The Effects of Pugmill Structure and Asphalt Spraying Mechanism on the Mixing and Properties of the Mixture

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●THE MIXING system of the conventional asphalt paving materials mixer has not changed much in seventy years. There remain in use the batch and continuous types, but in both the mixing itself is in a twin-shaft pug mill.

The impact type or a fast modification of it, is pressing for a place in today's construction. Engineers will first have to be sold on the potentialities of both its product and production for it to become required equipment on paving contracts. Very few contractors will buy it as merely permitted equipment.

A passing note may be made of a closed rotary drum type of mixer that was in limited use throughout the South prior to World War II and is still permitted by Alabama Specifications. It is mentioned because by means of compressed air it too charged a mist of asphalt into the cascading aggregates inside the rotating drum. It made a whole truck load at a batch, six or more tons, but it required several minutes, a lot of clamping and bolting and other cumbersome operations, and use of a very heavy plant. In spite of the fact that the asphalt in the very hot mix had to absorb the hardening effects of the compressed air, it did produce materials for some very excellent pavements, especially sand-asphalt and sheet asphalt pavements.

A specification writer today elaborates on various details of the required plant, but makes only scant reference to the mixer itself. It is taken for granted much like the engine in the sales description of the new automobiles. Many words are used to describe the windshield, seats, trunk, fenders, etc., but only two lines cover its vitals.

The specification writer claims he is specifying required results and leaving mechanical features open for development. The developer on the other hand counter claims there is no real need to offer improvements unless they carry with them inducements for the customer to buy new mixers. For a mixer unit, features like lower power and maintenance requirements, easier charging and discharging, adjustability, and a better mixed product can never offer an inducement to buy that will match one like bigger batches and more of them per hour.

More and bigger batches per hour, after all of the lost motion in batching is absorbed, means stretching mixer efficiency and trimming the total dry and wet mixing time. That is where the specification writer and the equipment supplier, each with an interest to defend, conflict. The specification must protect against use of the relics and insure a good mix from the average and better plant in use in the area. With over-all considerations the specifier cannot suddenly rule out all but the very newest units. Because both traditionally and currently, mixing time is the only reliable measure of mix control available one is faced with the choice of a time cycle that will not sacrifice quality of mix from one plant, but may limit production capacity from another.

If there were some nationally established method of rating effectiveness of mixing, the mixing time requirements could be eliminated, but as things stand now, it takes very little imagination to visualize the confusion that would exist should one make and model of plant be allowed an acceptable mixing time of 25 sec, another 35 sec, and a third 45 sec.

In cement concrete paving work, often with the same paver, there is such a wide variety of mixing volume and mixing time requirements in all of the states that a national experimental study is being conducted by Bureau of Public Roads to try to settle on uniformity in such requirements. Over twenty states have agreed to participate. Similar work is under way in the field of mixing for bituminous pavements. A report may be made on it next year, and it is hoped that it will provide a usable rating method.

The only mixing rating now available is loaded with human element. The inspector

judges the mix to be satisfactory when the asphalt is evenly dispersed through the mortar, when there are no balls of too much or too little asphalt, when the coarsest particles appear completely coated and when the mass has a uniformly fluffy texture with a slightly glossy appearance. The contractor may be fully willing for his product to be accepted on such a basis, but if it is rejected, he may feel a need for something more substantial than personal opinion. The inspector may listen to a long argument about the dangers of damage from over-mixing and may also begin to feel insecure in his rulings. There is, of course, some scientific support for accelerated hardening of hot asphalt by aeration, but with a difference of a few seconds, the use of the fact as "scare talk" is doing more damage then hardened asphalt in the mix.

The pug mill itself, after it has once turned out a satisfactory mix, is then accepted on faith—and why not? It is a relatively simple machine with a simple function to perform. It distributed fines by dry mixing. The fines immediately catch the hot asphalt when it is introduced and are glued together. The tossing and scouring action of the paddles "unglue" the mortar and knead it over the surface and into the voids of the coarse aggregates with a little air to make the mass into a black concrete. The mechanical action of the performance is something that after long research is manufactured into the mill. Some makes are strong in one feature and others in another. The power supplied the arm length, size, setting and speed of rotation of the paddles, lining clearance and arrangement for discharge are features that, good or bad, are built into the mill as are the various means for charging aggregates and asphalt. The operator can maintain it in near factory condition and make a few minor adjustments in paddle settings to avoid segregation, but after that, results will depend upon using proper materials and following a fixed sequence.

Let it be remembered, however, that when a desirable product leaves the pug mill much can happen to it before it becomes a pavement.