

From the foregoing may be had an explanation of the speaker's inclination toward the employment in new organizations of inspectors rather than resident engineers on the jobs to be done under him as well as for the retention in his own hands, while chief engineer, or perhaps more of his authority, as such, than in the similar work of many other organizations.

After the final establishment of a definite policy towards its roads on the part of a state; after the proper provision of funds for the carrying out of this policy for at least a reasonably appreciable time; after the public has become accustomed to and a decent majority has settled down to the support of such a policy, and after the employees in the organization, who, are likely to perhaps need authority, have become properly grounded and trained to support satisfactorily certain responsibility, then a change or development of the organization above outlined may be, and generally is, desirable for the sake of greater efficiency in the results from expenditures.

We may, therefore, now look at the matter of the organization of a state highway department from the second point suggested at the outset.

Efficiency should, of course, be kept in mind as described in the earlier consideration, but there as may have been hinted at least, it was not the only object, and consequently in the earlier days of the work, the efficiency from a purely financial standpoint may have been obliged to retire at times in favor of what seemed to be for the ultimate public good.

Now considering efficiency alone, the speaker believes that:—

The commission of three may well give way to that of one, or even in the latter case that a competent individual may satisfactorily fill such a position as engineer-commissioner, and the position of chief engineer, as well as the board of commissioners, be avoided. That the position of assistant engineer in charge of surveying and planning may, perhaps, with the central department for his work, be abolished and the work better done under the division engineers assigned to sections of the state. This, however depends entirely upon local conditions and no general rule can be here laid down concerning the point. That it is possible to say the same concerning the assistant engineers respectively in charge of construction and of maintenance, as said immediately above; but in such a case, the necessity for avoiding any serious distraction from maintenance problems by those of construction, should be clearly and constantly kept in mind. That the delegation of more and more of the authority of the chief engineer may be advisable as the training of the subordinates proceeds and the reliance on them is warranted.

With these steps taken at the proper time, the expense for overhead charges should be reduced without depreciation in the value of the physical results and thus the efficiency of the organization increased. Inappropriately taken, they will quickly produce the opposite results on a large scale. The difference between a proper organization and an improper one may be only five per cent. of the total expenditures in the work and this difference can be readily offset many times by the difference in the quality of the physical results, the expenditures for which will probably amount to nearly 90 per cent. of the total expenditures.

The necessity for the proper organization of a state highway department should be recognized by all, but unfortunately the instances of such recognition, or at least the evidence by results of it, seem to be in the minority.

The speaker hopes that the discussion here of the matter, which discussion he has attempted to stimulate by a brief outline of some of his views, may be fruitful in good results.

## SLUDGE DISPOSAL.\*

By Karl Imhoff.†

Sludge results from all methods of treating sewage. The problem of handling this sludge satisfactorily is just as important as the treatment of the sewage itself, for experience has shown that sludge which has been poorly handled is much more objectionable than the worst sewage.

**Wet Sludge.**—Fresh wet sludge contains ordinarily more than 90 per cent. water and can be pumped out of the settling tanks in the same way as sewage or water. It would therefore seem a simple matter to get rid of it by pumping it onto low-lying ground and allowing it to remain there with the hope that it would in time become firm. Such treatment is unfortunately almost always without success. Sludge deposited in deep lays does not dry, and the ground remains wet. This treatment is therefore useful only when the sludge is spread out in very thin layers. The sludge can also be discharged into shallow trenches. Under these conditions the sludge dries in some weeks, and can be plowed into the ground for agricultural purposes. The sludge thus becomes used, as it were, for irrigation, just as with sewage. There is the disadvantage, however, that a large area is necessary, and that objectionable odors cannot be prevented.

In the case of cities located near the ocean, the problem becomes simpler. Such cities can send their sludge in ships out to sea and allow it to sink. Since it becomes necessary to carry the sludge a considerable distance from the shore, the cost of this method of disposal is quite high, and it is very probable that some of the cities which have been using this method of sludge disposal could now accomplish the desired ends cheaper by adopting another method of disposal.

In general, one can say with assurance that the cases are very few where it is desirable to dispose of sludge in a wet condition.

**Dry Sludge.**—As soon as sludge has been properly dried, it has lost most of its objectionable characteristics. In any case, dry sludge can be used as easily for agricultural purposes as other kinds of fertilizer. Its value, however, for agricultural purposes depends more on its physical characteristics than on its fertilizing value.

Dry sludge can also be used for filling low land just as well as ordinary earth. In almost every case this method of disposal is the most economical, if it is not possible to use it for agricultural purposes. Especially with cities which use their refuse for filling is this method of sludge disposal particularly adaptable, because the dry sludge has a volume only about one-fifth of that of the city refuse, and if a city has sufficient ground for dumping its refuse, there will also be sufficient area for the sludge.

In cities where the refuse is burned, consideration should be given to the possibility of burning the dry sludge with the refuse. In such an event, however, there is the danger that the slag will not be so good. In addition to the incineration of sludge, it is not worth considering other methods of artificial disposal of dry sludge; such, for example, as using it for the production of gas or for the reclaiming of the fat contained in it.

As incineration is carried out on a large scale only in one instance (Frankfurt-am-Main) it may be concluded that for the disposal of dry sludge there are left only the two

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