

and pressure which will allow of its operating at its highest efficiency. In the majority of cases in actual practice the maximum available head is usually fixed, so that the chief problem for the engineer to solve is to properly adjust the distribution of this head, the length of cycle, and the spacing of the nozzle, so as to give the maximum efficiency, at the same time not neglecting to consider the factor of the relative economy of installation. It is believed that the first three of these points may be met to advantage and with a fair degree of ease by the method illustrated.

BITUMINOUS PAVING PLANTS.

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ENGINEERING literature of the past few years has been prolific with discussion of various features in the production of bituminous pavements—with types of pavement, methods of construction, qualities of materials and other considerations. Little has been said, however, in regard to the factor of plant equipment used in the manufacture of bituminous paving compositions, and as to the effect, in a general way, upon paving work, of the efficiency of various types of plants in producing good or poor pavement mixtures. The writer proposes to discuss somewhat, the practical effect of this factor of paving plant upon the finished pavement.

Conditions Encountered.—During the writer's experience, situations have been frequently encountered in which contracts have been let for paving work under well-drawn specifications calling for good type of construction, good materials, etc., but when actual construction was commenced, there was found a contractor on the job with a contraption for turning out a pavement, ranging anywhere in character from a "peanut roaster" to a converted concrete mixer. The problem then presented to the engineer, when faced with such conditions, is to produce a good pavement under most disadvantageous and most adverse conditions with reference to plant facilities.

The writer is able to trace a number of instances of bad construction to nothing but this particular factor of inadequate and improper plant equipment, resulting in the production of uneven and frequently totally defective mixture. In fact, this condition has appeared so frequently on account of the large increase in the amount of asphalt construction, and the large number of new and inexperienced contractors entering upon this work, that in the latest specifications, a description has been included covering, so far as possible, the essential requirements for plant equipment. This requirement, as included in the writer's specifications, is given as follows:—

"Minimum Plant Requirements.—The paving plant shall be of an approved type, properly adapted for producing the character of mixture hereinafter described. It shall consist of separate units for melting and preparing asphaltic cement, a dryer for heating mineral aggregate, a screen and storage bin, having at least two compartments whereby the mineral aggregate may be separated by means of a 6 or 8-mesh screen into two sizes, that passing through the screen being collected in one compartment, while the rejection is collected in another compartment. Plant shall further be equipped with the necessary devices for weighing separately the fine and coarse aggregate from each compartment of the storage bin. An asphalt cement bucket shall be provided with scales attached in order that the amount of asphaltic cement

which is put into the mixture may be properly gauged. The mixing unit shall consist of a twin pugmill mixer or its equivalent with blades so spaced as to produce a thoroughly homogeneous mixture."

This description is intended to eliminate certain types of equipment which are favorably regarded by the inexperienced contractor undertaking asphalt construction, with the idea of simple work and large profits. Plants which fail to meet the above description should not be allowed on a paving job.

It is believed that the formulation and preparation of a good bituminous mixture, capable of withstanding modern conditions of traffic is a matter of sufficient difficulty and involves a sufficiently high degree of judgment and care, to at least call for the best of facilities in preparing such mixtures, and certainly the engineer engaged in such work should not be harassed and handicapped by plant facilities which frequently vitiate and certainly make most burdensome, the successful production of a well-planned mixture.

Changed Conditions.—In the manufacture of paving plants in years past, it is apparent that the producers of such plants were concerned much more with those mechanical features which tended to greater capacity, and ease of mechanical operation, rather than to ease of controlling product. It is only within the very recent years that some attention has been paid to this latter factor, and while this tendency is a matter of encouragement to those engaged in controlling paving mixtures, yet it is apparent that there is much room for further improvement in this direction.

Conditions with respect to plant requirements have changed greatly within the last few years. Asphalt paving construction is being called for by cities of much smaller size than heretofore, and a large amount of road work of mechanically mixed type is being laid throughout the country.

As a result of this wider spread use of asphalt surface, the demand for portable plants, either of railway or road type, has been greatly increased. The permanent plant which was maintained in the larger cities could be set up with facilities for handling materials which are not generally available in connection with the portable plants.

Again, prior to ten years ago, very little asphalt work was done excepting sheet asphalt pavements, whereas in more recent years, types of bituminous pavements have been developed of more complexity, containing stone as well as sand aggregate, thereby necessitating improvement in plant facilities over those available before. It is therefore apparent that as the complexity of our mixtures has been increased and the factor of portability has become so important, more is being demanded of the paving plant to make it adaptable to the latest conditions.

Need of Greater Accuracy.—It is unnecessary to point out the need for accuracy and uniformity in preparing bituminous paving mixture. This is particularly true in the newer forms of construction which include a wider range of aggregates than heretofore. It is well known that variations in uniformity permissible in a sheet asphalt mixture, are frequently disastrous in connection with asphaltic concrete mixtures. These latter mixtures are much more susceptible to variations in content of asphalt cement than are sheet asphalt mixtures, and not only is this true with respect to the mixtures themselves, but conditions of traffic make it necessary to observe finer points in their preparation than has been the case heretofore.

For example, an asphaltic concrete mixture under heavy automobile traffic must be regulated to narrower