flow in the combined sewers exceeds the maximum rate of dry weather flow the surplus flow, over and above that which can be intercepted, escapes, with the result that a mixture of sewage and storm water must reach the streams.

It is true that the overflow of raw sewage from combined sewers into the streams ordinarily would take place only during periods of storm, but even the occasional discharge of raw unscreened sewage into a stream is a question which must be carefully considered. It might be the case, and probably often would be the case, that as far as the temporary reduction of dissolved oxgyen in the stream is concerned no harm would be done, but floating particles of paper and faecal matter are offensive to the sight. If, however, the stream into which the overflow of sewage would take place is sluggish and with but little velocity it may easily be that the continued overflow of sewage into it, from time to time, with the accumulation of sludge deposits on the bottom, would lead to offensive conditions.

Consideration for the Community .- While considering the question of the overflow of raw sewage from combined sewers one point of view of the public should not be overlooked. In general, the public knows but little of the difference between the separate and the combined system. They know that sewers are needed, that the sewage must be treated before being finally disposed of, and that a disposal works must therefore be built. Their natural inference is then that all of the sewage will be treated at all times. If the separate system is adopted well and good. But if, instead, the sewers are built on the combined system and the public sees raw sewage, even if dilute, discharged into the streams from time to time will they be satisfied? And again, will the state authorities be satisfied? The question is one, aside from dollars and cents, which should and must receive the most careful consideration.

With a combined system, in order to reduce the number of times during the year that raw sewage would overflow, it might be planned to intercept some storm water as well as the dry weather flow. One direct effect which this would have on the sewage treatment works would be to increase their size, and consequently their cost, over and above that which would be required if the separate system had been adopted.

If it is found desirable or necessary to intercept and treat the first wash from the streets the separate system is more advantageous than the combined system, as by its adoption no overflow of raw sewage to the streams will take place. The storm water drains receive only storm water and the first wash from the streets can be intercepted in the storm water drains and discharged either into the sanitary sewers, or into the intercepting sewer leading to the treatment works. As the flow in the storm water drains increases, the surplus water, over and above that intercepted, overflows to the streams but carries no sewage with it.