Advantage to Railways.

Railway engineers and officials interested in improving their means of communication throughout the different divisions will do well to consult with the departments of the different manufacturers who specialize in this work.

In a future issue some of the problems of straight train dispatching systems will be discussed.

Although this is intended as a mere outline of the most simple application of simultaneous telegraphy and telephony, still it must not be forgotten that the principle is capable of many extensions.

On the lately completed New York and Denver circuit, as a case in point, three telephone messages and eight telegraph messages are being sent simultaneously over two pairs of wires. Over long lines the increase of capacity obtained in this way is appreciated not only by those directly concerned, but by any layman who will consider the question.

Railroad men, in particular, who have never investigated this method of communication, can solve many of their problems in this department by an application of either Composite or Simplex circuits.

NOTES ON THE THEORY AND PRACTICE OF PERCOLATING FILTERS.*

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Before anything new can be put into practical form the mind must have been at work, and worked out certain details, also the expected results. How and when the idea entered the mind of the first one to put into practice the percolating method of sewage purification I cannot say, as I have not seen any definite record of the event. It was probably brought about by the action of rain falling on porous soil, and the purification effected by this means. The means of imitating the dropping of rain for the spraying of the sewage on the surface of the filters, I do not intend going into in this paper, as they are well known. The theory of the percolating method of filtration is, that when a foul liquid is passed over a surface, such surface becomes coated with the purifying agent necessary for the purification expected. In practice it is known that by this means purification is effected, but the simple theory as mentioned is only a portion of that required to explain the whole working of a filter. By allowing the foul liquid to flow over a surface, you obtain certain results ; it is quite natural the mind would work on the questions of the cause and also on probable improvements.

One factor that comes to one's mind on considering the theory is that of surface area. It would be expected that if the area was increased, greater purification would be effected; this is proved by the greater purification given by a clinker filter than with one of gravel, the grade and quantities being equal.

On comparing the surface area of a material of different sizes, it is seen that with the same mass the surface area can be increased considerably. Taking a 1-ft. cube measure, which would hold one sphere of 1 ft. diameter, containing 904.78 cube inches, it would have a surface area of 452.39 square inches, but the same measure would hold 1,728 spheres of 1 in. diameter, the total area being 5428.6 square inches and the mass 904.78 cube inches, the same mass as the sphere of 1 ft. diameter, but with twelve times the surface area. Another factor that must be taken into consideration is the size of the space left between one particle and another forming the body of the filter. If the size is too small the friction is too great for the proper passage, in the downward direction, of the solid matter, also for the movement of the air. Taking the same measure and spheres as above, the size of the spaces, with 1 ft. diameter sphere, would be 205.8 cube inches each, and with 1 in. diameter, 0.48 cube inch. These calculations being made from mathematical figures, the results are more correct than any which can possibly be obtained in practice, but they are useful in giving an impetus to the mind to work out an ideal filter.

In the theory as mentioned the following conclusions are arrived at:—(1) The smaller the particles comprising the filter the greater the surface area; (2) the smaller the particles comprising the filter the smaller the individual space between the particles. In my opinion these two conclusions have a great bearing on the construction of a filter, when the work expected to be done is taken into consideration, namely, the oxidation of the matter in suspension and the purification of the liquid. If the space between the individual particles is of such a fineness that the resistance to the passage of the solid matter is greater than the accumulation rate choking is the result, also ponding of the surface.

The capacity of the interstices can be decreased, not only by using smaller material, assuming it is all one grade, but by mixing a small grade and a large together. This is apparent when the capacity of the interstices of any given grade of spheres is taken—for instance, 1 in. spheres—a cube foot would take 1,728 spheres of at least ⅜ in. diameter, and reduce the total capacity of the interstices from 823.22 to 775.5 cube inches, but increase the surface area from 5428.6 to 6191.8 square inches. The remaining interstices would still take a sphere of about 1/16 in. diameter, and still further increase the surface area, but with a lessened interstitial capacity. It is obvious that to increase the surface area by so mixing the grades, the resistance to the passage of the solid matter and air is increased.

A general conclusion from the foregoing is that the following are factors that must be taken into consideration before determining the grade of material to use:—(1) Quality of the sewage liquid required to be treated; (2) quantity required to be treated on any given area, and (3) the degree of purification required.

In practice many materials are used because of their cheapness or proved suitability. Clinker is the material mostly used, as in thickly populated districts it is a by-product from the manufacture of products that have become necessities with the rise of civilization—in some places gravel, waste from potteries, &c., is cheaper, but cheapness should not altogether be taken as the main reason for the use of any particular material, as it may not have the properties required to produce the desired purification. Clinker has the advantage over many materials in having a large surface area for its mass, and so is very suitable, giving a greater degree of purification than smoother surfaced materials. A material may be composed of such different-sized particles that when not graded the interstices may conform to that which is required of the filter, but care must be used, as the obtaining of a solid mass, as in the mixing of materials for concrete, is to be avoided, that which is to be kept in mind being maximum surface area with a maximum interstitial volume. To obtain these maximums, clinker is generally used, and the filter built up in grades, the larger size at the bottom, decreasing in size to the top.

By having the small sized materials at the top, the surface area per cube unit is greater than the lower depth,

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